

HANDBOOK OF COMPARATIVE WORLD STEEL STANDARDS

SECOND EDITION

JOHN E. BRINGAS, EDITOR

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- Search
- Table of Contents
- Indexes
 - Steel Grade/Name Index
 - UNS Number Index
 - Steel Number Index



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Handbook of Comparative World Steel Standards

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John E. Bringas, Editor

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A book and accompanying e-book cannot be produced by one person. It takes a dedicated team of professionals. These acknowledgments cannot, however, adequately express the author's sincere appreciation and gratitude for everyone's assistance. Without it, this book would never have been completed.

Preface

This is the book I never wanted to write, but always wanted to have. As a metallurgical engineer, author of the four CASTI Metals Data Books, and member of ASTM A01 and B02 standard committees, I knew all too well the many pitfalls and challenges of writing such a book. And there were many I wasn't aware of, which created far too many surprises and delays in completing this book.

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

To say the least, these rules changed from chapter to chapter while the book was being written. It wasn't until the last chapter and appendix were completed that I was able to finalize the rules of comparison. In the end, a complete review of the book was performed which resulted in a reorganization of some chapters, while other chapters only needed some fine tuning. There were too many occasions when I thought the book was finished, only to have to change, add, or delete a rule which made yet another review of the book necessary.

After more than a year of researching and gathering metals data from around the world, then trying to develop a comparison order to more than 100,000 pieces of data, I see this book as the first step of an ongoing and expanding project. The addition of a fully searchable e-book on CD-ROM makes this product even more valuable, since trying to find one piece of data in more than 100,000 is not an easy task. The e-book makes searching for a comparable steel a quick and easy process. In some cases, the user may find out that the steel is non-comparable.

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

John E. Bringas, P.Eng.

Getting Started With This Book

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

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

For example, the steels listed in 5.3.2A Chemical Composition of Alloy Steel Tubes for Low Temperature Service, were compared based on their chemical composition; whereas the steels listed in 5.3.2B Mechanical Properties of Alloy Steel Tubes for Low Temperature Service, were arranged in the same groups as those in the chemical composition table (i.e., the mechanical properties table was "mirrored" from the chemical composition table).

Each group of steel data in the tables is separated by two types of horizontal lines: black and grey. Black lines separate groups of steels that are more closely comparable to each other, whereas grey lines separate steel data within a comparative group. *Caution:* do not confuse the thinner dividing black line within a table, with the thicker black line that borders the outside of the table. The pages are formatted to keep comparative groups together as much as possible. However, when a group of comparative steels extends to more than one page, a note is placed at the bottom of the page to indicate that the comparative group continues on the following page, i.e., NOTE: This section continues on the next page.

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Table of Contents

1. Introduction to Comparing World Steel Standards	
Myth and Methodology When Comparing Steel Standards	1
“Comparative” and “Closest Match”	2
Organization	4
Definition and Steel Terms	5
Questions Regarding the Rules of Comparison	6
Non-Comparable Steels	6
Criteria for Comparing Steels	6
List of Comparison Rules	8
Brief Introduction to Steel Standards and Designation Systems	9
ASTM Designation System	10
ASTM Reference Standards and Supplementary Requirements	11
SAE Designation System and Discontinued AISI Designation System	11
UNS Designation System	13
Canadian Standards Association (CSA)	14
Introduction to European Standard Steel Designation System	14
EN 10027 Standard Designation System for Steels	15
Steel Names	15
Steel Numbers	15
Former National Standards Replaced by CEN Standards	16
2. Carbon and Alloy Steels for General Use	18
3. Structural Steel Plates	42
4. Pressure Vessel Steel Plates	96
5. Steel Tubes and Pipes	148
6. Steel Forgings	312
7. Steel Castings	364
8. Wrought Stainless Steels	422
9. Steels for Special Use	474
Free-Machining Steels	476
Spring Steels	481
Tool Steels	485
Bearing Steels	492
Appendix 1 - ASTM Ferrous Metal Standards	498
Appendix 2 - ASTM Discontinued Ferrous Metal Standards	514
Appendix 3 - JIS Steel and Related Standards	526
Appendix 4 - JIS Discontinued Steel and Related Standards	532
Appendix 5 - CEN Current Steel Standards	538
Appendix 6 - CEN Standards with Superseded Former National Standards	544
Appendix 7 - Former National Standards Superseded by CEN Standards	556
Appendix 8 - ISO Iron and Steel Product Standards	568
Appendix 9 - ASTM A 941-00 Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys	576
Appendix 10 - ASTM E 527-83 (1997) Numbering Metals and Alloys (UNS)	584
Appendix 11 - SI Quick Reference Guide	592
Steel Grade/Name Index	598
UNS Number Index	648
Steel Number Index	656

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	1.40-1.80	---	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:

1. Carbon and Alloy Steels for General Use
2. Structural Steel Plates
3. Pressure Vessel Steel Plates
4. Steel Tubes and Pipes
5. Steel Forgings
6. Steel Castings
7. Wrought Stainless Steels and Heat-Resisting Steels
8. 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 8) 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.

List of Comparison Rules

1. Carbon steel comparisons are based on the specified minimum tensile strength and listed in ascending order. Typically, comparative groups are made for every 50 MPa (50 N/mm²) in tensile strength (that is, a black line divides comparative groups every 50 MPa (50 N/mm²)). When an abundance of data is available, this limit may be reduced to improve the comparison accuracy. Mechanical property sub-categories, such as steels with impact testing below 0°C, are used to further narrow the comparison process.
2. If a carbon steel's tensile strength varies with section thickness, the tensile strength of the lowest section thickness will be used as the governing comparison factor.
3. If a carbon steel standard does not contain mechanical properties, such as those found in Chapter 2 on Carbon and Alloy Steels for General Use, then the steels will be compared based on their carbon content.
4. The major criterion for alloy steel and stainless steel comparisons is chemical composition. Once these steels are placed in a comparative group by chemical composition, they are then arranged in ascending order within these groups by their tensile strength. Where possible, subcategories of alloy and stainless steel groups are made to further narrow the comparison process.
5. Chemical compositions listed are the heat analysis requirements in the standards (also called ladle or cast analysis). Product analyses are not listed.
6. The chemical composition and mechanical properties data for the same steel grades are not listed on the same page due to space limitations. Consequently, as a means of keeping the data consistent between these two sets of tables, each table is numbered, and each table number ends with either the letter A or B
7. Each set of steel data in the tables is divided by two types of horizontal lines: black and grey. Black lines separate groups of steels that are more closely comparable to each other, whereas grey lines separate steel data within a comparative group. This does not mean that steels outside of these groups cannot be compared, since these horizontal lines are dependent upon all of the comparison lines in this list and can be subjective at times. Caution: do not confuse the thinner dividing black line within a table with the thicker black rule that borders the table. To assist in this regard, the pages were formatted to keep comparative groups together as much as practicable. However, when a group of comparative steels extends to more than one page, a note is placed at the bottom of the page to indicate that the comparative group continues on the following page, that is, "NOTE: this section continues on the next page."
8. Steel data in standards are not always mandatory. Some data are listed as typical values or informative values, or are found in supplementary requirements. This type of data is still very useful, and has been included in this book whenever possible. This type of data is identified with an explanatory note that appears in the list of standards at the beginning of the related chapter.

9. Some standards included multiple requirements for impact testing, for example, differing test temperatures or requirements for subsize specimens. Where permitted, as much data as possible were included. However, there are occasions when the phrase "see standard" was used to indicate that more data could be found in the standard. The phrase "see standard" was also used when the standard did not specify a test temperature, but did specify an absorbed energy value. Impact testing values listed in the tables are typically for full-size specimens and for the minimum average result at the testing temperature, but do not include the minimum individual test piece requirement, if any.
10. For the purpose of this book, phrases like: "may be applied if necessary" or "may be applied by agreement between the purchaser and supplier" or "the manufacturer may find it necessary to" or "when specified" or "may be added if necessary" are not a part of the comparison process.
11. Data from footnotes in the chemical composition and mechanical properties tables of steel standards were considered during the comparison process, but were not always reported in the book due to lack of space in the tables or because they represented technical issues that were too complex to be represented in a tabular format. In these cases, the note "see standard" was used.
12. For the most part, we kept the same heat treatment terms used in each standard and listed them at the beginning of each chapter. Abbreviations in the tables were made based on the terms used in the standards. A concerted effort was made to make the abbreviations consistent from chapter to chapter, although there are exceptions, because each heat treatment abbreviation must be referred to in the list of heat treatment terms at the beginning of each chapter. There are many instances when the heat treatment requirements within a standard became very cumbersome to include in a small cell within a table. Consequently, the phrase "see standard" is used to direct the user to the standard to read all the heat treatment details involved.
13. A determined effort was made to enter the data in this book in a manner identical to that listed in the related standard, including the use of Nb (niobium) or Cb (columbium). It should be noted that even within the same SDO, data were not always entered in the same manner from standard to standard, for example, TP304 versus TP 304, where a space between the letter P and the number 3 is listed in the data. This becomes significant when using the search engine on the accompanying e-book's CD-ROM.
14. When a steel grade was found to be non-comparable, it was included at the end of the chapter in the non-comparable list. Therefore, if a particular steel was found to be unique and did not have a comparable steel, the user would not have to search any further.

Brief Introduction to Steel Standards and Designation Systems

In the world of standardization, metals were at the forefront at the turn of the twentieth century. In 1895, the French government assigned a commission to formulate standard methods of testing materials of construction. Later that year, the European member countries of the International Association for Testing Materials (IATM) held their first conference in Zurich and standardization of metals began.

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

ASTM Designation System

ASTM's designation system for metals consists of a letter (A for ferrous materials) followed by an arbitrary sequentially assigned number. These designations often apply to specific products, for example A 548 is applicable to cold-heading quality carbon steel wire for tapping or sheet metal screws. Metric ASTM standards have a suffix letter M.

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

ASTM A 516/A 516M-90 (2001) Grade 70 - Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service:

- The "A" describes a ferrous metal, but does not subclassify it as cast iron, carbon steel, alloy steel, or stainless steel.
- 516 is a sequential number without any relationship to the metal's properties.
- The "M" indicates that the standard A 516M is written in rationalized SI units (the "M" comes from the word "Metric"), hence together A 516/A 516M utilizes both inch-pound and SI units.
- 90 indicates the year of adoption or last revision.
- (2001) number in parentheses indicates the year of last reapproval.
- Grade 70 indicates the minimum tensile strength in ksi, 70 ksi or 70,000 psi.

In the steel industry, the terms *Grade*, *Type*, and *Class* have specific meaning. *Grade* is used to describe chemical composition, *Type* is used to define deoxidation practice, and *Class* is used to indicate other characteristics such as strength level or surface finish. However, within ASTM standards, these terms were adapted for use to identify a particular metal within a metal standard and are used without any "strict" definition, but essentially mean the same thing. Some rules do exist, as follows.

ASTM A 106-99 Grade A, Grade B, Grade C – Seamless Carbon Steel Pipe for High-Temperature Service:

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

ASTM A 276-00 Type 304, 316, 410 – Stainless and Heat-Resisting Steel Bars and Shapes:

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

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

- ASTM A 335/A 335M-99 Grade P22; Seamless Ferritic Alloy-Steel Pipe for High-Temperature Service.
- ASTM A 213/A 213M-99 Grade T22; Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater, and Heat-Exchanger Tubes.
- ASTM A 269-01 Grade TP304; Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
- ASTM A 312/A 312M-00 Grade TP304; Seamless and Welded Austenitic Stainless Steel Pipes.
- ASTM A 336/A 336M-99 Class F22 - Steel Forgings, Alloy, for Pressure and High-Temperature Parts.

ASTM Reference Standards and Supplementary Requirements

ASTM standards contain a section known as "Reference Documents" that lists other ASTM standards, that either become a part of the original standard or its supplementary requirements. Supplementary requirements are listed at the end of the ASTM standards and do not apply unless specified in the purchase order, that is, they are optional.

SAE Designation System and Former AISI Designation System

Carbon and Alloy Steels

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

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

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

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

Additional letters added between the second and third digits include "B" when boron is added (between 0.0005 and 0.003 %) for enhanced hardenability, and "L" when lead is added (between 0.15 and 0.35 %) for enhanced machinability. The prefix "M" is used to designate merchant quality steel (the least restrictive quality descriptor for hot-rolled steel bars used in noncritical parts of structures and machinery). The prefix "E" (electric-furnace steel) and the suffix "H" (hardenability requirements) are mainly applicable to alloy steels. The full series of classification groups is shown in Table 1.5.

Table 1.5 Types and Identifying Elements in Standard SAE Carbon and Alloy Steels

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

UNS Designation System

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

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

Where possible, the first letter in the system denotes the metal group, for instance "S" designates stainless steels. Of the five digits of the UNS designation for stainless steels, the first three are the SAE alloy classification, for example, S304XX. The final two digits are equivalent to the various modifications represented by suffix letters in the SAE system as given in the list of suffixes in Table 1.5. The UNS designations for ferrous metals and alloys are described in Table 1.6.

Table 1.6. UNS Designations for Ferrous Metals and Alloys

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

Canadian Standards Association (CSA)

The Canadian Standards Association (CSA) has established metal standards for structural steels (CSA G40.20/40.21), pipeline steels (CSA Z245.1), corrugated steel pipe (G401), wire products (CSA G4, G12, G30.x, G279.2, G387), sprayed metal coatings (G189), and welding consumables (CSA W48.x).

Most CSA material standards use SI units, although some are available in both SI and Imperial units (for example, CSA G4), while others are available in both units but published separately (for example, CSA G40.20/G40.21-M92 (SI) and G40.20/G40.21-92 (Imperial)). When a CSA standard designation is followed by the letter "M," it uses SI units, and if the letter "M" is not present, it may use both units or use only Imperial units. The type of measurement units adopted in CSA standards are specific industry driven, with some industries moving faster towards the exclusive use of SI units than others, and thus the reason for these differences.

As far as practicable, rationalization with relevant International Standards Organization (ISO) standards has been achieved in CSA G4, Steel Wire Rope for General Purpose and for Mine Hoisting and for Mine Haulage. In a similar light, the 1998 edition of CSA Z245.1, Steel Line Pipe, references requirements for ISO 1027:1993 on radiographic image indicators for non-destructive testing: principles and identification, as well as ISO 5579:1985 on nondestructive testing – radiographic examination of metallic materials by X- and gamma rays – basic rules.

Introduction to European Standard Steel Designation System

The Comité Européen de Normalisation (CEN) (European Committee for Standardization) is an association of the national standards organizations of 18 countries of the European Union and of the European Free Trade Association. The principal task of CEN is to prepare and issue European Standards (EN), defined as a set of technical specifications established and approved in collaboration with the parties concerned in the various member countries of CEN. They are established on the principle of consensus and adopted by the votes of weighted majority. Adopted standards must be implemented in their entirety as national standards by each member country, regardless of the way in which the national member voted, and any conflicting national standards must be withdrawn.

The identification of European standards in each member country begins with the reference letters of the country's national standards body, for example, BS for BSI in the United Kingdom, DIN for DIN in Germany, NF for AFNOR in France, etc., followed by the initials EN and a sequential number of up to five digits, for example, BS EN 10025, DIN EN 10025, or NF EN 10025 are all the same standard.

An EN standard may contain one document or it may be made up of several parts, for example, EN 10028 Parts 1 through 8, where each part specifies a particular characteristic of the steel product, and may not include the word *part* in the designation, but rather replace it with a hyphen, for

example, EN 10028-1, meaning Part 1. The prefix “pr” preceding the EN designation identifies the document as a draft standard that has not yet been approved, for example, prEN 10088-1.

EN 10027 Standard Designation System for Steels

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

- Part 1 - Steel Names
- Part 2 - Steel Numbers

The steel name is a combination of letters and numbers as described by EN 10027-1. Within this system, steel names are classified into two groups. The system is similar in some respects to, but not identical with, that outlined in an ISO technical report (ISO TR 4949:1989 (E) "Steel names based on letter symbols").

Steel Names

Steel Names Group 1 within EN 10027-1 refers to steels that are designated according to their application and mechanical or physical properties. These have names that are comprised of one or more letters, related to the application, followed by a number related to properties. For example, the name for structural steels begins with the letter S, line pipe steels begin with the letter L, rail steels begin with the letter R, and steels for pressure purposes begin with the letter P, such as EN 10028-3 Steel Name P275N.

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

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

Steel Numbers

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

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

Former National Standards Replaced by CEN Standards

An increasing number of national European and UK standards are being withdrawn and replaced by CEN standards. This transition, from old to new standards, has made it increasingly more difficult to compare the replaced national standards with current standards from other nations outside of Europe and the UK, let alone comparing them to the new CEN standards. Appendix 6 lists the CEN standards with the superseded national standards and Appendix 7 lists the national standards that were superseded by the current CEN standards (that is, the reverse of Appendix 6).

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

Superseded national standards may be replaced by more than one new CEN standard and some may have been partially replaced. So, a superseded national standard could be replaced by 2, 3, 4, or more new CEN standards, or it may be only partially replaced by these new CEN standards. These details can be found in Appendixes 6 and 7.

Indexes in this Book

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

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

CHAPTER

2

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

ASTM Standards

ASTM A 29/A 29M-99	Steel Bars, Carbon and Alloy, Hot-Wrought and Cold-Finished
ASTM A 108-99	Steel Bars, Carbon, Cold-Finished, Standard Quality
ASTM A 576-90 (1995)	Steel Bars, Carbon, Hot-Wrought, Special Quality
ASTM A 322-91 (1996)	Steel Bars, Alloy, Standard Grades
ASTM A 355-89 (2000)	Standard Specification for Steel Bars, Alloys, for Nitriding

SAE Standards

SAE J403 AUG95	Chemical Compositions of SAE Carbon Steels (Hot Rolled and Cold Finished Bars Only)
SAE J404 APR94	Chemical Compositions of SAE Alloy Steels (Hot Rolled and Cold Finished Bars Only)

JIS Standards

JIS G 4051:1979	Carbon Steels for Machine Structural Use
JIS G 4102:1979	Nickel Chromium Steels
JIS G 4103:1979	Nickel Chromium Molybdenum Steels
JIS G 4104:1979	Chromium Steels
JIS G 4105:1979	Chromium Molybdenum Steels
JIS G 4106:1979	Manganese Steels and Manganese Chromium Steels for Machine Structural Use
JIS G 4202:1979	Aluminium Chromium Molybdenum Steels

CEN Standards

EN 10016-2:1994	Non-Alloy Steel Rod for Drawing and/or Cold Rolling - Part 2: Specific Requirements for General Purposes Rod
EN 10016-4:1994	Non-Alloy Steel Rod for Drawing and/or Cold Rolling - Part 4: Specific Requirements for Rod for Special Applications
EN 10083-1:1991 A1:1996	Quenched and Tempered Steels – Technical Delivery Conditions for Special Steels (Amendment A1:1996)
EN 10083-2:1991 A1:1996	Quenched and Tempered Steels – Technical Delivery Conditions for Unalloyed Quality Steels (Amendment A1:1996)
EN 10084:1998	Case Hardening Steels - Technical Delivery Conditions

ISO Standards

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

2.1 Chemical Composition of Carbon Steels for General Use

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 29/A 29M-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

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 29/A 29M-99	1015	---	G10150	0.13-0.18	0.30-0.60	---	0.040	0.050	---	---	---	---
	1016	---	G10160	0.13-0.18	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 108-99	1015	---	G10150	0.13-0.18	0.30-0.60	---	0.040	0.050	---	---	---	---
	1016	---	G10160	0.13-0.18	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 576-90	1015	---	G10150	0.13-0.18	0.30-0.60	---	0.040	0.050	---	---	---	---
	1016	---	G10160	0.13-0.18	0.60-0.90	---	0.040	0.050	---	---	---	---
SAE J403 AUG95	1015	---	G10150	0.13-0.18	0.30-0.60	---	0.030	0.050	---	---	---	---
	1016	---	G10160	0.13-0.18	0.60-0.90	---	0.030	0.050	---	---	---	---
JIS G 4051 (1979)	S 15 C	---	---	0.13-0.18	0.30-0.60	0.15-0.35	0.030	0.035	0.20	0.20	---	Cu 0.30; Ni+Cr 0.35
	S 15 CK	---	---	0.13-0.18	0.30-0.60	0.15-0.35	0.025	0.025	0.20	0.20	---	Cu 0.25; Ni+Cr 0.30
EN 10016-2:1994	C15D	1.0413	---	0.12-0.17	0.30-0.60	0.30	0.035	0.035	0.20	0.25	0.05	Cu 0.30; Al 0.01
EN 10016-4:1994	C15D2	1.1126	---	0.13-0.17	0.30-0.50	0.30	0.020	0.025	0.10	0.10	0.05	Cu 0.15; Al 0.01; N 0.007
EN 10084:1998	C15E	1.1141	---	0.12-0.18	0.30-0.60	0.40	0.035	0.035	---	---	---	---
	C15R	1.1140	---	0.12-0.18	0.30-0.60	0.40	0.035	0.020-0.040	---	---	---	---
	C16E	1.1148	---	0.12-0.18	0.60-0.90	0.40	0.035	0.035	---	---	---	---
	C16R	1.1208	---	0.12-0.18	0.60-0.90	0.40	0.035	0.020-0.040	---	---	---	---
ISO 683-11:1987	C 15 E4	---	---	0.12-0.18	0.30-0.60	0.15-0.40	0.035	0.035	---	---	---	---
	C 15 M2	---	---	0.12-0.18	0.30-0.60	0.15-0.40	0.035	0.020-0.040	---	---	---	---
	C 16 E4	---	---	0.12-0.18	0.60-0.90	0.15-0.40	0.035	0.035	---	---	---	---
	C 16 M2	---	---	0.12-0.18	0.60-0.90	0.15-0.40	0.035	0.020-0.040	---	---	---	---
ASTM A 29/A 29M-99	1017	---	G10170	0.15-0.20	0.30-0.60	---	0.040	0.050	---	---	---	---
	1018	---	G10180	0.15-0.20	0.60-0.90	---	0.040	0.050	---	---	---	---
	1019	---	G10190	0.15-0.20	0.70-1.00	---	0.040	0.050	---	---	---	---
ASTM A 108-99	1018	---	G10180	0.15-0.20	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 576-90	1017	---	G10170	0.15-0.20	0.30-0.60	---	0.040	0.050	---	---	---	---
	1018	---	G10180	0.15-0.20	0.60-0.90	---	0.040	0.050	---	---	---	---
	1019	---	G10190	0.15-0.20	0.70-1.00	---	0.040	0.050	---	---	---	---
SAE J403 AUG95	1017	---	G10170	0.15-0.20	0.30-0.60	---	0.030	0.050	---	---	---	---
	1018	---	G10180	0.15-0.20	0.60-0.90	---	0.030	0.050	---	---	---	---
JIS G 4051 (1979)	S 17 C	---	---	0.15-0.20	0.30-0.60	0.15-0.35	0.030	0.035	0.20	0.20	---	Cu 0.30; Ni+Cr 0.35
EN 10016-2:1994	C18D	1.0416	---	0.15-0.20	0.30-0.60	0.30	0.035	0.035	0.20	0.25	0.05	Cu 0.30; Al 0.01
EN 10016-4:1994	C18D2	1.1129	---	0.16-0.20	0.30-0.50	0.30	0.020	0.025	0.10	0.10	0.05	Cu 0.15; Al 0.01; N 0.007

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 29/A 29M-99	1020	---	G10200	0.18-0.23	0.30-0.60	---	0.040	0.050	---	---	---	---
	1021	---	G10210	0.18-0.23	0.60-0.90	---	0.040	0.050	---	---	---	---
	1022	---	G10220	0.18-0.23	0.70-1.00	---	0.040	0.050	---	---	---	---
ASTM A 108-99	1020	---	G10200	0.18-0.23	0.30-0.60	---	0.040	0.050	---	---	---	---
	1022	---	G10220	0.18-0.23	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 576-90	1020	---	G10200	0.18-0.23	0.30-0.60	---	0.040	0.050	---	---	---	---
	1021	---	G10210	0.18-0.23	0.60-0.90	---	0.040	0.050	---	---	---	---
	1022	---	G10220	0.18-0.23	0.70-1.00	---	0.040	0.050	---	---	---	---
SAE J403 AUG95	1020	---	G10200	0.18-0.23	0.30-0.60	---	0.030	0.050	---	---	---	---
	1021	---	G10210	0.18-0.23	0.60-0.90	---	0.030	0.050	---	---	---	---
	1022	---	G10220	0.18-0.23	0.70-1.00	---	0.030	0.050	---	---	---	---
JIS G 4051 (1979)	S 20 C	---	---	0.18-0.23	0.30-0.60	0.15-0.35	0.030	0.035	0.20	0.20	---	Cu 0.30; Ni+Cr 0.35
	S 20 CK	---	---	0.18-0.23	0.30-0.60	0.15-0.35	0.025	0.025	0.20	0.20	---	Cu 0.25; Ni+Cr 0.30
EN 10016-2:1994	C20D	1.0414	---	0.18-0.23	0.30-0.60	0.30	0.035	0.035	0.20	0.25	0.05	Cu 0.30; Al 0.01
EN 10016-4:1994	C20D2	1.1137	---	0.18-0.23	0.30-0.50	0.30	0.020	0.025	0.10	0.10	0.05	Cu 0.15; Al 0.01; N 0.007
EN 10083-1:1991	2 C 22	---	---	0.17-0.24	0.40-0.70	0.40	0.035	0.035	0.40	0.40	0.10	Cr+Mo+Ni 0.63
	3 C 22	---	---	0.17-0.24	0.40-0.70	0.40	0.035	0.020-0.040	0.40	0.40	0.10	Cr+Mo+Ni 0.63
EN 10083-2:1991	1 C 22	1.0402	---	0.17-0.24	0.40-0.70	0.40	0.045	0.045	0.40	0.40	0.10	Cr+Ni+Mo 0.63
ASTM A 29/A 29M-99	1023	---	---	0.20-0.25	0.30-0.60	---	0.040	0.050	---	---	---	---
ASTM A 576-90	1023	---	G10230	0.20-0.25	0.30-0.60	---	0.040	0.050	---	---	---	---
SAE J403 AUG95	1023	---	G10230	0.20-0.25	0.30-0.60	---	0.030	0.050	---	---	---	---
JIS G 4051 (1979)	S 22 C	---	---	0.20-0.25	0.30-0.60	0.15-0.35	0.030	0.035	---	---	---	---

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 29/A 29M-99	1025	---	G10250	0.22-0.28	0.30-0.60	---	0.040	0.050	---	---	---	---
	1026	---	G10260	0.22-0.28	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 108-99	1025	---	G10250	0.22-0.28	0.30-0.60	---	0.040	0.050	---	---	---	---
ASTM A 576-90	1025	---	G10250	0.22-0.28	0.30-0.60	---	0.040	0.050	---	---	---	---
	1026	---	G10260	0.22-0.28	0.60-0.90	---	0.040	0.050	---	---	---	---
SAE J403 AUG95	1025	---	G10250	0.22-0.28	0.30-0.60	---	0.030	0.050	---	---	---	---
	1026	---	G10260	0.22-0.28	0.60-0.90	---	0.030	0.050	---	---	---	---
JIS G 4051 (1979)	S 25 C	---	---	0.22-0.28	0.30-0.60	0.15-0.35	0.030	0.035	0.20	0.20	---	Cu 0.30; Ni+Cr 0.35
EN 10016-2:1994	C26D	1.0415	---	0.24-0.29	0.50-0.80	0.10-0.30	0.035	0.035	0.20	0.25	0.05	Cu 0.30; Al 0.01
EN 10016-4:1994	C26D2	1.1139	---	0.24-0.29	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.05	Cu 0.15; Al 0.01; N 0.007
EN 10083-1:1991	2 C 25	---	---	0.22-0.29	0.40-0.70	0.40	0.035	0.035	0.40	0.40	0.10	Cr+Mo+Ni 0.63
	3 C 25	---	---	0.22-0.29	0.40-0.70	0.40	0.035	0.020-0.040	0.40	0.40	0.10	Cr+Mo+Ni 0.63
EN 10083-2:1991	1 C 25	---	---	0.22-0.29	0.40-0.70	0.40	0.045	0.045	0.40	0.40	0.10	Cr+Mo+Ni 0.63
ISO 683-1:1987	C 25	---	---	0.22-0.29	0.40-0.70	0.10-0.40	0.045	0.045	---	---	---	---
	C 25 E 4	---	---	0.22-0.29	0.40-0.70	0.10-0.40	0.035	0.035	---	---	---	---
	C 25 M 2	---	---	0.22-0.29	0.40-0.70	0.10-0.40	0.035	0.020-0.040	---	---	---	---
ASTM A 29/A 29M-99	1029	---	G10290	0.25-0.31	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 576-90	1029	---	G10290	0.25-0.31	0.60-0.90	---	0.040	0.050	---	---	---	---
SAE J403 AUG95	1029	---	G10290	0.25-0.31	0.60-0.90	---	0.030	0.050	---	---	---	---
JIS G 4051:1979	S 28 C	---	---	0.25-0.31	0.60-0.90	0.15-0.35	0.030	0.035	0.20	0.20	---	Cu 0.30; Ni+Cr 0.35
ASTM A 29/A 29M-99	1030	---	G10300	0.28-0.34	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 108-99	1030	---	G10300	0.28-0.34	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 576-90	1030	---	G10300	0.28-0.34	0.60-0.90	---	0.040	0.050	---	---	---	---
SAE J403 AUG95	1030	---	G10300	0.28-0.34	0.60-0.90	---	0.030	0.050	---	---	---	---
JIS G 4051 (1979)	S 30 C	---	---	0.27-0.33	0.60-0.90	0.15-0.35	0.030	0.035	0.20	0.20	---	Cu 0.30; Ni+Cr 0.35
EN 10016-4:1994	C32D2	1.1143	---	0.30-0.34	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.05	Cu 0.15; Al 0.01; N 0.007
EN 10083-1:1991	C30E	1.1178	---	0.27-0.34	0.50-0.80	0.40	0.035	0.035	0.40	0.40	0.10	Cr+Mo+Ni 0.63
	C30R	1.1179	---	0.27-0.34	0.50-0.80	0.40	0.035	0.020-0.040	0.40	0.40	0.10	Cr+Mo+Ni 0.63
EN 10083-2:1991	1 C 30	---	---	0.27-0.34	0.50-0.80	0.40	0.045	0.045	0.40	0.40	0.10	Cr+Mo+Ni 0.63
ISO 683-1:1987	C 30	---	---	0.27-0.34	0.50-0.80	0.10-0.40	0.045	0.045	---	---	---	---
	C 30 E 4	---	---	0.27-0.34	0.50-0.80	0.10-0.40	0.035	0.035	---	---	---	---
	C 30 M 2	---	---	0.27-0.34	0.50-0.80	0.10-0.40	0.035	0.020-0.040	---	---	---	---

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 4051 (1979)	S 33 C	---	---	0.30-0.36	0.60-0.90	0.15-0.35	0.030	0.035	0.20	0.20	---	Cu 0.30; Ni+Cr 0.35
EN 10016-2:1994	C32D	1.0530	---	0.30-0.35	0.50-0.80	0.10-0.30	0.035	0.035	0.20	0.25	0.05	Cu 0.30; Al 0.01
ASTM A 29/A 29M-99	1034	---	G10340	0.32-0.38	0.50-0.80	---	0.040	0.050	---	---	---	---
	1035	---	G10350	0.32-0.38	0.60-0.90	---	0.040	0.050	---	---	---	---
	1037	---	G10370	0.32-0.38	0.70-1.00	---	0.040	0.050	---	---	---	---
ASTM A 108-99	1035	---	G10350	0.32-0.38	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 576-90	1035	---	G10350	0.32-0.38	0.60-0.90	---	0.040	0.050	---	---	---	---
	1037	---	G10350	0.32-0.38	0.70-1.00	---	0.040	0.050	---	---	---	---
SAE J403 AUG95	1035	---	G10350	0.32-0.38	0.60-0.90	---	0.030	0.050	---	---	---	---
JIS G 4051 (1979)	S 35 C	---	---	0.32-0.38	0.60-0.90	0.15-0.35	0.030	0.035	0.20	0.20	---	Cu 0.30; Ni+Cr 0.35
EN 10016-4:1994	C36D2	1.1145	---	0.34-0.38	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.05	Cu 0.15; Al 0.01; N 0.007
EN 10083-1:1991	C35E	1.1181	---	0.32-0.39	0.50-0.80	0.40	0.035	0.035	0.40	0.40	0.10	Cr+Mo+Ni 0.63
	C35R	1.1180	---	0.32-0.39	0.50-0.80	0.40	0.035	0.020-0.040	0.40	0.40	0.10	Cr+Mo+Ni 0.63
EN 10083-2:1991	1 C 35	---	---	0.32-0.39	0.50-0.80	0.40	0.045	0.045	0.40	0.40	0.10	Cr+Mo+Ni 0.63
ISO 683-1:1987	C 35	---	---	0.32-0.39	0.50-0.80	0.10-0.40	0.045	0.045	---	---	---	---
	C 35 E 4	---	---	0.32-0.39	0.50-0.80	0.10-0.40	0.035	0.035	---	---	---	---
	C 35 M 2	---	---	0.32-0.39	0.50-0.80	0.10-0.40	0.035	0.020-0.040	---	---	---	---
ASTM A 29/A 29M-99	1038	---	G10380	0.35-0.42	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 576-90	1038	---	G10380	0.35-0.42	0.60-0.90	---	0.040	0.050	---	---	---	---
SAE J403 AUG95	1038	---	G10380	0.35-0.42	0.60-0.90	---	0.030	0.050	---	---	---	---
JIS G 4051 (1979)	S 38 C	---	---	0.35-0.41	0.60-0.90	0.15-0.35	0.030	0.035	0.20	0.20	---	Cu 0.30; Ni+Cr 0.35
EN 10016-2:1994	C38D	1.0516	---	0.35-0.40	0.50-0.80	0.10-0.30	0.035	0.035	0.20	0.25	0.05	Cu 0.30; Al 0.01
EN 10016-4:1994	C38D2	1.1150	---	0.36-0.40	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.05	Cu 0.15; Al 0.01; N 0.007

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 29/A 29M-99	1039	---	G10390	0.37-0.44	0.70-1.00	---	0.040	0.050	---	---	---	---
	1040	---	G10400	0.37-0.44	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 108-99	1040	---	G10400	0.37-0.44	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 576-90	1039	---	G10390	0.37-0.38	0.70-1.00	---	0.040	0.050	---	---	---	---
	1040	---	G10400	0.37-0.38	0.60-0.90	---	0.040	0.050	---	---	---	---
SAE J403 AUG95	1039	---	G10400	0.37-0.43	0.70-1.00	---	0.030	0.050	---	---	---	---
	1040	---	G10400	0.37-0.43	0.60-0.90	---	0.030	0.050	---	---	---	---
JIS G 4051 (1979)	S 40 C	---	---	0.37-0.43	0.60-0.90	0.15-0.35	0.030	0.035	0.20	0.20	---	Cu 0.30; Ni+Cr 0.35
EN 10016-4:1994	C40D2	1.1153	---	0.38-0.42	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.05	Cu 0.15; Al 0.01; N 0.007
EN 10083-1:1991	C40E	1.1186	---	0.37-0.44	0.50-0.80	0.040	0.035	0.035	0.40	0.40	0.10	Cr+Mo+Ni 0.63
	C40R	1.1189	---	0.37-0.44	0.50-0.80	0.040	0.035	0.020-0.040	0.40	0.40	0.10	Cr+Mo+Ni 0.63
EN 10083-2:1991	1 C 40	---	---	0.37-0.44	0.50-0.80	0.040	0.045	0.045	0.40	0.40	0.10	Cr+Mo+Ni 0.63
ISO 683-1:1987	C 40	---	---	0.37-0.44	0.50-0.80	0.10-0.40	0.045	0.045	---	---	---	---
	C 40 E 4	---	---	0.37-0.44	0.50-0.80	0.10-0.40	0.035	0.035	---	---	---	---
	C 40 M 2	---	---	0.37-0.44	0.50-0.80	0.10-0.40	0.035	0.020-0.040	---	---	---	---
ASTM A 29/A 29M-99	1042	---	G10420	0.40-0.47	0.60-0.90	---	0.040	0.050	---	---	---	---
	1043	---	G10430	0.40-0.47	0.70-1.00	---	0.040	0.050	---	---	---	---
ASTM A 576-90	1042	---	G10420	0.40-0.47	0.60-0.90	---	0.040	0.050	---	---	---	---
	1043	---	G10430	0.40-0.47	0.70-1.00	---	0.040	0.050	---	---	---	---
SAE J403 AUG95	1042	---	G10420	0.40-0.47	0.60-0.90	---	0.030	0.050	---	---	---	---
	1043	---	G10430	0.40-0.47	0.70-1.00	---	0.030	0.050	---	---	---	---
JIS G 4051 (1979)	S 43 C	---	---	0.40-0.46	0.60-0.90	0.15-0.35	0.030	0.035	0.20	0.20	---	Cu 0.30; Ni+Cr 0.35
EN 10016-2:1994	C42D	1.0541	---	0.40-0.45	0.50-0.80	0.10-0.30	0.035	0.035	0.20	0.25	0.05	Cu 0.30; Al 0.01
EN 10016-4:1994	C42D2	1.1154	---	0.40-0.44	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.05	Cu 0.15; Al 0.01; N 0.007

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 29/A 29M-99	1044	---	G10440	0.43-0.50	0.30-0.60	---	0.040	0.050	---	---	---	---
	1045	---	G10450	0.43-0.50	0.60-0.90	---	0.040	0.050	---	---	---	---
	1046	---	G10460	0.43-0.50	0.70-1.00	---	0.040	0.050	---	---	---	---
ASTM A 108-99	1045	---	G10450	0.43-0.50	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 576-90	1044	---	G10440	0.43-0.50	0.30-0.60	---	0.040	0.050	---	---	---	---
	1045	---	G10450	0.43-0.50	0.60-0.90	---	0.040	0.050	---	---	---	---
	1046	---	G10460	0.43-0.50	0.70-1.00	---	0.040	0.050	---	---	---	---
SAE J403 AUG95	1044	---	G10440	0.43-0.50	0.30-0.60	---	0.030	0.050	---	---	---	---
	1045	---	G10450	0.43-0.50	0.60-0.90	---	0.030	0.050	---	---	---	---
	1046	---	G10460	0.43-0.50	0.70-1.00	---	0.030	0.050	---	---	---	---
JIS G 4051 (1979)	S 45 C	---	---	0.42-0.48	0.60-0.90	0.15-0.35	0.030	0.035	0.20	0.20	---	Cu 0.30; Ni+Cr 0.35
EN 10016-4:1994	C46D2	1.1162	---	0.44-0.48	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.05	Cu 0.15; Al 0.01; N 0.007
EN 10083-1:1991	C45E	1.1191	---	0.42-0.50	0.50-0.80	0.40	0.035	0.035	0.40	0.40	0.10	Cr+Mo+Ni 0.63
	C45R	1.1201	---	0.42-0.50	0.50-0.80	0.40	0.035	0.020-0.040	0.40	0.40	0.10	Cr+Mo+Ni 0.63
EN 10083-2:1991	1 C 45	---	---	0.42-0.50	0.50-0.80	0.40	0.045	0.045	0.40	0.40	0.10	Cr+Mo+Ni 0.63
ISO 683-1:1987	C 45	---	---	0.42-0.50	0.50-0.80	0.10-0.40	0.045	0.045	---	---	---	---
	C 45 E 4	---	---	0.42-0.50	0.50-0.80	0.10-0.40	0.035	0.035	---	---	---	---
	C 45 M 2	---	---	0.42-0.50	0.50-0.80	0.10-0.40	0.035	0.020-0.040	---	---	---	---
JIS G 4051 (1979)	S 48 C	---	---	0.45-0.51	0.60-0.90	0.15-0.35	0.030	0.035	0.20	0.20	---	Cu 0.30; Ni+Cr 0.35
EN 10016-2:1994	C48D	1.0517	---	0.45-0.50	0.50-0.80	0.10-0.30	0.035	0.035	0.15	0.20	0.05	Cu 0.25; Al 0.01
EN 10016-4:1994	C48D2	1.1164	---	0.46-0.50	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.05	Cu 0.15; Al 0.01; N 0.007

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 29/A 29M-99	1049	---	G10490	0.46-0.53	0.60-0.90	---	0.040	0.050	---	---	---	---
	1050	---	G10500	0.48-0.55	0.60-0.90	---	0.040	0.050	---	---	---	---
	1053	---	G10530	0.48-0.55	0.70-1.00	---	0.040	0.050	---	---	---	---
ASTM A 108-99	1050	---	G10500	0.48-0.55	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 576-90	1049	---	G10490	0.46-0.53	0.60-0.90	---	0.040	0.050	---	---	---	---
	1050	---	G10500	0.48-0.55	0.60-0.90	---	0.040	0.050	---	---	---	---
	1053	---	G10530	0.48-0.55	0.70-1.00	---	0.040	0.050	---	---	---	---
SAE J403 AUG95	1049	---	G10490	0.46-0.53	0.60-0.90	---	0.030	0.050	---	---	---	---
	1050	---	G10500	0.48-0.55	0.60-0.90	---	0.030	0.050	---	---	---	---
	1053	---	G10530	0.48-0.55	0.70-1.00	---	0.030	0.050	---	---	---	---
JIS G 4051 (1979)	S 50 C	---	---	0.47-0.53	0.60-0.90	0.15-0.35	0.030	0.035	0.20	0.20	---	Cu 0.30; Ni+Cr 0.35
EN 10016-2:1994	C50D	1.0586	---	0.48-0.53	0.50-0.80	0.10-0.30	0.035	0.035	0.15	0.20	0.05	Cu 0.25; Al 0.01
EN 10016-4:1994	C50D2	1.1171	---	0.48-0.52	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.05	Cu 0.15; Al 0.01; N 0.007
EN 10083-1:1991	C50E	1.1206	---	0.47-0.55	0.60-0.90	0.40	0.035	0.035	0.40	0.40	0.10	Cr+Mo+Ni 0.63
	C50R	1.1241	---	0.47-0.55	0.60-0.90	0.40	0.035	0.020-0.040	0.40	0.40	0.10	Cr+Mo+Ni 0.63
EN 10083-2:1991	1 C 50	---	---	0.47-0.55	0.60-0.90	0.40	0.045	0.045	0.40	0.40	0.10	Cr+Mo+Ni 0.63
ISO 683-1:1987	C 50	---	---	0.47-0.55	0.60-0.90	0.10-0.40	0.045	0.045	---	---	---	---
	C 50 E 4	---	---	0.47-0.55	0.60-0.90	0.10-0.40	0.035	0.035	---	---	---	---
	C 50 M 2	---	---	0.47-0.55	0.60-0.90	0.10-0.40	0.035	0.020-0.040	---	---	---	---
JIS G 4051 (1979)	S 53 C	---	---	0.50-0.56	0.60-0.90	0.15-0.35	0.030	0.035	0.20	0.20	---	Cu 0.30; Ni+Cr 0.35
EN 10016-2:1994	C52D	1.0588	---	0.50-0.55	0.50-0.80	0.10-0.30	0.035	0.035	0.20	0.25	0.05	Cu 0.30; Al 0.01
EN 10016-4:1994	C52D2	1.1202	---	0.50-0.54	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.05	Cu 0.15; Al 0.01; N 0.007

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 29/A 29M-99	1055	---	G10550	0.50-0.60	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 576-90	1055	---	G10550	0.50-0.60	0.60-0.90	---	0.040	0.050	---	---	---	---
SAE J403 AUG95	1055	---	G10550	0.50-0.60	0.60-0.90	---	0.030	0.050	---	---	---	---
JIS G 4051:1979	S 55 C	---	---	0.52-0.58	0.60-0.90	0.15-0.35	0.030	0.035	0.20	0.20	---	Cu 0.30; Ni+Cr 0.35
EN 10016-2:1994	C56D	1.0518	---	0.53-0.58	0.50-0.80	0.10-0.30	0.035	0.035	0.15	0.20	0.05	Cu 0.25; Al 0.01
EN 10016-4:1994	C56D2	1.1220	---	0.54-0.58	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.05	Cu 0.15; Al 0.01; N 0.007
EN 10083-1:1991	C55E	1.1203	---	0.52-0.60	0.60-0.90	0.40	0.035	0.035	0.40	---	0.10	Cr+Mo+Ni 0.63
	C55R	1.1209	---	0.52-0.60	0.60-0.90	0.40	0.035	0.020-0.040	0.40	---	0.10	Cr+Mo+Ni 0.63
EN 10083-2:1991	1 C 55	---	---	0.52-0.60	0.60-0.90	0.40	0.045	0.045	0.40	---	0.10	Cr+Mo+Ni 0.63
ISO 683-1:1987	C 55	---	---	0.52-0.60	0.60-0.90	0.10-0.40	0.045	0.045	---	---	---	---
	C 55 E 4	---	---	0.52-0.60	0.60-0.90	0.10-0.40	0.035	0.035	---	---	---	---
	C 55 M 2	---	---	0.52-0.60	0.60-0.90	0.10-0.40	0.035	0.020-0.040	---	---	---	---
ASTM A 29/A 29M-99	1059	---	G10590	0.55-0.65	0.50-0.80	---	0.040	0.050	---	---	---	---
	1060	---	G10600	0.55-0.65	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 576-90	1060	---	G10600	0.55-0.65	0.60-0.90	---	0.040	0.050	---	---	---	---
SAE J403 AUG95	1060	---	G10600	0.55-0.65	0.60-0.90	---	0.030	0.050	---	---	---	---
JIS G 4051:1979	S 58 C	---	---	0.55-0.61	0.60-0.90	0.15-0.35	0.030	0.035	0.20	0.20	---	Cu 0.30; Ni+Cr 0.35
EN 10016-2:1994	C58D	1.0609	---	0.55-0.60	0.50-0.80	0.10-0.30	0.035	0.035	0.15	0.20	0.05	Cu 0.25; Al 0.01
	C60D	1.0610	---	0.58-0.63	0.50-0.80	0.10-0.30	0.035	0.035	0.20	0.25	0.05	Cu 0.30; Al 0.01
EN 10016-4:1994	C58D2	1.1212	---	0.54-0.58	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.05	Cu 0.15; Al 0.01; N 0.007
	C60D2	1.1228	---	0.58-0.62	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.05	Cu 0.15; Al 0.01; N 0.007
EN 10083-1:1991	C60E	1.1221	---	0.57-0.65	0.60-0.90	0.40	0.035	0.035	0.40	0.40	0.10	Cr+Mo+Ni 0.63
	C60R	1.1223	---	0.57-0.65	0.60-0.90	0.40	0.035	0.020-0.040	0.40	0.40	0.10	Cr+Mo+Ni 0.63
EN 10083-2:1991	1 C 60	---	---	0.57-0.65	0.60-0.90	0.40	0.045	0.045	0.40	0.40	0.10	Cr+Mo+Ni 0.63
ISO 683-1:1987	C 60	---	---	0.57-0.65	0.60-0.90	0.10-0.40	0.045	0.045	---	---	---	---
	C 60 E 4	---	---	0.57-0.65	0.60-0.90	0.10-0.40	0.035	0.035	---	---	---	---
	C 60 M 2	---	---	0.57-0.65	0.60-0.90	0.10-0.40	0.035	0.020-0.040	---	---	---	---

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 29/A 29M-99	1064	---	G10640	0.60-0.70	0.50-0.80	---	0.040	0.050	---	---	---	---
	1065	---	G10650	0.60-0.70	0.60-0.90	---	0.040	0.050	---	---	---	---
SAE J403 AUG95	1065	---	G10650	0.60-0.70	0.60-0.90	---	0.030	0.050	---	---	---	---
EN 10016-2:1994	C62D	1.0611	---	0.60-0.65	0.50-0.80	0.10-0.30	0.035	0.035	0.15	0.20	0.05	Cu 0.25; Al 0.01
	C66D	1.0612	---	0.63-0.68	0.50-0.80	0.10-0.30	0.035	0.035	0.15	0.20	0.05	Cu 0.25; Al 0.01
	C68D	1.0613	---	0.65-0.70	0.50-0.80	0.10-0.30	0.035	0.035	0.15	0.20	0.05	Cu 0.25; Al 0.01
EN 10016-4:1994	C62D2	1.1222	---	0.60-0.64	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.05	Cu 0.15; Al 0.01; N 0.007
	C66D2	1.1236	---	0.64-0.68	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.05	Cu 0.15; Al 0.01; N 0.007
	C68D2	1.1232	---	0.66-0.70	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.05	Cu 0.15; Al 0.01; N 0.007
ASTM A 29/A 29M-99	1069	---	G10690	0.65-0.75	0.40-0.70	---	0.040	0.050	---	---	---	---
	1070	---	G10700	0.65-0.75	0.60-0.90	---	0.040	0.050	---	---	---	---
	1071	---	G10710	0.65-0.70	75-1.05	---	0.040	0.050	---	---	---	---
ASTM A 576-90	1070	---	G10700	0.65-0.75	0.60-0.90	---	0.040	0.050	---	---	---	---
SAE J403 AUG95	1070	---	G10700	0.65-0.75	0.60-0.90	---	0.030	0.050	---	---	---	---
EN 10016-2:1994	C70D	1.0615	---	0.68-0.73	0.50-0.80	0.10-0.30	0.035	0.035	0.15	0.20	0.05	Cu 0.25; Al 0.01
	C72D	1.0617	---	0.70-0.75	0.50-0.80	0.10-0.30	0.035	0.035	0.15	0.20	0.05	Cu 0.25; Al 0.01
EN 10016-4:1994	C70D2	1.1251	---	0.68-0.72	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.05	Cu 0.15; Al 0.01; N 0.007
	C72D2	1.1242	---	0.70-0.74	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.05	Cu 0.15; Al 0.01; N 0.007
ASTM A 29/A 29M-99	1074	---	G10740	0.70-0.80	0.50-0.80	---	0.040	0.050	---	---	---	---
	1075	---	G10750	0.70-0.80	0.40-0.70	---	0.040	0.050	---	---	---	---
EN 10016-2:1994	C76D	1.0614	---	0.73-0.78	0.50-0.80	0.10-0.30	0.035	0.035	0.15	0.20	0.05	Cu 0.25; Al 0.01
	C78D	1.0620	---	0.75-0.80	0.50-0.80	0.10-0.30	0.035	0.035	0.15	0.20	0.05	Cu 0.25; Al 0.01
EN 10016-4:1994	C76D2	1.1253	---	0.74-0.78	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.05	Cu 0.15; Al 0.01; N 0.007
	C78D2	1.1252	---	0.76-0.80	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.05	Cu 0.15; Al 0.01; N 0.007
ASTM A 29/A 29M-99	1078	---	G10780	0.72-0.85	0.30-0.60	---	0.040	0.050	---	---	---	---
ASTM A 576-90	1078	---	G10780	0.72-0.85	0.30-0.60	---	0.040	0.050	---	---	---	---
SAE J403 AUG95	1078	---	G10780	0.72-0.85	0.30-0.60	---	0.030	0.050	---	---	---	---
EN 10016-2:1994	C80D	1.0622	---	0.78-0.83	0.50-0.80	0.10-0.30	0.035	0.035	0.15	0.20	0.05	Cu 0.25; Al 0.01
	C82D	1.0626	---	0.80-0.85	0.50-0.80	0.10-0.30	0.035	0.035	0.15	0.20	0.05	Cu 0.25; Al 0.01
EN 10016-4:1994	C80D2	1.1255	---	0.78-0.82	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.05	Cu 0.15; Al 0.01; N 0.007
	C82D2	1.1262	---	0.80-0.84	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.05	Cu 0.15; Al 0.01; N 0.007

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 29/A 29M-99	1080	---	G10800	0.75-0.88	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 576-90	1080	---	G10800	0.75-0.88	0.60-0.90	---	0.040	0.050	---	---	---	---
SAE J403 AUG95	1080	---	G10800	0.75-0.88	0.60-0.90	---	0.030	0.050	---	---	---	---
EN 10016-2:1994	C86D	1.0616	---	0.83-0.88	0.50-0.80	0.10-0.30	0.035	0.035	0.15	0.20	0.05	Cu 0.25; Al 0.01
EN 10016-4:1994	C86D2	1.1265	---	0.84-0.88	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.05	Cu 0.15; Al 0.01; N 0.007
ASTM A 29/A 29M-99	1084	---	G10840	0.80-0.93	0.60-0.90	---	0.040	0.050	---	---	---	---
	1086	---	G10860	0.80-0.93	0.30-0.50	---	0.040	0.050	---	---	---	---
ASTM A 576-90	1084	---	G10840	0.80-0.93	0.60-0.90	---	0.040	0.050	---	---	---	---
SAE J403 AUG95	1086	---	G10860	0.80-0.93	0.30-0.50	---	0.030	0.050	---	---	---	---
EN 10016-2:1994	C88D	1.0628	---	0.85-0.90	0.50-0.80	0.10-0.30	0.035	0.035	0.15	0.20	0.05	Cu 0.25; Al 0.01
EN 10016-4:1994	C88D2	1.1272	---	0.86-0.90	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.05	Cu 0.15; Al 0.01; N 0.007
ASTM A 29/A 29M-99	1090	---	G10900	0.85-0.98	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 576-90	1090	---	G10900	0.85-0.98	0.60-0.90	---	0.040	0.050	---	---	---	---
SAE J403 AUG95	1090	---	G10900	0.85-0.98	0.60-0.90	---	0.030	0.050	---	---	---	---
EN 10016-2:1994	C92D	1.0618	---	0.90-0.95	0.50-0.80	0.10-0.30	0.035	0.035	0.15	0.20	0.05	Cu 0.25; Al 0.01
EN 10016-4:1994	C92D2	1.1282	---	0.90-0.95	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.05	Cu 0.15; Al 0.01; N 0.007
ASTM A 29/A 29M-99	1095	---	G10950	0.90-1.03	0.30-0.50	---	0.040	0.050	---	---	---	---
ASTM A 108-99	1095	---	G10950	0.90-1.03	0.30-0.50	---	0.040	0.050	---	---	---	---
ASTM A 576-90	1095	---	G10950	0.90-1.03	0.30-0.50	---	0.040	0.050	---	---	---	---
SAE J403 AUG95	1095	---	G10950	0.90-1.03	0.30-0.50	---	0.030	0.050	---	---	---	---
EN 10016-4:1994	C98D2	1.1283	---	0.96-1.00	0.50-0.70	0.10-0.30	0.020	0.025	0.10	0.10	0.05	Cu 0.15; Al 0.01; N 0.007

2.2 Chemical Composition of High Manganese Carbon Steels for General Use

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 29/A 29M-99	1522	---	G15220	0.18-0.24	1.10-1.40	---	0.040	0.050	---	---	---	---
ASTM A 576-90	1522	---	G15220	0.18-0.24	1.10-1.40	---	0.040	0.050	---	---	---	---
SAE J403 AUG95	1522	---	G15220	0.18-0.24	1.10-1.40	---	0.040	0.050	---	---	---	---
JIS G 4106:1979	SMn 420	---	---	0.17-0.23	1.20-1.50	0.15-0.35	0.030	0.030	0.35	0.25	---	Cu 0.30
	SMnC 420	---	---	0.17-0.23	1.20-1.50	0.15-0.35	0.030	0.030	0.35-0.70	0.25	---	Cu 0.30
ISO 683-1:1987	22 Mn 6	---	---	0.19-0.26	1.30-1.60	0.10-0.40	0.035	0.035	---	---	---	---
ASTM A 29/A 29M-99	1536	---	G15360	0.30-0.37	1.20-1.50	---	0.040	0.050	---	---	---	---
ASTM A 576-90	1536	---	G15360	0.30-0.37	1.20-1.50	---	0.040	0.050	---	---	---	---
JIS G 4106:1979	SMn 433	---	---	0.30-0.36	1.20-1.50	0.15-0.35	0.030	0.030	0.35	0.25	---	Cu 0.30
EN 10083-1:1991	28 Mn 6	---	---	0.25-0.32	1.30-1.65	0.40	0.035	0.035	0.40	0.40	0.10	Cr+Ni+Mo 0.63
ISO 683-1:1987	28 Mn 6	---	---	0.25-0.32	1.30-1.65	0.10-0.40	0.035	0.035	---	---	---	---
SAE J403 AUG95	1541	---	G15410	0.36-0.44	1.35-1.65	---	0.040	0.050	---	---	---	---
ASTM A 29/A 29M-99	1541	---	G15410	0.36-0.44	1.35-1.65	---	0.040	0.050	---	---	---	---
ASTM A 576-90	1541	---	G15410	0.36-0.44	1.35-1.65	---	0.040	0.050	---	---	---	---
JIS G 4106:1979	SMn 438	---	---	0.35-0.41	1.35-1.65	0.15-0.35	0.030	0.030	0.35	0.25	---	Cu 0.30
ISO 683-1:1987	36 Mn 6	---	---	0.33-0.40	1.35-1.65	0.10-0.40	0.035	0.035	---	---	---	---
JIS G 4106:1979	SMn 443	---	---	0.40-0.46	1.35-1.65	0.15-0.35	0.030	0.030	0.35	0.25	---	Cu 0.30
	SMnC 443	---	---	0.40-0.46	1.35-1.65	0.15-0.35	0.030	0.030	0.35-0.70	0.25	---	Cu 0.30
ISO 683-1:1987	42 Mn 6	---	---	0.39-0.46	1.30-1.65	0.10-0.40	0.035	0.035	---	---	---	---

2.3 Chemical Composition of Alloy Steels for General Use

2.3.1 Chromium (Cr) Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 4104:1979	SCr 415	---	---	0.13-0.18	0.60-0.85	0.15-0.35	0.030	0.030	0.90-1.20	0.25	---	Cu 0.30
EN 10084:1998	17Cr3	1.7016	---	0.14-0.20	0.60-0.90	0.40	0.035	0.035	0.70-1.00	---	---	---
	17CrS3	1.7014	---	0.14-0.20	0.60-0.90	0.40	0.035	0.020-0.040	0.70-1.00	---	---	---
ASTM A 29/A 29M-99	5120	---	G51200	0.17-0.22	0.70-0.90	0.15-0.35	0.035	0.040	0.70-0.90	0.25	0.06	Cu 0.35
ASTM A 322-91 (1996)	5120	---	G51200	0.17-0.22	0.70-0.90	0.15-0.35	0.035	0.040	0.70-0.90	0.25	0.06	Cu 0.35
SAE J404 APR94	5120	---	G51200	0.17-0.22	0.70-0.90	0.15-0.35	0.035	0.040	0.70-0.90	0.25	0.06	Cu 0.35
JIS G 4104:1979	SCr 420	---	---	0.18-0.23	0.60-0.85	0.15-0.35	0.030	0.030	0.90-1.20	0.25	---	Cu 0.30
ISO 683-11:1987	20 Cr 4	---	---	0.17-0.23	0.60-0.90	0.15-0.40	0.035	0.035	0.90-1.20	---	---	---
	20 CrS 4	---	---	0.17-0.23	0.60-0.90	0.15-0.40	0.035	0.020-0.040	0.90-1.20	---	---	---
ASTM A 29/A 29M-99	5130	---	G51300	0.28-0.33	0.70-0.90	0.15-0.35	0.035	0.040	0.80-1.10	0.25	0.06	Cu 0.35
ASTM A 322-91 (1996)	5130	---	G51300	0.28-0.33	0.70-0.90	0.15-0.35	0.035	0.040	0.80-1.10	0.25	0.06	Cu 0.35
SAE J404 APR94	5130	---	G51300	0.28-0.33	0.70-0.90	0.15-0.35	0.035	0.040	0.80-1.10	0.25	0.06	Cu 0.35
JIS G 4104:1979	SCr 430	---	---	0.28-0.33	0.60-0.85	0.15-0.35	0.030	0.030	0.90-1.20	0.25	---	Cu 0.30
EN 10084:1998	28Cr4	1.7030	---	0.24-0.31	0.60-0.90	0.40	0.035	0.035	0.90-1.20	---	---	---
	28CrS4	1.7036	---	0.24-0.31	0.60-0.90	0.40	0.035	0.020-0.040	0.90-1.20	---	---	---
ASTM A 29/A 29M-99	5132	---	G51320	0.30-0.35	0.60-0.80	0.15-0.35	0.035	0.040	0.75-1.00	0.25	0.06	Cu 0.35
ASTM A 322-91 (1996)	5132	---	G51320	0.30-0.35	0.60-0.80	0.15-0.35	0.035	0.040	0.75-1.00	0.25	0.06	Cu 0.35
SAE J404 APR94	5132	---	G51320	0.30-0.35	0.60-0.80	0.15-0.35	0.035	0.040	0.75-1.00	0.25	0.06	Cu 0.35
JIS G 4104:1979	SCr 435	---	---	0.33-0.38	0.60-0.85	0.15-0.35	0.035	0.030	0.90-1.20	0.25	---	Cu 0.30
EN 10083-1:1991	34 Cr 4	---	---	0.30-0.37	0.60-0.90	0.40	0.035	0.035	0.90-1.20	---	---	---
	34 CrS 4	---	---	0.30-0.37	0.60-0.90	0.40	0.035	0.020-0.040	0.90-1.20	---	---	---
ISO 683-1:1987	34 Cr 4	---	---	0.30-0.37	0.60-0.90	0.10-0.40	0.035	0.035	0.90-1.20	---	---	---
	34 CrS 4	---	---	0.30-0.37	0.60-0.90	0.10-0.40	0.035	0.020-0.040	0.90-1.20	---	---	---
ASTM A 29/A 29M-99	5135	---	G51350	0.33-0.38	0.60-0.80	0.15-0.35	0.035	0.040	0.80-1.05	0.25	0.06	Cu 0.35
ASTM A 322-91 (1996)	5135	---	G51350	0.33-0.38	0.60-0.80	0.15-0.35	0.035	0.040	0.80-1.05	0.25	0.06	Cu 0.35
EN 10083-1:1991	37 Cr 4	---	---	0.34-0.41	0.60-0.90	0.40	0.035	0.035	0.90-1.20	---	---	---
	37 CrS 4	---	---	0.34-0.41	0.60-0.90	0.40	0.035	0.020-0.040	0.90-1.20	---	---	---
ISO 683-1:1987	37 Cr 4	---	---	0.34-0.41	0.60-0.90	0.10-0.40	0.035	0.035	0.90-1.20	---	---	---
	37 CrS 4	---	---	0.34-0.41	0.60-0.90	0.10-0.40	0.035	0.020-0.040	0.90-1.20	---	---	---

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

2.3.1 Chromium (Cr) Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 29/A 29M-99	5140	---	G51400	0.38-0.43	0.70-0.90	0.15-0.35	0.035	0.040	0.70-0.90	0.25	0.06	Cu 0.35
ASTM A 322-91 (1996)	5140	---	G51400	0.38-0.43	0.70-0.90	0.15-0.35	0.035	0.040	0.70-0.90	0.25	0.06	Cu 0.35
SAE J404 APR94	5140	---	G51400	0.38-0.43	0.70-0.90	0.15-0.35	0.035	0.040	0.70-0.90	0.25	0.06	Cu 0.35
JIS G 4104:1979	SCr 440	---	---	0.38-0.43	0.60-0.85	0.15-0.35	0.030	0.030	0.90-1.20	0.25	---	Cu 0.30
EN 10083-1:1991	41 Cr 4	---	---	0.38-0.45	0.60-0.90	0.40	0.035	0.035	0.90-1.20	---	---	---
	41 CrS 4	---	---	0.38-0.45	0.60-0.90	0.40	0.035	0.020-0.040	0.90-1.20	---	---	---
ISO 683-1:1987	41 Cr 4	---	---	0.38-0.45	0.60-0.90	0.10-0.40	0.035	0.035	0.90-1.20	---	---	---
	41 CrS 4	---	---	0.38-0.45	0.60-0.90	0.10-0.40	0.035	0.020-0.040	0.90-1.20	---	---	---
ASTM A 29/A 29M-99	5145	---	---	0.38-0.43	0.70-0.90	0.15-0.35	0.035	0.040	0.70-0.90	0.25	0.06	Cu 0.35
JIS G 4104:1979	SCr 445	---	---	0.43-0.48	0.60-0.85	0.15-0.35	0.030	0.030	0.90-1.20	---	---	---

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	---

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

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 29/A 29M-99	4137	---	G41370	0.35-0.40	0.70-0.90	0.15-0.35	0.035	0.040	0.80-1.10	0.25	0.15-0.25	Cu 0.35
ASTM A 322-91 (1996)	4137	---	G41370	0.35-0.40	0.70-0.90	0.15-0.35	0.035	0.040	0.80-1.10	0.25	0.15-0.25	Cu 0.35
SAE J404 APR94	4137	---	G41370	0.35-0.40	0.70-0.90	0.15-0.35	0.035	0.040	0.80-1.10	0.25	0.15-0.25	Cu 0.35
JIS G 4105:1979	SCM 435	---	---	0.33-0.38	0.60-0.85	0.15-0.35	0.030	0.030	0.90-1.20	0.25	0.15-0.30	Cu 0.30
EN 10083-1:1991	34 CrMo 4	---	---	0.30-0.37	0.60-0.90	0.40	0.035	0.035	0.90-1.20	---	0.15-0.30	---
	34 CrMoS 4	---	---	0.30-0.37	0.60-0.90	0.40	0.035	0.020-0.040	0.90-1.20	---	0.15-0.30	---
ISO 683-1:1987	34 CrMo 4	---	---	0.30-0.37	0.60-0.90	0.10-0.40	0.035	0.035	0.90-1.20	---	0.15-0.30	---
	34 CrMoS 4	---	---	0.30-0.37	0.60-0.90	0.10-0.40	0.035	0.020-0.040	0.90-1.20	---	0.15-0.30	---
ASTM A 29/A 29M-99	4140	---	G41400	0.38-0.43	0.75-1.00	0.15-0.35	0.035	0.040	0.80-1.10	0.25	0.15-0.25	Cu 0.35
ASTM A 322-91 (1996)	4140	---	G41400	0.38-0.43	0.75-1.00	0.15-0.35	0.035	0.040	0.80-1.10	0.25	0.15-0.25	Cu 0.35
SAE J404 APR94	4140	---	G41400	0.38-0.43	0.75-1.00	0.15-0.35	0.035	0.040	0.80-1.10	---	0.15-0.25	Cu 0.35
JIS G 4105:1979	SCM 440	---	---	0.38-0.43	0.60-0.85	0.15-0.35	0.030	0.030	0.90-1.20	0.25	0.15-0.30	Cu 0.30
EN 10083-1:1991	42 CrMo 4	---	---	0.38-0.45	0.60-0.90	0.40	0.035	0.035	0.90-1.20	---	0.15-0.30	---
	42 CrMoS 4	---	---	0.38-0.45	0.60-0.90	0.40	0.035	0.020-0.040	0.90-1.20	---	0.15-0.30	---
ISO 683-1:1987	42 CrMo 4	---	---	0.38-0.45	0.60-0.90	0.10-0.40	0.035	0.035	0.90-1.20	---	0.15-0.30	---
	42 CrMoS 4	---	---	0.38-0.45	0.60-0.90	0.10-0.40	0.035	0.020-0.040	0.90-1.20	---	0.15-0.30	---
ASTM A 29/A 29M-99	4145	---	G41450	0.43-0.48	0.75-1.00	0.15-0.35	0.035	0.040	0.80-1.10	0.25	0.15-0.25	Cu 0.35
ASTM A 322-91 (1996)	4145	---	G41450	0.43-0.48	0.75-1.00	0.15-0.35	0.035	0.040	0.80-1.10	0.25	0.15-0.25	Cu 0.35
SAE J404 APR94	4145	---	G41450	0.43-0.48	0.75-1.00	0.15-0.35	0.030	0.040	0.80-1.10	---	0.15-0.25	Cu 0.35
JIS G 4105:1979	SCM 445	---	---	0.43-0.48	0.60-0.85	0.15-0.35	0.030	0.030	0.90-1.20	0.25	0.15-0.30	Cu 0.30
ASTM A 29/A 29M-99	4150	---	G41500	0.48-0.53	0.75-1.00	0.15-0.35	0.035	0.040	0.80-1.10	0.25	0.15-0.25	Cu 0.35
ASTM A 322-91 (1996)	4150	---	G41500	0.48-0.53	0.75-1.00	0.15-0.35	0.035	0.040	0.80-1.10	0.25	0.15-0.25	Cu 0.35
SAE J404 APR94	4150	---	G41500	0.48-0.53	0.75-1.00	0.15-0.35	0.030	0.040	0.80-1.10	---	0.15-0.25	Cu 0.35
EN 10083-1:1991	50 CrMo 4	---	---	0.46-0.54	0.50-0.80	0.40	0.035	0.035	0.90-1.20	---	0.15-0.30	---
ISO 683-1:1987	50 CrMo 4	---	---	0.38-0.54	0.50-0.80	0.10-0.40	0.035	0.035	0.90-1.20	---	0.15-0.30	---

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

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 4103:1979	SNCM 415	---	---	0.12-0.18	0.40-0.70	0.15-0.35	0.030	0.030	0.40-0.65	1.60-2.00	0.15-0.30	Cu 0.30
ISO 683-11:1987	17 NiCrMo 6	---	---	0.14-0.20	0.60-0.90	0.15-0.40	0.035	0.035	0.80-1.10	1.20-1.60	0.15-0.25	---
ASTM A 29/A 29M-99	4320	---	G43200	0.17-0.22	0.45-0.65	0.15-0.35	0.035	0.040	0.40-0.60	1.65-2.00	0.20-0.30	Cu 0.35
ASTM A 322-91 (1996)	4320	---	G43200	0.17-0.22	0.45-0.65	0.15-0.35	0.035	0.040	0.40-0.60	1.65-2.00	0.20-0.30	Cu 0.35
SAE J404 APR94	4320	---	G43200	0.17-0.22	0.45-0.65	0.15-0.35	0.035	0.040	0.40-0.60	1.65-2.00	0.20-0.30	Cu 0.35
JIS G 4103:1979	SNCM 420	---	---	0.17-0.23	0.40-0.70	0.15-0.35	0.030	0.030	0.40-0.65	1.60-2.00	0.15-0.30	Cu 0.30
EN 10084:1998	20NiCrMoS6-4	1.6571	---	0.16-0.23	0.50-0.90	0.40	0.035	0.020-0.040	0.60-0.90	1.40-1.70	0.25-0.35	---
ASTM A 29/A 29M-99	4340	---	G43400	0.38-0.43	0.60-0.80	0.15-0.35	0.035	0.040	0.70-0.90	1.65-2.00	0.20-0.30	Cu 0.35
	E4340	---	G43406	0.38-0.43	0.65-0.85	0.15-0.35	0.025	0.025	0.70-0.90	1.65-2.00	0.20-0.30	Cu 0.35
ASTM A 322-91 (1996)	4340	---	G43400	0.38-0.43	0.60-0.80	0.15-0.35	0.035	0.040	0.70-0.90	1.65-2.00	0.20-0.30	Cu 0.35
	E4340	---	G43406	0.38-0.43	0.65-0.85	0.15-0.35	0.025	0.025	0.70-0.90	1.65-2.00	0.20-0.30	Cu 0.35
SAE J404 APR94	4340	---	G43400	0.38-0.43	0.60-0.80	0.15-0.35	0.035	0.040	0.70-0.90	1.65-2.00	0.20-0.30	Cu 0.35
	E4340	---	G43406	0.38-0.43	0.65-0.85	0.15-0.35	0.025	0.025	0.70-0.90	1.65-2.00	0.20-0.30	Cu 0.35
JIS G 4103:1979	SNCM 439	---	---	0.36-0.43	0.60-0.90	0.15-0.35	0.030	0.030	0.60-1.00	1.60-2.00	0.15-0.30	Cu 0.30
ASTM A 29/A 29M-99	8620	---	G86200	0.18-0.23	0.70-0.90	0.15-0.35	0.035	0.04	0.40-0.60	0.40-0.70	0.15-0.25	Cu 0.35
ASTM A 322-91 (1996)	8620	---	G86200	0.18-0.23	0.70-0.90	0.15-0.35	0.035	0.04	0.40-0.60	0.40-0.70	0.15-0.25	Cu 0.35
SAE J404 APR94	8620	---	G86200	0.18-0.23	0.70-0.90	0.15-0.35	0.030	0.040	0.40-0.60	0.40-0.70	0.15-0.25	Cu 0.35
JIS G 4103:1979	SNCM 220	---	---	0.17-0.23	0.60-0.90	0.15-0.35	0.030	0.030	0.40-0.65	0.40-0.70	0.15-0.30	Cu 0.30
EN 10084:1998	20NiCrMo2-2	1.6523	---	0.17-0.23	0.65-0.95	0.40	0.035	0.035	0.35-0.70	0.40-0.70	0.15-0.25	---
	20NiCrMoS2-2	1.6526	---	0.17-0.23	0.65-0.95	0.40	0.035	0.020-0.040	0.35-0.70	0.40-0.70	0.15-0.25	---
ISO 683-11:1987	20 NiCrMo 2	---	---	0.17-0.23	0.65-0.95	0.15-0.40	0.035	0.035	0.30-0.65	0.40-0.70	0.15-0.25	---
	20 NiCrMoS 2	---	---	0.17-0.23	0.65-0.95	0.15-0.40	0.035	0.020-0.040	0.30-0.65	0.40-0.70	0.15-0.25	---
ASTM A 29/A 29M-99	8640	---	G86400	0.38-0.43	0.75-1.00	0.15-0.35	0.035	0.040	0.40-0.60	0.40-0.70	0.15-0.25	Cu 0.35
ASTM A 322-91 (1996)	8640	---	G86400	0.38-0.43	0.75-1.00	0.15-0.35	0.035	0.040	0.40-0.60	0.40-0.70	0.15-0.25	Cu 0.35
SAE J404 APR94	8640	---	G86400	0.38-0.43	0.75-1.00	0.15-0.35	0.030	0.040	0.40-0.60	0.40-0.70	0.15-0.25	Cu 0.35
JIS G 4103:1979	SNCM 240	---	---	0.38-0.43	0.70-1.00	0.15-0.35	0.030	0.030	0.40-0.65	0.40-0.70	0.15-0.30	Cu 0.30
ISO 683-1:1987	41 CrNiMo 2	---	---	0.37-0.44	0.70-1.00	0.10-0.40	0.035	0.035	0.40-0.60	0.40-0.70	0.15-0.30	---
	41 CrNiMoS 2	---	---	0.37-0.44	0.70-1.00	0.10-0.40	0.035	0.020-0.040	0.40-0.60	0.40-0.70	0.15-0.30	---
ASTM A 29/A 29M-99	E9310	---	G93106	0.08-0.13	0.45-0.65	0.15-0.30	0.025	0.025	1.00-1.40	3.00-3.50	0.08-0.15	---
EN 10084:1998	14NiCrMo13-4	1.6657	---	0.11-0.17	0.30-0.60	0.40	0.035	0.035	0.80-1.10	3.00-3.50	0.10-0.25	---

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

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 355-89 (2000)	A	---	K24065	0.38-0.43	0.50-0.70	0.15-0.35	0.035	0.040	1.40-1.80	---	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

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

2.3.5 Boron (B) Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 29/A 29M-99	50B44	---	G50441	0.43–0.48	0.75–1.00	0.15–0.35	0.035	0.040	0.20–0.60	0.25	0.06	B 0.0005–0.003; Cu 0.35
	50B46	---	G50461	0.44–0.49	0.75–1.00	0.15–0.35	0.035	0.040	0.20–0.35	0.25	0.06	B 0.0005–0.003; Cu 0.35
	50B50	---	G50501	0.48–0.53	0.75–1.00	0.15–0.35	0.035	0.040	0.40–0.60	0.25	0.06	B 0.0005–0.003; Cu 0.35
	50B60	---	G50601	0.56–0.64	0.75–1.00	0.15–0.35	0.035	0.040	0.40–0.60	0.25	0.06	B 0.0005–0.003; Cu 0.35
	51B60	---	G51601	0.56–0.64	0.75–1.00	0.15–0.35	0.035	0.040	0.70–0.90	0.25	0.06	B 0.0005–0.003; Cu 0.35
ASTM A 322-91 (1996)	50B44	---	G50441	0.43–0.48	0.75–1.00	0.15–0.35	0.035	0.040	0.20–0.60	0.25	0.06	B 0.0005–0.003; Cu 0.35
	50B46	---	G50461	0.44–0.49	0.75–1.00	0.15–0.35	0.035	0.040	0.20–0.35	0.25	0.06	B 0.0005–0.003; Cu 0.35
	50B50	---	G50501	0.48–0.53	0.75–1.00	0.15–0.35	0.035	0.040	0.40–0.60	0.25	0.06	B 0.0005–0.003; Cu 0.35
	50B60	---	G50601	0.56–0.64	0.75–1.00	0.15–0.35	0.035	0.040	0.40–0.60	0.25	0.06	B 0.0005–0.003; Cu 0.35
	51B60	---	G51601	0.56–0.64	0.75–1.00	0.15–0.35	0.035	0.040	0.70–0.90	0.25	0.06	B 0.0005–0.003; Cu 0.35
SAE J404 APR94	50B46	---	G50461	0.44–0.49	0.75–1.00	0.15–0.35	0.030	0.040	0.20–0.35	0.25	0.06	B 0.0005–0.003; Cu 0.35
	51B60	---	G51601	0.56–0.64	0.75–1.00	0.15–0.35	0.030	0.040	0.70–0.90	0.25	0.06	B 0.0005–0.003; Cu 0.35
EN 10083-3:1995	27MnCrB5-2	1.7182	---	0.24–0.30	1.10–1.40	0.40	0.035	0.040	0.30–0.60	---	---	B 0.0008–0.0050
	33MnCrB5-2	1.7185	---	0.30–0.36	1.20–1.50	0.40	0.035	0.040	0.30–0.60	---	---	B 0.0008–0.0050
	39MnCrB5-2	1.7189	---	0.36–0.42	1.40–1.70	0.40	0.035	0.040	0.30–0.60	---	---	B 0.0008–0.0050

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

2.3.6 Chromium-Vanadium (Cr-V) Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 29/A 29M-99	6150	---	G61500	0.48-0.53	0.70-0.90	0.15-0.35	0.035	0.040	0.80-1.10	0.25	0.06	V 0.15 min
ASTM A 322-91 (1996)	6150	---	G61500	0.48-0.53	0.70-0.90	0.15-0.35	0.035	0.040	0.80-1.10	0.25	0.06	V 0.15 min
SAE J404 APR94	6150	---	G61500	0.48-0.53	0.70-0.90	0.15-0.35	0.035	0.040	0.80-1.10	0.25	0.06	V 0.15 min
EN 10083-1:1991	51 CrV 4	---	---	0.47-0.55	0.70-1.10	0.40	0.030	0.035	0.90-1.20	---	---	V 0.10-0.25
ISO 683-1:1987	51 CrV 4	---	---	0.47-0.55	0.60-1.00	0.10-0.40	0.035	0.035	0.80-1.10	---	---	V 0.10-0.25

2.4 Non-Comparable Carbon and Alloy Steels for General Use

ASTM A 29/A 29M-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	---	---	---	---	---	---

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

SAE J404 APR94 Chemical Compositions of SAE Alloy Steels (Hot Rolled and Cold Finished Bars Only)												
Grade	1335	1340	4023	4027	4037	4047	4142	4620	4820	5150	5160	8615
UNS Number	G13350	G13400	G40230	G40270	G40370	G40470	G41420	G46200	G48200	G51500	G51600	G86150
Grade	8617	8622	8630	8645	8720	8822	9259	9260	---	---	---	---
UNS Number	G86170	G86220	G86300	G86450	G87200	G88200	G92590	G92600	---	---	---	---
JIS G 4103:1979 Nickel Chromium Molybdenum Steels												
Symbol of Class	SNCM 431	SNCM 447	SNCM616	SNCM 625	SNCM 630	SNCM 815	---	---	---	---	---	---
Previous Symbol	SNCM 1	SNCM 9	SNCM 26	SNCM 2	SNCM 5	SNCM 25	---	---	---	---	---	---
JIS G 4105:1979 Chromium Molybdenum Steels												
Symbol of Class	SCM 415	---	---	---	---	---	---	---	---	---	---	---
Previous Symbol	SCM 21	---	---	---	---	---	---	---	---	---	---	---
EN 10083-1:1991 Quenched and Tempered Steels – Technical Delivery Conditions for Special Steels												
Steel Name	36 CrNiMo 4	34 CrNiMo 6	30 CrNiMo 8	36 NiCrMo 16	---	---	---	---	---	---	---	---
Steel Number	---	---	---	---	---	---	---	---	---	---	---	---
EN 10084:1998 Case Hardening Steels - Technical Delivery Conditions												
Steel Name	16MnCr5	16MnCrS5	16MnCrB	20MnCr5	20MnCrS5	16NiCr4	16NiCrS4	10NiCr5-4	18NiCr5-4	17CrNi6-6	15NiCr13	17NiCrMo6-4
Steel Number	1.7131	1.7139	1.7139	1.7147	1.7149	1.5714	1.5715	1.5805	1.5810	1.5918	1.5752	1.6566
Steel Name	17NiCrMoS6-4	18CrNiMo7-6	---	---	---	---	---	---	---	---	---	---
Steel Number	1.6569	1.6657	---	---	---	---	---	---	---	---	---	---
ISO 683-1:1987 Heat-Treatable Steels, Alloy Steels and Free-Cutting Steels – Part 1: Direct-Hardening Unalloyed and Low-Alloyed Wrought Steel in Form of Different Black Products												
Type of Steel	36 CrNiMo 4	36 CrNiMo 6	31 CrNiMo 8	51 CrV 4	---	---	---	---	---	---	---	---
ISO 683-10:1987 Heat-Treatable Steels, Alloy Steels and Free-Cutting Steels – Part 10: Wrought Nitriding Steels												
Type of Steel	31 CrMo 12	33 CrAlMo 5 4	---	---	---	---	---	---	---	---	---	---
ISO 683-11:1987 Heat-Treatable Steels, Alloy Steels and Free-Cutting Steels – Part 11: Wrought Case-Hardening Steels												
Type of Steel	16 MnCr 5	16 MnCrS 5	15 NiCr 13	18 CrNiMo 7	---	---	---	---	---	---	---	---

CHAPTER

3

STRUCTURAL STEEL PLATES

ASTM Standards

ASTM A 36/A 36M-00	Carbon Structural Steel
ASTM A 242/A 242M-00	High-Strength Low-Alloy Structural Steel
ASTM A 283/A 283M-00	Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A 514/A 514M-00	High- Yield- Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding
ASTM A 529/A 529M-96	High-Strength Carbon-Manganese Steel of Structural Quality
ASTM A 570/A 570M-98	Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality
ASTM A 572/A 572M-00	High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A 573/A 573M-93 (1998)	Structural Carbon Steel Plates of Improved Toughness
ASTM A 588/A 588M-00	High-Strength Low-Alloy Structural Steel With 50 ksi [345 MPa] Minimum Yield Point to 4 in. [100 mm] Thick
ASTM A 606-98	Steel, Sheet and Strip, High- Strength, Low-Alloy, Hot- Rolled and Cold- Rolled, with Improved Atmospheric Corrosion Resistance
ASTM A 633/A 633M-00	Normalized High-Strength Low-Alloy Structural Steel Plates
ASTM A 656/A 656M-00	Hot-Rolled Structural Steel, High-Strength Low-Alloy Plate with Improved Formability
ASTM A 678/A 678M-00	Quenched-and-Tempered Carbon and High-Strength Low-Alloy Structural Steel Plates
ASTM A 709/A 709M-00	Carbon and High-Strength Low-Alloy Structural Steel Shapes, Plates, and Bars and Quenched-and-Tempered Alloy Structural Steel Plates for Bridges
ASTM A 710/A 710M-95	Age-Hardening Low-Carbon Nickel-Copper-Chromium-Molybdenum-Columbium Alloy Structural Steel Plates
ASTM A 852/A 852M-00	Quenched and Tempered Low-Alloy Structural Steel Plate with 70 ksi (485 MPa) Minimum Yield Strength to 4 in. [100 mm] Thick
ASTM A 871/A 871M-00	High- Strength Low-Alloy Structural Steel Plate with Atmospheric Corrosion Resistance

JIS Standards

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

CEN Standards

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

ISO Standards

ISO 630:1995	Structural Steels - Plates, Wide Flats, Bars, Sections and Profiles
ISO 4950-2:1995	High Yield Strength Flat Steel Products, Part 2: Products Supplied in the Normalized or Controlled Rolled Condition
ISO 4950-3:1995	High Yield Strength Flat Steel Products, Part 3: Products Supplied in the Heat-Treated (Quenched + Tempered) Condition
ISO 4952:1981	Structural Steels with Improved Atmospheric Corrosion Resistance
ISO 5952:1998	Continuously Hot-Rolled Steel Sheet of Structural Quality with Improved Atmospheric Corrosion Resistance

CSA Standards

CSA G40.21-98	Structural Quality Steel - Plates, Sheet, Floor Plates, Bars, and Welded Shapes
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Heat Treatment Terms Applicable to this Chapter

Standard	Heat Treatment Terms
ASTM A 36/A 36M-00	---
ASTM A 242/A 242M-00	---
ASTM A 283/A 283M-00	---
ASTM A 514/A 514M-00	QT: quenched and tempered
ASTM A 529/A 529M-96	---
ASTM A 570/A 570M-98	HR: hot-rolled
ASTM A 572/A 572M-00	---
ASTM A 573/A 573M-93 (1998)	---
ASTM A 588/A 588M-00	---
ASTM A 606-98	HR: hot-rolled (as-rolled); CR: cold-rolled; A: annealed; N: normalized
ASTM A 633/A 633M-00	N: normalized; N+N: double normalized
ASTM A 656/A 656M-00	HR: hot-rolled
ASTM A 678/A 678M-00	QT: quenched and tempered
ASTM A 709/A 709M-00	---; QT: quenched and tempered
ASTM A 710/A 710M-95	PH: precipitation heat treatment; N+PH: normalized followed by precipitation heat treatment; Q+PH: quenched followed by precipitation heat treatment
ASTM A 852/A 852M-00	QT: quenched and tempered
ASTM A 871/A 871M-00	HR: hot-rolled (as rolled); N: normalized; QT: quenched and tempered
JIS G 3101:1995	HR: hot-rolled
JIS G 3106:1999	HR: hot-rolled
JIS G 3114:1998	HR: hot-rolled
JIS G 3125:1987	CR: cold-rolled; HR: hot-rolled
JIS G 3128:1999	QT: quenched and tempered
JIS G 3136:1994	HR: hot-rolled
EN 10025:1993	HR: hot-rolled; N: normalized rolled
EN 10113-2:1993	N: normalized or normalized rolled treatment
EN 10113-3:1993	TMCP: thermomechanically rolled
EN 10137-2:1995	QT: quenched and tempered
EN 10137-3:1995	PH: precipitation hardened
EN 10155:1993	HR: hot-rolled; N: normalized or normalized rolled
ISO 630:1995	AR: as rolled; N: normalized or equivalent (obtained by controlled rolling); AD: as delivered
ISO 4950-2:1995	NT: normalized and tempered; CTR: controlled rolled condition
ISO 4950-3:1995	QT: quenched and tempered
ISO 4952:1981	AR: as rolled; N: normalized or equivalent (obtained by controlled rolling)
ISO 5952:1998	HR: hot-rolled
CSA G40.21-98	---; AR: as-rolled; QT: quenched and tempered

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	---			24	
	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

3.1A 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		
ISO 630:1995 (Continued)	E 235 D	---	---	D ₁ : N D ₂ : AD	≤ 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	
ASTM A 283/A 283M-00	B	---	---	---	---	---	185	27	345-450	50-65	28	---

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		
ASTM A 570/A 570M-98	33	---	K02502	HR	$0.65 \leq t < 1.6$	$0.025 \leq t < 0.064$	230	33	360 min	52 min	18	---
					$1.6 \leq t < 2.5$	$0.064 \leq t < 0.097$					22	
					$2.5 \leq t < 6.0$	$0.097 \leq t < 0.230$					23	
EN 10025:1993	S235JR	1.0037	---	HR	< 3	---	235	---	360-510	---	---	---
					$3 \leq t \leq 16$	---	235	---	340-470	---	24	27 J at 20°C
					$16 < t \leq 40$	---	225	---			---	---
					$40 < t \leq 100$	---	---	---			---	---
	S235JRG1	1.0036	---	HR	< 3	---	235	---	360-510	---	---	---
					$3 \leq t \leq 16$	---	235	---	340-470	---	24	27 J at 20°C
					$16 < t \leq 40$	---	225	---			---	---
					$40 < t \leq 100$	---	---	---			---	---
	S235JRG2	1.0038	---	HR	< 3	---	235	---	360-510	---	---	---
					$3 \leq t \leq 16$	---	235	---	340-470	---	24	27 J at 20°C
					$16 < t \leq 40$	---	225	---			24	
					$40 < t \leq 63$	---	215	---			23	
					$63 < t \leq 80$	---	215	---			22	
					$80 < t \leq 100$	---	215	---			22	
					$100 < t \leq 150$	---	195	---			22	
					$150 < t \leq 200$	---	185	---	320-470	---	21	23 J at 20°C
					$200 < t \leq 250$	---	175	---			21	
	S235J0	1.0114	---	HR	< 3	---	235	---	360-510	---	---	---
					$3 \leq t \leq 16$	---	235	---	340-470	---	24	27 J at 0°C
					$16 < t \leq 40$	---	225	---			24	
					$40 < t \leq 63$	---	215	---			23	
					$63 < t \leq 80$	---	215	---			22	
					$80 < t \leq 100$	---	215	---			22	
					$100 < t \leq 150$	---	195	---			22	
					$150 < t \leq 200$	---	185	---	320-470	---	21	23 J at 0°C
					$200 < t \leq 250$	---	175	---			21	

NOTE: This section continued on next page.

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		
EN 10025:1993 (Continued)	S235J2G3	1.0116	---	N	< 3	---	235	---	360-510	---	---	---
					3 ≤ t ≤ 16	---	235	---	340-510	---	24	27 J at -20°C
					16 < t ≤ 40	---	225	---			24	
					40 < t ≤ 63	---	215	---			23	
					63 < t ≤ 80	---	215	---			22	
					80 < t ≤ 100	---	215	---			22	
					100 < t ≤ 150	---	195	---	340-470	---	22	
					150 < t ≤ 200	---	185	---	320-470	---	21	23 J at -20°C
					200 < t ≤ 250	---	175	---			21	
	S235J2G4	1.0117	---	HR	< 3	---	235	---	360-510	---	---	---
					3 ≤ t ≤ 16	---	235	---	340-470	---	24	27 J at -20°C
					16 < t ≤ 40	---	225	---			24	
					40 < t ≤ 63	---	215	---			23	
					63 < t ≤ 80	---	215	---			22	
					80 < t ≤ 100	---	215	---			22	
					100 < t ≤ 150	---	195	---			22	
					150 < t ≤ 200	---	185	---	320-470	---	21	23 J at -20°C
					200 < t ≤ 250	---	175	---			21	
ASTM A 570/A 570M-98	Gr. 36 Type 1	---	K02502	HR	0.65 ≤ t < 1.6	0.025 ≤ t < 0.064	250	36	365 min	53 min	17	---
					1.6 ≤ t < 2.5	0.064 ≤ t < 0.097					21	
					2.5 ≤ t < 6.0	0.097 ≤ t < 0.230					22	

3.1 Carbon 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		
ASTM A 283/A 283M-00	C	---	K02401	---	---	---	205	30	380-515	55-75	25	---
ASTM A 570/A 570M-98	40	---	K02502	HR	$0.65 \leq t < 1.6$	$0.025 \leq t < 0.064$	275	40	380 min	55 min	16	---
					$1.6 \leq t < 2.5$	$0.064 \leq t < 0.097$					20	
					$2.5 \leq t < 6.0$	$0.097 \leq t < 0.230$					21	
ASTM A 36/A 36M-00	---	---	K02595 K02596 K02597 K02598 K02599	---	---	---	250	36	400-550	58-80	23	---
ASTM A 570/A 570M-98	Gr. 36 Type 2	---	K02502	HR	$0.65 \leq t < 1.6$	$0.025 \leq t < 0.064$	250	36	400-550	58-80	16.0	---
					$1.6 \leq t < 2.5$	$0.064 \leq t < 0.097$					20.0	
					$2.5 \leq t < 6.0$	$0.097 \leq t < 0.230$					21.0	
ASTM A 573/A 573M-98	58 [400]	---	K02301	---	≤ 40	≤ 1.5	220	32	400-490	58-71	24	---
ASTM A 709/A 709M-00	36 [250]	---	---	---	≤ 100	≤ 4	250	36	400-550	58-80	23	---
JIS G 3101:1995	SS400	---	---	HR	≤ 16	---	245	---	400-510	---	17	---
					$16 < t \leq 40$	---	235	---			21	
					> 40	---	215	---			23	
JIS G 3106:1999	SM400A	---	---	HR	≤ 16	---	245	---	400-510	---	18 min	---
					$16 < t \leq 40$	---	235	---			22 min	
					$40 < t \leq 75$	---	215	---			24 min	
					$75 < t \leq 100$	---	215	---			24 min	
					$100 < t \leq 160$	---	205	---			24 min	
					$160 < t \leq 200$	---	195	---			24 min	
	SM400B	---	---	HR	≤ 16	---	245	---	400-510	---	18 min	27 J at 0°C
					$16 < t \leq 40$	---	235	---			22 min	
					$40 < t \leq 75$	---	215	---			24 min	
					$75 < t \leq 100$	---	215	---			24 min	
					$100 < t \leq 160$	---	205	---			24 min	
					$160 < t \leq 200$	---	195	---			24 min	

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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 3106:1999 (Continued)	SM400C	---	---	HR	≤ 16	---	245	---	400-510	---	18 min	47 J at 0°C
					16 < t ≤ 40	---	235	---			22 min	
					40 < t ≤ 75	---	215	---			24 min	
					75 < t ≤ 100	---	215	---			24 min	
JIS G 3136:1994	SN400A	---	---	HR	≤ 16	---	235	---	400-510	---	17	---
					16 < t ≤ 40	---	235	---			21	
					40 < t ≤ 100	---	215	---			23	
	SN400B	---	---	HR	≤ 16	---	235-355	---	400-510	---	18	27 J at 0°C
					16 < t ≤ 40	---	235-355	---			22	
					40 < t ≤ 100	---	215-335	---			24	
	SN400C	---	---	HR	≤ 16	---	235-355	---	400-510	---	18	27 J at 0°C
					16 < t ≤ 40	---	235-355	---			22	
					40 < t ≤ 100	---	215-335	---			24	

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		
ISO 630:1995	E 275 A	---	---	AR	≤ 16	---	275	---	410-540	---	20	---
					16 < t ≤ 40	---	265	---			19	
					40 < t ≤ 63	---	255	---			18	
					63 < t ≤ 80	---	245	---			18	
					80 < t ≤ 100	---	235	---			16	
					100 < t ≤ 150	---	225	---			15	
					150 < t ≤ 200	---	215	---			15	
	E 275 B	---	---	AR	≤ 16	---	275	---	410-540	---	20	27 J at 20°C
					16 < t ≤ 40	---	265	---			19	
					40 < t ≤ 63	---	255	---			18	
					63 < t ≤ 80	---	245	---			18	
					80 < t ≤ 100	---	235	---			16	
					100 < t ≤ 150	---	225	---			15	
					150 < t ≤ 200	---	215	---			15	
	E 275 C	---	---	AR	≤ 16	---	275	---	410-540	---	20	27 J at 0°C
					16 < t ≤ 40	---	265	---			19	
					40 < t ≤ 63	---	255	---			18	
					63 < t ≤ 80	---	245	---			18	
					80 < t ≤ 100	---	235	---			16	
					100 < t ≤ 150	---	225	---			15	
					150 < t ≤ 200	---	215	---			15	
	E 275 D	---	---	D ₁ : N D ₂ : AD	≤ 16	---	275	---	410-540	---	20	27 J at -20°C
					16 < t ≤ 40	---	265	---			19	
					40 < t ≤ 63	---	255	---			18	
					63 < t ≤ 80	---	245	---			18	
					80 < t ≤ 100	---	235	---			16	
					100 < t ≤ 150	---	225	---			15	
					150 < t ≤ 200	---	215	---			15	
ASTM A 283/A 283M-00	D	---	K02702	---	---	---	230	33	415-550	60-80	23	---
ASTM A 570/A 570M-98	45	---	K02507	HR	0.65 ≤ t < 1.6	0.025 ≤ t < 0.064	310	45	415 min	60 min	13.0	---
					1.6 ≤ t < 2.5	0.064 ≤ t < 0.097					18.0	
					2.5 ≤ t < 6.0	0.097 ≤ t < 0.230					19.0	

3.1 Carbon 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		
EN 10025:1993	S275JR	1.0044	---	HR	< 3	---	275	---	430-580	---	---	---
					3 ≤ t ≤ 16	---	275	---	410-560	---	20	27 J at 20°C
					16 < t ≤ 40	---	265	---			20	
					40 < t ≤ 63	---	255	---			19	
					63 < t ≤ 80	---	245	---			18	
					80 < t ≤ 100	---	235	---			18	
					100 < t ≤ 150	---	225	---	400-540	---	18	23 J at 20°C
					150 < t ≤ 200	---	215	---	380-540	---	17	
					200 < t ≤ 250	---	205	---			17	
	S275J0	1.0143	---	HR	< 3	---	275	---	430-580	---	---	---
					3 ≤ t ≤ 16	---	275	---	410-560	---	20	27 J at 0°C
					16 < t ≤ 40	---	265	---			20	
					40 < t ≤ 63	---	255	---			19	
					63 < t ≤ 80	---	245	---			18	
					80 < t ≤ 100	---	235	---			18	
					100 < t ≤ 150	---	225	---	400-540	---	18	23 J at 0°C
					150 < t ≤ 200	---	215	---	380-540	---	17	
					200 < t ≤ 250	---	205	---			17	
	S275J2G3	1.0144	---	N	< 3	---	275	---	430-580	---	---	---
					3 ≤ t ≤ 16	---	275	---	410-560	---	20	27 J at -20°C
					16 < t ≤ 40	---	265	---			20	
					40 < t ≤ 63	---	255	---			19	
					63 < t ≤ 80	---	245	---			18	
					80 < t ≤ 100	---	235	---			18	
					100 < t ≤ 150	---	225	---	400-540	---	18	23 J at -20°C
					150 < t ≤ 200	---	215	---	380-540	---	17	
					200 < t ≤ 250	---	205	---			17	

NOTE: This section continued on next page.

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		
EN 10025:1993 (Continued)	S275J2G4	1.0145	---	HR	< 3	---	275	---	430-580	---	---	---
					3 ≤ t ≤ 16	---	275	---	410-560	---	20	27 J at -20°C
					16 < t ≤ 40	---	265	---			20	
					40 < t ≤ 63	---	255	---			19	
					63 < t ≤ 80	---	245	---			18	
					80 < t ≤ 100	---	235	---			18	
					100 < t ≤ 150	---	225	---	400-540	---	18	23 J at -20°C
					150 < t ≤ 200	---	215	---	380-540	---	17	
					200 < t ≤ 250	---	205	---			17	
ASTM A 570/A 570M-98	50	---	K02507	HR	0.65 ≤ t < 1.6	0.025 ≤ t < 0.064	345	50	450 min	65 min	11.0	---
					1.6 ≤ t < 2.5	0.064 ≤ t < 0.097					16.0	
					2.5 ≤ t < 6.0	0.097 ≤ t < 0.230					17.0	
ASTM A 573/A 573M-98	65 [450]	---	K02404	---	≤ 40	≤ 1.5	240	35	450-530	65-77	23	---

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		
ASTM A 529/A 529M-96	50 [345]	---	K02703	---	≤ 25	≤ 1	345	50	485-690	70-100	21	---
	55 [380]	---	K02703	---	≤ 25	≤ 1	380	55			20	
ASTM A 570/A 570M-98	55	---	K02507	HR	0.65 ≤ t < 1.6	0.025 ≤ t < 0.064	380	55	480 min	70 min	9.0	---
					1.6 ≤ t < 2.5	0.064 ≤ t < 0.097					14.0	
					2.5 ≤ t < 6.0	0.097 ≤ t < 0.230					15.0	
ASTM A 573/A 573M-98	70 [485]	---	K02701	---	≤ 40	≤ 1.5	290	42	485-620	70-90	21	---
ASTM A 678/A 678M-00	A	---	K01600	QT	≤ 20	≤ ¾	345	50	485-620	70-90	22	---
					20 < t ≤ 40	¾ < t ≤ 1½	345	50				
JIS G 3101:1995	SS490	---	---	HR	≤ 16	---	285	---	490-610	---	15	---
					16 < t ≤ 40	---	275	---			19	
					> 40	---	255	---			21	
JIS G 3106:1999	SM490A	---	---	HR	≤ 16	---	325	---	490-610	---	17	---
					16 < t ≤ 40	---	315	---			21	
					40 < t ≤ 75	---	295	---			23	
					75 < t ≤ 100	---	295	---			23	
					100 < t ≤ 160	---	285	---			23	
					160 < t ≤ 200	---	275	---			23	
	SM490B	---	---	HR	≤ 16	---	325	---	490-610	---	17	27 J at 0°C
					16 < t ≤ 40	---	315	---			21	
					40 < t ≤ 75	---	295	---			23	
					75 < t ≤ 100	---	295	---			23	
					100 < t ≤ 160	---	285	---			23	
					160 < t ≤ 200	---	275	---			23	
	SM490C	---	---	HR	≤ 16	---	325	---	490-610	---	17	47 J at 0°C
					16 < t ≤ 40	---	315	---			21	
					40 < t ≤ 75	---	295	---			23	
					75 < t ≤ 100	---	295	---			23	
					100 < t ≤ 200	---	---	---			23	
					100 < t ≤ 200	---	---	---			23	

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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 3106:1999 (Continued)	SM490YA	---	---	HR	≤ 16	---	365	---	490-610	---	15	---
					16 < t ≤ 40	---	355	---			19	
					40 < t ≤ 75	---	335	---			21	
					75 < t ≤ 100	---	325	---			21	
	SM490YB	---	---	HR	≤ 16	---	365	---	490-610	---	15	27 J at 0°C
					16 < t ≤ 40	---	355	---			19	
					40 < t ≤ 75	---	335	---			21	
					75 < t ≤ 100	---	325	---			21	
JIS G 3136:1994	SN490B	---	---	HR	≤ 16	---	325-445	---	490-610	---	17	27 J at 0°C
					16 < t ≤ 40	---	325-445	---			21	
					40 < t ≤ 100	---	295-415	---			23	
	SN490C	---	---	HR	≤ 16	---	325-445	---	490-610	---	17	27 J at 0°C
					16 < t ≤ 40	---	325-445	---			21	
					40 < t ≤ 100	---	295-415	---			23	
EN 10025:1993	E 295	1.0050	---	HR	< 3	---	295	---	490-660	---	---	---
					3 ≤ t ≤ 16	---	295	---	470-610	---	18	
					16 < t ≤ 40	---	285	---			18	
					40 < t ≤ 63	---	275	---			17	
					63 < t ≤ 80	---	265	---			16	
					80 < t ≤ 100	---	255	---	450-610	---	16	
					100 < t ≤ 150	---	245	---			15	
					150 < t ≤ 200	---	235	---	440-610	---	14	
					200 < t ≤ 250	---	225	---			14	
ISO 630:1995	E 355 C	---	---	AR	≤ 16	---	355	---	490-640	---	22	27 J at 0°C
					16 < t ≤ 40	---	345	---			22	
					40 < t ≤ 63	---	335	---			21	
					63 < t ≤ 80	---	325	---			20	
					80 < t ≤ 100	---	315	---			20	
					100 < t ≤ 150	---	295	---			18	
					150 < t ≤ 200	---	285	---			17	

NOTE: This section continued on next page.

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		
ISO 630:1995 (Continued)	E 355 D	---	---	D ₁ : N D ₂ : AD	≤ 16	---	355	---	490-640	---	22	27 J at -20°C
					16 < t ≤ 40	---	345	---			22	
					40 < t ≤ 63	---	335	---			21	
					63 < t ≤ 80	---	325	---			20	
					80 < t ≤ 100	---	315	---			20	
					100 < t ≤ 150	---	295	---			18	
					150 < t ≤ 200	---	285	---			17	

3.1 Carbon 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		
EN 10025:1993	S355JR	1.0045	---	HR	< 3	---	355	---	510-680	---	---	---
					3 ≤ t ≤ 16	---	355	---	490-630	---	20	27 J at 20°C
					16 < t ≤ 40	---	345	---			20	
					40 < t ≤ 63	---	335	---			19	
					63 < t ≤ 80	---	325	---			18	
					80 < t ≤ 100	---	315	---			18	
					100 < t ≤ 150	---	295	---	470-630	---	18	23 J at 20°C
					150 < t ≤ 200	---	285	---	450-630	---	17	
					200 < t ≤ 250	---	275	---			17	
	S355J0	1.0553	---	HR	< 3	---	355	---	510-680	---	---	---
					3 ≤ t ≤ 16	---	355	---	490-630	---	20	27 J at 0°C
					16 < t ≤ 40	---	345	---			20	
					40 < t ≤ 63	---	335	---			19	
					63 < t ≤ 80	---	325	---			18	
					80 < t ≤ 100	---	315	---			18	
					100 < t ≤ 150	---	295	---	470-630	---	18	23 J at 0°C
					150 < t ≤ 200	---	285	---	450-630	---	17	
					200 < t ≤ 250	---	275	---			17	
	S355J2G3	1.0570	---	N	< 3	---	355	---	510-680	---	---	---
					3 ≤ t ≤ 16	---	355	---	490-630	---	20	27 J at -20°C
					16 < t ≤ 40	---	345	---			20	
					40 < t ≤ 63	---	335	---			19	
					63 < t ≤ 80	---	325	---			18	
					80 < t ≤ 100	---	315	---			18	
					100 < t ≤ 150	---	295	---	470-630	---	18	23 J at -20°C
					150 < t ≤ 200	---	285	---	450-630	---	17	
					200 < t ≤ 250	---	275	---			17	

NOTE: This section continued on next page.

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		
EN 10025:1993 (Continued)	S355J2G4	1.0577	---	HR	< 3	---	355	---	510-680	---	---	---
					3 ≤ t ≤ 16	---	355	---	490-630	---	20	27 J at -20°C
					16 < t ≤ 40	---	345	---			20	
					40 < t ≤ 63	---	335	---			19	
					63 < t ≤ 80	---	325	---			18	
					80 < t ≤ 100	---	315	---	470-630	---	18	23 J at -20°C
					100 < t ≤ 150	---	295	---			17	
					150 < t ≤ 200	---	285	---	450-630	---	17	33 J at -20°C
					200 < t ≤ 250	---	275	---			17	
	S355K2G3	1.0595	---	HR	< 3	---	355	---	510-680	---	---	---
					3 ≤ t ≤ 16	---	355	---	490-630	---	20	40 J at -20°C
					16 < t ≤ 40	---	345	---			20	
					40 < t ≤ 63	---	335	---			19	
					63 < t ≤ 80	---	325	---			18	
					80 < t ≤ 100	---	315	---	470-630	---	18	33 J at -20°C
					100 < t ≤ 150	---	295	---			17	
					150 < t ≤ 200	---	285	---	450-630	---	17	
					200 < t ≤ 250	---	275	---			17	
	S355K2G4	1.0596	---	HR	< 3	---	355	---	510-680	---	---	---
					3 ≤ t ≤ 16	---	355	---	490-630	---	20	40 J at -20°C
					16 < t ≤ 40	---	345	---			20	
					40 < t ≤ 63	---	335	---			19	
					63 < t ≤ 80	---	325	---			18	
					80 < t ≤ 100	---	315	---	470-630	---	18	33 J at -20°C
					100 < t ≤ 150	---	295	---			17	
					150 < t ≤ 200	---	285	---	450-630	---	17	
					200 < t ≤ 250	---	275	---			17	

NOTE: This section continued on next page.

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 3106:1999	SM520B	---	---	HR	≤ 16	---	365	---	520-640	---	15	27 J at 0°C
					16 < t ≤ 40	---	355	---			19	
					40 < t ≤ 75	---	335	---			21	
					75 < t ≤ 100	---	325	---			21	
	SM520C	---	---	HR	≤ 16	---	365	---	520-640	---	15	47 J at 0°C
					16 < t ≤ 40	---	355	---			19	
					40 < t ≤ 75	---	335	---			21	
					75 < t ≤ 100	---	325	---			21	
JIS G 3101:1995	SS540	---	---	HR	≤ 16	---	400	---	540 min	---	13	---
					16 < t ≤ 40	---	390	---			17	
					> 40	---	---	---			---	
ASTM A 678/A 678M-00	B	---	K02002	QT	t ≤ 20	t ≤ ¾	415	60	550-690	80-100	22	---
					20 < t ≤ 40	¾ < t ≤ 1½						
					40 < t ≤ 50	1½ < t ≤ 2						
					50 < t ≤ 65	2 < t ≤ 2½						

3.1 Carbon 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 3106:1999	SM570	---	---	HR	≤ 16	---	460	---	570-720	---	19	47 J at -5°C
					16 < t ≤ 40	---	450	---			---	
					40 < t ≤ 75	---	430	---			20	
					75 < t ≤ 100	---	420	---			20	
EN 10025:1993	E 335	1.0060	---	HR	< 3	---	335	---	590-770	---	---	---
					3 ≤ t ≤ 16	---	335	---	570-710	---	14	
					16 < t ≤ 40	---	325	---			14	
					40 < t ≤ 63	---	315	---			13	
					63 < t ≤ 80	---	305	---			12	
					80 < t ≤ 100	---	295	---			12	
					100 < t ≤ 150	---	275	---	550-710	---	11	
					150 < t ≤ 200	---	265	---	540-710	---	10	
					200 < t ≤ 250	---	255	---			10	
ASTM A 678/A 678M-00	C	---	K02204	QT	t ≤ 20	t ≤ ¾	515	75	655-790	95-115	19	---
					20 < t ≤ 40	¾ < t ≤ 1½	485	70	620-760	90-110		
					40 < t ≤ 50	1½ < t ≤ 2	450	65	585-720	85-105		
EN 10025:1993	E 360	1.0070	---	HR	< 3	---	360	---	690-900	---	---	---
					3 ≤ t ≤ 16	---	360	---	670-830	---	10	
					16 < t ≤ 40	---	355	---			10	
					40 < t ≤ 63	---	345	---			9	
					63 < t ≤ 80	---	335	---			8	
					80 < t ≤ 100	---	325	---			8	
					100 < t ≤ 150	---	305	---	650-830	---	7	
					150 < t ≤ 200	---	295	---	640-830	---	6	
					200 < t ≤ 250	---	285	---			6	

3.1 Carbon 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
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	---	---	---	---

3.1 Carbon Steel Structural Steel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 570/A 570M-98	33	---	K02502	≤ 6.0	≤ 0.229	0.25	0.90	report value	0.035	0.04	---	---	---	AI report value
EN 10025:1993	S235JR	1.0037	---	≤ 16	---	0.17	1.40	---	0.045	0.045	---	---	---	N 0.009
				16 < t ≤ 40	---	0.20	1.40	---	0.045	0.045	---	---	---	N 0.009
	S235JRG1	1.0036	---	≤ 16	---	0.17	1.40	---	0.045	0.045	---	---	---	N 0.007
				16 < t ≤ 40	---	0.20	1.40	---	0.045	0.045	---	---	---	N 0.007
	S235JRG2	1.0038	---	≤ 16	---	0.17	1.40	---	0.045	0.045	---	---	---	N 0.009
				16 < t ≤ 40	---	0.17	1.40	---	0.045	0.045	---	---	---	N 0.009
				> 40	---	0.20	1.40	---	0.045	0.045	---	---	---	N 0.009
	S235J0	1.0114	---	≤ 16	---	0.17	1.40	---	0.040	0.040	---	---	---	N 0.009
				16 < t ≤ 40	---	0.17	1.40	---	0.040	0.040	---	---	---	N 0.009
				> 40	---	0.17	1.40	---	0.040	0.040	---	---	---	N 0.009
	S235J2G3	1.0116	---	≤ 16	---	0.17	1.40	---	0.035	0.035	---	---	---	---
				16 < t ≤ 40	---	0.17	1.40	---	0.035	0.035	---	---	---	---
				> 40	---	0.17	1.40	---	0.035	0.035	---	---	---	---
EN 10025:1993 (Continued)	S235J2G4	1.0117	---	≤ 16	---	0.17	1.40	---	0.035	0.035	---	---	---	---
				16 < t ≤ 40	---	0.17	1.40	---	0.035	0.035	---	---	---	---
				> 40	---	0.17	1.40	---	0.035	0.035	---	---	---	---
ASTM A 570/A 570M-98	Gr. 36 Type 1	---	K02502	≤ 6.0	≤ 0.229	0.25	0.90	report value	0.035	0.04	---	---	---	AI report value

3.1 Carbon Steel Structural Steel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 283/A 283M-00	C	---	K02401	≤ 40	≤ 1.5	0.24	0.90	0.40	0.035	0.04	---	---	---	---
				> 40	> 1.5	0.24	0.90	0.15-0.40	0.035	0.04	---	---	---	---
ASTM A 570/A 570M-98	40	---	K02502	≤ 6.0	≤ 0.229	0.25	0.90	report value	0.035	0.04	---	---	---	AI report value
ASTM A 36/A 36M-00	---	---	K02595	≤ 20	≤ ¾	0.25	---	0.40	0.04	0.05	---	---	---	---
			K02596	20 < t ≤ 40	¾ < t ≤ 1½	0.25	0.80-1.20	0.40	0.04	0.05	---	---	---	---
			K02597	40 < t ≤ 65	1½ < t ≤ 2½	0.26	0.80-1.20	0.15-0.40	0.04	0.05	---	---	---	---
			K02598	65 < t ≤ 100	2½ < t ≤ 4	0.27	0.85-1.20	0.15-0.40	0.04	0.05	---	---	---	---
			K02599	> 100	> 4	0.29	0.85-1.20	0.15-0.40	0.04	0.05	---	---	---	---
ASTM A 570/A 570M-98	Gr. 36 Type 2	---	K02502	≤ 6.0	≤ 0.229	0.25	1.35	0.40	0.035	0.04	---	---	---	AI report value
ASTM A 573/A 573M-98	58 [400]	---	K02301	≤ 13	≤ ½	0.23	0.60-0.90	0.10-0.35	0.035	0.04	---	---	---	---
				13 < t ≤ 40	½ < t ≤ 1½	0.23	0.60-0.90	0.10-0.35	0.035	0.04	---	---	---	---
ASTM A 709/A 709M-00	36 [250]	---	---	≤ 20	≤ ¾	0.25	---	0.40	0.04	0.05	---	---	---	---
				20 < t ≤ 40	¾ < t ≤ 1½	0.25	0.80-1.20	0.40	0.04	0.05	---	---	---	---
				40 < t ≤ 65	1½ < t ≤ 2½	0.26	0.80-1.20	0.15-0.40	0.04	0.05	---	---	---	---
				65 < t ≤ 100	2½ < t ≤ 4	0.27	0.85-1.20	0.015-0.40	0.04	0.05	---	---	---	---
JIS G 3101:1995	SS400	---	---	---	---	---	---	---	0.050	0.050	---	---	---	---
JIS G 3106:1999	SM400A	---	---	≤ 50	---	0.23	2.5xC min	---	0.035	0.035	---	---	---	---
				50 < t ≤ 200	---	0.25	2.5xC min	---	0.035	0.035	---	---	---	---
	SM400B	---	---	≤ 50	---	0.20	0.60-1.40	0.35	0.035	0.035	---	---	---	---
				50 < t ≤ 200	---	0.22	0.60-1.40	0.35	0.035	0.035	---	---	---	---
JIS G 3136:1994	SM400C	---	---	≤ 100	---	0.18	1.40	0.35	0.035	0.035	---	---	---	---
	SN400A	---	---	6 ≤ t ≤ 100	---	0.24	---	---	0.050	0.050	---	---	---	---
				6 ≤ t ≤ 50	---	0.20	0.60-1.40	0.35	0.030	0.015	---	---	---	---
	SN400B	---	---	50 < t ≤ 100	---	0.22	0.60-1.40	0.35	0.030	0.015	---	---	---	---
				16 ≤ t ≤ 50	---	0.20	0.60-1.40	0.35	0.020	0.008	---	---	---	---
	SN400C	---	---	50 < t ≤ 100	---	0.22	0.60-1.40	0.35	0.020	0.008	---	---	---	---

3.1 Carbon Steel Structural Steel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ISO 630:1995	E 275 A	---	---	---	---	0.24	---	---	0.050	0.050	---	---	---	---
	E 275 B	---	---	≤ 40	---	0.21	1.50	0.40	0.045	0.045	---	---	---	Non-rimming
				> 40	---	0.22	1.50	0.40	0.045	0.045	---	---	---	Non-rimming
	E 275 C	---	---	---	---	0.20	1.50	0.40	0.040	0.040	---	---	---	Non-rimming
ASTM A 283/A 283M-00	D	---	K02702	≤ 40	≤ 1.5	0.27	0.90	0.40	0.035	0.04	---	---	---	---
				> 40	> 1.5	0.27	0.90	0.15-0.40	0.035	0.04	---	---	---	---
ASTM A 570/A 570M-98	45	---	K02507	≤ 6.0	≤ 0.229	0.25	1.35	report value	0.035	0.04	---	---	---	AI report value
EN 10025:1993	S275JR	1.0044	---	≤ 16	---	0.21	1.50	---	0.045	0.045	---	---	---	N 0.009
				16 < t ≤ 40	---	0.21	1.50	---	0.045	0.045	---	---	---	N 0.009
				> 40	---	0.22	1.50	---	0.045	0.045	---	---	---	N 0.009
	S275J0	1.0143	---	≤ 16	---	0.18	1.50	---	0.040	0.040	---	---	---	N 0.009
				16 < t ≤ 40	---	0.18	1.50	---	0.040	0.040	---	---	---	N 0.009
				> 40	---	0.18	1.50	---	0.040	0.040	---	---	---	N 0.009
	S275J2G3	1.0144	---	≤ 16	---	0.18	1.50	---	0.035	0.035	---	---	---	---
				16 < t ≤ 40	---	0.18	1.50	---	0.035	0.035	---	---	---	---
				> 40	---	0.18	1.50	---	0.035	0.035	---	---	---	---
	S275J2G4	1.0145	---	≤ 16	---	0.18	1.50	---	0.035	0.035	---	---	---	---
				16 < t ≤ 40	---	0.18	1.50	---	0.035	0.035	---	---	---	---
				> 40	---	0.18	1.50	---	0.035	0.035	---	---	---	---
ASTM A 570/A 570M-98	50	---	K02507	≤ 6.0	≤ 0.229	0.25	1.35	report value	0.035	0.04	---	---	---	AI report value
ASTM A 573/A 573M-98	65 [450]	---	K02404	≤ 13	≤ ½	0.24	0.85-1.20	0.15-0.40	0.035	0.04	---	---	---	---
				13 < t ≤ 40	½ < t ≤ 1½	0.26	0.85-1.20	0.15-0.40	0.035	0.04	---	---	---	---

3.1 Carbon Steel Structural Steel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 529/A 529M-96	50 [345]	---	K02703	≤ 25	≤ 1	0.27	1.35	0.40	0.04	0.05	---	---	---	---
	55 [380]	---	K02703	≤ 25	≤ 1	0.27	1.35	0.40	0.04	0.05	---	---	---	---
ASTM A 570/A 570M-98	55	---	K02507	≤ 6.0	≤ 0.229	0.25	1.35	report value	0.035	0.04	---	---	---	AI report value
ASTM A 573/A 573M-98	70 [485]	---	K02701	≤ 13	≤ ½	0.27	0.85-1.20	0.15-0.40	0.035	0.04	---	---	---	---
				13 < t ≤ 40	½ < t ≤ 1½	0.28	0.85-1.20	0.15-0.40	0.035	0.04	---	---	---	---
ASTM A 678/A 678M-00	A	---	K01600	≤ 40	≤ 1½	0.16	0.90-1.50	0.15-0.50	0.035	0.04	---	---	---	---
JIS G 3101:1995	SS490	---	---	---	---	---	---	---	0.050	0.050	---	---	---	---
JIS G 3106:1999	SM490A	---	---	≤ 50	---	0.20	1.60	0.55	0.035	0.035	---	---	---	---
				50 < t ≤ 200	---	0.22	1.60	0.55	0.035	0.035	---	---	---	---
	SM490B	---	---	≤ 50	---	0.18	1.60	0.55	0.035	0.035	---	---	---	---
				50 < t ≤ 200	---	0.20	1.60	0.55	0.035	0.035	---	---	---	---
	SM490C	---	---	≤ 100	---	0.18	1.60	0.55	0.035	0.035	---	---	---	---
	SM490YA	---	---	≤ 100	---	0.20	1.60	0.55	0.035	0.035	---	---	---	---
JIS G 3136:1994	SN490B	---	---	6 ≤ t ≤ 50	---	0.18	1.60	0.55	0.030	0.015	---	---	---	---
				50 < t ≤ 100	---	0.20	1.60	0.55	0.030	0.015	---	---	---	---
	SN490C	---	---	16 ≤ t ≤ 50	---	0.18	1.60	0.55	0.020	0.008	---	---	---	---
				50 < t ≤ 100	---	0.20	1.60	0.55	0.020	0.008	---	---	---	---
	EN 10025:1993	1.0050	---	---	---	---	---	---	0.045	0.045	---	---	---	N 0.009
ISO 630:1995	E 355 C	---	---	≤ 30	---	0.20	1.60	0.55	0.040	0.040	---	---	---	non-rimming
				> 30	---	0.22	1.60	0.55	0.040	0.040	---	---	---	non-rimming
	E 355 D	---	---	≤ 30	---	0.20	1.60	0.55	0.035	0.035	---	---	---	fine-grained
				> 30	---	0.22	1.60	0.55	0.035	0.035	---	---	---	fine-grained

3.1 Carbon Steel Structural Steel Plates

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

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

3.2 Alloy 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

3.2.1A 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		
ASTM A 572/A 572M-00	60 [415]	---	---	---	≤ 32	≤ 1¼	415	60	520	75	18	---
CSA G40.21:1998	400WT (60WT)	---	---	AR	≤ 65	≤ 2.5	400	60	520-690	75-100	20	---
ASTM A 572/A 572M-00	65 [450]	---	---	---	≤ 32	≤ 1¼	450	65	550	80	17	---
ASTM A 633/A 633M-00	E	---	K12202	N < 3 in. N+N > 3 in. (75 mm)	≤ 65	≤ 2.5	415	60	550-690	80-100	23	---
					65 < t ≤ 100	2.5 < t ≤ 4	415	60	550-690	80-100		
					100 < t ≤ 150	4 < t ≤ 6	380	55	515-655	75-95		
ASTM A 656/A 656M-00	70 [485]	---	---	HR	≤ 25	≤ 1	485	70	550	80	17	---

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	---	---	---	
ASTM A 572/A 572M-00	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	---	---	---	
	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
ASTM A 572/A 572M-00	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.

3.2 Alloy Steel Structural Steel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10113-3:1993	S355M	1.8823	---	≤ 63	---	0.14	1.60	0.50	0.035	0.030	---	0.30	0.20	Nb 0.05; V 0.10; Al 0.02 min; Ti 0.05; N 0.015
	S355ML	1.8834	---	≤ 63	---	0.14	1.60	0.50	0.030	0.025	---	0.30	0.20	Nb 0.05; V 0.10; Al 0.02 min; Ti 0.05; N 0.015
CSA G40.21:1998	300WT (44WT)	---	---	---	---	0.22	0.80-1.50	0.15-0.40	0.03	0.04	---	---	---	Grain refining elements 0.10

3.2 Alloy Steel Structural Steel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10113-2-93	S355N	1.0545	---	≤ 150	---	0.20	0.90-1.65	0.50	0.035	0.030	0.30	0.50	0.10	Nb 0.05; V 0.12; Al 0.02 min; Ti 0.03; Cu 0.35; N 0.015
	S355NL	1.0546	---	≤ 150	---	0.18	0.90-1.65	0.50	0.030	0.0250	0.30	0.50	0.10	Nb 0.05; V 0.12; Al 0.02 min; Ti 0.03; Cu 0.35; N 0.015
ASTM A 242/A 242M-00	1	---	K11510	≤ 100	≤ 4	0.15	1.00	---	0.15	0.05	---	---	---	Cu 0.20
CSA G40.21-98	350WT (50WT)	---	---	---	---	0.22	0.80-1.50	0.15-0.40	0.03	0.04	---	---	---	Grain refining elements 0.10
ASTM A 572/A 572M-00	55 [380] Type 1	---	---	≤ 50	≤ 2	0.25	1.35	0.15-0.40	0.04	0.05	---	---	---	Cb 0.005-0.05
	55 [380] Type 2	---	---	≤ 50	≤ 2	0.25	1.35	0.15-0.40	0.04	0.05	---	---	---	V 0.01-0.15
	55 [380] Type 3	---	---	≤ 50	≤ 2	0.25	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
	55 [380] Type 4	---	---	≤ 50	≤ 2	0.25	1.35	0.15-0.40	0.04	0.05	---	---	---	V 0.01-0.15; N 0.015
	55 [380] Type 5	---	---	≤ 50	≤ 2	0.25	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	60 [415] Type 3	---	---	≤ 40	≤ 1½	0.18	1.65	0.60	0.025	0.035	---	---	---	V 0.08; N 0.020; Cb 0.008-0.15
	60 [415] Type 7	---	---	≤ 40	≤ 1½	0.18	1.65	0.60	0.025	0.035	---	---	---	V 0.15; N 0.020; Cb 0.10
ASTM A 588/A 588M-00	A	---	K11430	≤ 200	≤ 8	0.19	0.80-1.25	0.30-0.65	0.04	0.05	0.40-0.65	0.40	---	Cu 0.25-0.40; V 0.02-0.10
	B	---	K12043	≤ 200	≤ 8	0.20	0.75-1.35	0.15-0.50	0.04	0.05	0.40-0.70	0.50	---	Cu 0.20-0.40; V 0.01-0.10
	C	---	K11538	≤ 200	≤ 8	0.15	0.80-1.35	0.15-0.40	0.04	0.05	0.30-0.50	0.25-0.50	---	Cu 0.20-0.50; V 0.01-0.10
	K	---	---	≤ 200	≤ 8	0.17	0.50-1.20	0.25-0.50	0.05	0.05	0.40-0.70	0.40	0.10	Cu 0.30-0.50; Cb 0.005-0.05
ASTM A 633/A 633M-00	C	---	K12000	≤ 100	≤ 4	0.20	1.15-1.50	0.15-0.50	0.035	0.04	---	---	---	Cb 0.01-0.05
	D	---	K12037	≤ 40	≤ 1½	0.20	0.70-1.35	0.15-0.50	0.035	0.04	0.25	0.25	0.08	Cu 0.35
				40 < t ≤ 100	1½ < t ≤ 4	0.20	1.00-1.60	0.15-0.50	0.035	0.04	0.25	0.25	0.08	Cu 0.35
EN 10113-3:1993	S420M	1.8825	---	≤ 63	---	0.16	1.70	0.50	0.035	0.030	---	0.30	0.20	Nb 0.05; V 0.12; Al 0.02 min; Ti 0.05; N 0.020
	S420ML	1.8836	---	≤ 63	---	0.16	1.70	0.50	0.030	0.025	---	0.30	0.20	Nb 0.05; V 0.12; Al 0.02 min; Ti 0.05; N 0.020

3.2 Alloy Steel Structural Steel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 572/A 572M-00	60 [415] Type 1	---	---	32	1¼	0.26	1.35	0.40	0.04	0.05	---	---	---	Cb 0.005-0.05
	60 [415] Type 2	---	---	32	1¼	0.26	1.35	0.40	0.04	0.05	---	---	---	V 0.01-0.15
	60 [415] Type 3	---	---	32	1¼	0.26	1.35	0.40	0.04	0.05	---	---	---	Cb 0.005-0.05; V 0.01-0.15; Cb + V 0.02-0.15
	60 [415] Type 4	---	---	32	1¼	0.26	1.35	0.40	0.04	0.05	---	---	---	V 0.01-0.15; N 0.015
	60 [415] Type 5	---	---	32	1¼	0.26	1.35	0.40	0.04	0.05	---	---	---	Ti 0.006-0.04; N 0.003-0.015; V 0.06
CSA G40.21:1998	400WT (60WT)	---	---	---	---	0.22	0.80-1.50	0.15-0.40	0.03	0.04	---	---	---	Grain refining elements 0.10
ASTM A 572/A 572M-00	65 [450] Type 1	---	---	≤ 13	≤ ½	0.26	1.35	0.40	0.04	0.05	---	---	---	Cb 0.005-0.05
				> 13-32	> ½-1¼	0.23	1.65	0.40	0.04	0.05	---	---	---	
	65 [450] Type 2	---	---	≤ 13	≤ ½	0.26	1.35	0.40	0.04	0.05	---	---	---	V 0.01-0.15
				> 13-32	> ½-1¼	0.23	1.65	0.40	0.04	0.05	---	---	---	
	65 [450] Type 3	---	---	≤ 13	≤ ½	0.26	1.35	0.40	0.04	0.05	---	---	---	Cb 0.005-0.05; V 0.01-0.15; Cb + V 0.02-0.15
				> 13-32	> ½-1¼	0.23	1.65	0.40	0.04	0.05	---	---	---	
	65 [450] Type 4	---	---	≤ 13	≤ ½	0.26	1.35	0.40	0.04	0.05	---	---	---	V 0.01-0.15; N 0.015
				> 13-32	> ½-1¼	0.23	1.65	0.40	0.04	0.05	---	---	---	
	65 [450] Type 5	---	---	≤ 13	≤ ½	0.26	1.35	0.40	0.04	0.05	---	---	---	Ti 0.006-0.04; N 0.003-0.015; V 0.06
				> 13-32	> ½-1¼	0.23	1.65	0.40	0.04	0.05	---	---	---	
ASTM A 633/A 633M-00	E	---	K12202	≤ 150	≤ 6	0.22	1.15-1.50	0.15-0.50	0.035	0.04	---	---	---	V 0.04-0.11; N 0.01-0.03
ASTM A 656/A 656M-00	70, Type 3	---	---	≤ 25	≤ 1	0.18	1.65	0.60	0.025	0.035	---	---	---	V 0.08; N 0.020; Cb 0.008-0.15
	70, Type 7	---	---	≤ 25	≤ 1	0.18	1.65	0.60	0.025	0.035	---	---	---	V 0.15; N 0.020; Cb 0.10

3.2 Alloy Steel Structural Steel Plates

3.2.2A Mechanical Properties of Alloy 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 4950-2:1995	E 355 DD	---	---	NT or CTR	t ≤ 16	---	355	---	470-630	---	22	39 J at -20°C
					16 < t ≤ 35	---	345	---				
					35 < t ≤ 50	---	335	---				
					50 < t ≤ 70	---	325	---				
					70 < t ≤ 100	---	305	---	450-610	---		
					100 < t ≤ 125	---	295	---	440-600	---		
					125 < t ≤ 150	---	285	---	430-590	---		
	E 355 E	---	---	NT or CTR	t ≤ 16	---	355	---	470-630	---	22	27 J at -50°C
					16 < t ≤ 35	---	345	---				
					35 < t ≤ 50	---	335	---				
					50 < t ≤ 70	---	325	---				
					70 < t ≤ 100	---	305	---	450-610	---		
					100 < t ≤ 125	---	295	---	440-600	---		
					125 < t ≤ 150	---	285	---	430-590	---		
ASTM A 709/A 709M-00	50W [345W] Grade A, B, C	---	---	---	≤ 100	≤ 4	345	50	485 min	70 min	21	---
ASTM A 710/A 710M-95	Gr. A Cl. 2	---	K20747	N + PH	≤ 25	≤ 1	450	65	495 min	72 min	20	---
					25 < t ≤ 30	1 < t ≤ 1¼	415	60				
					30 < t ≤ 50	1¼ < t ≤ 2			380	55		
					50 < t ≤ 100	2 < t ≤ 4	345	50				
					> 100	> 4						

3.2 Alloy Steel Structural Steel Plates

3.2.2A Mechanical Properties of Alloy 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		
EN 10137-2:1995	S460Q	1.8908	---	QT	3 ≤ t ≤ 50	---	460	---	550-720	---	17	see standard
					50 < t ≤ 100	---	440	---				
					100 < t ≤ 150	---	400	---	500-670	---		
	S460QL	1.8906	---	QT	3 ≤ t ≤ 50	---	460	---	550-720	---	17	see standard
					50 < t ≤ 100	---	440	---				
					100 < t ≤ 150	---	400	---	500-670	---		
	S460QL1	1.8916	---	QT	3 ≤ t ≤ 50	---	460	---	550-720	---	17	see standard
					50 < t ≤ 100	---	440	---				
					100 < t ≤ 150	---	400	---	500-670	---		
ISO 4950-3:1995	E 460 DD	---	---	QT	t ≤ 50	---	460	---	570-720	---	17	39 J at -20°C
					50 < t ≤ 70	---	440	---				
	E 460 E	---	---	QT	t ≤ 50	---	460	---	570-720	---	17	27 J at -50°C
					50 < t ≤ 70	---	440	---				
ASTM A 709/A 709M-00	HPS 70W [HPS 485W]	---	---	QT	≤ 100	≤ 4	485	70	585-760	85-110	19	---
ASTM A 710/A 710M-95	Gr. A Cl. 3	---	K20747	Q +PH	≤ 50	≤ 2	515	75	585	85	20	---
					50 < t ≤ 100	2 < t ≤ 4	450	65	515	75		
					> 100	> 4	415	60	485	70		
EN 10137-2:1995	S500Q	1.8924	---	QT	3 ≤ t ≤ 50	---	500	---	590-770	---	17	see standard
					50 < t ≤ 100	---	480	---				
					100 < t ≤ 150	---	440	---	540-720	---		
	S500QL	1.8909	---	QT	3 ≤ t ≤ 50	---	500	---	590-770	---	17	see standard
					50 < t ≤ 100	---	480	---				
					100 < t ≤ 150	---	440	---	540-720	---		
	S500QL1	1.8984	---	QT	3 ≤ t ≤ 50	---	500	---	590-770	---	17	see standard
					50 < t ≤ 100	---	480	---				
					100 < t ≤ 150	---	440	---	540-720	---		

3.2 Alloy Steel Structural Steel Plates

3.2.2A Mechanical Properties of Alloy 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		
EN 10137-3:1995	S500A	1.8980	---	PH	3 ≤ t ≤ 50	---	500	---	600-700	---	17	see standard
					50 < t ≤ 70	---	480	---				
	S500AL	1.8990	---	PH	3 ≤ t ≤ 50	---	500	---	600-700	---	17	see standard
					50 < t ≤ 70	---	480	---				
ASTM A 710/A 710M-95	Gr. A Cl. 1	---	K20747	PH	≤ 8	≤ 5/16	585	85	620	90	20	L: 27 J at -45°C T: 20 J at -45°C
					8 < t ≤ 20	5/16 < t ≤ 3/4	550	80				
ASTM A 852/A 852M-00	---	---	K12043	QT	≤ 100	≤ 4	485	70	620-760	90-110	19	27 J at 10°C
EN 10137-2:1995	S550Q	1.8904	---	QT	3 ≤ t ≤ 50	---	550	---	640-820	---	16	see standard
					50 < t ≤ 100	---	530	---				
					100 < t ≤ 150	---	490	---				
	S550QL	1.8926	---	QT	3 ≤ t ≤ 50	---	550	---	640-820	---	16	see standard
					50 < t ≤ 100	---	530	---				
					100 < t ≤ 150	---	490	---				
	S550QL1	1.8986	---	QT	3 ≤ t ≤ 50	---	550	---	640-820	---	16	see standard
					50 < t ≤ 100	---	530	---				
					100 < t ≤ 150	---	490	---				
EN 10137-3:1995	S550A	1.8991	---	PH	3 ≤ t ≤ 50	---	550	---	650-820	---	16	see standard
					50 < t ≤ 70	---	530	---				
	S550AL	1.8992	---	PH	3 ≤ t ≤ 50	---	550	---	650-820	---	16	see standard
					50 < t ≤ 70	---	530	---				

3.2 Alloy Steel Structural Steel Plates

3.2.2A Mechanical Properties of Alloy 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		
EN 10137-2:1995	S620Q	1.8914	---	QT	3 ≤ t ≤ 50	---	620	---	700-890	---	15	see standard
					50 < t ≤ 100	---	580	---				
					100 < t ≤ 150	---	560	---				
	S620QL	1.8927	---	QT	3 ≤ t ≤ 50	---	620	---	700-890	---	15	see standard
					50 < t ≤ 100	---	580	---				
					100 < t ≤ 150	---	560	---				
	S620QL1	1.8987	---	QT	3 ≤ t ≤ 50	---	620	---	700-890	---	15	see standard
					50 < t ≤ 100	---	580	---				
					100 < t ≤ 150	---	560	---				
EN 10137-3:1995	S620A	1.8993	---	PH	3 ≤ t ≤ 50	---	620	---	710-880	---	15	see standard
					50 < t ≤ 70	---	580	---				
	S620AL	1.8994	---	PH	3 ≤ t ≤ 50	---	620	---	710-880	---	15	see standard
					50 < t ≤ 70	---	580	---				
ASTM A 514/A 514M-94	all grades	---	---	QT	≤ 65	≤ 2½	690	100	760-895	110-130	18	---
					65 < t ≤ 150	2½ < t ≤ 6	620	90	690-895	100-130	16	
ASTM A 709/A 709M-00	100 [690]	---	---	QT	≤ 65	≤ 2½	690	100	760-895	110-130	18	---
					65 < t ≤ 100	2½ < t ≤ 4	620	90	690-895	100-130	16	
	100W [690W]	---	---	QT	≤ 65	≤ 2½	690	100	760-895	110-130	18	---
					65 < t ≤ 100	2½ < t ≤ 4	620	90	690-895	100-130	16	
EN 10137-3:1995	S690A	1.8995	---	PH	3 ≤ t ≤ 50	---	690	---	760-930	---	14	see standard
					50 < t ≤ 70	---	650	---				
	S690AL	1.8996	---	PH	3 ≤ t ≤ 50	---	690	---	760-930	---	14	see standard
					50 < t ≤ 70	---	650	---				
EN 10137-2:1995	S690Q	1.8931	---	QT	3 ≤ t ≤ 50	---	690	---	770-940	---	14	see standard
					50 < t ≤ 100	---	650	---	760-930	---		
					100 < t ≤ 150	---	630	---	710-900	---		
	S690QL	1.8928	---	QT	3 ≤ t ≤ 50	---	690	---	770-940	---	14	see standard
					50 < t ≤ 100	---	650	---	760-930	---		
					100 < t ≤ 150	---	630	---	710-900	---		
	S690QL1	1.8988	---	QT	3 ≤ t ≤ 50	---	690	---	770-940	---	14	see standard
					50 < t ≤ 100	---	650	---	760-930	---		
					100 < t ≤ 150	---	630	---	710-900	---		

3.2 Alloy Steel Structural Steel Plates

3.2.2A Mechanical Properties of Alloy 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 3128:1999	SHY 685	---	---	QT	≤ 50	---	685	---	780-930	---	see standard	47 J at -20°C
					50 < t ≤ 100	---	665	---	760-910	---		
	SHY 685 N	---	---	QT	≤ 50	---	685	---	780-930	---	see standard	47 J at -20°C
					50 < t ≤ 100	---	665	---	760-910	---		
	SHY 685 NS	---	---	QT	≤ 50	---	685	---	780-930	---	see standard	47 J at -40°C
					50 < t ≤ 100	---	665	---	760-910	---		
CSA G40.21:1998	700Q (100Q)	---	---	QT	t ≤ 65	t ≤ 2½	700	100	800-950	115-135	18	---
					65 < t ≤ 100	2½ < t ≤ 4						
	700QT (100QT)	---	---	QT	t ≤ 65	t ≤ 2½	700	100	800-950	115-135	18	---
					65 < t ≤ 100	2½ < t ≤ 4						

3.2 Alloy Steel Structural Steel Plates

3.2.2B Chemical Composition of Alloy 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 4950-2:1995	E 355 DD	---	---	---	---	0.18	0.9-1.6	0.50	0.030	0.030	0.25	0.30	0.10	Nb 0.015-0.060; V 0.02-0.10; Al 0.020 min; Ti 0.02-0.20; Cu 0.35
	E 355 E	---	---	---	---	0.18	0.9-1.6	0.50	0.025	0.025	0.25	0.30	0.10	Nb 0.015-0.060; V 0.02-0.10; Al 0.020 min; Ti 0.02-0.20; Cu 0.35
ASTM A 709/A 709M-00	50W [345W] A	---	---	---	---	0.19	0.80-1.25	0.30-0.65	0.04	0.05	0.40-0.65	0.40	---	Cu 0.25-0.40; V 0.02-0.10
	50W [345W] B	---	---	---	---	0.20	0.75-1.35	0.15-0.50	0.04	0.05	0.40-0.70	0.50	---	Cu 0.20-0.40; V 0.01-0.10
	50W [345W] C	---	---	---	---	0.15	0.80-1.35	0.15-0.40	0.04	0.05	0.30-0.50	0.25-0.50	---	Cu 0.20-0.50; V 0.01-0.10
ASTM A 710/A 710M-95	Gr. A Cl. 2	---	K20747	---	---	0.07	0.40-0.70	0.40	0.025	0.025	0.60-0.90	0.70-1.00	0.15-0.25	Cu 1.00-1.30; Cb 0.02 min
EN 10137-2:1995	S460Q	1.8908	---	---	---	0.20	1.70	0.80	0.025	0.015	1.50	2.0	0.70	N 0.015; B 0.0050; Cu 0.50; Nb 0.06; Ti 0.05; V 0.12; Zr 0.15
	S460QL	1.8906	---	---	---	0.20	1.70	0.80	0.020	0.010	1.50	2.0	0.70	N 0.015; B 0.0050; Cu 0.50; Nb 0.06; Ti 0.05; V 0.12; Zr 0.15
	S460QL1	1.8916	---	---	---	0.20	1.70	0.80	0.020	0.010	1.50	2.0	0.70	N 0.015; B 0.0050; Cu 0.50; Nb 0.06; Ti 0.05; V 0.12; Zr 0.15
ISO 4950-3:1995	E 460 DD	---	---	---	---	0.20	0.7-1.7	0.55	0.035	0.035	see std	see std	see std	see standard
	E 460 E	---	---	---	---	0.20	0.7-1.7	0.55	0.030	0.030	see std	see std	see std	see standard
ASTM A 709/A 709M-00	HPS 70W [HPS 485W]	---	---	---	---	0.11	1.10-1.35	0.30-0.50	0.020	0.006	0.45-0.70	0.25-0.40	0.02-0.08	N 0.015; Cu 0.25-0.40; V 0.04-0.08; Al 0.010-0.040
ASTM A 710/A 710M-95	Gr. A Cl. 3	---	K20747	---	---	0.07	0.40-0.70	0.40	0.025	0.025	0.60-0.90	0.70-1.00	0.15-0.25	Cu 1.00-0.30; Cb 0.02 min
EN 10137-2:1995	S500Q	1.8924	---	---	---	0.20	1.70	0.80	0.025	0.015	1.50	2.0	0.70	N 0.015; B 0.0050; Cu 0.50; Nb 0.06; Ti 0.05; V 0.12; Zr 0.15
	S500QL	1.8909	---	---	---	0.20	1.70	0.80	0.020	0.010	1.50	2.0	0.70	N 0.015; B 0.0050; Cu 0.50; Nb 0.06; Ti 0.05; V 0.12; Zr 0.15
	S500QL1	1.8984	---	---	---	0.20	1.70	0.80	0.020	0.010	1.50	2.0	0.70	N 0.015; B 0.0050; Cu 0.50; Nb 0.06; Ti 0.05; V 0.12; Zr 0.15

3.2 Alloy Steel Structural Steel Plates

3.2.2B Chemical Composition of Alloy 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
EN 10137-3:1995	S500A	1.8980	---	$3 \leq t \leq 70$	---	0.03-0.12	0.30-1.80	0.50	0.025	0.015	0.3	2	0.5	N 0.015; Cu 2; Nb 0.060; Ti 0.10; V 0.10; Al 0.080
	S500AL	1.8990	---	$3 \leq t \leq 70$	---	0.03-0.12	0.30-1.80	0.50	0.020	0.010	0.3	2	0.5	N 0.015; Cu 2; Nb 0.060; Ti 0.10; V 0.10; Al 0.080
ASTM A 710/A 710M-95	Gr. A Cl. 1	---	K20747	≤ 20	$\leq \frac{3}{4}$	0.07	0.40-0.70	0.40	0.025	0.025	0.60-0.90	0.70-1.00	0.15-0.25	Cu 1.00-1.30; Cb 0.02 min
ASTM A 852/A 852M-00	---	---	K12043	≤ 100	≤ 4	0.19	0.80-1.35	0.20-0.65	0.035	0.04	0.40-0.70	0.50	---	Cu 0.20-0.40; V 0.02-0.10
EN 10137-2:1995	S550Q	1.8904	---	---	---	0.20	1.70	0.80	0.025	0.015	1.50	2.0	0.70	N 0.015; B 0.0050; Cu 0.50; Nb 0.06; Ti 0.05; V 0.12; Zr 0.15
	S550QL	1.8926	---	---	---	0.20	1.70	0.80	0.020	0.010	1.50	2.0	0.70	N 0.015; B 0.0050; Cu 0.50; Nb 0.06; Ti 0.05; V 0.12; Zr 0.15
	S550QL1	1.8986	---	---	---	0.20	1.70	0.80	0.020	0.010	1.50	2.0	0.70	N 0.015; B 0.0050; Cu 0.50; Nb 0.06; Ti 0.05; V 0.12; Zr 0.15
EN 10137-3:1995	S550A	1.8991	---	$3 \leq t \leq 70$	---	0.03-0.12	0.30-1.80	0.50	0.025	0.015	0.3	2	0.5	N 0.015; Cu 2; Nb 0.060; Ti 0.10; V 0.10; Al 0.080
	S550AL	1.8992	---	$3 \leq t \leq 70$	---	0.03-0.12	0.30-1.80	0.50	0.020	0.010	0.3	2	0.5	N 0.015; Cu 2; Nb 0.060; Ti 0.10; V 0.10; Al 0.080

3.2 Alloy Steel Structural Steel Plates

3.2.2B Chemical Composition of Alloy 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
EN 10137-2:1995	S620Q	1.8914	---	---	---	0.20	1.70	0.80	0.025	0.015	1.50	2.0	0.70	N 0.015; B 0.0050; Cu 0.50; Nb 0.06; Ti 0.05; V 0.12; Zr 0.15
	S620QL	1.8927	---	---	---	0.20	1.70	0.80	0.020	0.010	1.50	2.0	0.70	N 0.015; B 0.0050; Cu 0.50; Nb 0.06; Ti 0.05; V 0.12; Zr 0.15
	S620QL1	1.8987	---	---	---	0.20	1.70	0.80	0.020	0.010	1.50	2.0	0.70	N 0.015; B 0.0050; Cu 0.50; Nb 0.06; Ti 0.05; V 0.12; Zr 0.15
EN 10137-3:1995	S620A	1.8993	---	3 ≤ t ≤ 70	---	0.03-0.12	0.30-1.80	0.50	0.025	0.015	0.3	2	0.5	N 0.015; Cu 2; Nb 0.060; Ti 0.10; V 0.10; Al 0.080
	S620AL	1.8994	---	3 ≤ t ≤ 70	---	0.03-0.12	0.30-1.80	0.50	0.020	0.010	0.3	2	0.5	N 0.015; Cu 2; Nb 0.060; Ti 0.10; V 0.10; Al 0.080
ASTM A 514/A 514M-94	A	---	K11856	≤ 32	≤ 1½	0.15-0.21	0.80-1.10	0.40-0.80	0.035	0.035	0.50-0.80	---	0.18-0.28	Zr 0.05-0.15; B 0.0025
	B	---	K11630	≤ 32	≤ 1½	0.12-0.21	0.70-1.00	0.20-0.35	0.035	0.035	0.40-0.65	---	0.15-0.25	V 0.03-0.08; Ti 0.01-0.03; B 0.0005-0.005
	C	---	K11511	≤ 32	≤ 1½	0.10-0.20	1.10-1.50	0.15-0.30	0.035	0.035	---	---	0.15-0.30	B 0.001-0.005
	E	---	K21604	≤ 150	≤ 6	0.12-0.20	0.40-0.70	0.20-0.40	0.035	0.035	1.40-2.00	---	0.40-0.60	Ti 0.01-0.10; B 0.001-0.005
	F	---	K11576	≤ 65	≤ 2½	0.10-0.20	0.60-1.00	0.15-0.35	0.035	0.035	0.40-0.65	0.70-1.00	0.40-0.60	V 0.03-0.08; Cu 0.15-0.50; B 0.0005-0.006
	H	---	K11646	≤ 50	≤ 2	0.12-0.21	0.95-1.30	0.20-0.35	0.035	0.035	0.40-0.65	0.30-0.70	0.20-0.30	V 0.03-0.08; B 0.0005-0.005
	J	---	K11625	≤ 32	≤ 1½	0.12-0.21	0.45-0.70	0.20-0.35	0.035	0.035	---	---	0.50-0.65	B 0.001-0.005
	K	---	---	≤ 50	≤ 2	0.10-0.20	1.10-1.50	0.15-0.30	0.035	0.035	---	---	0.45-0.55	B 0.001-0.005
	M	---	K11683	≤ 50	≤ 2	0.12-0.21	0.45-0.70	0.20-0.35	0.035	0.035	---	1.20-1.50	0.45-0.60	B 0.001-0.005
	P	---	K21650	≤ 150	≤ 6	0.12-0.21	0.45-0.70	0.20-0.35	0.035	0.035	0.85-1.20	1.20-1.50	0.45-0.60	B 0.001-0.005
	Q	---	---	≤ 150	≤ 6	0.14-0.21	0.95-1.30	0.15-0.35	0.035	0.035	1.00-1.50	1.20-1.50	0.40-0.60	V 0.03-0.08
	R	---	---	≤ 65	≤ 2½	0.15-0.20	0.85-1.15	0.20-0.35	0.035	0.035	0.35-0.65	0.90-1.10	0.15-0.25	V 0.03-0.08
ASTM A 709/A 709M-00	Gr. 100 [690] & 100W [690W] Type A	---	---	≤ 32	≤ 1½	0.15-0.21	0.80-1.10	0.40-0.80	0.035	0.035	0.50-0.80	---	0.18-0.28	Zr 0.05-0.15; B 0.0025
	Gr. 100 [690] & 100W [690W] Type B	---	---	≤ 32	≤ 1½	0.12-0.21	0.70-1.00	0.20-0.35	0.035	0.035	0.40-0.65	---	0.15-0.25	V 0.03-0.08; Ti 0.01-0.03; B 0.0005-0.005
	Gr. 100 [690] & 100W [690W] Type C	---	---	≤ 32	≤ 1½	0.10-0.20	1.10-1.50	0.15-0.30	0.035	0.035	---	---	0.15-0.30	B 0.001-0.005

Note: This section continued on next page

3.2 Alloy Steel Structural Steel Plates

3.2.2B Chemical Composition of Alloy 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
ASTM A 709/A 709M-00 (Continued)	Gr. 100 [690] & 100W [690W] Type E	---	---	≤ 100	≤ 4	0.12-0.20	0.40-0.70	0.20-0.40	0.035	0.035	1.40-2.00	---	0.40-0.60	Ti 0.01-0.10; B 0.001-0.005
	Gr. 100 [690] & 100W [690W] Type F	---	---	≤ 65	≤ 2½	0.10-0.20	0.60-1.00	0.15-0.35	0.035	0.035	0.40-0.65	0.70-1.00	0.40-0.60	V 0.03-0.08; Cu 0.15-0.50; B 0.0005-0.006
	Gr. 100 [690] & 100W [690W] Type H	---	---	≤ 50	≤ 2	0.12-0.21	0.95-1.30	0.20-0.35	0.035	0.035	0.40-0.65	0.30-0.70	0.20-0.30	V 0.03-0.08; B 0.0005-0.005
	Gr. 100 [690] & 100W [690W] Type J	---	---	≤ 32	≤ 1¼	0.12-0.21	0.45-0.70	0.20-0.35	0.035	0.035	---	---	0.50-0.65	B 0.001-0.005
	Gr. 100 [690] & 100W [690W] Type M	---	---	≤ 50	≤ 2	0.12-0.21	0.45-0.70	0.20-0.35	0.035	0.035	---	1.20-1.50	0.45-0.60	B 0.001-0.005
	Gr. 100 [690] & 100W [690W] Type P	---	---	≤ 100	≤ 4	0.12-0.21	0.45-0.70	0.20-0.35	0.035	0.035	0.85-1.20	1.20-1.50	0.45-0.60	B 0.001-0.005
	Gr. 100 [690] & 100W [690W] Type Q	---	---	≤ 100	≤ 4	0.14-0.21	0.95-1.30	0.15-0.35	0.035	0.035	1.00-1.50	1.20-1.50	0.40-0.60	V 0.03-0.08
EN 10137-3:1995	S690A	1.8995	---	3 ≤ t ≤ 70	---	0.03-0.12	0.30-1.80	0.50	0.025	0.015	0.3	2	0.5	N 0.015; Cu 2; Nb 0.060; Ti 0.10; V 0.10; Al 0.080
	S690AL	1.8996	---	3 ≤ t ≤ 70	---	0.03-0.12	0.30-1.80	0.50	0.020	0.010	0.3	2	0.5	N 0.015; Cu 2; Nb 0.060; Ti 0.10; V 0.10; Al 0.080
EN 10137-2:1995	S690Q	1.8931	---	---	---	0.20	1.70	0.80	0.025	0.015	1.50	2.0	0.70	N 0.015; B 0.0050; Cu 0.50; Nb 0.06; Ti 0.05; V 0.12; Zr 0.15
	S690QL	1.8928	---	---	---	0.20	1.70	0.80	0.020	0.010	1.50	2.0	0.70	N 0.015; B 0.0050; Cu 0.50; Nb 0.06; Ti 0.05; V 0.12; Zr 0.15
	S690QL1	1.8988	---	---	---	0.20	1.70	0.80	0.020	0.010	1.50	2.0	0.70	N 0.015; B 0.0050; Cu 0.50; Nb 0.06; Ti 0.05; V 0.12; Zr 0.15
JIS G 3128:1999	SHY 685	---	---	6 ≤ t ≤ 100	---	0.18	1.50	0.55	0.03	0.025	1.20	---	0.60	Cu 0.50; V 0.10; B 0.005
	SHY 685 N	---	---	6 ≤ t ≤ 100	---	0.18	1.50	0.55	0.030	0.025	0.80	0.30-1.50	0.60	Cu 0.50; V 0.10; B 0.005
	SHY 685 NS	---	---	6 ≤ t ≤ 100	---	0.14	1.50	0.55	0.015	0.015	0.80	0.30-1.50	0.60	Cu 0.50; V 0.05; B 0.005
CSA G40.21:1998	700Q (100Q)	---	---	---	---	0.20	1.50	0.15-0.40	0.03	0.04	---	---	---	B 0.0005-0.005
	700QT (100QT)	---	---	---	---	0.20	1.50	0.15-0.40	0.03	0.04	---	---	---	B is present

3.3 Atmospheric Corrosion Resisting Structural Steel Plates

3.3A Mechanical Properties of Atmospheric Corrosion Resisting 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 5952:1998	Gr. HSA 235W Class B, D	---	---	HR	< 3	---	235	---	360-510	---	20	---
					≥ 3	---	235	---	340-470	---	22	---
EN 10155:1993	S235J0W	1.8958	---	HR	t ≤ 3	---	235	---	360-510	---	---	27 J at 0°C
					3 < t ≤ 16	---	235	---	340-470	---	24	
					16 < t ≤ 40	---	225	---			24	
					40 < t ≤ 63	---	215	---			23	
					63 < t ≤ 80	---	215	---			22	
					80 < t ≤ 100	---	215	---			22	
	S235J2W	1.8961	---	N	t ≤ 3	---	235	---	360-510	---	---	27 J at -20°C
					3 < t ≤ 16	---	235	---	340-470	---	24	
					16 < t ≤ 40	---	225	---			24	
					40 < t ≤ 63	---	215	---			23	
					63 < t ≤ 80	---	215	---			22	
					80 < t ≤ 100	---	215	---			22	
ISO 4952:1981	Gr. Fe 235 W Quality B	---	---	Flat: AR or N Long: AR	t < 16	---	235	---	360	---	25	27 J at 20°C
					16 < t ≤ 40	---	225	---				
					40 < t ≤ 63	---	215	---				
	Gr. Fe 235 W Quality C	---	---	Flat: AR or N Long: AR or N	t < 16	---	235	---	360	---	25	27 J at 0°C
					16 < t ≤ 40	---	225	---				
					40 < t ≤ 63	---	215	---				
	Gr. Fe 235 W Quality D	---	---	Flat: N Long: AR or N	t < 16	---	235	---	360	---	25	27 J at -20°C
					16 < t ≤ 40	---	225	---				
					40 < t ≤ 63	---	215	---				

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		
ISO 5952:1998	Gr. HSA 245W Class B, D	---	---	HR	< 3	---	245	---	400-540	---	20	---
					≥ 3	---	245	---	400-540	---	22	---
JIS G 3114:1998	SMA400AW	---	---	HR	≤ 16	---	245 max	---	400-540	---	17	---
					16 < t ≤ 40	---	235 max	---			21	
					40 < t ≤ 100	---	215 max	---			23	
					100 < t ≤ 160	---	205 max	---				
					160 < t ≤ 200	---	195 max	---				
	SMA400BW	---	---	HR	≤ 16	---	245 max	---	400-540	---	17	27 J at 0°C
					16 < t ≤ 40	---	235 max	---			21	
					40 < t ≤ 100	---	215 max	---			23	
					100 < t ≤ 160	---	205 max	---				
					160 < t ≤ 200	---	195 max	---				
	SMA400CW	---	---	HR	≤ 16	---	245 max	---	400-540	---	17	47 J at 0°C
					16 < t ≤ 40	---	235 max	---			21	
					40 < t ≤ 100	---	215 max	---			23	
	SMA400AP	---	---	HR	≤ 16	---	245 max	---	400-540	---	17	---
					16 < t ≤ 40	---	235 max	---			21	
					40 < t ≤ 100	---	215 max	---			23	
					100 < t ≤ 160	---	205 max	---				
					160 < t ≤ 200	---	195 max	---				
	SMA400BP	---	---	HR	≤ 16	---	245 max	---	400-540	---	17	27 J at 0°C
					16 < t ≤ 40	---	235 max	---			21	
					40 < t ≤ 100	---	215 max	---			23	
					100 < t ≤ 160	---	205 max	---				
					160 < t ≤ 200	---	195 max	---				
	SMA400CP	---	---	HR	≤ 16	---	245 max	---	400-540	---	17	47 J at 0°C
					16 < t ≤ 40	---	235 max	---			21	
					40 < t ≤ 100	---	215 max	---			23	

3.3 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

3.3A 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 3114:1998 (Continued)	SMA490AP	---	---	HR	≤ 16	---	365 max	---	490-610	---	15	---
					16 < t ≤ 40	---	355 max	---			19	
					40 < t ≤ 75	---	335 max	---			21	
					75 < t ≤ 100	---	325 max	---			21	
					100 < t ≤ 160	---	305 max	---			21	
					160 < t ≤ 200	---	295 max	---			21	
	SMA490BW	---	---	HR	≤ 16	---	365 max	---	490-610	---	15	27 J at 0°C
					16 < t ≤ 40	---	355 max	---			19	
					40 < t ≤ 75	---	335 max	---			21	
					75 < t ≤ 100	---	325 max	---			21	
					100 < t ≤ 160	---	305 max	---			21	
					160 < t ≤ 200	---	295 max	---			21	
	SMA490BP	---	---	HR	≤ 16	---	365 max	---	490-610	---	15	27 J at 0°C
					16 < t ≤ 40	---	355 max	---			19	
					40 < t ≤ 75	---	335 max	---			21	
					75 < t ≤ 100	---	325 max	---			21	
					100 < t ≤ 160	---	305 max	---			21	
					160 < t ≤ 200	---	295 max	---			21	
	SMA490CW	---	---	HR	≤ 16	---	365 max	---	490-610	---	15	47 J at 0°C
					16 < t ≤ 40	---	355 max	---			19	
					40 < t ≤ 75	---	335 max	---			21	
					75 < t ≤ 100	---	325 max	---			21	
	SMA490CP	---	---	HR	≤ 16	---	365 max	---	490-610	---	15	47 J at 0°C
					16 < t ≤ 40	---	355 max	---			19	
					40 < t ≤ 75	---	335 max	---			21	
					75 < t ≤ 100	---	325 max	---			21	
ISO 5952:1998	Gr. HSA 365W Class B, D	---	---	HR	< 3	---	365	---	490-610	---	15	---
					≥ 3	---	365	---			19	

3.3 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		
EN 10155:1993	S355J0WP	1.8945	---	HR	$t \leq 3$	---	355	---	510-680	---	---	27 J at 0°C
					$3 < t \leq 16$	---			490-630	---	20	
	S355J2WP	1.8946	---	N	$t \leq 3$	---	355	---	510-680	---	---	27 J at -20°C
					$3 < t \leq 16$	---			490-630	---	20	
	S355J0W	1.8959	---	HR	$t \leq 3$	---	355	---	510-680	---	---	27 J at 0°C
					$3 < t \leq 16$	---	355	---	490-630	---	20	
					$16 < t \leq 40$	---	345	---			20	
					$40 < t \leq 63$	---	335	---			19	
					$63 < t \leq 80$	---	325	---			18	
					$80 < t \leq 100$	---	315	---			18	
	S355J2G1W	1.8963	---	N	$t \leq 3$	---	355	---	510-680	---	---	27 J at -20°C
					$3 < t \leq 16$	---	355	---	490-630	---	20	
					$16 < t \leq 40$	---	345	---			20	
					$40 < t \leq 63$	---	335	---			19	
					$63 < t \leq 80$	---	325	---			18	
					$80 < t \leq 100$	---	315	---			18	
	S355J2G2W	1.8965	---	HR	$t \leq 3$	---	355	---	510-680	---	---	27 J at -20°C
					$3 < t \leq 16$	---	355	---	490-630	---	20	
					$16 < t \leq 40$	---	345	---			20	
					$40 < t \leq 63$	---	335	---			19	
					$63 < t \leq 80$	---	325	---			18	
					$80 < t \leq 100$	---	315	---			18	
	S355K2G1W	1.8966	---	N	$t \leq 3$	---	355	---	510-680	---	---	40 J at -20°C
					$3 < t \leq 16$	---	355	---	490-630	---	20	
					$16 < t \leq 40$	---	345	---			20	
					$40 < t \leq 63$	---	335	---			19	
					$63 < t \leq 80$	---	325	---			18	
					$80 < t \leq 100$	---	315	---			18	

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		
EN 10155:1993 (Continued)	S355K2G2W	1.8967	---	HR	$t \leq 3$	---	355	---	510-680	---	---	40 J at -20°C
					$3 < t \leq 16$	---	355	---	490-630	---	20	
					$16 < t \leq 40$	---	345	---			20	
					$40 < t \leq 63$	---	335	---			19	
					$63 < t \leq 80$	---	325	---			18	
					$80 < t \leq 100$	---	315	---			18	
ISO 5952:1998	Gr. HSA355W1 Class A, D	---	---	HR	< 3	---	355	---	510-680	---	15	---
					≥ 3	---			490-630	---	19	
	Gr. HSA355W2 Class C, D	---	---	HR	< 3	---	355	---	510-680	---	18	---
					≥ 3	---			490-630	---	22	
ASTM A 871/A 871M-97	60 [415]	---	---	HR, N, or QT	≤ 12	$\leq \frac{1}{2}$	415	60	520 min	75 min	18	20 J at -18°C
					> 12	$> \frac{1}{2}$	415	60	520 min	75 min	18	20 J at -29°C
CSA G40.21:1998	400 A (60A)	---	---	---	≤ 65	$\leq 2\frac{1}{2}$	400	60	520-690	75-100	21	---
	400AT (60AT)	---	---	---	≤ 65	$\leq 2\frac{1}{2}$	400	60	520-690	75-100	21	---
ASTM A 871/A 871M-97	65 [450]	---	---	HR, N, or QT	≤ 12	$\leq \frac{1}{2}$	450	65	550 min	80 min	17	20 J at -18°C
					> 12	$> \frac{1}{2}$	450	65	550 min	80 min	17	20 J at -29°C
JIS G 3114:1998	SMA570W	---	---	HR	≤ 16	---	460 max	---	570-720	---	19	47 J at -5°C
					$16 < t \leq 40$	---	450 max	---			26	
					$40 < t \leq 75$	---	430 max	---			20	
					$75 < t \leq 100$	---	420 max	---			20	
	SMA570P	---	---	HR	≤ 16	---	460 max	---	570-720	---	19	47 J at -5°C
					$16 < t \leq 40$	---	450 max	---			26	
					$40 < t \leq 75$	---	430 max	---			20	
					$75 < t \leq 100$	---	420 max	---			20	
CSA G40.21-98	480A (70A)	---	---	---	≤ 65	$\leq 2\frac{1}{2}$	480	70	590-790	85-115	17	---
	480AT (70AT)	---	---	---	≤ 65	$\leq 2\frac{1}{2}$	480	70	590-790	85-115	17	---
	550A (80A)	---	---	---	≤ 65	$\leq 2\frac{1}{2}$	550	80	620-860	90-125	15	---
	550AT (80AT)	---	---	---	≤ 65	$\leq 2\frac{1}{2}$	550	80	620-860	90-125	15	---

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
ISO 5952:1998	Gr. HSA 235W Class B	---	---	---	---	0.13	0.20-0.60	0.10-0.40	0.040	0.035	0.40-0.80	0.65	---	Cu 0.25-0.55
	Gr. HSA 235W Class D	---	---	---	---	0.13	0.20-0.60	0.10-0.40	0.040	0.035	0.40-0.80	0.65	---	Cu 0.25-0.55; Al 0.020 min
EN 10155:1993	S235J0W	1.8958	---	≤ 100	---	0.13	0.20-0.60	0.40	0.040	0.040	0.40-0.80	---	---	N 0.009; Cu 0.25-0.55; Ni 0.65
	S235J2W	1.8961	---	≤ 100	---	0.13	0.20-0.60	0.40	0.040	0.035	0.40-0.80	---	---	Cu 0.25-0.55; N binding el.
ISO 4952:1981	Gr. Fe 235 W Quality B	---	---	---	---	0.13	0.20-0.60	0.10-0.40	< 0.040	0.035	0.40-0.80	0.65	---	Cu 0.20-0.50
	Gr. Fe 235 W Quality C	---	---	---	---	0.13	0.20-0.60	0.10-0.40	< 0.040	0.035	0.40-0.80	0.65	---	Cu 0.20-0.50; grain-refining el.
	Gr. Fe 235 W Quality D	---	---	---	---	0.13	0.20-0.60	0.10-0.40	< 0.040	0.035	0.40-0.80	0.65	---	Cu 0.20-0.50; grain-refining el.
ISO 5952:1998	HSA 245W-B	---	---	---	---	0.18	1.25	0.15-0.65	0.035	0.035	0.45-0.75	0.05-0.30	---	Cu 0.30-0.50; Mo+Nb+Ti+V+Zr 0.15 Total
	HSA 245W-D	---	---	---	---	0.18	1.25	0.15-0.65	0.035	0.035	0.45-0.75	0.05-0.30	---	Cu 0.30-0.50; Al 0.020 min; Mo+Nb+Ti+V+Zr 0.15 Total
JIS G 3114:1998	SMA400AW	---	---	≤ 200	---	0.18	1.25	0.15-0.65	0.035	0.035	0.45-0.75	0.05-0.30	---	Cu 0.30-0.50
	SMA400BW	---	---	≤ 200	---	0.18	1.25	0.15-0.65	0.035	0.035	0.45-0.75	0.05-0.30	---	Cu 0.30-0.50
	SMA400CW	---	---	≤ 100	---	0.18	1.25	0.15-0.65	0.035	0.035	0.45-0.75	0.05-0.30	---	Cu 0.30-0.50
	SMA400AP	---	---	≤ 200	---	0.18	1.25	0.55	0.035	0.035	0.30-0.55	---	---	Cu 0.20-0.35
	SMA400BP	---	---	≤ 200	---	0.18	1.25	0.55	0.035	0.035	0.30-0.55	---	---	Cu 0.20-0.35
	SMA400CP	---	---	≤ 100	---	0.18	1.25	0.55	0.035	0.035	0.30-0.55	---	---	Cu 0.20-0.35

3.3 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	---	---	$0.6 \leq t \leq 2.3$	---	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

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
EN 10155:1993	S355J0WP	1.8945	---	≤ 12	---	0.12	1.0	0.75	0.06-0.15	0.040	0.30-1.25	---	---	N 0.009; Cu 0.25-0.55; Ni 0.65
	S355J2WP	1.8946	---	≤ 12	---	0.12	1.0	0.75	0.06-0.15	0.035	0.30-1.25	---	---	Cu 0.25-0.55; N binding el.
	S355J0W	1.8959	---	≤ 100	---	0.16	0.50-1.50	0.50	0.040	0.040	0.40-0.80	---	---	N 0.009; Cu 0.25-0.55; Ni 0.65; Mo 0.30; Zr 0.15
	S355J2G1W	1.8963	---	≤ 100	---	0.16	0.50-1.50	0.50	0.035	0.035	0.40-0.80	---	---	Cu 0.25-0.55; N binding el.
	S355J2G2W	1.8965	---	≤ 100	---	0.16	0.50-1.50	0.50	0.035	0.035	0.40-0.80	---	---	Cu 0.25-0.55; N binding el.
	S355K2G1W	1.8966	---	≤ 100	---	0.16	0.50-1.50	0.50	0.035	0.035	0.40-0.80	---	---	Cu 0.25-0.55; N binding el.
	S355K2G2W	1.8967	---	≤ 100	---	0.16	0.50-1.50	0.50	0.035	0.035	0.40-0.80	---	---	Cu 0.25-0.55; N binding el.
ISO 5952:1998	HSA 355W1-A	---	---	---	---	0.12	1.00	0.20-0.75	0.06-0.15	0.035	0.30-1.25	0.65	---	Cu 0.25-0.55
	HSA 355W1-D	---	---	---	---	0.12	1.00	0.20-0.75	0.06-0.15	0.035	0.30-1.25	0.65	---	Cu 0.25-0.55; Al 0.020 min
	HSA 355W2-C	---	---	---	---	0.16	0.50-1.50	0.50	0.035	0.035	0.40-0.80	0.65	0.30	Cu 0.25-0.55; Zr 0.15
	HSA 355W2-D	---	---	---	---	0.16	0.50-1.50	0.50	0.035	0.035	0.40-0.80	0.65	0.30	Cu 0.25-0.55; Zr 0.15; Al 0.020 min
ASTM A 871/A 871M-97	Gr. 60 Type I	---	---	---	---	0.19	0.80-1.35	0.30-0.65	0.04	0.05	0.40-0.70	0.40	---	Cu 0.25-0.40; V 0.02-0.10
	Gr. 60 Type II	---	---	---	---	0.20	0.75-1.35	0.15-0.60	0.04	0.05	0.40-0.70	0.50	---	Cu 0.20-0.40; V 0.01-0.10
	Gr. 60 Type III	---	---	---	---	0.15	0.80-1.35	0.15-0.40	0.04	0.05	0.30-0.50	0.25-0.50	---	Cu 0.20-0.50; V 0.01-0.10
	Gr. 60 Type IV	---	---	---	---	0.17	0.50-1.20	0.25-0.50	0.04	0.05	0.40-0.70	0.40	0.10	Cu 0.30-0.50; Cb 0.005-0.05
CSA G40.21:1998	400A (60A)	---	---	---	---	0.20	0.75-1.35	0.15-0.50	0.03	0.04	0.70	0.90	---	Grain refining elements 0.10; Cu 0.20-0.60
	400AT (60AT)	---	---	---	---	0.20	0.75-1.35	0.15-0.50	0.03	0.04	0.70	0.90	---	Grain refining elements 0.10; Cu 0.20-0.60
ASTM A 871/A 871M-97	Gr. 65 Type I	---	---	---	---	0.19	0.80-1.35	0.30-0.65	0.04	0.05	0.40-0.70	0.40	---	Cu 0.25-0.40; V 0.02-0.10
	Gr. 65 Type II	---	---	---	---	0.20	0.75-1.35	0.15-0.60	0.04	0.05	0.40-0.70	0.50	---	Cu 0.20-0.40; V 0.01-0.10
	Gr. 65 Type III	---	---	---	---	0.15	0.80-1.35	0.15-0.40	0.04	0.05	0.30-0.50	0.25-0.50	---	Cu 0.20-0.50; V 0.01-0.10
	Gr. 65 Type IV	---	---	---	---	0.17	0.50-1.20	0.25-0.50	0.04	0.05	0.40-0.70	0.40	0.10	Cu 0.30-0.50; Cb 0.005-0.05
JIS G 3114:1998	SMA570W	---	---	≤ 100	---	0.18	1.40	0.15-0.65	0.035	0.035	0.45-0.75	0.05-0.30	---	Cu 0.30-0.50
	SMA570P	---	---	≤ 100	---	0.18	1.40	0.55	0.035	0.035	0.30-0.55	---	---	Cu 0.20-0.35
CSA G40.21:1998	480A (70A)	---	---	---	---	0.20	1.00-1.60	0.15-0.50	0.025	0.035	0.70	0.25-0.50	---	Grain refining elements 0.12; Cu 0.20-0.60
	480AT (70AT)	---	---	---	---	0.20	1.00-1.60	0.15-0.50	0.025	0.035	0.70	0.25-0.50	---	Grain refining elements 0.12; Cu 0.20-0.60
	550A (80A)	---	---	---	---	0.15	1.75	0.15-0.50	0.025	0.035	0.70	0.25-0.50	---	Grain refining elements 0.15; Cu 0.20-0.60
	550AT (80AT)	---	---	---	---	0.15	1.75	0.15-0.40	0.025	0.035	0.70	0.25-0.50	---	Cu 0.20-0.60

3.4 Non-Comparable High-Strength Low-Alloy Structural Steel Plates

ASTM A 656/A 656M-00 Hot-Rolled Structural Steel, High-Strength Low-Alloy Plate with Improved Formability												
Grade, Class, Type Symbol or Name	80	---	---	---	---	---	---	---	---	---	---	---
UNS Number	---	---	---	---	---	---	---	---	---	---	---	---
ASTM A 678/A 678M-00 Quenched-and-Tempered Carbon and High-Strength Low-Alloy Structural Steel Plates												
Grade, Class, Type Symbol or Name	D	---	---	---	---	---	---	---	---	---	---	---
UNS Number	K12202	---	---	---	---	---	---	---	---	---	---	---
EN 10113-2:1993 Hot-rolled products in weldable fine grain structural steels - Part 2: Delivery conditions for normalized/normalized rolled steels												
Grade, Class, Type Symbol or Name	S275N	S275NL	---	---	---	---	---	---	---	---	---	---
Steel Number	1.0490	1.0491	---	---	---	---	---	---	---	---	---	---
EN 10113-3:1993 Hot-rolled products in weldable fine grain structural steels - Part 3: Delivery conditions for thermomechanical rolled steels												
Grade, Class, Type or Symbol	S275M	S275ML	---	---	---	---	---	---	---	---	---	---
Steel Number	1.8818	1.8819	---	---	---	---	---	---	---	---	---	---
EN 10137-2:1996 Plates and wide flats made of high yield strength structural steels in the quenched and tempered or precipitation hardened conditions - Part 2: Delivery conditions for quenched and tempered steels												
Grade, Class, Type Symbol or Name	S890Q	S890QL	S890QL1	S960Q	S960QL	---	---	---	---	---	---	---
Steel Number	1.8940	1.8983	1.8925	1.8941	1.8933	---	---	---	---	---	---	---

CHAPTER

4

PRESSURE VESSEL STEEL PLATES

ASTM Standards

ASTM A 202/A 202M-93 (1999)	Pressure Vessel Plates, Alloy Steel, Chromium-Manganese-Silicon
ASTM A 203/A 203M-97	Pressure Vessel Plates, Alloy Steel, Nickel
ASTM A 204/A 204M-93 (1999)	Pressure Vessel Plates, Alloy Steel, Molybdenum
ASTM A 225/A 225M-93 (1999)	Pressure Vessel Plates, Alloy Steel, Manganese-Vanadium-Nickel
ASTM A 240/A 240M-00	Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels
ASTM A 285/A 285M-90 (1996)	Pressure Vessel Plates, Carbon Steel, Low- and Intermediate-Tensile Strength
ASTM A 299/A 299M-97	Pressure Vessel Plates, Carbon Steel, Manganese-Silicon
ASTM A 302/A 302M-97	Pressure Vessel Plates, Alloy Steel, Manganese-Molybdenum and Manganese-Molybdenum-Nickel
ASTM A 353/A 353M-93 (1999)	Pressure Vessel Plates, Alloy Steel, 9 Percent Nickel, Double-Normalized and Tempered
ASTM A 387/A 387M-99	Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum
ASTM A 455/A 455M-90 (1996)	Pressure Vessel Plates, Carbon Steel, High Strength Manganese
ASTM A 515/A 515M-97	Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service
ASTM A 516/A 516M-90 (2001)	Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ASTM A 517/A 517M-93 (1999)	Pressure Vessel Plates, Alloy Steel, High-Strength, Quenched and Tempered,
ASTM A 533/A 533M-93 (1999)	Pressure Vessel Plates, Alloy Steel, Quenched and Tempered, Manganese-Molybdenum and Manganese-Molybdenum-Nickel
ASTM A 537/A 537M-95	Pressure Vessel Plates, Heat-Treated, Carbon-Manganese-Silicon Steel
ASTM A 542/A 542M-99	Pressure Vessel Plates, Alloy Steel, Quenched-and-Tempered, Chromium-Molybdenum, and Chromium-Molybdenum-Vanadium
ASTM A 543/A 543M-93 (1999)	Pressure Vessel Plates, Alloy Steel, Quenched and Tempered Nickel-Chromium-Molybdenum
ASTM A 553/A 553M-93	Pressure Vessel Plates, Alloy Steel, Quenched and Tempered 8 and 9 Percent Nickel
ASTM A 562/A 562M-90 (1996)	Pressure Vessel Plates, Carbon Steel, Manganese-Titanium for Glass or Diffused Metallic Coatings
ASTM A 612/A 612M-98	Pressure Vessel Plates, Carbon Steel, High Strength, for Moderate and Lower Temperature Service
ASTM A 645/A 645M-99	Pressure Vessel Plates, Five Percent Nickel Alloy Steel, Specially Heat Treated
ASTM A 662/A 662M-99	Pressure Vessel Plates, Carbon-Manganese-Silicon Steel, for Moderate and Lower Temperature Service
ASTM A 724/A 724M-99	Pressure Vessel Plates, Carbon-Manganese-Silicon Steel, Quenched and Tempered, for Welded Layered Pressure Vessels
ASTM A 734/A 734 M-87 (1997)	Pressure Vessel Plates, Alloy Steel and High-Strength Low-Alloy Steel, Quenched-and-Tempered
ASTM A 735/A 735M-99	Pressure Vessel Plates, Low-Carbon Manganese-Molybdenum-Columbium Alloy Steel, for Moderate and Lower Temperature Service
ASTM A 736/A 736M-88 (1994)	Pressure Vessel Plates, Low-Carbon Age-Hardening Nickel-Copper-Chromium-Molybdenum-Columbium and Nickel-Copper-Manganese-Molybdenum-Columbium Alloy Steel
ASTM A 737/A 737M-99	Pressure Vessel Plates, High-Strength, Low-Alloy Steel
ASTM A 738/A 738M-00	Pressure Vessel Plates, Heat-Treated, Carbon-Manganese-Silicon Steel, for Moderate and Lower Temperature Service
ASTM A 782/A 782M-90 (1996)	Pressure-Vessel Plates, Quenched-and-Tempered, Manganese-Chromium-Molybdenum-Silicon Zirconium Alloy Steel
ASTM A 832/A 832M-99	Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum-Vanadium
ASTM A 841/A 841M-98	Steel Plates for Pressure Vessels, Produced by Thermo-Mechanical Control Process (TMCP)
ASTM A 844/A 844M-93	Steel Plates, 9 % Nickel Alloy, for Pressure Vessels, Produced by the Direct-Quenching Process

JIS Standards

JIS G 3103:1987	Carbon Steel and Molybdenum Alloy Steel Plates for Boilers and Other Pressure Vessels
JIS G 3115:1990	Steel Plates for Pressure Vessels for Intermediate Temperature Service
JIS G 3115-1:1995	Steel Plates for Pressure Vessels for Intermediate Temperature Service-Part 1: Thicker Plates
JIS G 3118:2000	Carbon Steel Plates for Pressure Vessels for Intermediate and Moderate Temperature Service
JIS G 3119:1987	Manganese-Molybdenum Alloy and Manganese-Molybdenum-Nickel Alloy Steel Plates for Boilers and Other Pressure Vessels
JIS G 3120:1987	Manganese-Molybdenum and Manganese-Molybdenum-Nickel Alloy Steel Plates Quenched and Tempered for Pressure Vessels
JIS G 3124:1987	High Strength Steel Plates for Pressure Vessel for Intermediate and Moderate Temperature Service
JIS G 3126:1990	Carbon Steel Plates for Pressure Vessels for Low Temperature Service
JIS G 3127:1990	Nickel Steel Plates for Pressure Vessels for Low Temperature Service
JIS G 4109:1987	Chromium-Molybdenum Alloy Steel Plates for Boilers and Pressure Vessels
JIS G 4110:1993	High Strength Chromium-Molybdenum Alloy Steel Plates for Pressure Vessels Under High-Temperature Service

CEN Standards

EN 10028-2:1992	Flat Products Made of Steels for Pressure Purposes - Part 2: Non-Alloy and Alloy Steels With Specified Elevated Temperature Properties
EN 10028-3:1992	Flat Products Made of Steels for Pressure Purposes - Part 3: Weldable Fine Grain Steels, Normalized
EN 10028-4:1994	Flat Products Made of Steels for Pressure Purposes - Part 4: Nickel Alloy Steels With Specified Low Temperature Properties
EN 10028-5:1996	Flat Products Made of Steels for Pressure Purposes - Part 5: Weldable Fine Grain Steels, Thermomechanically Rolled
EN 10028-6:1996	Flat Products Made of Steels for Pressure Purposes - Part 6: Weldable Fine Grain Steels, Quenched and Tempered
EN 10028-7:2000	Flat Products Made of Steels for Pressure Purposes - Part 7: Stainless Steels

ISO Standards

ISO 9328-2:1991	Steel Plates and Strips for Pressure Purposes - Technical Delivery Conditions - Part 2: Unalloyed and Low-Alloyed Steels With Specified Room Temperature and Elevated Temperature Properties
ISO 9328-3:1991	Steel Plates and Strips for Pressure Purposes - Technical Delivery Conditions - Part 3: Nickel-Alloyed Steels With Specified Low Temperature Properties
ISO 9328-4:1991	Steel Plates and Strips for Pressure Purposes - Technical Delivery Conditions - Part 4: Weldable Fine Grain Steels With High Proof Stress Supplied In The Normalized or Quenched and Tempered Condition
ISO 9328-5:1991	Steel Plates and Strips for Pressure Purposes - Technical Delivery Conditions - Part 5: Austenitic Steels

Heat Treatment Terms Applicable to this Chapter

Standard	Heat Treatment Terms
ASTM A 203/A 203M-97	N: normalized; QT: quenched and tempered
ASTM A 204/A 204M-93 (1999)	AR: as-rolled; N: normalized
ASTM A 240/A 240M-00	See standard
ASTM A 302/A 302M-97	AR: as-rolled; N: normalized
ASTM A 353/A 353M-93 (1999)	NNT: double-normalized and tempered
ASTM A 387/A 387M-99	A: annealed; NT: normalized and tempered
ASTM A 515/A 515M-97	AR: as-rolled; N: normalized
ASTM A 516/A 516M-90 (2001)	AR: as-rolled; N: normalized
ASTM A 533/A 533M-93 (1999)	QT: quenched and tempered
ASTM A 537/A 537M-95	N: normalized; QT: quenched and tempered
ASTM A 553/A 553M-93	QT: quenched and tempered
ASTM A 612/A 612M-98	AR: as-rolled
ASTM A 662/A 662M-99	AR: as-rolled; N: normalized
ASTM A 737/A 737M-99	N: normalized
ASTM A 738/A 738M-00	N: normalized; QT: quenched and tempered
ASTM A 841/A 841M-98	TMCP: thermo-mechanical control process
ASTM A 844/A 844M-93	Direct QT: direct quenched and tempered (quenched directly after rolling)
JIS G 3103:1987	AR: as-rolled; N: normalized
JIS G 3115:1990	AR: as-rolled
JIS G 3115-1:1995	AR: as-rolled
JIS G 3118:2000	AR: as-rolled; N: normalized
JIS G 3119:1987	AR: as-rolled; N: normalized
JIS G 3120:1987	QT: quenched and tempered
JIS G 3124:1987	R: as-rolled; N: normalized; NT: normalized and tempered; P: annealed
JIS G 3126:1990	N: normalized; QT: quench hardened and tempered; TMCP: thermo-mechanical control process
JIS G 3127:1990	N: normalized; QT: quench hardened and tempered; NNT: double normalized and tempered
JIS G 4109:1987	A: annealed; NT: normalized and tempered
EN 10028-2:1992	N: normalized; T: tempered; QA: air quenched; QL: liquid quenched
EN 10028-3:1992	N: normalized
EN 10028-4:1994	N: normalized; NT: normalized and tempered; NNT: double normalized and tempered; QT: quenched and tempered; HT640: NNT or QT (tempering at specified temperature); HT680: quenched followed by tempering at specified temperature
EN 10028-5:1996	TMCP: thermo-mechanical control process
EN 10028-7:2000	CR St, A: cold-rolled strip, annealed; HR St, A: hot-rolled strip, annealed; AT: solution annealed; HR PI, A: hot-rolled plate, annealed; HR PI, QT: hot-rolled plate, quenched and tempered
ISO 9328-2:1991	N: normalized; NT: normalized and tempered
ISO 9328-3:1991	N: normalized; NT: normalized and tempered; NNT: double-normalized and tempered; QT: quenched and tempered
ISO 9328-4:1991	N: normalized; N(+T): normalized and (if appropriate) tempered
ISO 9328-5:1991	Q: quenched

4.1 Carbon Steel Pressure Vessel Plates

4.1A Mechanical Properties of Carbon 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/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
EN 10028-2:1992	P235GH	1.0345	---	N	≤ 16	---	235	---	360-480	---	25	27 J at 0 °C
					16 < t ≤ 40	---	225	---		---	25	
					40 < t ≤ 60	---	215	---		---	25	
					60 < t ≤ 100	---	200	---		---	24	
					100 < t ≤ 150	---	185	---	350-480	---	24	
ISO 9328-2:1991	P 235 PH 235	---	---	N	3 ≤ t ≤ 16	---	235	---	360-480	---	25	27 J at 0 °C
					16 < t ≤ 40	---	225	---		---	25	
					40 < t ≤ 60	---	215	---		---	25	
					60 < t ≤ 100	---	200	---		---	24	
					100 < t ≤ 150	---	185	---	350-480	---	24	

4.1 Carbon 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		
JIS G 3115:1990	SPV 235	---	---	AR	6 ≤ t ≤ 50	---	235	---	400-510	---	≤16 mm: 17 >16 mm: 21 >40 mm: 24	47 J at 0°C
					50 < t ≤ 100	---	215	---				
					100 < t ≤ 200	---	195	---				
JIS G 3103:1987	SB 410	---	---	AR	6 ≤ t ≤ 50	225	---	410-550	---	≤ 50 mm: 21 > 50 mm: 25	---	
				N	50 < t ≤ 200							---
JIS G 3118:1987	SGV 410	---	---	AR	6 ≤ t ≤ 38	225	---	410-490	---	≤ 50 mm: 21 > 50 mm: 25	---	
				N	38 < t ≤ 200							---
EN 10028-2:1992	P265GH	1.0425	---	N	≤ 16	---	265	---	410-530	---	23	27 J at 0°C
					16 < t ≤ 40	---	255	---		---	23	
					40 < t ≤ 60	---	245	---		---	23	
					60 < t ≤ 100	---	215	---		---	22	
					100 < t ≤ 150	---	200	---	400-530	---	22	
ISO 9328-2:1991	P 265 PH 265	---	---	N	3 ≤ t ≤ 16	---	265	---	410-530	---	24	27 J at 0°C
					16 < t ≤ 40	---	255	---			24	
					40 < t ≤ 60	---	245	---			23	
					60 < t ≤ 100	---	215	---			22	
					100 < t ≤ 150	---	200	---	400-530	---	22	
ASTM A 515/A 515M-97	60	---	K02401	AR	≤ 50	≤ 2	220	32	415-550	60-80	25	---
				N	> 50	> 2						
EN 10028-2:1993	P 265 GH	1.0425	---	N	≤ 16	---	265	---	410-530	---	23	27J at 0°C
					16 < t ≤ 40	---	255	---	410-530	---		
					40 < t ≤ 60	---	245	---	410-530	---		
					60 < t ≤ 100	---	215	---	410-530	---	22	
					100 < t ≤ 150	---	200	---	400-530	---		
ASTM A 516/A 516M-90 (2001)	60	---	K02100	AR	≤ 40	≤ 1.5	220	32	415-550	60-80	25	---
				N	> 40	> 1.5						
ISO 9328-4:1991	P 315 TN PH 315 TN PL 315 TN	---	---	N	≤ 35	---	315	---	440-560	---	23	see standard
					35 < t ≤ 50	---	305	---				
					50 < t ≤ 70	---	295	---				

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	---
				N	38 < t ≤ 200	---					> 50 mm: 23	
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

4.1A 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 537/A 537M-95	1	---	K12437	N	≤ 65	≤ 2½	345	50	485-620	70-90	22	---
					65 < t ≤ 100	2½ < t ≤ 4	310	45	450-585	65-85		
ASTM A 737/A 737M-99	B	---	K12001	N	---	---	345	50	485-620	70-90	23	---
JIS G 3115:1990	SPV 315	---	---	AR	6 ≤ t ≤ 50	---	≥ 315	---	490-610	---	≤16 mm: 16 >16 mm: 20 >40 mm: 23	47 J at 0°C
					50 < t ≤ 100	---	≥ 295	---				
ISO 9328-2:1991	P 315 PH 315	---	---	N	3 ≤ t ≤ 16	---	315	---	490-610	---	21	27 J at 0°C
					16 < t ≤ 40	---	310	---		---	21	
					40 < t ≤ 60	---	305	---		---	21	
					60 < t ≤ 100	---	280	---		---	20	
					100 < t ≤ 150	---	255	---	470-600	---	20	
EN 10028-5:1996	P420 P420ML1 P420ML2	1.8824 1.8835 1.8828	---	TMCP	≤ 16	---	420	---	500-660	---	19	---
					16 < t ≤ 40	---	400	---				
					40 < t ≤ 63	---	390	---				
JIS G 3124:1987	SEV 245	---	---	R, N, NT or P	≤ 50	---	370	---	510-650	---	16	31 J at 0°C
					50 < t ≤ 100	---	355	---			20	
					100 < t ≤ 125	---	345	---	500-640	---		
					125 < t ≤ 150	---	335	---	490-630	---		
EN 10028-2:1992	P355GH	1.0473	---	N	≤ 16	---	355	---	510-650	---	21	27 J at 0°C
					16 < t ≤ 40	---	345	---				
					40 < t ≤ 60	---	335	---	490-630	---	20	
					60 < t ≤ 100	---	315	---				
100 < t ≤ 150	---	295	---	480-630	---							
ASTM A 738/A 738M-00	A	---	K12447	N or QT	≤ 65	≤ 2½	310	45	515-655	75-95	20	---
				QT	> 65	> 2½						
JIS G 3115:1990	SPV 355	---	---	AR	6 ≤ t ≤ 50	---	≥ 355	---	520-640	---	≤16 mm: 14 >16 mm: 18 >40 mm: 21	47 J at 0°C
					50 < t ≤ 75	---	≥ 335	---		---		
JIS G 3115-1:1995	SPV 355	---	---	AR	75 < t ≤ 100	---	≥ 335	---	520-640	---	No. 1A: 18 No. 4: 21	47 J at 0°C
					100 < t ≤ 150	---	≥ 315	---		---		
EN 10028-5:1996	P460M P460ML1 P460ML2	1.8826 1.8837 1.8831	---	TMCP	≤ 16	---	460	---	530-720	---	17	---
					16 < t ≤ 40	---	440	---				
					40 < t ≤ 63	---	430	---				

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 537/A 537M-95	2	---	K12437	QT	≤ 65	≤ 2½	415	60	550-690	80-100	22	---
					65 < t ≤ 100	2½ < t ≤ 4	380	55	515-655	75-95	22	---
					100 < t ≤ 150	4 < t ≤ 6	315	46	485-620	70-90	20	---
	3	---	K12437	QT	≤ 65	≤ 2½	380	55	550-690	80-100	22	---
					65 < t ≤ 100	2½ < t ≤ 4	345	50	515-655	75-95	22	---
					100 < t ≤ 150	4 < t ≤ 6	275	40	485-620	70-90	20	---
ASTM A 737/A 737M-99	C	---	K12202	N	---	---	415	60	550-690	80-100	23	---
ASTM A 738/A 738M-00	C	---	---	QT	≤ 65	≤ 2½	415	60	550-690	80-100	22	---
					65 < t ≤ 100	2½ < t ≤ 4	380	55	515-655	75-95	22	---
					> 100	> 4	315	46	485-620	70-90	20	---
ASTM A 612/A 612M-98	---	---	K02900	AR	≤ 12.5	≤ ½	345	50	570-725	83-105	22	---
					12.5 < t ≤ 25	½ < t ≤ 1	345	50	560-695	81-101	22	---
ASTM A 738/A 738M-00	B	---	K12001	QT	---	---	415	60	585-705	85-102	20	---

4.1 Carbon Steel Pressure Vessel Plates

4.1B Chemical Composition of Carbon Steel Pressure Plates

Standard Designation	Grade, Class, Type, Symbol, or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10028-2:1992	P235GH	1.0345	---	---	---	0.16	0.40-1.20	0.35	0.030	0.025	0.30	0.30	0.08	Cu 0.30; Nb 0.010; Ti 0.03; V 0.02; Al \geq 0.020; Cr+Cu+Mo+Ni 0.70
ISO 9328-2:1991	P 235 PH 235	---	---	---	---	0.17	0.40-1.20	0.35	0.035	0.030	0.30	0.30	0.08	Cu 0.30; Al \geq 0.020; Cr+Cu+Mo+Ni 0.70
JIS G 3115:1990	SPV 235	---	---	≤ 100	---	0.18	1.40	0.15-0.35	0.030	0.030	---	---	---	---
				> 100	---	0.20	1.40	0.15-0.35	0.030	0.030	---	---	---	---
JIS G 3103:1987	SB 410	---	---	≤ 25	---	0.24	0.90	0.15-0.30	0.035	0.040	---	---	---	---
				$25 < t \leq 50$	---	0.27	0.90	0.15-0.30	0.035	0.040	---	---	---	---
				$50 < t \leq 200$	---	0.30	0.90	0.15-0.30	0.035	0.040	---	---	---	---
JIS G 3118:1987	SGV 410	---	---	≤ 12.5	---	0.21	0.85-1.20	0.15-0.30	0.035	0.040	---	---	---	---
				$12.5 < t \leq 50$	---	0.23	0.85-1.20	0.15-0.30	0.035	0.040	---	---	---	---
				$50 < t \leq 100$	---	0.25	0.85-1.20	0.15-0.30	0.035	0.040	---	---	---	---
				$100 < t \leq 200$	---	0.27	0.85-1.20	0.15-0.30	0.035	0.040	---	---	---	---
EN 10028-2:1992	P265GH	1.0425	---	---	---	0.20	0.50-1.40	0.40	0.030	0.025	0.30	0.30	0.08	Cu 0.30; Nb 0.010; Ti 0.03; V 0.02; Al \geq 0.020; Cr+Cu+Mo+Ni 0.70
ISO 9328-2:1991	P 265 PH 265	---	---	---	---	0.20	0.50-1.40	0.35	0.035	0.030	0.30	0.30	0.08	Cu 0.30; Al \geq 0.020; Cr+Cu+Mo+Ni 0.70
ASTM A 515/A 515M-97	60 [415]	---	K02401	≤ 25	≤ 1	0.24	0.90	0.15-0.40	0.035	0.035	---	---	---	---
				$25 < t \leq 50$	$1 < t \leq 2$	0.27	0.90	0.15-0.40	0.035	0.035	---	---	---	---
				$50 < t \leq 100$	$2 < t \leq 4$	0.29	0.90	0.15-0.40	0.035	0.035	---	---	---	---
				$100 < t \leq 200$	$4 < t \leq 8$	0.31	0.90	0.15-0.40	0.035	0.035	---	---	---	---
				> 200	> 8	0.31	0.90	0.15-0.40	0.035	0.035	---	---	---	---
EN 10028-2:1993	P 265 GH	1.0425	---	---	---	0.20	0.40-1.40	0.40	0.030	0.025	0.30	0.30	0.08	Cu 0.30; Nb 0.01; Ti 0.03; V 0.02; Al \geq 0.020; Cr+Cu+Mo+Ni 0.70
ASTM A 516/A 516M-90 (2001)	60 [415]	---	K02100	≤ 12.5	$\leq \frac{1}{2}$	0.21	0.60-0.90	0.15-0.40	0.035	0.035	---	---	---	---
				$12.5 < t \leq 50$	$\frac{1}{2} < t \leq 2$	0.23	0.85-1.20	0.15-0.40	0.035	0.035	---	---	---	---
				$50 < t \leq 100$	$2 < t \leq 4$	0.25	0.85-1.20	0.15-0.40	0.035	0.035	---	---	---	---
				$100 < t \leq 200$	$4 < t \leq 8$	0.27	0.85-1.20	0.15-0.40	0.035	0.035	---	---	---	---
				> 200	> 8	0.27	0.85-1.20	0.15-0.40	0.035	0.035	---	---	---	---
ISO 9328-4:1991	P 315 TN PH 315 TN	---	---	---	---	0.18	0.70-1.50	0.10-0.40	0.035	0.035	0.30	0.30	0.08	Cu 0.30; Nb 0.05; Ti 0.03; V 0.05; N 0.020; Al \geq 0.020; Nb+Ti+V 0.05; Cr+Cu+Mo 0.45
	PL 315 TN	---	---	---	---	0.16	0.70-1.50	0.10-0.40	0.030	0.030				

4.1 Carbon 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	65 [450]	---	K02800	≤ 25	≤ 1	0.28	0.90	0.15-0.40	0.035	0.035	---	---	---	---
				25 < t ≤ 50	1 < t ≤ 2	0.31	0.90	0.15-0.40	0.035	0.035	---	---	---	---
				50 < t ≤ 100	2 < t ≤ 4	0.33	0.90	0.15-0.40	0.035	0.035	---	---	---	---
				100 < t ≤ 200	4 < t ≤ 8	0.33	0.90	0.15-0.40	0.035	0.035	---	---	---	---
				> 200	> 8	0.33	0.90	0.15-0.40	0.035	0.035	---	---	---	---
ASTM A 516/A 516M-90 (2001)	65 [450]	---	K02403	≤ 12.5	≤ ½	0.24	0.85-1.20	0.15-0.40	0.035	0.035	---	---	---	---
				12.5 < t ≤ 50	½ < t ≤ 2	0.26	0.85-1.20	0.15-0.40	0.035	0.035	---	---	---	---
				50 < t ≤ 100	2 < t ≤ 4	0.28	0.85-1.20	0.15-0.40	0.035	0.035	---	---	---	---
				100 < t ≤ 200	4 < t ≤ 8	0.29	0.85-1.20	0.15-0.40	0.035	0.035	---	---	---	---
				> 200	> 8	0.29	0.85-1.20	0.15-0.40	0.035	0.035	---	---	---	---
JIS G 3103:1987	SB 450	---	---	≤ 25	---	0.28	0.90	0.15-0.30	0.035	0.040	---	---	---	---
				25 < t ≤ 50	---	0.31	0.90	0.15-0.30	0.035	0.040	---	---	---	---
				50 < t ≤ 100	---	0.33	0.90	0.15-0.30	0.035	0.040	---	---	---	---
JIS G 3118:1987	SGV 450	---	---	≤ 12.5	---	0.24	0.85-1.20	0.15-0.30	0.035	0.040	---	---	---	---
				12.5 < t ≤ 50	---	0.26	0.85-1.20	0.15-0.30	0.035	0.040	---	---	---	---
				50 < t ≤ 100	---	0.28	0.85-1.20	0.15-0.30	0.035	0.040	---	---	---	---
				100 < t ≤ 200	---	0.29	0.85-1.20	0.15-0.30	0.035	0.040	---	---	---	---
EN 10028-5:1996	P355M	1.8821	---	---	---	0.14	1.60	0.50	0.025	0.020	---	0.50	0.20	Nb 0.05; Ti 0.05; V 0.10; N 0.015; Al ≥ 0.020;
	P355ML1	1.8832	---	---	---	0.14	1.60	0.50	0.020	0.015				
	P355ML2	1.8833	---	---	---	0.14	1.60	0.50	0.020	0.015				
EN 10028-2:1992	P295GH	1.0481	---	---	---	0.08-0.20	0.90-1.50	0.40	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
ISO 9328-2:1991	P 290	---	---	---	---	0.20	0.90-1.50	0.40	0.035	0.030	0.30	0.30	0.08	Cu 0.30; Al ≥ 0.020; Cr+Cu+Mo+Ni 0.70
	PH 290	---	---	---	---	0.14-0.20								
JIS G 3103:1987	SB 480	---	---	≤ 25	---	0.31	0.90	0.15-0.30	0.035	0.040	---	---	---	---
				25 < t ≤ 50	---	0.33	0.90	0.15-0.30	0.035	0.040	---	---	---	---
				50 < t ≤ 200	---	0.35	0.90	0.15-0.30	0.035	0.040	---	---	---	---
JIS G 3118:1987	SGV 480	---	---	≤ 12.5	---	0.27	0.85-1.20	0.15-0.30	0.035	0.040	---	---	---	---
				12.5 < t ≤ 50	---	0.28	0.85-1.20	0.15-0.30	0.035	0.040	---	---	---	---
				50 < t ≤ 100	---	0.30	0.85-1.20	0.15-0.30	0.035	0.040	---	---	---	---
				100 < t ≤ 200	---	0.31	0.85-1.20	0.15-0.30	0.035	0.040	---	---	---	---

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				

4.1 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	Other
ASTM A 537/A 537M-95	2, 3	---	K12437	≤ 40	≤ 1½	0.24	0.70-1.35	0.15-0.50	0.035	0.035	0.25	0.25	0.08	Cu 0.35
				> 40	> 1½		1.00-1.60							
ASTM A 737/A 737M-99	C	---	K12202	---	---	0.22	1.15-1.50	0.15-0.50	0.035	0.030	---	---	---	V 0.04-0.11; N 0.03
ASTM A 738/A 738M-00	C	---	---	≤ 65	≤ 2½	0.20	1.50	0.15-0.50	0.025	0.025	0.25	0.50	0.08	Cu 0.35; V 0.05
				> 65	> 2½		1.60							
ASTM A 612/A 612M-98	---	---	K02900	---	---	0.25	1.00-1.50	0.15-0.50	0.035	0.035	0.25	0.25	0.08	Cu 0.35; V 0.08
ASTM A 738/A 738M-00	B	---	K12001	≤ 40	≤ 1½	0.20	0.90-1.50	0.15-0.55	0.030	0.030	0.30	0.60	0.20	Cu 0.35; V 0.07; Cb 0.04; Cb+V 0.08
				40 ≤ t ≤ 65	1½ ≤ t ≤ 2½	0.20	0.90-1.50	0.15-0.55	0.030	0.030	0.30	0.60	0.30	
				> 65	> 2½	0.20	0.90-1.60	0.15-0.55	0.030	0.030	0.30	0.60	0.30	

4.2 Carbon 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

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 9328-4:1991	P 255 TN PH 255 TN PL 255 TN	---	---	N	≤ 35	---	255	---	360-480	---	25	see standard
					35 < t ≤ 50	---	245	---				
					50 < t ≤ 70	---	235	---				
EN 10028-3:1992	P275N P275NH P275NL1 P275NL2	1.0486 1.0487 1.0488 1.1104	---	N	≤ 16	---	275	---	390-510	---	24	see standard
					16 < t ≤ 35	---	275	---				
					35 < t ≤ 50	---	265	---				
					50 < t ≤ 70	---	255	---				
					70 < t ≤ 100	---	235	---	370-490	---	23	
					100 < t ≤ 150	---	225	---	350-470	---		
ISO 9328-4:1991	P 285 TN PH 285 TN PL 285 TN	---	---	N	≤ 35	---	285	---	390-510	---	24	see standard
					35 < t ≤ 50	---	275	---				
					50 < t ≤ 70	---	265	---				
ASTM A 662/A 662M-99	A	---	K01701	N	---	---	275	40	400-540	58-78	23	see standard
JIS G 3126:1990	SLA 235 A, B	---	---	N	≤ 40	---	235	---	400-510	---	6-16 mm: 18	see standard
					>40	---	215	---			>16 mm: 22 >40 mm: 24	
	SLA 325 A	---	---	N	---	---	325	---	440-560	---	6-16 mm: 22 >16 mm: 30	see standard
	SLA 325 B	---	---	QT	---	---	325	---	440-560	---	>20 mm: 22	

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	---	---	---	---	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
	PH 255 TN	---	---	---	---	0.15			0.030	0.030				
EN 10028-3:1992	P275N	1.0486	---	---	---	0.18	0.50-1.50	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	0.030			0.020					
	P275NL1	1.0488	---	---		0.030			0.020					
	P275NL2	1.1104	---	---		0.025			0.015					
ISO 9328-4:1991	P 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
	PH 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	1.0562	---	---	---	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
	P355NH	1.0565	---	---	0.18	0.030			0.020					
	P355NL1	1.0566	---	---		0.025			0.015					
ISO 9328-4:1991	P 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
	PH 355 TN	---	---	---	---	0.18			0.030	0.030				
	PL 355 TN	---	---	---	---				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	---	---	---	---

4.2 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 (Continued)

Standard Designation	Grade, Class, Type, Symbol, or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 3126:1990	SLA 410	---	---	6 ≤ t ≤ 32	---	0.18	0.80-1.60	0.15-0.55	0.030	0.025	---	---	---	---
ASTM A 841/A 841M-98	A, Cl. 2	---	---	≤ 40	≤ 1½	0.20	0.70-1.35	0.15-0.50	0.030	0.030	0.25	0.25	0.08	Cu 0.35; V 0.06; Cb 0.03; Al ≥ 0.020
				> 40	> 1½	0.20	1.00-1.60							
	B, Cl. 2	---	---	≤ 40	≤ 1½	0.15	0.70-1.35	0.15-0.50	0.030	0.025	0.25	0.60	0.30	Cu 0.35; V 0.06; Cb 0.03; Al ≥ 0.020
				> 40	> 1½	0.15	1.00-1.60							
	C, Cl. 2	---	---	≤ 40	≤ 1½	0.10	0.70-1.60	0.15-0.50	0.030	0.015	0.25	0.25	0.08	Cu 0.35; V 0.06; Cb 0.06; Ti 0.006-0.02
				> 40	> 1½	0.10	1.00-1.60							

4.3 ½Mo Alloy Steel Pressure Vessel Plates

4.3A Chemical Composition of ½Mo 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
ASTM A 204/A 204M-93 (1999)	A	---	K11820	≤ 25	≤ 1	0.18	0.90	0.15-0.40	0.035	0.035	---	---	0.45-0.60	---
				25 < t ≤ 50	1 < t ≤ 2	0.21								
				50 < t ≤ 100	2 < t ≤ 4	0.23								
				> 100	> 4	0.25								
JIS G 3103:1987	SB 450 M	---	---	≤ 25	---	0.18	0.90	0.15-0.30	0.035	0.040	---	---	0.45-0.60	---
				25 < t ≤ 50	---	0.21								
				50 < t ≤ 100	---	0.23								
				100 < t ≤ 150	---	0.25								
	SB 480 M	---	---	≤ 25	---	0.20	0.90	0.15-0.30	0.035	0.040	---	---	0.45-0.60	---
				25 < t ≤ 50	---	0.23								
				50 < t ≤ 100	---	0.25								
				100 < t ≤ 150	---	0.27								
ASTM A 204/A 204M-93 (1999)	B	---	K12020	≤ 25	≤ 1	0.20	0.90	0.15-0.40	0.035	0.035	---	---	0.45-0.60	---
				25 < t ≤ 50	1 < t ≤ 2	0.23								
				50 < t ≤ 100	2 < t ≤ 4	0.25								
				> 100	> 4	0.27								
	C	---	K12320	≤ 25	≤ 1	0.23	0.90	0.15-0.40	0.035	0.035	---	---	0.45-0.60	---
				25 < t ≤ 50	1 < t ≤ 2	0.26								
				50 < t ≤ 100	2 < t ≤ 4	0.28								
				> 100	> 4	0.28								
ASTM A 302/A 302M-97	A	---	K12021	≤ 25	≤ 1	0.20	0.95-1.30	0.15-0.40	0.035	0.035	---	---	0.45-0.60	---
				25 < t ≤ 50	1 < t ≤ 2	0.23								
				> 50	> 2	0.25								
JIS G 3119:1987	SBV 1 A	---	---	≤ 25	---	0.20	0.95-1.30	0.15-0.30	0.035	0.040	---	---	0.45-0.60	---
				25 < t ≤ 50	---	0.23								
				50 < t ≤ 150	---	0.25								
JIS G 3124:1987	SEV 295	---	---	6 ≤ t ≤ 150	---	0.19	0.80-1.60	0.15-0.60	0.035	0.035	---	---	0.10-0.40	Cu 0.35; Nb 0.05; V 0.10
JIS G 3119:1987	SBV 1 B	---	---	≤ 25	---	0.20	1.15-1.50	0.15-0.30	0.035	0.040	---	---	0.45-0.60	---
				25 < t ≤ 50	---	0.23								
				50 < t ≤ 150	---	0.25								

Note: This section continued on next page

4.3 ½Mo Alloy Steel Pressure Vessel Plates

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

Standard Designation	Grade, Class, Type, Symbol, or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 302/A 302M-97	B	---	K12022	≤ 25	≤ 1	0.20	1.15-1.50	0.15-0.40	0.035	0.035	---	---	0.45-0.60	---
				25 < t ≤ 50	1 < t ≤ 2	0.23								
				> 50	> 2	0.25								
JIS G 3120:1987	SQV 1 A	---	---	---	---	0.25	1.15-1.50	0.15-0.30	0.035	0.040	---	---	0.45-0.60	---
ASTM A 533/A 533M-93	Type A, Cl. 1	---	K12521	---	---	0.25	1.15-1.50	0.15-0.40	0.035	0.035	---	---	0.45-0.60	---
JIS G 3124:1987	SEV 345	---	---	6 ≤ t ≤ 150	---	0.19	0.80-1.70	0.15-0.60	0.035	0.035	---	---	0.15-0.50	Cu 0.35; Nb 0.05; V 0.10
JIS G 3120:1987	SQV 1 B	---	---	---	---	0.25	1.15-1.50	0.15-0.30	0.035	0.040	---	---	0.45-0.60	---
ASTM A 533/A 533M-93	Type A, Cl. 2	---	K12521	---	---	0.25	1.15-1.50	0.15-0.40	0.035	0.035	---	---	0.45-0.60	---
	Type A, Cl. 3													

4.3 ½Mo Alloy Steel Pressure Vessel Plates

4.3B Mechanical Properties of ½Mo 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/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 204/A 204M-93 (1999)	A	---	K11820	AR	≤ 40	≤ 1.5	255	37	450-585	65-85	23	---
				N	> 40	> 1.5						
JIS G 3103:1987	SB 450 M	---	---	≤ 38: AR > 38: N	6 ≤ t ≤ 150	---	255	---	450-590	---	23	---
	SB 480M	---	---	≤ 38: AR > 38: N	6 ≤ t ≤ 150	---	275	---	480-620	---	21	---
ASTM A 204/A 204M-93 (1999)	B	---	K12020	AR	≤ 40	≤ 1.5	275	40	485-620	70-90	21	---
				N	> 40	> 1.5						
	C	---	K12320	AR	≤ 40	≤ 1.5	295	43	515-655	75-95	20	---
				N	> 40	> 1.5						
ASTM A 302/A 302M-97	A	---	K12021	AR	≤ 50	≤ 2	310	45	515-655	75-95	19	---
N				> 50	> 2							
JIS G 3119:1987	SBV 1 A	---	---	AR	≤ 50	---	315	---	520-660	---	19	---
				N	> 50	---						
JIS G 3124:1987	SEV 295	---	---	R, N, NT or P	≤ 50	---	420	---	540-690	---	15	31 J at 0°C
					50 < t ≤ 100	---	400	---			19	
					100 < t ≤ 125	---	390	---	530-680	---		
					125 < t ≤ 150	---	380	---	520-670	---		
JIS G 3119:1987	SBV 1 B	---	---	AR or N	≤ 50	---	345	---	550-690	---	18	---
					> 50	---						
ASTM A 302/A 302M-97	B	---	K12022	AR	≤ 50	≤ 2	345	50	550-690	80-100	18	---
N				> 50	> 2							
JIS G 3120:1987	SQV 1 A	---	---	Q T	---	---	345	---	550-690	---	18	see standard
ASTM A 533/A 533M-93	Type A, Cl. 1	---	K12521	Q T	> 6.5	> 0.25	345	50	550-690	80-100	18	---
JIS G 3124:1987	SEV 345	---	---	R, N, NT or P	≤ 50	---	430	---	590-740	---	14	31 J at 0°C
					50 < t ≤ 100	---					18	
					100 < t ≤ 125	---	420	---	580-730	---		
					125 < t ≤ 150	---	410	---	570-720	---		
JIS G 3120:1987	SQV 1 B	---	---	QT	---	---	480	---	620-790	---	16	see standard
ASTM A 533/A 533M-93	Type A, Cl. 2	---	K12521	QT	> 6.5	> 0.25	485	70	620-795	90-115	16	---
	Type A, Cl. 3	---	K12521	QT	6.5 < t ≤ 65	0.25 < t ≤ 2½	570	83	690-860	100-125	16	---

4.4 Cr-Mo Alloy Steel Pressure Vessel Plates

4.4.1A Chemical Composition of $\frac{3}{4}\text{Cr}-\frac{1}{2}\text{Mo}$ 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
ASTM A 387/A 387M-99	Gr. 2, Cl. 1	---	K12143	---	---	0.05-0.21	0.55-0.80	0.15-0.40	0.035	0.035	0.50-0.80	---	0.45-0.60	---
JIS G 4109:1987	SCMV 1 Div. 1	---	---	---	---	0.21	0.55-0.80	0.40	0.030	0.030	0.50-0.80	---	0.45-0.60	---
	SCMV 1 Div. 2	---	---	---	---	0.21	0.55-0.80	0.40	0.030	0.030	0.50-0.80	---	0.45-0.60	---
ASTM A 387/A 387M-99	Gr. 2, Cl. 2	---	K12143	---	---	0.05-0.21	0.55-0.80	0.15-0.40	0.035	0.035	0.50-0.80	---	0.45-0.60	---

4.4.1B Mechanical Properties of $\frac{3}{4}\text{Cr}-\frac{1}{2}\text{Mo}$ 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/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 387/A 387M-99	Gr. 2, Cl. 1	---	K12143	A or NT	---	---	---	33	380-550	55-80	22	---
JIS G 4109:1987	SCMV 1 Div. 1	---	---	A or NT	6 ≤ t ≤ 50	---	225	---	380-550	---	18	---
					50 < t ≤ 200	---					22	
	SCMV 1 Div. 2	---	---	NT	6 ≤ t ≤ 50	---	315	---	480-620	---	18	---
					50 < t ≤ 200	---					22	
ASTM A 387/A 387M-99	Gr. 2, Cl. 2	---	K12143	A or NT	---	---	310	45	485-620	70-90	22	---

4.4 Cr-Mo Alloy Steel Pressure Vessel Plates

4.4.2A Chemical Composition of 1Cr-½Mo 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
ASTM A 387/A 387M-99	Gr. 12, Cl. 1	---	K11757	---	---	0.05-0.17	0.40-0.65	0.15-0.40	0.035	0.035	0.80-1.15	---	0.45-0.60	---
JIS G 4109:1987	SCMV 2 Div 1	---	---	---	---	0.17	0.40-0.65	0.40	0.030	0.030	0.80-1.15	---	0.45-0.60	---
ASTM A 387/A 387M-99	Gr. 12, Cl. 2	---	K11757	---	---	0.05-0.17	0.40-0.65	0.15-0.40	0.035	0.035	0.80-1.15	---	0.45-0.60	---
JIS G 4109:1987	SCMV 2 Div 2	---	---	---	---	0.17	0.40-0.65	0.40	0.030	0.030	0.80-1.15	---	0.45-0.60	---
EN 10028-2:1992	13 CrMo 4-5	1.7335	---	---	---	0.08-0.18	0.40-1.00	0.35	0.030	0.025	0.70-1.15	---	0.40-0.60	Cu 0.30
ISO 9328-2:1991	14 CrMo 4 5	---	---	---	---	0.08-0.18	0.40-1.00	0.35	0.035	0.030	0.70-1.15	---	0.40-0.60	Cu 0.30

4.4.2B Mechanical Properties of 1Cr-½Mo Alloy 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/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 387/A 387M-99	Gr. 12, Cl. 1	---	K11757	A or NT	---	---	---	33	380-550	55-80	22	---
JIS G 4109:1987	SCMV 2 Div. 1	---	---	A or NT	6 ≤ t ≤ 50	---	225	---	380-550	---	19	---
					50 < t ≤ 200	---					22	
ASTM A 387/A 387M-99	Gr. 12, Cl. 2	---	K11757	A or NT	---	---	275	40	450-585	65-85	22	---
JIS G 4109:1987	SCMV 2 Div. 2	---	---	NT	6 ≤ t ≤ 50	---	275	---	450-590	---	18	---
					50 < t ≤ 200	---					22	
EN 10028-2:1992	13 CrMo 4-5	1.7335	---	NT	≤ 16	---	300	---	450-600	---	20	31 J at 20°C
					16 < t ≤ 60	---	295	---			19	27 J at 20°C
				NT, QA or QL	60 < t ≤ 100	---	275	---	440-590	---		
				QL	100 < t ≤ 150	---	255	---	430-580	---		
ISO 9328-2:1991	14 CrMo 4 5	---	---	NT	3 ≤ t ≤ 16	---	300	---	450-600	---	20	31 J at 20°C
					16 < t ≤ 40	---						
					40 < t ≤ 60	---						
					60 < t ≤ 100	---	275	---	440-590	---	18	27 J at 20°C
					100 < t ≤ 150	---	255	---	430-580	---		

4.4 Cr-Mo Alloy Steel Pressure Vessel Plates

4.4.3A Chemical Composition of 1¼Cr-½Mo 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 3 Div 1	---	---	---	---	0.17	0.40-0.65	0.50-0.80	0.030	0.030	1.00-1.50	---	0.45-0.65	---
ASTM A 387/A 387M-99	Gr. 11, Cl. 1	---	K11789	---	---	0.05-0.17	0.40-0.65	0.50-0.80	0.035	0.035	1.00-1.50	---	0.45-0.65	---
	Gr. 11, Cl. 2	---	K11789	---	---	0.05-0.17	0.40-0.65	0.50-0.80	0.035	0.035	1.00-1.50	---	0.45-0.65	---
JIS G 4109:1987	SCMV 3 Div 2	---	---	---	---	0.17	0.40-0.65	0.50-0.80	0.030	0.030	1.00-1.50	---	0.45-0.65	---

4.4.3B Mechanical Properties of 1¼Cr-½Mo Alloy 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/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
JIS G 4109:1987	SCMV 3 Div. 1	---	---	A or NT	6 ≤ t ≤ 50	---	235	---	410-590	---	19	---
					50 < t ≤ 200	---					22	
ASTM A 387/A 387M-99	Gr. 11, Cl. 1	---	K11789	A or NT	---	---	---	35	415-585	60-85	22	---
	Gr. 11, Cl. 2	---	K11789	A or NT	---	---	310	45	515-690	75-100	22	---
JIS G 4109:1987	SCMV 3 Div. 2	---	---	NT	6 ≤ t ≤ 50	---	315	---	520-690	---	18	---
					50 < t ≤ 200	---					22	

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/mm ² or MPa	ksi	N/mm ² 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				

4.4 Cr-Mo Alloy Steel Pressure Vessel Plates

4.4.5A Chemical Composition of 3Cr-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 5 Div 1	---	---	---	---	0.17	0.30-0.60	0.50	0.030	0.030	2.75-3.25	---	0.90-1.10	---
ASTM A 387/A 387M-99	Gr. 21, Cl. 1	---	K31545	---	---	0.05-0.15	0.30-0.60	0.50	0.035	0.035	2.75-3.25	---	0.90-1.10	---
	Gr. 21 L, Cl. 1	---				0.10								
	Gr. 21, Cl. 2	---				0.05-0.05								
JIS G 4109:1987	SCMV 5 Div 2	---	---	---	---	0.17	0.30-0.60	0.50	0.030	0.030	2.75-3.25	---	0.90-1.10	---

4.4.5B Mechanical Properties of 3Cr-1Mo Alloy 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/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
JIS G 4109:1987	SCMV 5 Div 1	---	---	A or NT	6 ≤ t ≤ 300	---	205	---	410-590	---	18	---
ASTM A 387/A 387M-99	Gr. 21, Cl. 1	---	K31545	A or NT	---	---	---	30	415-585	60-85	18	---
	Gr. 21 L, Cl. 1	---										
	Gr. 21, Cl. 2	---		A or NT	---	---	310	45	515-690	75-100	18	---
JIS G 4109:1987	SCMV 5 Div 2	---	---	NT	6 ≤ t ≤ 300	---	315	---	520-690	---	18	---

4.4 Cr-Mo Alloy Steel Pressure Vessel Plates

4.4.6A Chemical Composition of 5Cr-½Mo 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 6 Div 1	---	---	---	---	0.15	0.30-0.60	0.50	0.030	0.030	4.00-6.00	---	0.45-0.65	---
ASTM A 387/A 387M-99	Gr. 5, Cl. 1	---	K41545	---	---	0.15	0.30-0.60	0.50	0.035	0.030	4.00-6.00	---	0.45-0.65	---
	Gr. 5, Cl. 2	---	S50100 S50200	---	---	0.15	0.30-0.60	0.50	0.035	0.030	4.00-6.00	---	0.45-0.65	---
JIS G 4109:1987	SCMV 6 Div 2	---	---	---	---	0.15	0.30-0.60	0.50	0.030	0.030	4.00-6.00	---	0.45-0.65	---

4.4.6B Mechanical Properties of 5Cr-½Mo Alloy 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/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
JIS G 4109:1987	SCMV 6 Div 1	---	---	A or NT	6 ≤ t ≤ 300	---	205	---	410-590	---	18	---
ASTM A 387/A 387M-99	Gr. 5, Cl. 1	---	K41545 S50100 S50200	A or NT	---	---	---	30	415-585	60-85	18	---
	Gr. 5, Cl. 2	---	K41545 S50100 S50200	A or NT	---	---	310	45	515-690	75-100	18	---
JIS G 4109:1987	SCMV 6 Div 2	---	---	NT	6 ≤ t ≤ 300	---	315	---	520-690	---	18	---

4.5 Ni Alloy Steel Pressure Vessel Plates

4.5.1A Chemical Composition of ½Ni 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
EN 10028-4:1994	11MnNi5-3	1.6212	---	---	---	0.14	0.70-1.50	0.50	0.025	0.015	---	0.30-0.80	---	V 0.05; Nb 0.05; Al 0.020
	13MnNi6-3	1.6217	---	---	---	0.16	0.85-1.70	0.50	0.025	0.015	---	0.30-0.85	---	V 0.05; Nb 0.05; Al 0.020
ISO 9328-3:1991	11MnNi 5 3	---	---	3 ≤ t ≤ 50	---	0.14	0.70-1.50	0.50	0.030	0.025	---	0.30-0.80	---	V 0.05; Nb 0.05; Al 0.020
	13 Mn Ni 6 3	---	---	3 ≤ t ≤ 50	---	0.16	0.85-1.65	0.50	0.030	0.025	---	0.30-0.85	---	V 0.05; Nb 0.05; Al 0.020

4.5.1B Mechanical Properties of ½Ni Alloy 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/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
EN 10028-4:1994	11MnNi5-3	1.6212	---	NT	≤ 30	---	285	---	420-530	---	24	see standard
					30 < t ≤ 50	---	275	---				
	13MnNi6-3	1.6217	---	NT	≤ 30	---	355	---	490-610	---	22	see standard
					30 < t ≤ 50	---	345	---				
ISO 9328-3:1991	11 MnNi 5 3	---	---	NT	3 < t ≤ 30	---	285	---	420-530	---	24	see standard
					30 < t ≤ 50	---	275	---				
	13 MnNi 6 3	---	---	NT	3 < t ≤ 30	---	355	---	490-610	---	22	see standard
					30 < t ≤ 50	---	345	---				

4.5 Ni Alloy Steel Pressure Vessel Plates

4.5.2A Chemical Composition of 1½Ni 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
EN 10028-4:1994	15NiMn6	1.6228	---	---	---	0.18	0.80-1.50	0.35	0.025	0.015	---	1.30-1.70	---	V 0.05
ISO 9328-3:1991	15 NiMn 6	---	---	3 ≤ t ≤ 50	---	0.18	0.80-1.50	0.35	0.025	0.020	---	1.30-1.70	---	V 0.05

4.5.2B Mechanical Properties of 1½Ni Alloy 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/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
EN 10028-4:1994	15NiMn6	1.6228	---	N or NT or QT	≤ 30	---	355	---	490-640	---	22	see standard
					30 < t ≤ 50	---	345	---				
ISO 9328-3:1991	15 NiMn 6	---	---	N or NT or QT	3 < t ≤ 30	---	355	---	490-640	---	22	see standard
					30 < t ≤ 50	---	345	---				

4.5 Ni Alloy Steel Pressure Vessel Plates

4.5.3A Chemical Composition of 2¼Ni Alloy 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 3127:1990	SL 2N 255	---	---	6 ≤ t ≤ 50	---	0.17	0.70	0.30	0.025	0.025	---	2.10-2.50	---	---
ASTM A 203/A 203M-97	A	---	K21703	≤ 50	≤ 2	0.17	0.70	0.15-0.40	0.035	0.035	---	2.10-2.50	---	---
				50 < t ≤ 100	2 < t ≤ 4	0.20	0.80	0.15-0.40	0.035	0.035	---	2.10-2.50	---	---
				> 100	> 4	0.23	0.80	0.15-0.40	0.035	0.035	---	2.10-2.50	---	---
				≤ 50	≤ 2	0.21	0.70	0.15-0.40	0.035	0.035	---	2.10-2.50	---	---
	B	---	K22103	50 < t ≤ 100	2 < t ≤ 4	0.24	0.80	0.15-0.40	0.035	0.035	---	2.10-2.50	---	---
				> 100	> 4	0.25	0.80	0.15-0.40	0.035	0.035	---	2.10-2.50	---	---

4.5.3B Mechanical Properties of 2¼Ni Alloy 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/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
JIS G 3127:1990	SL 2N 255	---	---	N	6 ≤ t ≤ 16	---	255	---	450-590	---	24	see standard
					> 16	---					29	
					> 20	---					24	
ASTM A 203/A 203M-97	A	---	K21703	N	≤ 50	≤ 2	255	37	450-585	65-85	23	---
					> 50	> 2						
	B	---	K22103	N	≤ 50	≤ 2	275	40	485-620	70-90	21	---
					> 50	> 2						

4.5 Ni Alloy Steel Pressure Vessel Plates

4.5.4A Chemical Composition of 3½Ni 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 3127:1990	SL 3N 255	---	---	6 ≤ t ≤ 50	---	0.15	0.70	0.30	0.025	0.025	---	3.25-3.75	---	---
ASTM A 203/A 203M-97	D	---	K31718	≤ 50	≤ 2	0.17	0.70	0.15-0.40	0.035	0.035	---	3.25-3.75	---	---
				50 < t ≤ 100	2 < t ≤ 4	0.20	0.80	0.15-0.40	0.035	0.035	---	3.25-3.75	---	---
ISO 9328-3:1991	12 Ni 14 G1	---	---	3 ≤ t ≤ 50	---	0.15	0.30-0.80	0.35	0.025	0.020	---	3.25-3.75	---	V 0.05
	12 Ni 14 G2	---	---	3 ≤ t ≤ 50	---	0.15	0.30-0.80	0.35	0.025	0.020	---	3.25-3.75	---	V 0.05
JIS G 3127:1990	SL 3N 275	---	---	6 ≤ t ≤ 50	---	0.17	0.70	0.30	0.025	0.025	---	3.25-3.75	---	---
ASTM A 203/A 203M-97	E	---	K32018	≤ 50	≤ 2	0.20	0.70	0.15-0.40	0.035	0.035	---	3.25-3.75	---	---
				50 < t ≤ 100	2 < t ≤ 4	0.23	0.80	0.15-0.40	0.035	0.035	---	3.25-3.75	---	---
EN 10028-4:1994	12Ni14	1.5637	---	---	---	0.15	0.30-0.80	0.35	0.020	0.010	---	3.25-3.75	---	V 0.05
JIS G 3127:1990	SL 3N 440	---	---	6 ≤ t ≤ 50	---	0.15	0.70	0.30	0.025	0.025	---	3.25-3.75	---	---
ASTM A 203/A 203M-97	F	---	---	≤ 50	≤ 2	0.20	0.70	0.15-0.40	0.035	0.035	---	3.25-3.75	---	---
				50 < t ≤ 100	2 < t ≤ 4	0.23	0.80	0.15-0.40	0.035	0.035	---	3.25-3.75	---	---

4.5 Ni Alloy Steel Pressure Vessel Plates

4.5.4B Mechanical Properties of 3½Ni 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/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
JIS G 3127:1990	SL 3N 255	---	---	N	6 ≤ t ≤ 16	---	255	---	450-590	---	24	see standard
					> 16	---					29	
					> 20	---					24	
ASTM A 203/A 203M-97	D	---	K31718	N	≤ 50	≤ 2	255	37	450-585	65-85	23	---
					> 50	> 2						
ISO 9328-3:1991	12 Ni 14 G1	---	---	N or NT or QT	3 < t ≤ 30	---	285	---	450-600		23	see standard
					30 < t ≤ 50	---	275	---				
	12 Ni 14 G2	---	---	N or NT or QT	3 < t ≤ 30	---	355	---	470-620		22	see standard
					30 < t ≤ 50	---	345	---				
JIS G 3127:1990	SL 3N 275	---	---	N	6 ≤ t ≤ 16	---	275	---	480-620	---	22	see standard
					> 16	---					26	
					> 20	---					22	
ASTM A 203/A 203M-97	E	---	K32018	N	≤ 50	≤ 2	275	40	485-620	70-90	21	---
					> 50	> 2						
EN 10028-4:1994	12Ni14	1.5637	---	N or NT or QT	≤ 30	---	355	---	490-640	---	22	see standard
					30 < t ≤ 50	---	345	---				
JIS G 3127:1990	SL 3N 440	---	---	QT	6 ≤ t ≤ 16	---	440	---	540-690	---	21	see standard
					> 16	---					25	
					> 20	---					21	
ASTM A 203/A 203M-97	F	---	---	QT	≤ 50	≤ 2	55	380	550-690	80-100	20	---
					> 50	> 2	50	345	515-655	75-95		

4.5 Ni Alloy Steel Pressure Vessel Plates

4.5.5A Chemical Composition of 5Ni 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
EN 10028-4:1994	12Ni19	1.5680	---	---	---	0.15	0.30-0.80	0.35	0.020	0.010	---	4.75-5.25	---	V 0.05
JIS G 3127:1990	SL 5N 590	---	---	$6 \leq t \leq 50$	---	0.13	1.50	0.30	0.025	0.025	---	4.75-6.00	---	---

4.5.5B Mechanical Properties of 5Ni 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/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
EN 10028-4:1994	12Ni19	1.5680	---	N or NT or QT	≤ 30	---	390	---	530-710	---	20	see standard
					$30 < t \leq 50$	---	380	---				
JIS G 3127:1990	SL 5 N 590	---	---	QT	$6 \leq t \leq 16$	---	590	---	690-830	---	21	see standard
					> 16	---					25	
					> 20	---					21	

4.5 Ni Alloy Steel Pressure Vessel Plates

4.5.6A Chemical Composition of 9Ni 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
ISO 9328-3:1991	X 8 Ni 9	---	---	$3 \leq t \leq 50$	---	0.10	0.30-0.80	0.35	0.025	0.020	---	8.5-10.0	0.10	V 0.05
EN 10028-4:1994	X8Ni 9	1.5662	---	---	---	0.10	0.30-0.80	0.35	0.020	0.010	---	8.50-10.00	0.10	V 0.05
	X7Ni9	1.5663	---	---	---	0.10	0.30-0.80	0.35	0.015	0.005	---	8.50-10.00	0.10	V 0.01
JIS G 3127:1990	SL 9N 520	---	---	$6 \leq t \leq 50$	---	0.12	0.90	0.30	0.025	0.025	---	8.50-9.50	---	---
ASTM A 353/A 353M-93 (1999)	---	---	K81340	---	---	0.13	0.90	0.15-0.40	0.035	0.035	---	8.50-9.50	---	---
ASTM A 553/A 553M-95	Type I	---	K81340	---	---	0.13	0.90	0.15-0.40	0.035	0.035	---	8.50-9.50	---	---
	Type II	---	K71340	---	---	0.13	0.90	0.15-0.40	0.035	0.035	---	7.50-8.50	---	---
JIS G 3127:1990	SL 9N 590	---	---	$6 \leq t \leq 50$	---	0.12	0.90	0.30	0.025	0.025	---	8.50-9.50	---	---
ASTM A 844/A 844M-93 (1999)	---	---	K81340	---	---	0.13	0.90	0.15-0.40	0.020	0.020	---	8.50-9.50	---	---

4.5 Ni Alloy Steel Pressure Vessel Plates

4.5.6B Mechanical Properties of 9Ni 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/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ISO 9328-3:1991	X 8 Ni 9	---	---	NNT or QT	$3 \leq t \leq 30$	---	490	---	640-840	---	18	see standard
					$30 < t \leq 50$	---	480	---				
EN 10028-4:1994	X8Ni9	1.5662	---	HT 640: NNT or QT	≤ 30	---	490	---	640-840	---	18	see standard
					$30 < t \leq 50$	---	480	---				
				HT 680: QT	≤ 30	---	585	---	680-820	---	18	see standard
					$30 < t \leq 50$	---	575	---				
	X7Ni9	1.5663	---	QT	≤ 30	---	585	---	680-820	---	18	see standard
					$30 < t \leq 50$	---	575	---				
JIS G 3127:1990	SL 9N 520	---	---	NNT	$6 \leq t \leq 16$	---	520	---	690-830	---	21	see standard
					> 16	---					25	
					> 20	---					21	
ASTM A 353/A 353M-93 (1999)	---	---	K81340	NNT	---	---	515	75	690-825	100-120	20.0	see standard
ASTM A 553/A 553M-95	Type I	---	K81340	QT	---	---	585	85	690-825	100-120	20.0	see standard
	Type II	---	K71340									
JIS G 3127:1990	SL 9N 590	---	---	QT	$6 \leq t \leq 16$	---	590	---	690-830	---	21	see standard
					> 16	---					25	
					> 20	---					21	
ASTM A 844/A 844M-93 (1999)	---	---	K81340	Direct QT	≤ 50	≤ 2	585	85	690-825	100-120	20	see standard

4.6 Ni-Mo Alloy Steel Pressure Vessel Plates

4.6.1A Chemical Composition of ½Ni-½Mo 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
ASTM A 533/A 533M-93	Type B, Cl. 1	---	K12539	---	---	0.25	1.15-1.50	0.15-0.40	0.035	0.035	---	0.40-0.70	0.45-0.60	---
JIS G 3120:1987	SQV 2 A	---	---	---	---	0.25	1.15-1.50	0.15-0.30	0.035	0.040	---	0.40-0.70	0.45-0.60	---
JIS G 3119:1987	SBV 2	---	---	≤ 25	---	0.20	1.15-1.50	0.15-0.30	0.035	0.040	---	0.40-0.70	0.45-0.60	---
				25 < t ≤ 50	---	0.23	1.15-1.50	0.15-0.30	0.035	0.040	---	0.40-0.70	0.45-0.60	---
				50 < t ≤ 150	---	0.25	1.15-1.50	0.15-0.30	0.035	0.040	---	0.40-0.70	0.45-0.60	---
ASTM A 302/A 302M-97	C	---	K12039	≤ 25	≤ 1	0.20	1.15-1.50	0.15-0.40	0.035	0.035	---	0.40-0.70	0.45-0.60	---
				25 < t ≤ 50	1 < t ≤ 2	0.23	1.15-1.50	0.15-0.40	0.035	0.035	---	0.40-0.70	0.45-0.60	---
				> 50	> 2	0.25	1.15-1.50	0.15-0.40	0.035	0.035	---	0.40-0.70	0.45-0.60	---
ASTM A 533/A 533M-93	Type B, Cl. 2	---	K12539	---	---	0.25	1.15-1.50	0.15-0.40	0.035	0.035	---	0.40-0.70	0.45-0.60	---
JIS G 3120:1987	SQV 2 B	---	---	---	---	0.25	1.15-1.50	0.15-0.30	0.035	0.040	---	0.40-0.70	0.45-0.60	---
ASTM A 533/A 533M-93	Type B, Cl. 3	---	K12539	---	---	0.25	1.15-1.50	0.15-0.40	0.035	0.035	---	0.40-0.70	0.45-0.60	---

4.6.1B Mechanical Properties of ½Ni-½Mo 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/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 533/A 533M-93	Type B, Cl. 1	---	K12539	QT	> 6.5	> 0.25	345	50	550-690	80-100	18	---
JIS G 3120:1987	SQV 2 A	---	---	QT	---	---	345	---	550-690	---	18	see standard
JIS G 3119:1987	SBV 2	---	---	AR	6 ≤ t ≤ 50	---	345	---	550-690	---	17	---
				N	50 < t ≤ 150	---					20	
ASTM A 302/A 302M-97	C	---	K12039	AR	6.5 ≤ t ≤ 50	¼ ≤ t ≤ 2	345	50	550-690	80-100	20	---
				N	> 50	> 2						
ASTM A 533/A 533M-93	Type B, Cl. 2	---	K12539	QT	> 6.5	> 0.25	485	70	620-795	90-115	16	---
JIS G 3120:1987	SQV 2 B	---	---	QT	---	---	480	---	620-790	---	16	see standard
ASTM A 533/A 533M-93	Type B, Cl. 3	---	K12539	QT	6.5 ≤ t ≤ 65	¼ ≤ t ≤ 2½	570	83	690-860	100-125	16	---

4.6 Ni-Mo Alloy Steel Pressure Vessel Plates

4.6.2A Chemical Composition of $\frac{3}{4}\text{Ni}-\frac{1}{2}\text{Mo}$ 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
ASTM A 533/A 533M-93	Type C, Cl. 1	---	K12554	---	---	0.25	1.15-1.50	0.15-0.40	0.035	0.035	---	0.70-1.00	0.45-0.60	---
JIS G 3119:1987	SBV 3	---	---	≤ 25	---	0.20	1.15-1.50	0.15-0.30	0.035	0.040	---	0.70-1.00	0.45-0.60	---
				$25 < t \leq 50$	---	0.23	1.15-1.50	0.15-0.30	0.035	0.040	---	0.70-1.00	0.45-0.60	---
				$50 < t \leq 150$	---	0.25	1.15-1.50	0.15-0.30	0.035	0.040	---	0.70-1.00	0.45-0.60	---
ASTM A 302/A 302M-97	D	---	K12054	≤ 25	≤ 1	0.20	1.15-1.50	0.15-0.40	0.035	0.035	---	0.70-1.00	0.45-0.60	---
				$25 < t \leq 50$	$1 < t \leq 2$	0.23	1.15-1.50	0.15-0.40	0.035	0.035	---	0.70-1.00	0.45-0.60	---
				> 50	> 2	0.25	1.15-1.50	0.15-0.40	0.035	0.035	---	0.70-1.00	0.45-0.60	---
JIS G 3120:1987	SQV 3 A	---	---	---	---	0.25	1.15-1.50	0.15-0.30	0.035	0.040	---	0.70-1.00	0.45-0.60	---
ASTM A 533/A 533M-93	Type C, Cl. 2	---	K12554	---	---	0.25	1.15-1.50	0.15-0.40	0.035	0.035	---	0.70-1.00	0.45-0.60	---
JIS G 3120:1987	SQV 3 B	---	---	---	---	0.25	1.15-1.50	0.15-0.30	0.035	0.040	---	0.70-1.00	0.45-0.60	---
ASTM A 533/A 533M-93	Type C, Cl. 3	---	K12554	---	---	0.25	1.15-1.50	0.15-0.40	0.035	0.035	---	0.70-1.00	0.45-0.60	---

4.6.2B Mechanical Properties of $\frac{3}{4}\text{Ni}-\frac{1}{2}\text{Mo}$ 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/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 533/A 533M-93	Type C, Cl. 1	---	K12554	QT	> 6.5	> 0.25	345	50	550-690	80-100	18	---
JIS G 3119:1987	SBV 3	---	---	AR	$6 \leq t \leq 50$	---	345	---	550-690	---	17	---
				N	$50 < t \leq 150$	---					20	
ASTM A 302/A 302M-97	D	---	K12054	AR	$6.5 \leq t \leq 50$	$\frac{1}{4} \leq t \leq 2$	345	50	550-690	80-100	20	---
				N	> 50	> 2						
JIS G 3120:1987	SQV 3 A	---	---	QT	---	---	345	---	550-690	---	18	see standard
ASTM A 533/A 533M-93	Type C, Cl. 2	---	K12554	QT	> 6.5	> 0.25	485	70	620-795	90-115	16	---
JIS G 3120:1987	SQV 3 B	---	---	QT	---	---	480	---	620-790	---	16	see standard
ASTM A 533/A 533M-93	Type C, Cl. 3	---	K12554	QT	$6.5 \leq t \leq 65$	$\frac{1}{4} \leq t \leq 2\frac{1}{2}$	570	83	690-860	100-125	16	---

4.7 Ferritic and Martensitic Stainless Steel Pressure Vessel Plates

4.7A Chemical Composition of Ferritic and Martensitic 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	405	---	S40500	---	---	0.08	1.00	1.00	0.040	0.030	11.5-14.5	0.60	---	Al 0.10-0.30
EN 10028-7:2000	X2CrNi12	1.4003	---	---	---	0.030	1.50	1.00	0.040	0.015	10.50-12.50	0.30-1.00	---	N 0.030
ASTM A 240/A 240M-00	---	---	S40975	---	---	0.030	1.00	1.00	0.040	0.030	10.5-11.7	0.50-1.00	---	N 0.030; Ti 6 x (C+N) to 0.75
EN 10028-7:2000	X6CrNiTi12	1.4516	---	---	---	0.08	1.50	0.70	0.040	0.015	10.50-12.50	0.50-1.50	---	Ti 0.05-0.35
ASTM A 240/A 240M-00	---	---	S41500	---	---	0.05	0.50-1.00	0.60	0.030	0.030	11.5-14.0	3.5-5.5	0.50-1.00	---
EN 10028-7:2000	X3CrNiMo13-4	1.4313	---	---	---	0.05	1.50	0.70	0.040	0.015	12.00-14.00	3.50-4.50	0.30-0.70	N 0.020
ASTM A 240/A 240M-00	439	---	S43035	---	---	0.07	1.00	1.00	0.040	0.030	17.0-19.0	0.50	---	Ti [0.20+4(C+N)] to 1.10 N 0.04; Al 0.15
EN 10028-7:2000	X3CrTi17	1.4510	---	---	---	0.05	1.00	1.00	0.040	0.015	16.00-18.00	---	---	Ti [4 x (C+N)+0.15] to 0.80
ASTM A 240/A 240M-00	---	---	S43932	---	---	0.030	1.00	1.00	0.040	0.030	17.0-19.0	0.50	---	(Ti+Cb) [0.20+4(C+N)] to 0.75 N 0.030; Al 0.15
	---	---	S43940	---	---	0.030	1.00	1.00	0.040	0.015	17.5-18.5	---	---	Ti 0.10-0.60; Cb [0.30+(3 x C)] min
EN 10028-7:2000	X2CrTiNb18	1.4509	---	---	---	0.030	1.00	1.00	0.040	0.015	17.50-18.50	---	---	Ti 0.10-0.60; Nb [3 x C+0.30] to 1.00
ASTM A 240/A 240M-00	444	---	S44400	---	---	0.025	1.00	1.00	0.040	0.030	17.5-19.5	1.00	1.75-2.50	(Ti+Cb) [0.20+4(C+N)] to 0.80; N 0.035
EN 10028-7:2000	X2CrMoTi18-2	1.4521	---	---	---	0.025	1.00	1.00	0.040	0.015	17.00-20.00	---	1.80-2.50	Ti [4 x (C+N)+0.15] to 0.80; N 0.030

4.7 Ferritic and Martensitic Stainless Steel Pressure Vessel Plates (Continued)

4.7B Mechanical Properties of Ferritic and Martensitic 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/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 240/A 240M-00	405	---	S40500	---	---	---	170	25	415 min	60 min	20.0	---
EN 10028-7:2000	X2CrNi12	1.4003	---	CR St, A	≤ 6	---	280 L; 320 T	---	450-650	---	20	see standard
				HR St, A	≤ 12	---					18	
				HR Pl, A	≤ 25	---	250 L; 280 T	---			18	
ASTM A 240/A 240M-00	---	---	S40975	---	---	---	275	40	415 min	60 min	20.0	---
EN 10028-7:2000	X6CrNiTi12	1.4516	---	CR St, A	≤ 6	---	280 L; 320 T	---	450-650	---	23	see standard
				HR St, A	≤ 12	---					20	
				HR Pl, A	≤ 25	---	250 L; 280 T	---			20	
ASTM A 240/A 240M-00	---	---	S41500	---	---	---	620	90	795 min	115 min	15.0	---
EN 10028-7:2000	X3CrNiMo13-4	1.4313	---	HR Pl, QT	≤ 75	---	650	---	780-980	---	14	see standard
ASTM A 240/A 240M-00	439	---	S43035	---	---	---	205	30	415 min	60 min	22.0	---
EN 10028-7:2000	X3CrTi17	1.4510	---	CR St, A	≤ 3	---	230 L; 240 T	---	420-600	---	23	see standard
ASTM A 240/A 240M-00	---	---	S43932	---	---	---	205	30	415 min	60 min	22.0	---
	---	---	S43940	---	---	---	250	36	430 min	62 min	18	---
EN 10028-7:2000	X2CrTiNb18	1.4509	---	CR St, A	≤ 2.5	---	230 L; 250 T	---	430-630	---	18	see standard
ASTM A 240/A 240M-00	444	---	S44400	---	---	---	275	40	415 min	60 min	20.0	---
EN 10028-7:2000	X2CrMoTi18-2	1.4521	---	CR St, A	≤ 2.5	---	300 L; 320 T	---	420-640	---	20	see standard

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	X2CrNi18-10	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

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified								
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 240/A 240M-00	316L	---	S31603	---	---	0.030	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	N 0.10
EN 10028-7:2000	X2CrNiMo17-12-2	1.4404	---	---	---	0.030	2.00	1.00	0.045	0.015	16.50-18.50	10.00-13.00	2.00-2.50	N 0.11
	X2CrNiMo17-12-3	1.4432	---	---	---	0.030	2.00	1.00	0.045	0.015	16.50-18.50	10.50-13.00	2.50-3.00	N 0.11
	X2CrNiMo18-14-3	1.4435	---	---	---	0.030	2.00	1.00	0.045	0.015	17.00-19.00	12.50-15.00	2.50-3.00	N 0.11
ISO 9328-5:1991	X 2 CrNiMo 17 12	---	---	---	---	0.030	2.00	1.00	0.045	0.030	16.50-18.50	11.00-14.00	2.00-2.50	---
	X 2 CrNiMo 17 13	---	---	---	---	0.030	2.00	1.00	0.045	0.030	16.50-18.50	11.50-14.50	2.50-3.00	---
ASTM A 240/A 240M-00	316H	---	S31609	---	---	0.04-0.10	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
ISO 9328-5:1991	X 7 CrNiMo 17 12	---	---	---	---	0.04-0.10	2.00	1.00	0.045	0.030	16.50-18.50	10.50-13.50	2.00-2.50	---
ASTM A 240/A 240M-00	316Ti	---	S31635	---	---	0.08	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	Ti 5 x (C+N) min, 0.70 max; N 0.10;
EN 10028-7:2000	X6CrNiMoTi17-12-2	1.4571	---	---	---	0.08	2.00	1.00	0.045	0.015	16.50-18.50	10.50-13.50	2.00-2.50	Ti 5 x C - 0.70
ISO 9328-5:1991	X 6 CrNiMoTi 17 12	---	---	---	---	0.08	2.00	1.00	0.045	0.030	16.50-18.50	11.00-14.00	2.00-2.50	Ti 5 X C to 0.80
ASTM A 240/A 240M-00	316Cb	---	S31640	---	---	0.08	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	Cb 10 x C to 1.10; N 0.10
EN 10028-7:2000	X6CrNiMoNb17-12-2	1.4580	---	---	---	0.08	2.00	1.00	0.045	0.015	16.50-18.50	10.50-13.50	2.00-2.50	Nb 10 x C to 1.00
ISO 9328-5:1991	X 6 CrNiMoNb 17 12	---	---	---	---	0.08	2.00	1.00	0.045	0.030	16.50-18.50	11.00-14.00	2.00-2.50	Nb 10 x C to 1.00
ASTM A 240/A 240M-00	316LN	---	S31653	---	---	0.030	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	N 0.10-0.16
EN 10028-7:2000	X2CrNiMoN17-11-2	1.4406	---	---	---	0.030	2.00	1.00	0.045	0.015	16.50-18.50	10.00-12.00	2.00-2.50	N 0.12-0.22
	X2CrNiMoN17-13-3	1.4429	---	---	---	0.030	2.00	1.00	0.045	0.015	16.50-18.50	11.00-14.00	2.50-3.00	N 0.12-0.22
ISO 9328-5:1991	X 2 CrNiMoN 17 12	---	---	---	---	0.030	2.00	1.00	0.045	0.030	16.50-18.50	10.50-13.50	2.00-2.50	N 0.12-0.22
	X 2 CrNiMoN 17 13	---	---	---	---	0.030	2.00	1.00	0.045	0.030	16.50-18.50	11.50-14.50	2.50-3.00	N 0.12-0.22
ASTM A 240/A 240M-00	317L	---	S31703	---	---	0.030	2.00	0.75	0.045	0.030	18.0-20.0	11.0-15.0	3.0-4.0	N 0.10
EN 10028-7:2000	X2CrNiMo18-15-4	1.4438	---	---	---	0.030	2.00	1.00	0.045	0.015	17.50-19.50	13.00-16.00	3.00-4.00	N 0.11
ISO 9328-5:1991	X 3 CrNiMo 18 16 4	---	---	---	---	0.030	2.00	1.00	0.045	0.030	17.50-19.50	14.00-17.00	3.00-4.00	---
ASTM A 240/A 240M-00	317LN	---	S31753	---	---	0.030	2.00	0.75	0.045	0.030	18.0-20.0	11.0-15.0	3.0-4.0	N 0.10-0.22
EN 10028-7:2000	X2CrNiMoN18-12-4	1.4434	---	---	---	0.030	2.00	1.00	0.045	0.015	16.50-19.50	10.50-14.00	3.00-4.00	N 0.10-0.20

4.8 Austenitic Stainless Steel Pressure Vessel Plates

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Section Thickness		Weight, %, Maximum, Unless Otherwise Specified									
				t, mm	t, in.	C	Mn	Si	P	S	Cr	Ni	Mo	Others	
ASTM A 240/A 240M-00	317LMN	---	S31726	---	---	0.030	2.00	0.75	0.045	0.030	17.0-20.0	13.5-17.5	4.0-5.0	N 0.10-0.20	
EN 10028-7:2000	X2CrNiMoN17-13-5	1.4439	---	---	---	0.030	2.00	1.00	0.045	0.015	16.50-18.50	12.50-14.50	4.00-5.00	N 0.12-0.22	
ISO 9328-5:1991	X 2 CrNiMoN 17 13 5	---	---	---	---	0.030	2.00	1.00	0.045	0.025	16.50-18.50	12.50-14.50	4.00-5.00	N 0.12-0.22	
ASTM A 240/A 240M-00	321	---	S32100	---	---	0.08	2.00	0.75	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 5 x (C+N) to 0.70; N 0.10	
EN 10028-7:2000	X6CrNiTi18-10	1.4541	---	---	---	0.08	2.00	1.00	0.045	0.015	17.00-19.00	9.00-12.00	---	Ti 5 x C to 0.70	
ISO 9328-5:1991	X 6 CrNiTi 18 10	---	---	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-12.00	---	Ti 5 x C to 0.80	
ASTM A 240/A 240M-00	321H	---	S32109	---	---	0.04-0.10	2.00	0.75	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 4 x (C+N) to 0.70	
EN 10028-7:2000	X6CrNiTiB18-10	1.4941	---	---	---	0.04-0.08	2.00	1.00	0.035	0.015	17.00-19.00	9.00-12.00	---	Ti 5 x C to 0.80; B 0.0015-0.0050	
ISO 9328-5:1991	X 7 CrNiTi 18 10	---	---	---	---	0.04-0.10	2.00	1.00	0.045	0.030	17.00-19.00	9.00-12.00	---	Ti 5 x C to 0.80	
ASTM A 240/A 240M-00	347	---	S34700	---	---	0.08	2.00	0.75	0.045	0.030	17.0-19.0	9.0-13.0	---	Cb 10 x C to 1.00	
EN 10028-7:2000	X6CrNiNb18-10	1.4550	---	---	---	0.08	2.00	1.00	0.045	0.015	17.00-19.00	9.00-12.00	---	Nb 10 x C to 1.00	
ISO 9328-5:1991	X 6 CrNiNb 18 10	---	---	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-12.00	---	Nb 10 x C to 1.00	
ASTM A 240/A 240M-00	347H	---	S34709	---	---	0.04-0.10	2.00	0.75	0.045	0.030	17.0-19.0	9.0-13.0	---	Cb 8 x C to 1.00	
EN 10028-7:2000	X8CrNiNb16-13	1.4961	---	---	---	0.04-0.10	1.50	0.30-0.60	0.035	0.015	15.00-17.00	12.00-14.00	---	Nb 10 x C to 1.20	
ISO 9328-5:1991	X 7 CrNiNb 18 10	---	---	---	---	0.04-0.10	2.00	1.00	0.045	0.030	17.00-19.00	9.00-12.00	---	Nb 10 x C to 1.20	
ASTM A 240/A 240M-00	904L	---	N08904	---	---	0.020	2.00	1.00	0.045	0.035	19.0-23.0	23.0-28.0	4.0-5.0	Cu 1.0-2.0; N 0.10	
EN 10028-7:2000	X1NiCrMoCu25-20-5	1.4539	---	---	---	0.020	2.00	0.70	0.030	0.010	19.00-21.00	24.00-26.00	4.00-5.00	Cu 1.20-2.00; N 0.15	
ISO 9328-5:1991	X 2 NiCrMoCu 25 20 5	---	---	---	---	0.025	2.00	1.00	0.035	0.025	19.00-22.00	24.00-27.00	4.00-5.00	Cu 1.00-2.00	
ASTM A 240/A 240M-00	---	---	N08926	---	---	0.020	2.00	0.50	0.030	0.010	19.0-21.0	24.0-26.0	6.0-7.0	Cu 0.5-1.5; N 0.15-0.25	
EN 10028-7:2000	X1NiCrMoCuN25-20-7	1.4529	---	---	---	0.020	1.00	0.50	0.030	0.010	19.00-21.00	24.00-26.00	6.00-7.00	Cu 0.50-1.50; N 0.15-0.25	
ASTM A 240/A 240M-00	800	---	N08800	---	---	0.10	1.50	1.00	0.045	0.015	19.0-23.0	30.0-35.0	---	Cu 0.75; Ti 0.15-0.60 Al 0.15-0.60; Fe 39.5 min;	
ISO 9328-5:1991	X 7 NiCrAlTi 32 21 TQ1, 2	---	---	---	---	0.10	2.00	1.00	0.030	0.020	19.00-23.00	30.00-35.00	---	Cu 0.75; Ti 0.15-0.60; Al 0.15-0.60	
ASTM A 240/A 240M-00	800H	---	N08810	---	---	0.05-0.10	1.50	1.00	0.045	0.015	19.0-23.0	30.0-35.0	---	Cu 0.75; Ti 0.15-0.60; Al 0.15-0.60; Fe 39.5 min	
	---	---	N08811	---	---	0.06-0.10	1.50	1.00	0.040	0.015	19.0-23.0	30.0-35.0	---	Cu 0.75; Ti 0.15-0.60; Al 0.15-0.60; Fe 39.5 min	
EN 10028-7:2000	X8NiCrAlTi32-21	1.4959	---	---	---	0.05-0.10	1.50	0.70	0.015	0.010	19.00-22.00	30.00-34.00	---	Cu 0.50; Ti 0.25-0.65; N 0.030; Al 0.25-0.65; Co 0.50; Ni+Co 30.00-34.00	
ISO 9328-5:1991	X 8 NiCrAlTi 32 21 TQ1, 2	---	---	---	---	0.05-0.10	2.00	1.00	0.030	0.020	19.00-23.00	30.00-35.00	---	Cu 0.75; Ti 0.15-0.60; Al 0.15-0.60	

4.8 Austenitic Stainless 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/mm ² or MPa	ksi	N/mm ² 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	---

4.8 Austenitic Stainless Steel Pressure Vessel Plates

4.8B Mechanical Properties of Austenitic Stainless 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 240/A 240M-00	309H	---	S30909	---	---	---	205	30	515 min	75 min	40.0	---
EN 10028-7:2000	X6CrNi23-13	1.4950	---	CR St, AT	≤ 6	---	220	---	530-730	---	35	see standard
				HR St, AT	≤ 12	---	200	---	510-710			
				HR Pl, AT	≤ 75	---	200	---				
ASTM A 240/A 240M-00	310H	---	S31009	---	---	---	205	30	515 min	75 min	40.0	---
EN 10028-7:2000	X6CrNi25-20	1.4951	---	CR St, AT	≤ 6	---	220	---	530-730	---	35	see standard
				HR St, AT	≤ 12	---	200	---	510-710			
				HR Pl, AT	≤ 75	---	200	---				
ASTM A 240/A 240M-00	316	---	S31600	---	---	---	205	30	515 min	75 min	40.0	---
EN 10028-7:2000	X5CrNiMo17-12-2	1.4401	---	CR St, AT	≤ 6	---	240	---	530-680	---	40	see standard
				HR St, AT	≤ 12	---	220	---			45	
				HR Pl, AT	≤ 75	---	220	---	520-670			
	X3CrNiMo17-13-3	1.4436	---	CR St, AT	≤ 6	---	240	---	550-700	---	40	see standard
				HR St, AT	≤ 12	---	220	---				
				HR Pl, AT	≤ 75	---	220	---	530-730			
ISO 9328-5:1991	X 5 CrNiMo 17 12	---	---	Q	---	---	205	---	510-710	---	40	---
	X 5 CrNiMo 17 13	---	---	Q	---	---	205	---	510-710	---	40	---
ASTM A 240/A 240M-00	316L	---	S31603	---	---	---	170	25	485 min	70 min	40.0	---
EN 10028-7:2000	X2CrNiMo17-12-2	1.4404	---	CR St, AT	≤ 6	---	240	---	530-680	---	40	see standard
				HR St, AT	≤ 12	---	220	---			45	
				HR Pl, AT	≤ 75	---	220	---	520-670			
	X2CrNiMo17-12-3	1.4432	---	CR St, AT	≤ 6	---	240	---	550-700	---	40	see standard
				HR St, AT	≤ 12	---	220	---			45	
				HR Pl, AT	≤ 75	---	220	---	520-670			
	X2CrNiMo18-14-3	1.4435	---	CR St, AT	≤ 6	---	240	---	550-700	---	40	see standard
				HR St, AT	≤ 12	---	220	---			45	
				HR Pl, AT	≤ 75	---	220	---	520-670			
ISO 9328-5:1991	X 2 CrNiMo 17 12	---	---	Q	---	---	190	---	490-690	---	40	---
	X 2 CrNiMo 17 13	---	---	Q	---	---	190	---	490-690	---	40	---
ASTM A 240/A 240M-00	316H	---	---	---	---	---	205	30	515 min	75 min	40.0	---
ISO 9328-5:1991	X 7 CrNiMo 17 12	---	---	Q	---	---	205	---	510-710	---	40	---

4.8 Austenitic Stainless Steel Pressure Vessel Plates

4.8B Mechanical Properties of Austenitic Stainless 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 240/A 240M-00	316Ti	---	S31635	---	---	---	205	30	515 min	75 min	40.0	---
EN 10028-7:2000	X6CrNiMoTi17-12-2	1.4571	---	CR St, AT	≤ 6	---	240	---	540-690	---	40	see standard
				HR St, AT	≤ 12	---	220	---				
				HR Pl, AT	≤ 75	---	220	---	520-670	---	---	---
ISO 9328-5:1991	X 6 CrNiMoTi 17 12	---	---	Q	---	---	210	---	510-710	---	35	---
ASTM A 240/A 240M-00	316Cb	---	S31640	---	---	---	205	30	515 min	75 min	30.0	---
EN 10028-7:2000	X6CrNiMoNb17-12-2	1.4580	---	HR Pl, AT	≤ 75	---	220	---	520-720	---	40	see standard
ISO 9328-5:1991	X 6 CrNiMoNb 17 12	---	---	Q	---	---	215	---	510-710	---	30	---
ASTM A 240/A 240M-00	316LN	---	S31653	---	---	---	205	30	515 min	75 min	40.0	---
EN 10028-7:2000	X2CrNiMoN17-11-2	1.4406	---	CR St, AT	≤ 6	---	300	---	580-780	---	40	see standard
				HR St, AT	≤ 12	---	280	---				
				HR Pl, AT	≤ 75	---	280	---				
	X2CrNiMoN17-13-3	1.4429	---	CR St, AT	≤ 6	---	300	---	580-780	---	35	see standard
				HR St, AT	≤ 12	---	280	---			40	
				HR Pl, AT	≤ 75	---	280	---			---	---
ISO 9328-5:1991	X 2 CrNiMoN 17 12	---	---	Q	---	---	280	---	580-780	---	35	---
	X 2 CrNiMoN 17 13	---	---	Q	---	---	280	---	580-780	---	35	---
ASTM A 240/A 240M-00	317L	---	S31703	---	---	---	205	30	515 min	75 min	40.0	---
EN 10028-7:2000	X2CrNiMo18-15-4	1.4438	---	CR St, AT	≤ 6	---	240	---	550-700	---	35	see standard
				HR St, AT	≤ 12	---	220	---			40	
				HR Pl, AT	≤ 75	---	220	---	520-720	---	---	---
ISO 9328-5:1991	X 3 CrNiMo 18 16 4	---	---	Q	---	---	195	---	490-690	---	35	---
ASTM A 240/A 240M-00	317LN	---	S31753	---	---	---	240	35	550 min	80 min	40.0	---
EN 10028-7:2000	X2CrNiMoN18-12-4	1.4434	---	CR St, AT	≤ 6	---	290	---	570-770	---	35	see standard
				HR St, AT	≤ 12	---	270	---			40	
				HR Pl, AT	≤ 75	---	270	---	540-740	---	---	---
ASTM A 240/A 240M-00	317LMN	---	S31726	---	---	---	240	35	550 min	80 min	40.0	---
EN 10028-7:2000	X2CrNiMoN17-13-5	1.4439	---	CR St, AT	≤ 6	---	290	---	580-780	---	35	see standard
				HR St, AT	≤ 12	---	270	---			40	
				HR Pl, AT	≤ 75	---	270	---			---	---
ISO 9328-5:1991	X 2 CrNiMoN 17 13 5	---	---	Q	---	---	285	---	580-800	---	35	---

4.8 Austenitic Stainless Steel Pressure Vessel Plates

4.8B Mechanical Properties of Austenitic Stainless 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 240/A 240M-00	321	---	S32100	---	---	---	205	30	515 min	75 min	40.0	---
EN 10028-7:2000	X6CrNiTi18-10	1.4541	---	CR St, AT	≤ 6	---	220	---	520-720	---	40	see standard
				HR St, AT	≤ 12	---	200	---				
				HR Pl, AT	≤ 75	---	200	---	500-700	---	---	
ISO 9328-5:1991	X 6 CrNiTi 18 10	---	---	Q	---	---	200	---	510-710	---	35	---
ASTM A 240/A 240M-00	321H	---	S32109	---	---	---	205	30	515 min	75 min	40.0	---
EN 10028-7:2000	X6CrNiTiB18-10	1.4941	---	CR St, AT	≤ 6	---	220	---	510-710	---	40	see standard
				HR St, AT	≤ 12	---	200	---				
				HR Pl, AT	≤ 75	---	200	---	490-690	---	---	
ISO 9328-5:1991	X 7 CrNiTi 18 10	---	---	Q	---	---	175	---	490-690	---	35	---
ASTM A 240/A 240M-00	347	---	S34700	---	---	---	205	30	515 min	75 min	40.0	---
EN 10028-7:2000	X6CrNiNb18-10	1.4550	---	HR Pl, AT	≤ 75	---	200	---	500-700	---	40	see standard
ISO 9328-5:1991	X 6 CrNiNb 18 10	---	---	Q	---	---	205	---	510-710	---	30	---
ASTM A 240/A 240M-00	347H	---	S34709	---	---	---	205	30	515 min	75 min	40.0	---
EN 10028-7:2000	X8CrNiNb16-13	1.4961	---	HR Pl, AT	≤ 75	---	200	---	510-690	---	35	see standard
ISO 9328-5:1991	X 7 CrNiNb 18 10	---	---	Q	---	---	205	---	510-710	---	30	---
ASTM A 240/A 240M-00	904L	---	N08904	---	---	---	220	31	490 min	71 min	35.0	---
EN 10028-7:2000	X1NiCrMoCu25-20-5	1.4539	---	CR St, AT	≤ 6	---	240	---	530-730	---	35	see standard
				HR St, AT	≤ 12	---	220	---				
				HR Pl, AT	≤ 75	---	220	---	520-720	---	---	
ISO 9328-5:1991	X 2 NiCrMoCu 25 20 5	---	---	---	---	---	220	---	520-720	---	35	---
ASTM A 240/A 240M-00	---	---	N08926	---	---	---	295	43	650 min	94 min	35.0	---
EN 10028-7:2000	X1NiCrMoCuN25-20-7	1.4529	---	HR Pl, AT	≤ 75	---	300	---	650-850	---	40	see standard
ASTM A 240/A 240M-00	800	---	N08800	---	---	---	205	30	520 min	75 min	30.0	---
ISO 9328-5:1991	X 7 NiCrAlTi 32 21 TQ1	---	---	Q1	---	---	165	---	430-680	---	25	---
	X 7 NiCrAlTi 32 21 TQ2	---	---	Q2	---	---	210	---	500-750	---	22	---
ASTM A 240/A 240M-00	800H	---	N08810	---	---	---	170	25	450 min	65 min	30.0	---
	---	---	N08811	---	---	---	170	25	450 min	65 min	30.0	---
EN 10028-7:2000	X8NiCrAlTi32-21	1.4959	---	HR Pl, AT	≤ 75	---	170	---	500-750	---	30	see standard
ISO 9328-5:1991	X 8 NiCrAlTi 32 21 TQ1	---	---	Q1	---	---	165	---	430-680	---	25	---
	X 8 NiCrAlTi 32 21 TQ2	---	---	Q2	---	---	210	---	500-750	---	22	---

4.9 Duplex Stainless Steel Pressure Vessel Plates

4.9A Chemical Composition of Duplex (Ferritic-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	2205	---	S32205	---	---	0.030	2.00	1.00	0.030	0.020	22.0-23.0	4.5-6.5	3.0-3.5	N 0.14-0.20	
EN 10028-7:2000	X2CrNiMoN22-5-3	1.4462	---	---	---	0.030	2.00	1.00	0.035	0.015	21.00-23.00	4.50-6.50	2.50-3.50	N 0.10-0.22	
ASTM A 240/A 240M-00	2304	---	S32304	---	---	0.030	2.50	1.00	0.040	0.030	21.5-24.5	3.0-5.5	0.05-0.60	N 0.05-0.20; Cu 0.05-0.60	
EN 10028-7:2000	X2CrNiN23-4	1.4362	---	---	---	0.030	2.00	1.00	0.035	0.015	22.00-24.00	3.50-5.50	0.10-0.60	N 0.05-0.20; Cu 0.10-0.60	
ASTM A 240/A 240M-00	---	---	S32520	---	---	0.030	1.50	0.80	0.035	0.020	24.0-26.0	5.5-8.0	3.0-4.0	N 0.20-0.35; Cu 0.50-2.00	
EN 10028-7:2000	X2CrNiMoCuN25-6-3	1.4507	---	---	---	0.030	2.00	0.70	0.035	0.015	24.00-26.00	5.50-7.50	2.70-4.00	N 0.15-0.30; Cu 1.00-2.50	
ASTM A 240/A 240M-00	2507	---	S32750	---	---	0.030	1.20	0.80	0.035	0.020	24.0-26.0	6.0-8.0	3.0-5.0	N 0.24-0.32; Cu 0.50	
EN 10028-7:2000	X2CrNiMoN25-7-4	1.4410	---	---	---	0.030	2.00	1.00	0.035	0.015	24.00-26.00	6.00-8.00	3.00-4.50	N 0.20-0.35	
ASTM A 240/A 240M-00	---	---	S32760	---	---	0.030	1.00	1.00	0.030	0.010	24.0-26.0	6.0-8.0	3.0-4.0	N 0.20-0.30; Cu 0.50-1.00; W 0.50-1.00	
EN 10028-7:2000	X2CrNiMoCuWN25-7-4	1.4501	---	---	---	0.030	1.00	1.00	0.035	0.015	24.00-26.00	6.00-8.00	3.00-4.00	N 0.20-0.30; Cu 0.50-1.00; W 0.50-1.00	

4.9 Duplex Stainless Steel Pressure Vessel Plates

4.9B Mechanical Properties of Duplex (Ferritic-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/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 240/A 240M-00	2205	---	S32205	---	---	---	450	65	620 min	90 min	25.0	---
EN 10028-7:2000	X2CrNiMoN22-5-3	1.4462	---	CR St, AT	t ≤ 6; w < 300	---	465	---	660-950	---	20	see standard
					t ≤ 6; w ≥ 300	---	480	---			25	
				HR St, AT	t ≤ 12; w < 300	---	445	---			25	
					t ≤ 12; w ≥ 300	---	460	---			25	
				HR Pl, AT	t ≤ 75; w < 300	---	445	---	640-840	---	25	
					t ≤ 75; w ≥ 300	---	460	---			25	
ASTM A 240/A 240M-00	2304	---	S32304	---	---	---	400	58	600 min	87 min	25.0	---
EN 10028-7:2000	X2CrNiN23-4	1.4362	---	CR St, AT	t ≤ 6; w < 300	---	405	---	600-850	---	20	see standard
					t ≤ 6; w ≥ 300	---	420	---			25	
				HR St, AT	t ≤ 12; w < 300	---	385	---			25	
					t ≤ 12; w ≥ 300	---	400	---			25	
				HR Pl, AT	t ≤ 75; w < 300	---	385	---	630-800	---	25	
					t ≤ 75; w ≥ 300	---	400	---			25	
ASTM A 240/A 240M-00	---	---	S32520	---	---	---	550	80	770 min	112 min	25.0	---
EN 10028-7:2000	X2CrNiMoCuN25-6-3	1.4507	---	CR St, AT	t ≤ 6; w < 300	---	495	---	690-940	---	20	see standard
					t ≤ 6; w ≥ 300	---	510	---			25	
				HR St, AT	t ≤ 12; w < 300	---	475	---			25	
					t ≤ 12; w ≥ 300	---	490	---			25	
				HR Pl, AT	t ≤ 75; w < 300	---	475	---	690-890	---	25	
					t ≤ 75; w ≥ 300	---	490	---			25	
ASTM A 240/A 240M-00	2507	---	S32750	---	---	---	550	80	795 min	116 min	15.0	---
EN 10028-7:2000	X2CrNiMoN25-7-4	1.4410	---	CR St, AT	t ≤ 6; w < 300	---	535	---	750-1000	---	20	see standard
					t ≤ 6; w ≥ 300	---	550	---			25	
				HR St, AT	t ≤ 12; w < 300	---	515	---			25	
					t ≤ 12; w ≥ 300	---	530	---			25	
				HR Pl, AT	t ≤ 75; w < 300	---	515	---	730-930	---	25	
					t ≤ 75; w ≥ 300	---	530	---			25	
ASTM A 240/A 240M-00	---	---	S32760	---	---	---	550	80	750 min	108 min	25.0	---
EN 10028-7:2000	X2CrNiMoCuWN25-7-4	1.4501	---	HR Pl, AT	t ≤ 75; w < 300	---	515	---	730-930	---	25	see standard
					t ≤ 75; w ≥ 300	---	530	---			25	

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	---	---	---	---	---	---	---	---	---	---	---

4.10 Non-Comparable Pressure Vessel Carbon and Alloy Steel Standards (Continued)

ASTM A 562/A 562M-90 (1996) - Pressure Vessel Plates, Carbon Steel, Manganese-Titanium for Glass or Diffused Metallic Coatings												
Grade, Class, Type	---	---	---	---	---	---	---	---	---	---	---	---
UNS Number	---	---	---	---	---	---	---	---	---	---	---	---
ASTM A 645/A 645M-99 - Pressure Vessel Plates, Five Percent Nickel Alloy Steel, Specially Heat Treated												
Grade, Class, Type	---	---	---	---	---	---	---	---	---	---	---	---
UNS Number	K41583	---	---	---	---	---	---	---	---	---	---	---
ASTM A 724/A 734 M-99 - Pressure Vessel Plates, Carbon-Manganese-Silicon Steel, Quenched and Tempered, for Welded Layered Pressure Vessels												
Grade, Class, Type	A	B	C	---	---	---	---	---	---	---	---	---
UNS Number	K11831	K12031	K12037	---	---	---	---	---	---	---	---	---
ASTM A 734/A 734 M-87 (1997) - Pressure Vessel Plates, Alloy Steel and High-Strength Low-Alloy Steel, Quenched-and-Tempered												
Grade, Class, Type	A	B	---	---	---	---	---	---	---	---	---	---
UNS Number	K21205	K11720	---	---	---	---	---	---	---	---	---	---
ASTM A 735/A 735M-99 - Pressure Vessel Plates, Low-Carbon Manganese-Molybdenum-Columbium Alloy Steel, for Moderate and Lower Temperature Service												
Grade, Class, Type	1, 2, 3, 4	---	---	---	---	---	---	---	---	---	---	---
UNS Number	K10623	---	---	---	---	---	---	---	---	---	---	---
ASTM A 736/A 736M-88 (1994) - Pressure Vessel Plates, Low-Carbon Age-Hardening Nickel-Copper-Chromium-Molybdenum-Columbium and Nickel-Copper-Manganese-Molybdenum-Columbium Alloy Steel												
Grade, Class, Type	Gr. A Cl. 1, 2, 3	Gr. C Cl. 1, 3	---	---	---	---	---	---	---	---	---	---
UNS Number	K20747	---	---	---	---	---	---	---	---	---	---	---
ASTM A 782/A 782M-90 (1996) - Pressure-Vessel Plates Quenched-and-Tempered, Manganese-Chromium-Molybdenum-Silicon Zirconium Alloy Steel												
Grade, Class, Type	Cl. 1, 2, 3	---	---	---	---	---	---	---	---	---	---	---
UNS Number	---	---	---	---	---	---	---	---	---	---	---	---
ASTM A 832/A 832M-99 - Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum-Vanadium												
Grade, Class, Type	21V	22V	23V	---	---	---	---	---	---	---	---	---
UNS Number	K31830	K31830	K31830	---	---	---	---	---	---	---	---	---

4.10 Non-Comparable Pressure Vessel Carbon and Alloy Steel Standards (Continued)

JIS G 3115:1990 - Steel Plates for Pressure Vessels for Intermediate Temperature Service												
Symbol	SPV 410	SPV 450	SPV 490	---	---	---	---	---	---	---	---	---
Previous Symbol	SPV 42	SPV 46	SPV 50	---	---	---	---	---	---	---	---	---
JIS G 3115-1:1990 - Steel Plates for Pressure Vessels for Intermediate Temperature Service - Part 1: Thicker Plates												
Symbol	SPV 315	SPV 410	SPV 450	SPV 490	---	---	---	---	---	---	---	---
Previous Symbol	---	---	---	---	---	---	---	---	---	---	---	---
JIS G 4110:1993 - High Strength Chromium-Molybdenum Alloy Steel Plates for Pressure Vessels Under High-Temperature Service												
Symbol	SCMQ4E	SCMQ4V	SCMQ5V	---	---	---	---	---	---	---	---	---
Previous Symbol	---	---	---	---	---	---	---	---	---	---	---	---
EN 10028-2:1993 - Flat Products Made of Steels for Pressure Purposes – Part 2: Non-Alloy and Alloy Steels With a Specified Elevated Temperature Properties												
Steel Name	16 Mo 3	---	---	---	---	---	---	---	---	---	---	---
Steel Number	1.5415	---	---	---	---	---	---	---	---	---	---	---
EN 10028-3:1993 - Flat Products Made of Steels for Pressure Purposes – Part 3: Weldable Fine Grain Steels, Normalized												
Steel Name	P460N	P460NH	P460NL1	P460NL2	---	---	---	---	---	---	---	---
Steel Number	1.8905	1.8935	1.8915	1.8918	---	---	---	---	---	---	---	---
EN 10028-6:1997 - Flat Products Made of Steels for Pressure Purposes – Part 6: Weldable Fine Grain Steels, Quenched and Tempered												
Steel Name	P355Q	P355QH	P355QL1	P355QL2	P460Q	P460QH	P460QL1	P460QL2	P500Q	P500QH	P500QL1	P500QL2
Steel Number	1.8866	1.8867	1.8868	1.8869	1.8870	1.8871	1.8872	1.8864	1.8873	1.8874	1.8875	1.8865
Steel Name	P690Q	P690QH	P690QL1	P690QL2	---	---	---	---	---	---	---	---
Steel Number	1.8879	1.8880	1.8881	1.8888	---	---	---	---	---	---	---	---
ISO 9328-2:1991 - Steel Plates and Strips for Pressure Purposes – Part 2: Unalloyed and Low-Alloyed Steels with Specified Room Temperature and Elevated Temperature Properties												
Steel Type	P 355	PH 355	16 Mo 3	---	---	---	---	---	---	---	---	---
Steel Type	---	---	---	---	---	---	---	---	---	---	---	---
ISO 9328-4:1991 - Steel Plates and Strips for Pressure Purposes – Part 4: Weldable Fine Grain Steels with High Proof Stress Supplied in the Normalized or Quenched and Tempered Condition												
Steel Type	P 390 TN	PH 390 TN	PL 390 TN	PLH 390 TN	P 420 TN	PH 420 TN	PL 420 TN	PLH 420 TN	P 460 TN	PH 460 TN	PL 460 TN	PLH 460 TN
Steel Type	P 460 TQ	PH 460 TQ	PL 460 TQ	PLH 460 TQ	P 500 TQ	PH 500 TQ	PL 500 TQ	PLH 500 TQ	P 550 TQ	PH 550 TQ	PL 550 TQ	PLH 550 TQ
Steel Type	P 620 TQ	PH 620 TQ	PL 620 TQ	PLH 620 TQ	P 690 TQ	PH 690 TQ	PL 690 TQ	PLH 690 TQ	---	---	---	---

4.11 Non-Comparable Pressure Vessel Stainless Steel Standards

ASTM A 240/A 240M-00 Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels (Non-Comparable)													
Grade, Class, Type	---	409	409	409	---	---	410	---	410S	---	---	---	429
UNS Number	S32803	S40910	S40920	S40930	S40945	S40977	S41000	S41003	S41008	S41045	S41050	S42035	S42900
Grade, Class, Type	430	434	436	---	XM-33	XM-27	---	---	---	---	---	---	---
UNS Number	S43000	S43400	S43600	S44500	S44626	S44627	S44635	S44660	S44700	S44735	S44800	S46800	---
Grade, Class, Type	---	---	201	---	---	---	202	---	XM-19	XM-31	XM-17	XM-18	---
UNS Number	N08020	N08367	S20100	S20103	S20153	S20161	S20200	S20400	S20910	S21400	S21600	S21603	S21800
Grade, Class, Type	XM-29	301	301L	302	---	XM-21	305	---	---	---	---	309S	309Cb
UNS Number	S24000	S30100	S30103	S30200	S30415	S30452	S30500	S30600	S30601	S30615	S30815	S30908	S30940
Grade, Class, Type	309HCB	310S	310Cb	310HCB	310MoLN	---	---	316N	317	317LM	---	---	---
UNS Number	S30941	S31008	S31040	S31041	S31050	S31254	S31266	S31651	S31700	S31725	S32050	S32615	S32654
Grade, Class, Type	---	334	---	348	348H	---	---	---	XM-15	---	---	---	---
UNS Number	S33228	S33400	S34565	S34800	S34809	S35045	S35135	S35315	S38100	---	---	---	S31200
Grade, Class, Type	---	---	---	255	329	---	---	---	---	---	---	---	---
UNS Number	S31260	S31803	S32001	S32550	S32900	S32950	---	---	---	---	---	---	---
EN 10028-7:2000 Flat Products Made of Steels for Pressure Purposes – Part 7: Stainless Steels													
Steel Name	X1CrNiMoN25-22-2	X4CrNiMo16-5-1	X1CrNiMoCuN25-25-5	X1CrNiMoCuN20-18-7	X3CrNiMoBN17-13-3	X1NiCrMoCu31-27-4	X5NiCrAlTi31-20 (+RA)		X1CrNi25-21				
Steel Number	1.4466	1.4418	1.4537	1.4547	1.4910	1.4563	1.4958 (+RA)		1.4335				
Steel Name	X2CrTi17	---	---	---	---	---	---		---				
Steel Number	1.4520	---	---	---	---	---	---		---				
ISO 9328-5:1991 Steel Plates and Strips for Pressure Purposes – Technical Delivery Conditions – Part 5: Austenitic Steels													
Steel Type	X 7 CrNiMoB 17 12	---	---	---	---	---	---		---		---		

CHAPTER
5

STEEL TUBES AND PIPES

ASTM Standards

ASTM A 53/A 53M-99	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 106-99	Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A 135-97	Electric-Resistance-Welded Steel Pipe
ASTM A 139-00	Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over)
ASTM A 178/A 178M-95	Electric-Resistance-Welded Carbon Steel and Carbon-Manganese Steel Boiler and Superheater Tubes <i>Note: Mechanical properties data are supplementary requirements, provided for information only.</i>
ASTM A 179/A 179M-90 (1996)	Seamless Cold-Drawn Low-Carbon Steel Heat-Exchanger and Condenser Tubes <i>Note: Mechanical properties data are supplementary requirements, provided for information only.</i>
ASTM A 192-96	Seamless Carbon Steel Boiler Tubes for High-Pressure Service <i>Note: Mechanical properties data are supplementary requirements, provided for information only.</i>
ASTM A 209-98	Seamless Carbon-Molybdenum Alloy-Steel Boiler and Superheater Tubes
ASTM A 210/A 210M-96	Seamless Medium-Carbon Steel Boiler and Superheater Tubes
ASTM A 213/A 213M-99	Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater, and Heat-Exchanger Tubes
ASTM A 214/A 214M-96	Electric-Resistance-Welded Carbon Steel Heat-Exchanger and Condenser Tubes
ASTM A 249/A 249M-98	Welded Austenitic Steel Boiler, Superheater, Heat-Exchanger, and Condenser Tubes
ASTM A 250/A 250M-95	Electric-Resistance-Welded Ferritic Alloy-Steel Boiler and Superheater Tubes
ASTM A 268/A 268M-00	Seamless and Welded Ferritic and Martensitic Stainless Steel Tubing for General Service
ASTM A 269-01	Seamless and Welded Austenitic Stainless Steel Tubing for General Service
ASTM A 312/A 312M-00	Seamless and Welded Austenitic Stainless Steel Pipes
ASTM A 333/A 333M-99	Seamless and Welded Steel Pipe for Low-Temperature Service
ASTM A 334/A 334M-99	Seamless and Welded Carbon and Alloy-Steel Tubes for Low-Temperature Service
ASTM A 335/A 335M-99	Seamless Ferritic Alloy-steel Pipe for High-Temperature Service
ASTM A 358/A 358M-98	Electric-Fusion-Welded Austenitic Chromium-Nickel Alloy Steel Pipe for High-Temperature Service
ASTM A 376/A 376M-98	Seamless Austenitic Steel Pipe for High-Temperature Central-Station Service
ASTM A 409/A 409M-95	Welded Large Diameter Austenitic Steel Pipe for Corrosive or High-Temperature Service
ASTM A 500-99	Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 501-99	Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A 511-96	Seamless Stainless Steel Mechanical Tubing <i>Note: Mechanical properties data are supplementary requirements, provided for information only.</i>
ASTM A 512-96	Cold-Drawn Buttweld Carbon Steel Mechanical Tubing <i>Note: Mechanical properties data are supplementary requirements, provided for information only.</i>
ASTM A 513-00	Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing <i>Note: Mechanical properties data are supplementary requirements, provided for information only.</i>
ASTM A 519-96	Seamless Carbon and Alloy Steel Mechanical Tubing <i>Note: Mechanical properties data are supplementary requirements, provided for information only. Data are "typical" values.</i>
ASTM A 554-98	Welded Stainless Steel Mechanical Tubing <i>Note: Mechanical properties data are supplementary requirements, provided for information only.</i>
ASTM A 556/A 556M-96	Seamless Cold-Drawn Carbon Steel Feedwater Heater Tubes
ASTM A 595-98	Steel Tubes, Low-Carbon, Tapered for Structural Use
ASTM A 632-98	Seamless and Welded Austenitic Stainless Steel Tubing (Small-Diameter) for General Service
ASTM A 688/A 688M-00	Welded Austenitic Stainless Steel Feedwater Heater Tubes
ASTM A 778-00	Welded, Unannealed Austenitic Stainless Steel Tubular Products

ASTM Standards (Continued)

ASTM A 803/A 803M-98	Welded Ferritic Stainless Steel Feedwater Heater Tubes
ASTM A 851-96	High-Frequency Induction Welded, Unannealed, Austenitic Steel Condenser Tubes
ASTM A 984/A 984M-00	Steel Line Pipe, Black, Plain-End, Electric-Resistance-Welded
ASTM A 1005/A 1005M-00	Steel Line Pipe, Black, Plain End, Longitudinal and Helical Seam, Double Submerged-Arc Welded

SAE Standard

SAE J526 FEB96	Welded Low-Carbon Steel Tubing
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API Standard

API 5L - 2000	Specification for Line Pipe
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CSA Standard

CSA Z245.1 - 2000	Steel Line Pipe
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JIS Standards

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

BSI Standards

BSI BS 1717:1983	Steel Tubes for Cycle and Motor Cycle Purposes
BSI BS 3059-1:1987	Steel Boiler and Superheater Tubes - Part 1 - Specification for Low Tensile Carbon Steel Tubes Without Specified Elevated Temperature Properties
BSI BS 3059-2:1990	Steel Boiler and Superheater Tubes - Part 2 - Specification for Carbon, Alloy and Austenitic Stainless Steel Tubes with Specified Elevated Temperature Properties
BSI BS 3601:1987	Carbon Steel Pipes and Tubes with Specified Room Temperature Properties for Pressure Purposes
BSI BS 3602-1:1987	Steel Pipes and Tubes for Pressure Purposes: Carbon and Carbon Manganese Steel with Specified Elevated Temperature Properties. Part 1. Specification for Seamless and Electric Resistance Welded Including Induction Welded Tubes
BSI BS 3602-2:1991	Specification for Steel Pipes and Tubes for Pressure Purposes: Carbon and Carbon Manganese Steel with Specified Elevated Temperature Properties - Specification for Longitudinally Arc Welded Tubes
BSI BS 3603:1991	Carbon and Alloy Steel Pipes and Tubes with Specified Low Temperature Properties for Pressure Purposes
BSI BS 3604-1:1990	Steel Pipes and Tubes for Pressure Purposes: Ferritic Alloy Steel with Specified Elevated Temperature Properties Part 1. Specification for Seamless and Electric Resistance Welded Tubes
BSI BS 3604-2:1991	Steel Pipes and Tubes for Pressure Purposes: Ferritic Alloy Steel with Specified Elevated Temperature Properties - Specification for Longitudinally Arc Welded Tubes

BSI Standards (Continued)

BSI BS 3605-1:1991	Austenitic Stainless Steel Pipes and Tubes for Pressure Purposes. Part 1. Specification for Seamless Tubes
BSI BS 3605-2:1992	Austenitic Stainless Steel Pipes and Tubes for Pressure Purposes. Part 2. Specification for Longitudinally Welded Tubes
BSI BS 3606:1992	Steel Tubes for Heat Exchangers
BSI BS 6323-2:1982	Seamless and Welded Steel Tubes for Automobile, Mechanical and General Engineering Purposes Part 2: Specific Requirements for Hot Finished Welded Steel Tubes
BSI BS 6323-3:1982	Seamless and Welded Steel Tubes for Automobile, Mechanical and General Engineering Purposes Part 3: Specific Requirements for Hot Finished Seamless Steel Tubes
BSI BS 6323-4:1982	Seamless and Welded Steel Tubes for Automobile, Mechanical and General Engineering Purposes Part 4: Specific Requirements for Cold Finished Seamless Steel Tubes
BSI BS 6323-5:1982	Seamless and Welded Steel Tubes for Automobile, Mechanical and General Engineering Purposes Part 5: Specific Requirements for Electric Resistance Welded (Including Induction Welded) Steel Tubes
BSI BS 6323-6:1982	Seamless and Welded Steel Tubes for Automobile, Mechanical and General Engineering Purposes Part 6: Specific Requirements for Cold Finished Electric Resistance Welded (Including Induction Welded) Steel Tubes
BSI BS 6323-7:1982	Seamless and Welded Steel Tubes for Automobile, Mechanical and General Engineering Purposes Part 7: Specific Requirements for Submerged Arc Welded Steel Tubes
BSI BS 6323-8:1982	Seamless and Welded Steel Tubes for Automobile, Mechanical and General Engineering Purposes Part 8: Specific Requirements for Longitudinally Welded Stainless Steel Tubes

DIN Standards

DIN 1615:1984	Welded Circular Unalloyed Steel Tubes Not Subject to Special Requirements
DIN 1626:1984	Welded Circular Unalloyed Steel Tubes Subject to Special Requirements
DIN 1628:1984	High Performance Welded Circular Unalloyed Steel Tubes; Technical Delivery Conditions
DIN 1629:1984	Seamless Circular Unalloyed Steel Tubes Subject to Special Requirements
DIN 1630:1984	High performance seamless circular unalloyed steel tubes
DIN 17173:1985	Seamless Circular Tubes Made from Steels with Low Temperature Toughness
DIN 17174:1985	Welded Circular Tubes made From Steels with Low Temperature Toughness
DIN 17175:1979	Seamless Tubes of Heat-Resistant Steels
DIN 17177:1979	Electric Pressure-welded Steel Tubes for Elevated Temperatures
DIN 17178:1986	Welded Circular Fine Grain Steel Tubes Subject to Special Requirements; Technical Delivery Conditions
DIN 17179:1986	Seamless Circular Fine Grain Steel Tubes Subject to Special Requirements; Technical Delivery Conditions
DIN 17204:1990	Seamless Circular Tubes Made from Steels for Quenching and Tempering; Technical Delivery Conditions
DIN 17455:1985	General Purpose Welded Circular Stainless Steel Tubes - Technical Delivery Conditions
DIN 17456:1985	General Purpose Seamless Circular Stainless Steel Tubes - Technical Delivery Conditions
DIN 17457:1985	Welded Circular Austenitic Stainless Steel Tubes Subject to Special Requirements - Technical Delivery Conditions
DIN 17458:1985	Seamless Circular Austenitic Stainless Steel Tubes Subject to Special Requirements - Technical Delivery Conditions
DIN 17459:1992	Seamless Circular High-Temperature Austenitic Steel Tubes - Technical Delivery Conditions
DIN 2391-2:1994	Seamless Precision Steel Tubes
DIN 2393-2:1994	Welded Precision Steel Tubes
DIN 2394-2:1994	Welded and Sized Precision Steel Tubes - Technical Delivery Conditions
DIN 28180:1985	Seamless Steel Tubes for Tubular Heat Exchangers; Dimensions, Dimensional Deviations and Materials
DIN 28181:1985	Welded Steel Tubes for Tubular Heat Exchangers; Dimensions, Dimensional Deviations and Materials

AFNOR Standards

AFNOR NF A 49-111:1978	Plain End Seamless Tubes of Commercial Quality for General Purposes at Mean Pressure
AFNOR NF A 49-112:1987	Plain End Seamless Hot Rolled Tubes with Specified Room Temperature Properties and with Special Delivery Conditions - Dimensions - Technical Delivery Conditions
AFNOR NF A 49-141:1978	Welded Plain End Tubes of Commercial Quality for General Purposes at Mean Pressure Dimensions - Technical Delivery Conditions
AFNOR NF A 49-142:1987	Longitudinally Pressure Welded Plain Ended and Hot Finished Tubes. Diameters From 13,5 to 168,3 mm with Specified Room Temperature Properties and with Special Delivery Conditions - Dimensions - Technical Delivery Conditions
AFNOR NF A 49-213:1990	Seamless Unalloyed and Mo and Cr-Mo Alloyed Steel Tubes for Use at High Temperatures - Dimensions (With Normal Tolerances) - Technical Delivery Conditions
AFNOR NF A 49-214:1978	Seamless Austenitic Steel Tubes for Use at High Temperatures. Dimensions (With Normal Tolerances) - Technical Conditions of Delivery
AFNOR NF A 49-215:1981	Seamless Tubes for Ferritic Non Alloy and Alloy Steel Heat Exchangers Dimensions - Technical Delivery Conditions
AFNOR NF A 49-217:1987	Seamless Tubes for Heat Exchangers - Stainless Ferritic, Austenitic or Ferritic-Austenitic Steel Grades Dimensions - Technical Delivery Conditions

AFNOR Standards (Continued)

AFNOR NF A 49-219:1990	Non-Alloy and Mo and Cr-Mo Alloy Steel Seamless Tubes for Furnaces - Dimensions - Technical Delivery Conditions
AFNOR NF A 49-220:1990	Grooved Seamless Steel Tubes for Use at High Temperature - Dimensions - Technical Delivery Conditions
AFNOR NF A 49-242:1985	Longitudinally Pressure Welded Tubes D Inferior or Equal to 168,3 mm in Non Alloyed and Low Alloyed Steels Used at Medium Elevated Temperatures - Dimensions - Technical Delivery Conditions
AFNOR NF A 49-243:1985	Longitudinally Pressure Welded Tubes D Inferior or Equal to 168,3 mm in Non Alloyed and Ferritic Alloyed Steels, Used at Elevated Temperatures - Dimensions - Technical Delivery Conditions
AFNOR NF A 49-244:1993	Welded Austenitic Stainless and Austenitic Ferritic Steel Rolled Tubes for Pressure Service - Dimensions, Technical Conditions for Delivery
AFNOR NF A 49-245:1986	Longitudinally Pressure Welded Tubes from Non Alloy and Ferritic Alloy Steels for Heat Exchangers in Diameters from 15.9 mm and 76.1 mm inclusive - Dimensions - Technical Delivery Conditions
AFNOR NF A 49-247:1981	Tubes Welded Longitudinally for Heat Exchangers - Austenitic Stainless Steels Dimensions - Technical Delivery Conditions
AFNOR NF A 49-250:1979	Welded Plain End Tubes of Commercial Quality with or without Special Delivery Conditions Dimensions (D Superior or Equal to 168.3 mm) - Technical Delivery Conditions
AFNOR NF A 49-252:1982	Welded Non Alloy Steel Tubes of Diameters 168,3 mm to 1220 mm Used at Averagely Elevated Temperatures. Dimensions - Technical Delivery Conditions
AFNOR NF A 49-253:1982	Longitudinally Fusion Welded Non Alloy Steel and Ferritic Alloy Steel Tubes for Use at Elevated Temperatures - Dimensions - Technical Delivery Conditions
AFNOR NF A 49-310:1994	Seamless Precision Tubes for Mechanical Application Dimensions - Technical Delivery Conditions
AFNOR NF A 49-311:1974	Seamless Tubes for Mechanical Application Dimensions - Technical Delivery Conditions
AFNOR NF A 49-317:1980	Seamless Plain End Tubes for Engineering Use. Austenitic Stainless Steels Dimensions - Technical Delivery Conditions
AFNOR NF A 49-341:1975	Precision Welded Tubes for Mechanical Application Dimensions. Technical Delivery Conditions
AFNOR NF A 49-343:1980	Longitudinally Welded D Inferior or Equal to 168.3 mm for Engineering Use Dimensions - Technical Delivery Conditions
AFNOR NF A 49-647:1979	Structural Welded Tubes, Circular, Square, Rectangular or Oval, in Ferritic or Austenitic Stainless Steels Dimensions - Technical Delivery Conditions

CEN Standards

EN 10208-1:1998	Steel Pipes for Pipelines for Combustible Fluids. Technical Delivery Conditions. Part 1 : Pipes of Requirement Class A
EN 10208-2:1996	Steel Pipes for Pipelines for Combustible Fluids. Technical Delivery Conditions. Part 2 : Pipes of Requirement Class B

ISO Standards

ISO 2604-II:1975	Steel Products for Pressure Purposes - Quality Requirements - Part 2 - Wrought Seamless Tubes
ISO 2604-III:1975	Steel Products for Pressure Purposes - Quality Requirements - Part 3 - Electric Resistance and Induction-Welded Tubes
ISO 2604-V:1978	Steel Products for Pressure Purposes - Quality Requirements - Part 5: Longitudinally Welded Austenitic Stainless Steel Tubes
ISO 2937:1974	Plain End Seamless Steel Tubes for Mechanical Application
ISO 3183-1:1996	Steel Pipe for Pipelines -- Technical Delivery Conditions -- Part 1: Pipes of Requirement Class A
ISO 3183-2:1996	Steel Pipe for Pipelines -- Technical Delivery Conditions -- Part 2: Pipes of Requirements Class B
ISO 3304:1985	Plain End Seamless Precision Steel Tubes - Technical Conditions for Delivery
ISO 3305:1985	Plain End Welded Precision Steel Tubes - Technical Conditions for Delivery
ISO 3306:1985	Plain End As-Welded and Sized Precision Steel Tubes - Technical Conditions for Delivery
ISO 9329-3:1997	Seamless Steel Tubes for Pressure Purposes. Technical Delivery Conditions Part 3: Unalloyed and Alloyed Steels with Specified Low Temperature Properties
ISO 9330-3:1997	Welded Steel Tubes for Pressure Purposes. Technical Delivery Conditions. Part 3 : Electric Resistance and Induction Welded Unalloyed and Alloyed Steel Tubes with Specified Low Temperature Properties
ISO 9330-5:2000	Welded Steel Tubes for Pressure Purposes - Technical Delivery Conditions Part 5: Submerged Arc-Welded Unalloyed and Alloyed Steel Tubes with Specified Low Temperature Properties

Heat Treatment Terms Applicable to this Chapter

5.1 Tubes for General and Structural Applications

Standard	Heat Treatment Terms
AFNOR NF A 49-111:1978	HR: hot rolled
AFNOR NF A 49-141:1978	HR: hot rolled; CFT: cold finished and tempered
AFNOR NF A 49-250:1979	AM: as manufactured
AFNOR NF A 49-310:1994	BK: cold worked, hard; BK+S: cold worked hard and stress relieved; BKW: cold worked, soft; GBK: annealed; NBK: normalized
AFNOR NF A 49-311:1974	AM: as manufactured
AFNOR NF A 49-317:1980	HQ: hyperquenched
AFNOR NF A 49-341:1975	BK: cold worked, hard; BKW: cold worked, soft; traite
AFNOR NF A 49-343:1980	HW: hot worked; CW+N: cold worked and normalized
AFNOR NF A 49-647:1979	AM: as manufactured
ASTM A 268/A 268M-00	HT: heat treat
ASTM A 269-01	HT: heat treat
ASTM A 500-99	CF: cold formed; SR: stress relieved; A: annealed; HT: heat treated
ASTM A 501-99	HF: hot formed
ASTM A 511-96	A: annealed
ASTM A 512-96	SA: soft-annealed; SR A: stress relief annealed
ASTM A 513-00	AW: as-welded; N: normalized; SD: sink-drawn; MD: mandrel-drawn; MD SR: mandrel-drawn stress-relieved
ASTM A 519-96	HR: hot rolled; CW: cold worked; SR: stress relieved; A: annealed; N: normalized
ASTM A 554-98	A: annealed
ASTM A 595-98	RCCM: roll compressed cold on a mandrel
ASTM A 632-98	HT: heat treat
ASTM A 778-00	AM: as manufacture
BSI BS 1717:1983	BK: cold finished, hard; KM1, KM2 (AW): as welded; GBK, GKM1, GKM2 (A): annealed; NBK, NKM1, NKM2 (N):normalized
BSI BS 6323-2:1982	HF: hot finished
BSI BS 6323-3:1982	HF: hot finished
BSI BS 6323-4:1982	BK: cold finished, hard; BKW: cold finished, soft; GBK and GZF (A): annealed; NKM and NZF (N): normalized
BSI BS 6323-5:1982	KM: as welded; GKM and GZF (A): annealed; NKM and NZF (N): normalized
BSI BS 6323-6:1982	BK: cold finished, hard; BKW: cold finished, soft; GBK and GZF (A): annealed; NKM and NZF (N): normalized
BSI BS 6323-7:1982	AW: as welded; HS: hot sized; CS: cold sized
BSI BS 6323-8:1982	KM: as welded
DIN 1615:1984	AD: as delivered
DIN 2391-2:1994	BK: cold finished, hard; BKW: cold finished, soft; BKS: cold finished and stress-relieved; GBK (A): annealed; NBK (N): normalized
DIN 2393-2:1994	BK: cold finished, hard; BKW: cold finished, soft; BKS: cold finished and stress-relieved; GBK (A): annealed; NBK (N): normalized
DIN 2394-2:1994	BKM: welded and sized; GBK (A): annealed; NBK (N): normalized
DIN 17204:1990	Hot formed: U: not heat treated; G: annealed; N: normalized; QT (V): quenched and tempered Cold formed: BK: bright drawn; GBK: annealed; NBK: normalized; QT (V): quenched and tempered
DIN 17455:1985	A: annealed; SA+Q: solution annealed and quenched
DIN 17456:1985	A: annealed; SA+Q: solution annealed and quenched; SA+Q (HW):solution annealed and quenched, suitable for hot worked tubes
ISO 2937:1974	HF: hot finished
ISO 3304:1985	BK: cold-finished, as drawn; BKW: lightly cold-worked condition; GBK and GZF (A): annealed; NBK and NZF (N): normalized
ISO 3305:1985	BK: cold-finished, as drawn; BKW: lightly cold-worked condition; GBK and GZF (A): annealed; NBK and NZF (N): normalized
ISO 3306:1985	KM: as-welded and sized; GKM and GZF (A): annealed; NKM and NZF (N): normalized
JIS G 3441:1988	AM: as manufactured; CF: cold finished; A: annealed
JIS G 3444:1994	AM: as manufactured

Heat Treatment Terms Applicable to this Chapter(Continued)

5.1 Tubes for General and Structural Applications (Continued)

Standard	Heat Treatment Terms
JIS G 3445:1988	AM: as manufactured; CF: cold formed; AHT: appropriate heat treatment
JIS G 3446:1994	ST: solution treatment; AM: as manufactured; A: annealed
JIS G 3472:1988	See standard
JIS G 3473:1988	AM: as manufactured; CF, SR: cold formed and stress relieved
JIS G 3474:1995	AM: as manufactured
SAE J526 FEB96	See standard

5.2 Tubes for Heat Transfer Applications

Standard	Heat Treatment Terms
AFNOR NF A 49-215:1981	N: normalized; Heat; Heat + T: heat + tempered; heat + slow cool; Heat + air cool + T: heat + air cool + tempered
AFNOR NF A 49-217:1987	HF + CR + T: hot formed + cold rolled + tempered; HF + CR +Q (HY): hot formed + cold rolled + hyperquenched
AFNOR NF A 49-245:1986	N: normalized; HF: hot finished, air cooled; HF + T: hot finished, air cooled + tempered; H: heat
AFNOR NF A 49-247:1981	Q (HY): hyperquenched
ASTM A 178/A 178M-95	See standard
ASTM A 179/A 179M-90 (1996)	CD + 1200°F min: cold drawn + heat treated at 1200°F or higher
ASTM A 192-96	HF: hot finished; CF + 1200°F min: cold finished + heat treated at 1200°F or higher
ASTM A 209-98	See standard
ASTM A 210/A 210M-96	HF: hot finished; cf: cold finished; SA: subcritical anneal; A: full anneal; N: normalizing
ASTM A 213/A 213M-99	A: annealed; IA: isothermal annealed; NT: normalized and tempered
ASTM A 214/A 214M-96	See standard
ASTM A 249/A 249M-98	H + RC: heat + rapid cool; ST: solution treated; H + WQ or RC: heat + water quench or rapid cool
ASTM A 250/A 250M-95	A: full annealed; IA: isothermal annealed; N: normalized; NT: normalized and tempered
ASTM A 556/A 556M-96	CD + 1200°F min: cold drawn + heat treated to 1200°F or higher
ASTM A 688/A 688M-00	SA: solution-annealed
ASTM A 803/A 803M-98	SA: solution-annealed
ASTM A 851-96	H + WQ or RC: heat + water quench or rapid cool
BSI BS 3059-1:1987	See standard
BSI BS 3059-2:1990	N: normalized; S: seamless; NT: normalized and tempered; A: annealed; ST: solution treated
BSI BS 3606: 1992	N: normalized; N+T: normalized and tempered; A: annealed; ST: solution treated
DIN 28180:1985	N: normalized; V (QT): quenched and tempered; see standard; SA & Q: solution annealed and quenched
DIN 28181:1985	N: normalized; NG: normalized starting product, weld only normalized; AD: as delivered; see standard; SA & Q: solution annealed and quenched
ISO 2604-2:1975	HF: hot finished; SCA: subcritical annealed; A: annealed; N: normalized; T: tempered; Q: quenched
ISO 2604-3:1975	A: annealed; HR: hot-reduced; N: normalized; SCA: subcritical annealed; T: tempered; W: welded
ISO 2604-5:1978	Q: quenched
JIS G 3461:1988	See standard
JIS G 3462:1988	LTA: low temperature annealing; IA: isothermal annealing; A: full annealing; N: normalizing; NT: normalizing and tempering
JIS G 3463:1994	A: annealed; ST: solution treatment
JIS G 3467:1988	HFS: hot finished seamless; CFS: cold finished seamless; AM: as manufactured; LTA: low temperature annealing; IA: isothermal annealing; A: full annealing; N: normalizing; NT: normalizing and tempering; ST: solution treatment;

Heat Treatment Terms Applicable to this Chapter(Continued)**5.3 Tubes for Low Temperature Service**

Standard	Heat Treatment Terms
AFNOR NF A 49-215:1981	N: normalized; NT: normalized and tempered; WQT: water quenched + tempered
AFNOR NF A 49-245:1986	N: normalized; NT: normalized and tempered
ASTM A 334/A 334M-99	N: normalized; NT: normalized and tempered; QT: quenched and tempered; NNT: double normalized and tempered
BSI BS 3603: 1991	HF: hot finished; N: normalized; NT: normalized and tempered; QT: quenched and tempered; N1N2T: normalized + normalized +tempered
DIN 17173:1985	N: normalized; V: quenched and tempered
DIN 17174:1985	N: normalized; NG: normalized starting product, weld only normalized; V: quenched and tempered
ISO 9329-3:1997	N: normalized; QT: quenched and tempered
ISO 9330-3:1997	N: normalizing; QT: quenching and tempering
ISO 9330-5:2000	N: normalizing; QT: quenching and tempering
JIS G 3464:1988	N: normalizing; NT: normalizing and tempering; NNT: double normalizing and tempering; QT: quenching and tempering

5.4 Tubes and Pipes for Pressure Service

Standard	Heat Treatment Terms
ASTM A 53/A 53M-99b	AM: as manufactured; T: tempered
ASTM A 106-99	HF: hot finished; CD + 1200°F min: cold drawn + heat treated at 1200°F or higher
ASTM A 135-97c	AM: as manufactured; T: tempered
ASTM A 139-00	See standard
ASTM A 312/A 312M-00	HF: hot finished; CF: cold finished; A: annealed
ASTM A 333/A 333M-99	See standard; QT: quenched and tempered; NNT: double normalized and tempered;
ASTM A 335/A 335M-99	FA: full annealed; IA: isothermal annealed; NT: normalized and tempered
ASTM A 358/A 358M-98	H: heat at specified temperature and water quench or rapid cool; HT: a final heat treatment temperature under 1900°F; HT-O: no final heat treatment of pipe fabricated of plate that has been solution treated at temperatures required by this specification; HT-SO: No final heat treatment of pipe fabricated of plate that has not been heat treated
ASTM A 376/A 376M-98	See standard
ASTM A 409/A 409M-95a	H: heat at specified temperature and water quench or rapid cool; HT: a final heat treatment temperature under 1900°F; HT-O: no final heat treatment of pipe fabricated of plate that has been solution treated at temperatures required by this specification; HT-SO: No final heat treatment of pipe fabricated of plate that has not been heat treated
BS 1387:1985	See standard
BS 3601: 1987	See standard
BS 3602-1: 1987	HF: hot finished; CF: cold finished; N: normalized; S: seamless; AW: as welded
BS 3602-2:1991	AW: as welded; W + SR: welded + stress relieved; W + N: welded + normalized
BS 3604-1: 1990	NT: normalized and tempered; A: annealed
BS 3604-2:1991	See standard
BS 3605-1: 1991	ST: solution treated; HF: hot finished
BS 3605-2: 1992	AW: as welded; ST: solution treated
DIN 1615:1984	AD: as delivered
DIN 1626:1984	See standard
DIN 1628:1984	AD: as delivered
DIN 1629:1984	See standard
DIN 1630:1984	AD: as delivered
DIN 17175:1979	See standard
DIN 17177:1979	AD: as delivered
DIN 17178:1986	N: normalized;
DIN 17457:1985	SA & Q: solution annealed and quenched
DIN 17458:1985	SA & Q: solution annealed and quenched
DIN 17459:1992	SHT: solution heat treated; A/R: annealed for recrystallization
JIS G 3452: 1997	AM: as manufactured; CF + A: cold finished and annealed

Heat Treatment Terms Applicable to this Chapter(Continued)

5.4 Tubes and Pipes for Pressure Service (Continued)

Standard	Heat Treatment Terms
JIS G 3454: 1988	AM: as manufactured; CF + A: cold finished and annealed
JIS G 3455: 1988	HFS: AM: hot-finished seamless: as manufactured; CFS: LTA or N: cold-finished seamless: low temperature annealed or normalized
JIS G 3456: 1988	See standard
JIS G 3457: 1988	As welded or as cold expanded
JIS G 3458: 1988	LTA: low temperature annealing; IA: isothermal annealing; FA: full annealing; N: normalized; NT: normalized and tempered
JIS G 3459: 1997	ST: solution treatment; CF: cold finished; HF: hot finished
JIS G 3460: 1988	N: normalized; NT: normalized and tempered; N1N2T: double normalized and tempered; QT: quenched and tempered
JIS G 3468: 1994	AM: as manufactured
NF A 49-112:1987	See standard
NF A 49-142:1987	HF: hot finished; CF + N: cold finished + normalized
NF A 49-213:1990	N: normalized; SR: stress relieved; T: tempered
NF A 49-214:1978	L: hot finished; F: cold finished; H + RC: heat + rapid cool
NF A 49-219:1990	N: normalized; T: tempered
NF A 49-220:1990	N: normalized; T: tempered
NF A 49-242:1985	See standard
NF A 49-243:1985	N: normalized; T: tempered
NF A 49-244:1993	ST: no thermal treatment; TT: with thermal treatment
NF A 49-252:1982	See standard
NF A 49-253:1982	N: normalized;; NT: normalized and tempered

5.5 Line Pipe Steels

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

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	---	---	---	170	---	290	---	14	65 HR30T max
			G10100									
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

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
DIN 2393-2:1994	RSt 34-2	1.0034	---	GBK	---	---	---	---	300	---	28	---
DIN 2394-2:1994	RSt 34-2	1.0034	---	GBK	---	---	---	---	300	---	28	---
ISO 3306:1985	R28	---	---	KM	---	---	---	---	300	---	10	---
BSI 1717:1983	ERW C2	---	---	GKM	---	---	160	---	300	---	27	---
BSI BS 6323-5: 1982 AMD 2:1989	ERW 2	---	---	GKM & GZF	---	---	160	---	300	---	27	---
BSI BS 6323-6:1982 AMD 2:1989	CEW 2	---	---	GBK & GZF	---	---	160	---	300	---	27	---
AFNOR	TS 30-0	---	---	A or N	---	---	180	---	300	---	25	---
NF A 49-341:1975	TS 30-a	---	---	A or N	---	---	190	---	310	---	30	---
BSI BS 6323-5:1982 AMD 2:1989	ERW 1	---	---	KM	≤ 20 D/a	---	200	---	300	---	10	---
					> 20 D/a	---	200	---	300	---	20	---
BSI BS 1717:1983	ERW C1	---	---	AW (KM1, KM2)	≤ 20 D/a	---	200	---	300	---	10	---
					> 20 D/a	---	200	---	300	---	20	---
DIN 2394-2:1994	RSt 34-2	1.0034	---	NBK	---	---	205	---	310-410	---	28	---
DIN 2393-2:1994	RSt 34-2	1.0034	---	NBK	---	---	205	---	310-410	---	28	---
ASTM A 513-00*	1015	---	G10150	N	---	---	207	30	310	45	30	70 HRB max
	1010	---	G10100	AW	---	---	221	32	310	45	15	55 HRB min
ASTM A 500-99	A	---	K03000	CF, SR, A	---	---	228	33	310	45	25	---
DIN 2393-2:1994	RSt 37-2	1.0038	---	GBK	---	---	---	---	315	---	25	---
DIN 2391-2:1994	St 35	1.0308	---	GBK	---	---	---	---	315	---	25	---
DIN 2394-2:1994	RSt 37-2	1.0038	---	GBK	---	---	---	---	315	---	25	---
AFNOR NF A 49-341:1975	TS 30-0	---	---	BKW	---	---	---	---	320	---	9	---
ISO 3304:1985	R33	---	---	GBK & GZF	---	---	---	---	320	---	27	---
ISO 3305:1985	R33	---	---	GBK & GZF	---	---	---	---	320	---	27	---
ISO 3306:1985	R33	---	---	GKM & GZF	---	---	---	---	320	---	27	---
BSI BS 1717:1983	ERW C2	---	---	NKM	---	---	195	---	320	---	25	---
BSI BS 6323-2:1982 AMD 2:1989	HFW 2	---	---	HF	---	---	195	---	320	---	25	---
ISO 3304:1985	R33	---	---	NBK & NZF	---	---	195	---	320	---	25	---
ISO 3305:1985	R33	---	---	NBK & NZF	---	---	195	---	320	---	25	---
ISO 3306:1985	R33	---	---	NKM & NZF	---	---	195	---	320	---	26	---

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

NOTE: This section continued on next page

5.1 Tubes for General and Structural Applications

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
BSI BS 6323-5: 1982 AMD 2:1989	ERW 2	---	---	NKM & NZF	---	---	195	---	320	---	25	---
BSI BS 6323-6:1982 AMD 2:1989	CEW 2	---	---	NBK & NZF	---	---	195	---	320	---	25	---
ISO 2937:1974	TS 1	---	---	HF	---	---	195	---	320-440	---	25	---
AFNOR NF A 49-310:1994	TU 37 b	---	---	GBK	---	---	---	---	325	---	25	---
ISO 3306:1985	R33	---	---	KM	---	---	---	---	330	---	8	---
DIN 2394-2:1994	RSt 34-2	1.0034	---	BKM	---	---	---	---	330	---	8	---
AFNOR NF A 49-341:1975	TS 34-a	---	---	A or N	---	---	215	---	330	---	28	---
ASTM A 519-96*	1020	---	G10200	A	---	---	193	28	331	48	30	50 HRB
ASTM A 513-00*	1015	---	G10150	AW	---	---	241	35	331	48	15	58 HRB min
	1008	---	G10080	SD	---	---	262	38	331	48	8	65 HRB min
ISO 3304:1985	R37	---	---	GBK & GZF	---	---	---	---	340	---	26	---
ISO 3305:1985	R37	---	---	GBK & GZF	---	---	---	---	340	---	26	---
ISO 3306:1985	R37	---	---	GKM & GZF	---	---	---	---	340	---	26	---
BSI BS 6323-4:1982 AMD 2:1989	CFS 3	---	---	GBK & GZF	---	---	170	---	340	---	26	---
	CFS 3A	---	---	GBK & GZF	---	---	170	---	340	---	26	---
BSI BS 6323-5: 1982 AMD 2:1989	ERW 3	---	---	GKM & GZF	---	---	170	---	340	---	26	---
BSI BS 6323-6:1982 AMD 2:1989	CEW 3	---	---	GBK & GZF	---	---	170	---	340	---	26	---
JIS G 3445:1988	STKM 12 A	---	---	AM, CF, or AHT	---	---	175	---	340	---	35	---
JIS G 3472:1988	STAM 340 G	---	---	see standard	---	---	195	---	340	---	35	---
BSI BS 1717:1983	ERW C3	---	---	GKM	---	---	200	---	340	---	26	---
DIN 2393-2:1994	RSt 37-2	1.0038	---	NBK	---	---	235	---	340-470	---	25	---
DIN 2391-2:1994	St 35	1.0308	---	NBK	---	---	235	---	340-470	---	25	---
DIN 2394-2:1994	RSt 37-2	1.0038	---	NBK	---	---	235	---	340-470	---	25	---
BSI BS 1717:1983	ERW C2	---	---	AW (KM1, KM2)	≤ 20 D/a	---	250	---	340	---	8	---
					> 20 D/a	---	250	---	340	---	15	---

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

NOTE: This section continued on next page

5.1 Tubes for General and Structural Applications

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
BSI BS 6323-5: 1982 AMD 2:1989	ERW 2	---	---	KM	≤ 20 D/a	---	250	---	340	---	8	---
					> 20 D/a	---	250	---	340	---	15	---
ASTM A 519-96*	1020	---	G10200	HR	---	---	221	32	345	50	25	55 HRB
ASTM A 513-00*	1020	---	G10200	N	---	---	241	35	345	50	25	75 HRB max
	1021	---	G10210	N	---	---	241	35	345	50	25	78 HRB max
	1010	---	G10100	SD	---	---	276	40	345	50	8	65 HRB min
ASTM A 512-96*	MT 1020	---	G10200	SA	---	---	207	30	345	50	32	50 HRB min

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

5.1 Tubes for General and Structural Applications

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
AFNOR NF A 49-341:1975	TS 30-a	---	---	BKW	---	---	---	---	350	---	12	---
ISO 3304:1985	R28	---	---	BKW	---	---	---	---	350	---	10	---
ISO 3305:1985	R28	---	---	BKW	---	---	---	---	350	---	10	---
BSI BS 6323-6:1982 AMD 2:1989	CEW 1	---	---	BKW	---	---	245	---	350	---	10	---
ASTM A 513-00*	1020	---	G10200	AW	---	---	262	38	359	52	12	62 HRB min
AFNOR NF A 49-341:1975	TS 30-0	---	---	BK	---	---	---	---	360	---	5	---
AFNOR NF A 49-111:1978	TU 37-a	---	---	HR	---	---	215	---	360	---	20	---
BSI BS 6323-4:1982 AMD 2:1989	CFS 3	---	---	NBK & NZF	---	---	215	---	360	---	24	---
	CFS 3A	---	---	NBK & NZF	---	---	215	---	360	---	24	---
BSI BS 6323-5: 1982 AMD 2:1989	ERW 3	---	---	NKM & NZF	---	---	215	---	360	---	24	---
BSI BS 6323-6:1982 AMD 2:1989	CEW 3	---	---	NBK & NZF	---	---	215	---	360	---	24	---
ISO 2937:1974	TS 4	---	---	HF	---	---	215	---	360-480	---	24	---
ISO 3304:1985	R37	---	---	NBK & NZF	---	---	215	---	360	---	24	---
ISO 3305:1985	R37	---	---	NBK & NZF	---	---	215	---	360	---	24	---
ISO 3306:1985	R37	---	---	NKM & NZF	---	---	215	---	360	---	24	---
BSI BS 1717:1983	CFS C3	---	---	NBK	---	---	215	---	360	---	24	---
	ERW C3	---	---	NKM	---	---	215	---	360	---	24	---
	CEW C3	---	---	NBK	---	---	215	---	360	---	24	---
BSI BS 6323-2:1982 AMD 2:1989	HFW 3	---	---	HF	---	---	215	---	360	---	24	---
BSI BS 6323-3:1982 AMD 2:1989	HFS 3	---	---	HF	---	---	215	---	360	---	24	---
AFNOR NF A 49-311:1974	TU 37-b	---	---	AM	< 6.3	---	220	---	360	---	20	---
					6.3 ≤ t < 16	---	220	---	360	---	23	---
					≥ 16 min	---	200	---	340	---	22	---

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

NOTE: This section continued on next page

5.1 Tubes for General and Structural Applications

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
AFNOR NF A 49-141:1978	TS 37-a	---	---	HR or CF+T	---	---	235	---	360	---	25	---
AFNOR NF A 49-250:1979	TS E 24-a	---	---	AM	---	---	235	---	360	---	23	---
AFNOR NF A 49-343:1980	TS 37 b	---	---	HW or CW+N	---	---	235	---	360	---	26	---
AFNOR NF A 49-310:1994	TU 37 b	---	---	NBK	---	---	240	---	360-500	---	25	---
	S 100	---	---	NBK	---	---	240	---	360-500	---	25	---
BSI BS 1717: 1983	ERW C5	---	---	NKM	---	---	260	---	360	---	28	---
ASTM A 519-96*	1025	---	G10250	A	---	---	207	30	365	53	25	57 HRB
AFNOR NF A 49-341:1975	TS 34-a	---	---	BKW	---	---	---	---	370	---	10	---
ISO 3304:1985	R33	---	---	BKW	---	---	---	---	370	---	10	---
ISO 3305:1985	R33	---	---	BKW	---	---	---	---	370	---	10	---
JIS G 3473:1988	STC 370	---	---	AM	---	---	215	---	370	---	30	---
JIS G 3445:1988	STKM 13 A	---	---	AM, CF, or AHT	---	---	215	---	370	---	30	---
BSI BS 6323-6:1982 AMD 2:1989	CEW 2	---	---	BKW	---	---	260	---	370	---	10	---
ASTM A 513-00*	1021	---	G10210	AW	---	---	276	40	372	54	12	62 HRB min
ASTM A 519-96*	1020	---	G10200	N	---	---	234	34	379	55	22	60 HRB
ASTM A 512-96*	MT 1025	---	G10250	SA	---	---	241	35	379	55	32	55 HRB min
ASTM A 519-96*	1025	---	G10250	HR	---	---	241	35	379	55	25	60 HRB
				N	---	---	248	36	379	55	22	60 HRB
ASTM A 513-00*	1025	---	G10250	N	---	---	255	37	379	55	25	80 HRB max
	1008	---	G10080	MD SR	---	---	310	45	379	55	12	68 HRB min
	1010	---	G10100	MD SR	---	---	310	45	379	55	12	68 HRB min
	1015	---	G10150	SD	---	---	310	45	379	55	8	67 HRB min
AFNOR NF A 49-341:1975	TS 30-a	---	---	BK	---	---	---	---	380	---	6	---
DIN 2391-2:1994	St 30 Si	1.0211	---	BKW/Soft	---	---	---	---	380	---	12	---
	St 30 Al	1.0212	---	BKW/Soft	---	---	---	---	380	---	12	---
AFNOR NF A 49-341:1975	TS 37-a	---	---	A or N	---	---	245	---	380	---	26	---
DIN 2391-2:1994	St 30 Si	1.0211	---	BKS	---	---	280	---	380	---	16	---
	St 30 Al	1.0212	---	BKS	---	---	280	---	380	---	16	---
ASTM A 513-00*	1025	---	G10250	AW	---	---	276	40	386	56	12	65 HRB min
DIN 2393-2:1994	St 44-2	1.0044	---	GBK	---	---	---	---	390	---	21	---

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

NOTE: This section continued on next page

5.1 Tubes for General and Structural Applications

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
DIN 2391-2:1994	St 45	1.0408	---	GBK	---	---	---	---	390	---	21	---
DIN 2394-2:1994	RSt 37-2	1.0038	---	BKM	---	---	---	---	390	---	7	---
	St 44-2	1.0044	---	GBK	---	---	---	---	390	---	21	---
AFNOR NF A 49-310:1994	TU 37 b	---	---	BKW	---	---	---	---	390	---	12	---
JIS G 3472:1988	STAM 390 G	---	---	see standard	---	---	235	---	390	---	30	---
JIS G 3445:1988	STKM 12 B	---	---	AM, CF, or AHT	---	---	275	---	390	---	25	---

5.1 Tubes for General and Structural Applications

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ISO 3304:1985	R28	---	---	BK	---	---	---	---	400	---	8	---
	R37	---	---	BKW	---	---	---	---	400	---	9	---
	R44	---	---	GBK & GZF	---	---	---	---	400	---	24	---
ISO 3305:1985	R28	---	---	BK	---	---	---	---	400	---	8	---
	R37	---	---	BKW	---	---	---	---	400	---	9	---
	R44	---	---	GBK & GZF	---	---	---	---	400	---	24	---
ISO 3306:1985	R37	---	---	KM	---	---	---	---	400	---	7	---
	R44	---	---	GKM & GZF	---	---	---	---	400	---	24	---
BSI BS 6323-4:1982 AMD 2:1989	CFS 4	---	---	GBK & GZF	---	---	200	---	400	---	24	---
BSI BS 6323-5: 1982 AMD 2:1989	ERW 4	---	---	GKM & GZF	---	---	200	---	400	---	24	---
BSI BS 6323-6:1982 AMD 2:1989	CEW 4	---	---	GBK & GZF	---	---	200	---	400	---	24	---
BSI BS 6323-4:1982 AMD 2:1989	CFS 3	---	---	BKW	---	---	280	---	400	---	9	---
	CFS 3A	---	---	BKW	---	---	280	---	400	---	9	---
BSI BS 6323-6:1982 AMD 2:1989	CEW 3	---	---	BKW	---	---	280	---	400	---	9	---
BSI BS 6323-5: 1982 AMD 2:1989	ERW 3	---	---	KM	≤ 20 D/a	---	300	---	400	---	7	---
					> 20 D/a	---	300	---	400	---	12	---
BSI BS 1717:1983	ERW C3	---	---	AW (KM1, KM2)	≤ 20 D/a	---	300	---	400	---	7	---
					> 20 D/a	---	300	---	400	---	12	---
BSI BS 6323-6:1982 AMD 2:1989	CEW 1	---	---	BK	---	---	320	---	400	---	6	---
JIS G 3444:1994	STK400	---	---	AM	---	---	235	---	400	---	23	---
ASTM A 500-99	D	---	---	HT	---	---	250	36	400	58	23	---
ASTM A 501-99	---	---	K03000	HF	---	---	250	36	400	58	23	---
ASTM A 500-99	B	---	K03000	CF, SR, A	---	---	290	42	400	58	23	---
DIN 2393-2:1994	RSt 34-2	1.0034	---	BKW/Soft	---	---	---	---	410	---	12	---
AFNOR NF A 49-341:1975	TS 34-a	---	---	BK	---	---	---	---	410	---	6	---

NOTE: This section continued on next page

5.1 Tubes for General and Structural Applications

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
DIN 2394-2:1994	St 44-2	1.0044	---	NBK	---	---	255	---	410-470	---	21	---
BSI BS 1717:1983	CFS C4	---	---	NBK	---	---	235	---	410	---	22	---
BSI BS 6323-4:1982 AMD 2:1989	CFS 4	---	---	NBK & NZF	---	---	235	---	410	---	22	---
BSI BS 6323-5: 1982 AMD 2:1989	ERW 4	---	---	NKM & NZF	---	---	235	---	410	---	22	---
BSI BS 6323-6:1982 AMD 2:1989	CEW 4	---	---	NBK & NZF	---	---	235	---	410	---	22	---
BSI BS 6323-2:1982 AMD 2:1989	HFW 4	---	---	HF	---	---	235	---	410	---	22	---
BSI BS 6323-3:1982 AMD 2:1989	HFS 4	---	---	HF	---	---	235	---	410	---	22	---
BSI BS 6323-7:1982 AMD 2:1989	SAW 4	---	---	AW, HS, CS	---	---	235	---	410	---	22	---
AFNOR NF A 49-250:1979	TS E 26-b	---	---	AM	---	---	255	---	410-490	---	23	---
ISO 2937:1974	TS 9	---	---	HF	---	---	235	---	410-530	---	22	---
DIN 2393-2:1994	St 44-2	1.0044	---	NBK	---	---	255	---	410-540	---	21	---
JIS G 3445:1988	STKM 14 A	---	---	AM, CF, or AHT	---	---	245	---	410	---	25	---
DIN 2393-2:1994	RSt 34-2	1.0034	---	BKS	---	---	305	---	410	---	16	---
ASTM A 519-96*	1035	---	G10350	A	---	---	228	33	414	60	25	67 HRB
ASTM A 513-00*	1026	---	G10260	N	---	---	276	40	414	60	25	85 HRB max
	1030	---	G10300	N	---	---	276	40	414	60	25	85 HRB max
	1008	---	G10080	MD	---	---	345	50	414	60	5	73 HRB min
	1010	---	G10100	MD	---	---	345	50	414	60	5	73 HRB min
	1015	---	G10150	MD SR	---	---	345	50	414	60	12	72 HRB min
	1020	---	G10200	SD	---	---	345	50	414	60	8	70 HRB min
DIN 2391-2:1994	St 35	1.0308	---	BKW/Soft	---	---	---	---	420	---	10	---
AFNOR NF A 49-341:1975	TS 37-a	---	---	BKW	---	---	---	---	420	---	8	---

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

NOTE: This section continued on next page

5.1 Tubes for General and Structural Applications

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ISO 3304:1985	R33	---	---	BK	---	---	---	---	420	---	6	---
ISO 3305:1985	R33	---	---	BK	---	---	---	---	420	---	6	---
DIN 17204:1990	C 22	1.0402	---	N	≤ 16	---	260	---	420-550	---	21 L; 19 T	---
					16 < t ≤ 40	---	240	---	400-530	---	24 L; 22 T	---
					40 < t ≤ 80	---	220	---	380-510	---	24 L; 22 T	---
	Ck 22	1.1151	---	N	≤ 16	---	260	---	420-550	---	21 L; 19 T	---
					16 < t ≤ 40	---	240	---	400-530	---	24 L; 22 T	---
					40 < t ≤ 80	---	220	---	380-510	---	24 L; 22 T	---
	Cm 22	1.1149	---	N	≤ 16	---	260	---	420-550	---	21 L; 19 T	---
					16 < t ≤ 40	---	240	---	400-530	---	24 L; 22 T	---
					40 < t ≤ 80	---	220	---	380-510	---	24 L; 22 T	---
DIN 2391-2:1994	St 35	1.0308	---	BKS	---	---	315	---	420	---	14	---
BSI BS 6323-6:1982 AMD 2:1989	CEW 2	---	---	BK	---	---	355	---	420	---	6	---
ASTM A 513-00*	1026	---	G10260	AW	---	---	310	45	427	62	12	68 HRB min
	1030	---	G10300	AW	---	---	310	45	427	62	10	70 HRB min
ASTM A 500-99	C	---	K02705	CF, SR, A	---	---	317	46	427	62	21	---
ASTM A 513-00*	1021	---	G10210	SD	---	---	359	52	428	62	7	70 HRB min
DIN 2391-2:1994	St 30 Si	1.0211	---	BK/Hard	---	---	---	---	430	---	8	---
	St 30 Al	1.0212	---	BK/Hard	---	---	---	---	430	---	8	---
ISO 3306:1985	R44	---	---	KM	---	---	---	---	430	---	6	---
ISO 3304:1985	R44	---	---	NBK & NZF	---	---	255	---	430	---	22	---
ISO 3305:1985	R44	---	---	NBK & NZF	---	---	255	---	430	---	22	---
ISO 3306:1985	R44	---	---	NKM & NZF	---	---	255	---	430	---	22	---
AFNOR NF A 49-341:1975	TS 42-a	---	---	A or N	---	---	270	---	430	---	23	---
BSI BS 1717:1983	ERW C5	---	---	AW (KM1, KM2)	≤ 20 D/a	---	350	---	430	---	10	---
					> 20 D/a	---	350	---	430	---	15	---
ASTM A 512-96*	MT 1010	---	G10100	SR A	---	---	400	58	434-689	63-100	15	70 HRB-90
	1110	---	G11100	SR A	---	---	400	58	434-689	63-100	15	70 HRB-100
DIN 2393-2:1994	RSt 37-2	1.0038	---	BKW/Soft	---	---	---	---	440	---	10	---
DIN 2394-2:1994	St 44-2	1.0044	---	BKM	---	---	---	---	440	---	6	---
AFNOR NF A 49-310:1994	TU 37 b	---	---	BK	---	---	---	---	440	---	6	---
DIN 2391-2:1994	St 45	1.0408	---	NBK	---	---	255	---	440-570	---	21	---
JIS G 3445:1988	STKM 18 A	---	---	AM, CF, or AHT	---	---	275	---	440	---	25	---

*: See "List of Standards" at the beginning of the chapter. NOTE: This section continued on next page

5.1 Tubes for General and Structural Applications

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
BSI BS 6323-4:1982 AMD 2:1989	CFS 6	---	---	GBK & GZF	---	---	300	---	440	---	22	---
JIS G 3445:1988	STKM 13 B	---	---	AM, CF, or AHT	---	---	305	---	440	---	20	---
JIS G 3472:1988	STAM 440 G	---	---	see standard	---	---	305	---	440	---	25	---
JIS G 3473:1988	STC 440	---	---	CF, SR	---	---	305	---	440	---	10	---
DIN 2393-2:1994	RSt 37-2	1.0038	---	BKS	---	---	325	---	440	---	14	---
JIS G 3472:1988	STAM 440 H	---	---	see standard	---	---	355	---	440	---	20	---
AFNOR	TU 37 b	---	---	BK + S	---	---	370	---	440	---	16	---
NF A 49-310:1994	S 100	---	---	BK + S	---	---	370	---	440	---	16	---
ASTM A 519-96*	1045	---	G10450	A	---	---	241	35	448	65	20	72 HRB
	1035	---	G10350	HR	---	---	276	40	448	65	20	72 HRB
	1035	---	G10350	N	---	---	276	40	448	65	20	72 HRB
ASTM A 513-00*	1035	---	G10350	N	---	---	310	45	448	65	20	88 HRB max
	1040	---	G10400	N	---	---	310	45	448	65	20	90 HRB max
ASTM A 519-96*	1020	---	G10200	SR	---	---	345	50	448	65	10	72 HRB
ASTM A 513-00*	1015	---	G10150	MD	---	---	379	55	448	65	5	77 HRB min
	1020	---	G10200	MD SR	---	---	379	55	448	65	10	75 HRB min
	1025	---	G10250	SD	---	---	379	55	448	65	7	72 HRB min
	MT 1030	---	G10300	SA	---	---	276	40	448	65	30	60 HRB min
ASTM A 512-96*	1011	---	G10110	SR A	---	---	407	59	448-689	65-100	13	70 HRB-100

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

5.1 Tubes for General and Structural Applications

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ISO 3304:1985	R37	---	---	BK	---	---	---	---	450	---	6	---
	R44	---	---	BKW	---	---	---	---	450	---	8	---
ISO 3305:1985	R37	---	---	BK	---	---	---	---	450	---	6	---
	R44	---	---	BKW	---	---	---	---	450	---	8	---
BSI BS 6323-4:1982 AMD 2:1989	CFS 4	---	---	BKW	---	---	315	---	450	---	8	---
BSI BS 6323-6:1982 AMD 2:1989	CEW 4	---	---	BKW	---	---	315	---	450	---	8	---
BSI BS 6323-5: 1982 AMD 2:1989	ERW 4	---	---	KM	≤ 20 D/a	---	350	---	450	---	6	---
					> 20 D/a	---	350	---	450	---	10	---
BSI BS 1717:1983	CFS C3	---	---	BK	---	---	360	---	450	---	6	---
	CEW C3	---	---	BK	---	---	360	---	450	---	6	---
BSI BS 6323-4:1982 AMD 2:1989	CFS 3	---	---	BK	---	---	360	---	450	---	6	---
	CFS 3A	---	---	BK	---	---	360	---	450	---	6	---
BSI BS 6323-6:1982 AMD 2:1989	CEW 3	---	---	BK	---	---	360	---	450	---	6	---
ASTM A 595-98	A	---	K02004	RCCM	---	---	380	55	450	65	23.0	---
ASTM A 513-00*	1035	---	G10350	AW	---	---	345	50	455	66	10	75 HRB min
	1524	---	G15240	AW	---	---	345	50	455	66	10	75 HRB min
	1040	---	G10400	AW	---	---	345	50	455	66	10	75 HRB min
ASTM A 512-96*	MT 1015	---	G10150	SR A	---	---	414	60	455-689	66-100	14	70 HRB-100
AFNOR NF A 49-341:1975	TS 37-a	---	---	BK	---	---	---	---	460	---	6	---
DIN 2393-2:1994	RSt 34-2	1.0034	---	BK/Hard	---	---	---	---	460	---	6	---
BSI BS 6323-4:1982 AMD 2:1989	CFS 6	---	---	NBK & NZF	---	---	280	---	460	---	21	---
ASTM A 512-96*	1016	---	G10160	SR A	---	---	421	61	462-689	67-100	13	70 HRB-100
	MT 1017	---	G10170	SR A	---	---	427	62	462-689	67-100	13	72 HRB-100
ASTM A 519-96*	1050	---	G10500	A	---	---	262	38	469	68	18	74 HRB
ASTM A 513-00*	1021	---	G10210	MD SR	---	---	400	58	469	68	10	75 HRB min
ASTM A 512-96*	1018	---	G10180	SR A	---	---	427	62	469-689	68-100	13	73 HRB-100

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

NOTE: This section continued on next page

5.1 Tubes for General and Structural Applications

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
AFNOR NF A 49-341:1975	TS 42-a	---	---	BKW	---	---	---	---	470	---	8	---
JIS G 3445:1988	STKM 15 A	---	---	AM, CF, or AHT	---	---	275	---	470	---	22	---
JIS G 3472:1988	STAM 470 G	---	---	see standard	---	---	325	---	470	---	22	---
JIS G 3445:1988	STKM 12 C	---	---	AM, CF, or AHT	---	---	355	---	470	---	20	---
JIS G 3472:1988	STAM 470 H	---	---	see standard	---	---	410	---	470	---	18	---
ISO 3304:1985	R50	---	---	GBK & GZF	---	---	---	---	480	---	23	---
ISO 3305:1985	R50	---	---	GBK & GZF	---	---	---	---	480	---	23	---
ISO 3306:1985	R50	---	---	GKM & GZF	---	---	---	---	480	---	23	---
DIN 2391-2:1994	St 35	1.0308	---	BK/Hard	---	---	---	---	480	---	6	---
AFNOR NF A 49-341:1975	TS 47-a	---	---	A or N	---	---	300	---	480	---	22	---
ASTM A 595-98	B	---	K02005	RCCM	---	---	410	60	480	70	21.0	---
ASTM A 519-96*	1025	---	G10250	SR	---	---	379	55	483	70	8	75 HRB
ASTM A 513-00*	1026	---	G10260	SD	---	---	379	55	483	70	7	77 HRB
	1020	---	G10200	MD	---	---	414	60	483	70	5	80 HRB min
ASTM A 519-96*	1020	---	G10200	CW	---	---	414	60	483	70	5	75 HRB
ASTM A 513-00*	1025	---	G10250	MD SR	---	---	414	60	483	70	10	77 HRB min
	1030	---	G10300	SD	---	---	427	62	483	70	7	78 HRB min
DIN 2393-2:1994	RSt 37-2	1.0038	---	BK/Hard	---	---	---	---	490	---	6	---
	St 52-3	1.0570	---	GBK	---	---	---	---	490	---	22	---
DIN 2394-2:1994	St 52-3	1.0570	---	GBK	---	---	---	---	490	---	22	---
AFNOR NF A 49-310:1994	TU 52 b	---	---	GBK	---	---	---	---	490	---	22	---
ISO 3304:1985	R50	---	---	NBK & NZF	---	---	285	---	490	---	21	---
ISO 3305:1985	R50	---	---	NBK & NZF	---	---	285	---	490	---	21	---
ISO 3306:1985	R50	---	---	NKM & NZF	---	---	285	---	490	---	21	---
JIS G 3444:1994	STK490	---	---	AM	---	---	315	---	490	---	23	---
JIS G 3445:1988	STKM 18 B	---	---	AM, CF, or AHT	---	---	315	---	490	---	23	---
	STKM 19 A	---	---	AM, CF, or AHT	---	---	315	---	490	---	23	---

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

NOTE: This section continued on next page

5.1 Tubes for General and Structural Applications

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
BSI BS 6323-4:1982 AMD 2:1989	CFS 5	---	---	NBK, NZF	---	---	340	---	490	---	20	---
BSI BS 6323-5:1982 AMD 2:1989	ERW 5	---	---	NKM, NZF	---	---	340	---	490	---	20	---
BSI BS 6323-6:1982 AMD 2:1989	CEW 5	---	---	NBK, NZF	---	---	340	---	490	---	20	---
BSI BS 6323-2:1982 AMD 2:1989	HFW 5	---	---	HF	---	---	340	---	490	---	20	---
BSI BS 6323-3:1982 AMD 2:1989	HFS 5	---	---	HF	---	---	340	---	490	---	20	---
BSI BS 6323-7:1982 AMD 2:1989	SAW 5	---	---	AW, HS, CS	---	---	340	---	490	---	20	---
DIN 2391-2:1994	St 52	1.0580	---	GBK	---	---	---	---	490	---	22	---
ISO 2937:1974	TS 18	---	---	HF	---	---	285	---	490-610	---	21	---
DIN 2391-2:1994	St 52	1.0580	---	NBK	---	---	355	---	490-630	---	22	---
DIN 2393-2: 1994	St 52-3	1.0570	---	NBK	---	---	355	---	490-630	---	22	---
DIN 2394-2:1994	St 52-3	1.0570	---	NBK	---	---	355	---	490-630	---	22	---
ASTM A 512-96*	MT 1020	---	G10200	SR A	---	---	448	65	490-896	71-130	11	75 HRB-20 HRC
ASTM A 513-00*	1021	---	G10210	MD	---	---	427	62	496	72	5	80 HRB min
ASTM A 512-96*	1025	---	G10250	SR A	---	---	462	67	496-896	72-130	11	78 HRB-20 HRC

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

5.1 Tubes for General and Structural Applications

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
DIN 17204:1990	C 22	1.0402	---	QT (V)	≤ 8	---	340	---	500-700	---	20 L; 18 T	---
					8 < t ≤ 20	---	290	---	470-670	---	22 L; 20 T	---
					20 < t ≤ 50	---	270	---	440-640	---	22 L; 20 T	---
					50 < t ≤ 80	---	260	---	420-620	---	22 L; 20 T	---
	Ck 22	1.1151	---	QT (V)	≤ 8	---	340	---	500-700	---	20 L; 18 T	50 J at RT
					8 < t ≤ 20	---	290	---	470-670	---	22 L; 20 T	---
					20 < t ≤ 50	---	270	---	440-640	---	22 L; 20 T	40 J at RT
					50 < t ≤ 80	---	260	---	420-620	---	22 L; 20 T	40 J at RT
	Cm 22	1.1149	---	QT (V)	≤ 8	---	340	---	500-700	---	20 L; 18 T	50 J at RT
					8 < t ≤ 20	---	290	---	470-670	---	22 L; 20 T	---
					20 < t ≤ 50	---	270	---	440-640	---	22 L; 20 T	40 J at RT
					50 < t ≤ 80	---	260	---	420-620	---	22 L; 20 T	40 J at RT
JIS G 3444:1994	STK500	---	---	AM	---	---	355	---	500	---	15	---
JIS G 3472:1988	STAM 500 G	---	---	see standard	---	---	355	---	500	---	18	---
JIS G 3445:1988	STKM 14 B	---	---	AM, CF, or AHT	---	---	355	---	500	---	15	---
JIS G 3472:1988	STAM 500 H	---	---	see standard	---	---	430	---	500	---	16	---
BSI BS 6323-5: 1982 AMD 2:1989	ERW 5	---	---	KM	≤ 20 D/a	---	420	---	500	---	6	---
					> 20 D/a	---	420	---	500	---	8	---
AFNOR NF A 49-341:1975	TS 42-a	---	---	BK	---	---	---	---	510	---	5	---
AFNOR NF A 49-310:1994	S 100	---	---	BK	---	---	---	---	510	---	8	---
DIN 2393-2:1994	St 44-2	1.0044	---	BKW/Soft	---	---	---	---	510	---	8	---
BSI BS 6323-4:1982 AMD 2:1989	CFS 8	---	---	GBK & GZF	---	---	300	---	510	---	20	---
JIS G 3445:1988	STKM 16 A	---	---	AM, CF, or AHT	---	---	325	---	510	---	20	---
AFNOR NF A 49-311:1974	TU 52-b	---	---	AM	< 6.3	---	345	---	510	---	17	---
					6.3 ≤ t < 16	---	345	---	510	---	20	---
					≥ 16 min	---	325	---	490	---	19	---
AFNOR NF A 49-343:1980	TS 18 M 5	---	---	HW or CW+N	---	---	345	---	510	---	20	---
AFNOR NF A 49-310:1994	TU 52 b	---	---	NBK	---	---	350	---	510-650	---	22	---

NOTE: This section continued on next page

5.1 Tubes for General and Structural Applications

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
DIN 2393-2:1994	St 44-2	1.0044	---	BKS	---	---	375	---	510	---	12	---
JIS G 3445:1988	STKM 13 C	---	---	AM, CF, or AHT	---	---	380	---	510	---	15	---
	STKM 18 C	---	---	AM, CF, or AHT	---	---	380	---	510	---	15	---
JIS G 3473:1988	STC 510A	---	---	CF or SR	---	---	380	---	510	---	10	---
	STC 510B	---	---	SR	---	---	380	---	510	---	15	---
ASTM A 519-96*	1045	---	G10450	HR	---	---	310	45	517	75	15	80 HRB
				N	---	---	331	48	517	75	15	80 HRB
ASTM A 513-00*	1025	---	G10250	MD	---	---	448	65	517	75	5	82 HRB min
	1026	---	G10260	MD SR	---	---	448	65	517	75	10	80 HRB min
ASTM A 519-96*	1025	---	G10250	CW	---	---	448	65	517	75	5	80 HRB
	1035	---	G10350	SR	---	---	448	65	517	75	8	80 HRB
AFNOR NF A 49-341:1975	TS 47-a	---	---	BKW	---	---	---	---	520	---	6	---
ISO 3304:1985	R44	---	---	BK	---	---	---	---	520	---	5	---
ISO 3305:1985	R44	---	---	BK	---	---	---	---	520	---	5	---
ISO 3306:1985	R50	---	---	KM	---	---	---	---	520	---	5	---
AFNOR NF A 49-310:1994	TU 20 MV 6	---	---	GBK	---	---	---	---	520	---	22	---
DIN 2391-2:1994	St 45	1.0408	---	BKW/Soft	---	---	---	---	520	---	8	---
DIN 17204:1990	C 35	1.0501	---	N	≤ 16	---	300	---	520-670	---	17 L; 15 T	---
					16 < t ≤ 40	---	280	---	500-650	---	19 L; 17 T	---
					40 < t ≤ 80	---	270	---	480-630	---	21 L; 19 T	---
	Ck 35	1.1181	---	N	≤ 16	---	300	---	520-670	---	17 L; 15 T	---
					16 < t ≤ 40	---	280	---	500-650	---	19 L; 17 T	---
					40 < t ≤ 80	---	270	---	480-630	---	21 L; 19 T	---
	Cm 35	1.1180	---	N	≤ 16	---	300	---	520-670	---	17 L; 15 T	---
					16 < t ≤ 40	---	280	---	500-650	---	19 L; 17 T	---
					40 < t ≤ 80	---	270	---	480-630	---	21 L; 19 T	---
AFNOR NF A 49-310:1994	18 MF6	---	---	NBK	---	---	360	---	520-650	---	22	---
DIN 2391-2:1994	St 45	1.0408	---	BKS	---	---	375	---	520	---	12	---
BSI BS 1717:1983	CFS C4	---	---	BK	---	---	415	---	520	---	5	---
BSI BS 6323-4:1982 AMD 2:1989	CFS 4	---	---	BK	---	---	415	---	520	---	5	---

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

NOTE: This section continued on next page

5.1 Tubes for General and Structural Applications

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
BSI BS 6323-6:1982 AMD 2:1989	CEW 4	---	---	BK	---	---	415	---	520	---	5	---
ASTM A 519-96*	1050	---	G10500	N	---	---	345	50	538	78	12	82 HRB
AFNOR NF A 49-311:1974	TU XC 35	---	---	AM	< 6.3	---	320	---	540	---	16	---
					$6.3 \leq t < 16$	---	320	---	540	---	19	---
					≥ 16	---	300	---	520	---	18	---
DIN 2394-2:1994	St 52-3	1.0570	---	BKM	---	---	---	---	540	---	5	---
ISO 2937:1974	C 35	---	---	HF	---	---	275	---	540-660	---	20	---
BSI BS 6323-3:1982 AMD 2:1989	HFS 8	---	---	HF	---	---	340	---	540	---	18	---
BSI BS 6323-4:1982 AMD 2:1989	CFS 8	---	---	NBK, NZF	---	---	340	---	540	---	18	---
	CFS 6	---	---	BKW	---	---	350	---	540	---	7	---
JIS G 3444:1994	STK540	---	---	AM	---	---	390	---	540	---	20	---
JIS G 3445:1988	STKM 20 A	---	---	AM, CF, or AHT	---	---	390	---	540	---	23	---
JIS G 3473:1988	STC 540	---	---	AM	---	---	390	---	540	---	20	---
JIS G 3474:1995	STKT 540	---	---	AM	---	---	390	---	540	---	20	---
JIS G 3472:1988	STAM 540 H	---	---	see standard	---	---	480	---	540	---	13	---

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

5.1 Tubes for General and Structural Applications

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ISO 3304:1985	R50	---	---	BKW	---	---	---	---	550	---	7	---
ISO 3305:1985	R50	---	---	BKW	---	---	---	---	550	---	7	---
AFNOR NF A 49-310:1994	TU 52 b	---	---	BKW	---	---	---	---	550	---	8	---
AFNOR NF A 49-311:1974	TU 56-b	---	---	AM	< 6.3	---	295	---	550	---	15	---
					6.3 ≤ t < 16	---	295	---	550	---	17	---
					≥ 16 min	---	275	---	530	---	16	---
JIS G 3445:1988	STKM 17 A	---	---	AM, CF, or AHT	---	---	345	---	550	---	20	---
BSI BS 6323-4:1982 AMD 2:1989	CFS 5	---	---	BKW	---	---	385	---	550	---	8	---
BSI BS 6323-6:1982 AMD 2:1989	CEW 5	---	---	BKW	---	---	385	---	550	---	6	---
JIS G 3445:1988	STKM 14 C	---	---	AM, CF, or AHT	---	---	410	---	550	---	15	---
	STKM 19 C	---	---	AM, CF, or AHT	---	---	410	---	550	---	15	---
AFNOR NF A 49-310:1994	TU 20 MV 6	---	---	NBK	---	---	410	---	550-700	---	22	---
ASTM A 519-96*	1050	---	G10500	HR	---	---	345	50	552	80	10	85 HRB
ASTM A 512-96*	1030	---	G10300	SR A	---	---	483	70	552-896	80-130	10	80 HRB-20 HRC
ASTM A 513-00*	1026	---	G10260	MD	---	---	483	70	552	80	5	85 HRB min
	1030	---	G10300	MD SR	---	---	483	70	552	80	10	81 HRB min
	1035	---	G10350	SD	---	---	483	70	552	80	7	82 HRB min
ASTM A 519-96*	1045	---	G10450	SR	---	---	483	70	552	80	8	85 HRB
AFNOR NF A 49-341:1975	TS 47-a	---	---	BK	---	---	---	---	560	---	4	---
DIN 2393-2:1994	St 44-2	1.0044	---	BK/Hard	---	---	---	---	560	---	5	---
ASTM A 519-96*	1050	---	G10500	SR	---	---	483	70	565	82	6	86 HRB
DIN 2391-2:1994	St 45	1.0408	---	BK	---	---	---	---	580	---	5	---
	St 52	1.0580	---	BKW	---	---	---	---	580	---	7	---
				BKS	---	---	420	---	580	---	10	---
JIS G 3445:1988	STKM 15 C	---	---	AM, CF, or AHT	---	---	430	---	580	---	12	---

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

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5.1 Tubes for General and Structural Applications

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 513-00*	1030	---	G10300	MD	---	---	517	75	586	85	5	87 HRB min
	1035	---	G10350	MD SR	---	---	517	75	586	85	10	85 HRB min
	1040	---	G10400	MD SR	---	---	517	75	586	85	10	85 HRB min
	1524	---	G15240	MD SR	---	---	517	75	586	85	10	85 HRB min
ASTM A 519-96*	1035	---	G10350	CW	---	---	517	75	586	85	5	88 HRB
DIN 2393-2:1994	St 52-3	1.0570	---	BKW/Soft	---	---	---	---	590	---	6	---
				BKS	---	---	435	---	590	---	10	---
JIS G 3474:1995	STKT 590	---	---	AM	---	---	440	---	590-740	---	20	---
BSI BS 6323-4:1982 AMD 2:1989	CFS 6	---	---	BK	---	---	470	---	590	---	5	---
JIS G 3473:1988	STC 590A	---	---	CF or SR	---	---	490	---	590	---	10	---
	STC 590B	---	---	SR	---	---	490	---	590	---	15	---

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

5.1 Tubes for General and Structural Applications

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ISO 3304:1985	R50	---	---	BK	---	---	---	---	600	---	4	---
ISO 3305:1985	R50	---	---	BK	---	---	---	---	600	---	4	---
BSI BS 6323-4:1982 AMD 2:1989	CFS 5	---	---	BK	---	---	480	---	600	---	4	---
BSI BS 6323-6:1982 AMD 2:1989	CEW 5	---	---	BK	---	---	480	---	600	---	4	---
AFNOR NF A 49-310:1994	18 MF6	---	---	BK + S	---	---	520	---	600	---	12	---
	TU 52 b	---	---	BK + S	---	---	520	---	600	---	12	---
AFNOR NF A 49-343:1980	TS 18 MDV 5	---	---	HW or CW+N	---	---	470	---	610	---	17	---
AFNOR NF A 49-310:1994	TU 20 MV 6	---	---	BKW	---	---	---	---	620	---	8	---
JIS G 3445:1988	STKM 16 C	---	---	AM, CF, or AHT	---	---	460	---	620	---	12	---
DIN 17204:1990	C 45	1.0503	---	N	≤ 16	---	350	---	610-760	---	16 L; 14 T	---
					16 < t ≤ 40	---	330	---	590-740	---	17 L; 15 T	---
					40 < t ≤ 80	---	320	---	570-720	---	17 L; 15 T	---
	Ck 45	1.1191	---	N	≤ 16	---	350	---	610-760	---	16 L; 14 T	---
					16 < t ≤ 40	---	330	---	590-740	---	17 L; 15 T	---
					40 < t ≤ 80	---	320	---	570-720	---	17 L; 15 T	---
	Cm 45	1.1201	---	N	≤ 16	---	350	---	610-760	---	16 L; 14 T	---
					16 < t ≤ 40	---	330	---	590-740	---	17 L; 15 T	---
					40 < t ≤ 80	---	320	---	570-720	---	17 L; 15 T	---
ASTM A 513-00*	1035	---	G10350	MD	---	---	552	80	621	90	5	90 HRB min
	1040	---	G10400	MD	---	---	552	80	621	90	5	90 HRB min
	1524	---	G15240	MD	---	---	552	80	621	90	5	90 HRB min
ASTM A 519-96*	1045	---	G10450	CW	---	---	552	80	621	90	5	90 HRB

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

NOTE: This section continued on next page

5.1 Tubes for General and Structural Applications

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
DIN 17204:1990	C 35	1.0501	---	QT (V)	≤ 8	---	430	---	630-830	---	17 L; 15 T	---
					8 < t ≤ 20	---	380	---	600-800	---	19 L; 17 T	
					20 < t ≤ 50	---	320	---	550-750	---	20 L; 18 T	
					50 < t ≤ 80	---	290	---	500-700	---	20 L; 18 T	
	Ck 35	1.1181	---	QT (V)	≤ 8	---	340	---	630-830	---	17 L; 15 T	35 J at RT
					8 < t ≤ 20	---	290	---	600-800	---	19 L; 17 T	
					20 < t ≤ 50	---	270	---	550-750	---	20 L; 18 T	
					50 < t ≤ 80	---	260	---	500-700	---	20 L; 18 T	
	Cm 35	1.1180	---	QT (V)	≤ 8	---	340	---	630-830	---	17 L; 15 T	35 J at RT
					8 < t ≤ 20	---	290	---	600-800	---	19 L; 17 T	
					20 < t ≤ 50	---	270	---	550-750	---	20 L; 18 T	
					50 < t ≤ 80	---	260	---	500-700	---	20 L; 18 T	
DIN 2393-2:1994	St 52-3	1.0570	---	BK/Hard	---	---	---	---	640	---	4	---
	St 52	1.0580	---	BK/Hard	---	---	---	---	640	---	4	---

5.1 Tubes for General and Structural Applications

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
AFNOR NF A 49-310:1994	18 MF6	---	---	BK	---	---	---	---	650	---	6	---
	TU 52 b	---	---	BK	---	---	---	---	650	---	4	---
BSI BS 6323-4:1982 AMD 2:1989	CFS 7	---	---	BKW	---	---	460	---	650	---	7	---
JIS G 3445:1988	STKM 17 C	---	---	AM, CF, or AHT	---	---	480	---	650	---	10	---
AFNOR NF A 49-310:1994	37 MF6	---	---	NBK	---	---	420	---	650-720	---	16	---
DIN 17204:1990	C 55	1.0535	---	N	≤ 16	---	370	---	670-820	---	14 L; 12 T	---
					16 < t ≤ 40	---	350	---	650-800	---	15 L; 13 T	---
					40 < t ≤ 80	---	340	---	620-770	---	15 L; 13 T	---
	Ck 55	1.1203	---	N	≤ 16	---	370	---	670-820	---	14 L; 12 T	---
					16 < t ≤ 40	---	350	---	650-800	---	15 L; 13 T	---
					40 < t ≤ 80	---	340	---	620-770	---	15 L; 13 T	---
	Cm 55	1.1209	---	N	≤ 16	---	370	---	670-820	---	14 L; 12 T	---
					16 < t ≤ 40	---	350	---	650-800	---	15 L; 13 T	---
					40 < t ≤ 80	---	340	---	620-770	---	15 L; 13 T	---
BSI BS 6323-4:1982 AMD 2:1989	CFS 8	---	---	BKW	---	---	470	---	670	---	6	---
AFNOR NF A 49-310:1994	TU 20 MV 6	---	---	BK + S	---	---	590	---	690	---	12	---

5.1 Tubes for General and Structural Applications

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
DIN 17204:1990	C 45	1.0503	---	QT (V)	≤ 8	---	490	---	700-900	---	14 L; 12 T	---
					8 < t ≤ 20	---	430	---	650-850	---	16 L; 14 T	
					20 < t ≤ 50	---	370	---	630-830	---	17 L; 15 T	
					50 < t ≤ 80	---	340	---	600-800	---	17 L; 15 T	
	Ck 45	1.1191	---	QT (V)	≤ 8	---	490	---	700-900	---	14 L; 12 T	25 J at RT
					8 < t ≤ 20	---	430	---	650-850	---	16 L; 14 T	
					20 < t ≤ 50	---	370	---	630-830	---	17 L; 15 T	
					50 < t ≤ 80	---	340	---	600-800	---	17 L; 15 T	
	Cm 45	1.1201	---	QT (V)	≤ 8	---	490	---	700-900	---	14 L; 12 T	25 J at RT
					8 < t ≤ 20	---	430	---	650-850	---	16 L; 14 T	
					20 < t ≤ 50	---	370	---	630-830	---	17 L; 15 T	
					50 < t ≤ 80	---	340	---	600-800	---	17 L; 15 T	
BSI BS 6323-4:1982 AMD 2:1989	CFS 7	---	---	BK	---	---	560	---	700	---	4	---
AFNOR NF A 49-310:1994	37 MF6	---	---	BK + S	---	---	630	---	700	---	12	---
				BK	---	---	---	---	720	---	4	---
DIN 17204:1990	C 60	1.0601	---	N	≤ 16	---	390	---	720-900	---	13 L; 11 T	---
					16 < t ≤ 40	---	370	---	700-880	---	14 L; 12 T	---
					40 < t ≤ 80	---	360	---	670-850	---	14 L; 12 T	---
	Ck 60	1.1221	---	N	≤ 16	---	390	---	720-900	---	13 L; 11 T	---
					16 < t ≤ 40	---	370	---	700-880	---	14 L; 12 T	---
					40 < t ≤ 80	---	360	---	670-850	---	14 L; 12 T	---
	Cm 60	1.1223	---	N	≤ 16	---	390	---	720-900	---	13 L; 11 T	---
					16 < t ≤ 40	---	370	---	700-880	---	14 L; 12 T	---
					40 < t ≤ 80	---	360	---	670-850	---	14 L; 12 T	---
BSI BS 6323-4:1982 AMD 2:1989	CFS 8	---	---	BK	---	---	575	---	720	---	4	---
AFNOR NF A 49-310:1994	TU 20 MV 6	---	---	BK	---	---	---	---	750	---	4	---

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	---	---	---	---

5.1 Tubes for General and Structural Applications

5.1.1B Chemical Composition of Carbon Steel Tubes for General and Structural Applications (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
DIN 2393-2:1994	RSt 34-2	1.0034	---	0.15	0.60	0.30	0.025	0.025	---	---	---	---
DIN 2394-2:1994	RSt 34-2	1.0034	---	0.15	0.60	0.30	0.025	0.025	---	---	---	---
ISO 3306:1985	R28	---	---	0.13	0.60	---	0.050	0.050	---	---	---	---
BSI BS 1717:1983	ERW C2	---	---	0.16	0.70	---	0.050	0.050	---	---	---	---
BSI BS 6323-5: 1982 AMD 2:1989	ERW 2	---	---	0.16	0.70	---	0.050	0.050	---	---	---	---
BSI BS 6323-6:1982 AMD 2:1989	CEW 2	---	---	0.16	0.70	---	0.050	0.050	---	---	---	---
AFNOR	TS 30-0	---	---	0.12	---	---	0.06	0.05	---	---	---	---
NF A 49-341:1975	TS 30-a	---	---	0.12	---	---	0.05	0.05	---	---	---	N 0.007
BSI BS 6323-5:1982 AMD 2:1989	ERW 1	---	---	0.13	0.60	---	0.050	0.050	---	---	---	---
BSI BS 1717:1983	ERW C1	---	---	0.13	0.60	---	0.050	0.050	---	---	---	---
ASTM A 513-00	1015	---	G10150	0.12-0.18	0.30-0.60	---	0.035	0.035	---	---	---	---
	1010	---	G10100	0.08-0.13	0.30-0.60	---	0.035	0.035	---	---	---	---
ASTM A 500-99	A	---	K03000	0.26	---	---	0.035	0.035	---	---	---	Cu 0.20 min
DIN 2393-2:1994	RSt 37-2	1.0038	---	0.17	0.70	0.30	0.025	0.025	---	---	---	---
DIN 2391-2:1994	St 35	1.0308	---	0.17	≥ 0.40	0.35	0.025	0.025	---	---	---	---
DIN 2394-2:1994	RSt 37-2	1.0038	---	0.17	0.70	0.30	0.025	0.025	---	---	---	---
ISO 3304:1985	R33	---	---	0.16	0.70	---	0.050	0.050	---	---	---	---
ISO 3305:1985	R33	---	---	0.16	0.70	---	0.050	0.050	---	---	---	---
ISO 3306:1985	R33	---	---	0.16	0.70	---	0.050	0.050	---	---	---	---
BSI BS 6323-2:1982 AMD 2:1989	HFW 2	---	---	0.16	0.70	---	0.050	0.050	---	---	---	---
ISO 2937:1974	TS 1	---	---	0.16	0.30-0.70	---	0.050	0.050	---	---	---	---
AFNOR NF A 49-310:1994	TU 37 b	---	---	0.18	0.80	0.35	0.040	0.040	---	---	---	---
AFNOR NF A 49-341:1975	TS 34-a	---	---	0.15	---	---	0.05	0.05	---	---	---	N 0.007
ASTM A 519-96	1020	---	G10200	0.18-0.23	0.30-0.60	---	0.040	0.050	---	---	---	---
ASTM A 513-00	1015	---	G10150	0.12-0.18	0.30-0.60	---	0.035	0.035	---	---	---	---
	1008	---	G10080	0.10	0.50	---	0.035	0.035	---	---	---	---

NOTE: This section continued on next page.

5.1 Tubes for General and Structural Applications

5.1.1B Chemical Composition of Carbon Steel Tubes for General and Structural Applications (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ISO 3304:1985	R37	---	---	0.17	0.8	0.35	0.050	0.050	---	---	---	---
ISO 3305:1985	R37	---	---	0.17	0.8	0.35	0.050	0.050	---	---	---	---
ISO 3306:1985	R37	---	---	0.17	0.8	0.35	0.050	0.050	---	---	---	---
BSI BS 6323-4:1982 AMD 2:1989	CFS 3	---	---	0.20	0.90	0.35	0.050	0.050	---	---	---	---
	CFS 3A	---	---	0.20	0.60-1.00	0.10-0.35	0.050	0.050	---	---	---	---
BSI BS 6323-5: 1982 AMD 2:1989	ERW 3	---	---	0.20	0.90	0.35	0.050	0.050	---	---	---	---
BSI BS 6323-6:1982 AMD 2:1989	CEW 3	---	---	0.20	0.90	0.35	0.050	0.050	---	---	---	---
JIS G 3445:1988	STKM 12 A	---	---	0.20	0.60	0.35	0.040	0.040	---	---	---	---
JIS G 3472:1988	STAM 340 G	---	---	0.20	0.60	0.35	0.035	0.035	---	---	---	---
BSI BS 1717:1983	ERW C3	---	---	0.20	0.90	0.35	0.050	0.050	---	---	---	---
	ERW C2	---	---	0.16	0.70	---	0.050	0.050	---	---	---	---
ASTM A 513-00	1020	---	G10200	0.17-0.23	0.30-0.60	---	0.035	0.035	---	---	---	---
	1021	---	G10210	0.17-0.23	0.30-0.90	---	0.035	0.035	---	---	---	---
ASTM A 512-96	MT 1020	---	G10200	0.15-0.25	0.30-0.60	---	0.04	0.045	---	---	---	---

5.1 Tubes for General and Structural Applications

5.1.1B Chemical Composition of Carbon Steel Tubes for General and Structural Applications (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								Others
				C	Mn	Si	P	S	Cr	Ni	Mo	
AFNOR NF A 49-341:1975	TS 30-a	---	---	0.12	---	---	0.05	0.05	---	---	---	N 0.007
ISO 3304:1985	R28	---	---	0.10	0.30	---	0.040	0.040	---	---	---	---
ISO 3305:1985	R28	---	---	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 513-00	1020	---	G10200	0.17-0.23	0.30-0.60	---	0.035	0.035	---	---	---	---
AFNOR NF A 49-341:1975	TS 30-0	---	---	0.12	---	---	0.06	0.05	---	---	---	---
AFNOR NF A 49-111:1978	TU 37-a	---	---	0.24	1.30	---	0.05	0.05	---	---	---	---
BSI BS 6323-4:1982 AMD 2:1989	CFS 3	---	---	0.20	0.90	0.35	0.050	0.050	---	---	---	---
	CFS 3A	---	---	0.20	0.60-1.00	0.10-0.35	0.050	0.050	---	---	---	---
BSI BS 6323-5: 1982 AMD 2:1989	ERW 3	---	---	0.20	0.90	0.35	0.050	0.050	---	---	---	---
BSI BS 6323-6:1982 AMD 2:1989	CEW 3	---	---	0.20	0.90	0.35	0.050	0.050	---	---	---	---
ISO 2937:1974	TS 4	---	---	0.17	0.40-0.80	0.35	0.045	0.045	---	---	---	---
ISO 3304:1985	R37	---	---	0.17	0.8	0.35	0.050	0.050	---	---	---	---
ISO 3305:1985	R37	---	---	0.17	0.8	0.35	0.050	0.050	---	---	---	---
ISO 3306:1985	R37	---	---	0.17	0.8	0.35	0.050	0.050	---	---	---	---
BSI BS 1717:1983	CFS C3	---	---	0.20	0.90	0.35	0.050	0.050	---	---	---	---
	ERW C3	---	---	0.20	0.90	0.35	0.050	0.050	---	---	---	---
	CEW C3	---	---	0.20	0.90	0.35	0.050	0.050	---	---	---	---
BSI BS 6323-2:1982 AMD 2:1989	HFW 3	---	---	0.20	0.90	0.35	0.050	0.050	---	---	---	---
BSI BS 6323-3:1982 AMD 2:1989	HFS 3	---	---	0.20	0.90	0.35	0.050	0.050	---	---	---	---
AFNOR NF A 49-311:1974	TU 37-b	---	---	0.18	0.75	0.35	0.04	0.04	---	---	---	---
AFNOR NF A 49-141:1978	TS 37-a (NE)	---	---	0.20	1.30	---	0.05	0.05	---	---	---	N 0.008
AFNOR NF A 49-250:1979	TS E 24-a	---	---	0.18	1.20	---	0.045	0.045	---	---	---	---

NOTE: This section continued on next page.

5.1 Tubes for General and Structural Applications

5.1.1B Chemical Composition of Carbon Steel Tubes for General and Structural Applications (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
AFNOR NF A 49-343:1980	TS 37 b	---	---	0.18	0.81	0.38	0.045	0.045	---	---	---	---
AFNOR NF A 49-310:1994	TU 37 b	---	---	0.18	0.80	0.35	0.040	0.040	---	---	---	---
	S 100	---	---	0.12	0.70-1.10	0.10-0.35	0.030	0.080-0.130	---	---	---	---
BSI BS 1717:1983	ERW C5	---	---	0.15	1.20	0.35	0.040	0.040	---	---	---	---
ASTM A 519-96	1025	---	G10250	0.22-0.28	0.30-0.60	---	0.040	0.050	---	---	---	---
AFNOR NF A 49-341:1975	TS 34-a	---	---	0.15	---	---	0.05	0.05	---	---	---	N 0.007
ISO 3304:1985	R33	---	---	0.16	0.70	---	0.050	0.050	---	---	---	---
ISO 3305:1985	R33	---	---	0.16	0.70	---	0.050	0.050	---	---	---	---
JIS G 3473:1988	STC 370	---	---	0.25	0.30-0.90	0.35	0.040	0.040	---	---	---	---
JIS G 3445:1988	STKM 13 A	---	---	0.25	0.30-0.90	0.35	0.040	0.040	---	---	---	---
BSI BS 6323-6:1982 AMD 2:1989	CEW 2	---	---	0.16	0.70	---	0.050	0.050	---	---	---	---
ASTM A 513-00	1021	---	G10210	0.17-0.23	0.30-0.90	---	0.035	0.035	---	---	---	---
ASTM A 519-96	1020	---	G10200	0.18-0.23	0.30-0.60	---	0.040	0.050	---	---	---	---
ASTM A 512-96	MT 1025	---	G10250	---	---	---	---	---	---	---	---	---
ASTM A 519-96	1025	---	G10250	0.22-0.28	0.30-0.60	---	0.040	0.050	---	---	---	---
ASTM A 513-00	1025	---	G10250	0.22-0.28	0.30-0.60	---	0.035	0.035	---	---	---	---
	1008	---	G10080	0.10	0.50	---	0.035	0.035	---	---	---	---
	1010	---	G10100	0.08-0.13	0.30-0.60	---	0.035	0.035	---	---	---	---
	1015	---	G10150	0.12-0.18	0.30-0.60	---	0.035	0.035	---	---	---	---
AFNOR NF A 49-341:1975	TS 30-a	---	---	0.12	---	---	0.05	0.05	---	---	---	N 0.007
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	---	---	---	---
AFNOR NF A 49-141:1978	TS 37-a (NE)	---	---	0.20	1.30	---	0.05	0.05	---	---	---	N 0.008
DIN 2393-2:1994	St 44-2	---	---	0.21	1.10	0.30	0.025	0.025	---	---	---	---
DIN 2391-2:1994	St 35	1.0308	---	0.17	≥ 0.40	0.35	0.025	0.025	---	---	---	---
DIN 2394-2:1994	RSt 37-2	1.0038	---	0.17	0.70	0.30	0.025	0.025	---	---	---	---
	St 44-2	1.0044	---	0.21	1.10	0.30	0.025	0.025	---	---	---	---
AFNOR NF A 49-310:1994	TU 37 b	---	---	0.18	0.80	0.35	0.040	0.040	---	---	---	---
JIS G 3472:1988	STAM 390 G	---	---	0.25	0.30-0.90	0.35	0.035	0.035	---	---	---	---
JIS G 3445:1988	STKM 12 B	---	---	0.20	0.60	0.35	0.040	0.040	---	---	---	---

5.1 Tubes for General and Structural Applications

5.1.1B Chemical Composition of Carbon Steel Tubes for General and Structural Applications (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ISO 3304:1985	R28	---	---	0.10	0.30	---	0.040	0.040	---	---	---	---
	R37	---	---	0.17	0.8	0.35	0.050	0.050	---	---	---	---
	R44	---	---	0.21	1.2	0.35	0.050	0.050	---	---	---	---
ISO 3305:1985	R28	---	---	0.13	0.60	---	0.050	0.050	---	---	---	---
	R37	---	---	0.17	0.8	0.35	0.050	0.050	---	---	---	---
	R44	---	---	0.21	1.2	0.35	0.050	0.050	---	---	---	---
ISO 3306:1985	R37	---	---	0.17	0.8	0.35	0.050	0.050	---	---	---	---
	R44	---	---	0.21	1.2	0.35	0.050	0.050	---	---	---	---
BSI BS 6323-4:1982 AMD 2:1989	CFS 4	---	---	0.25	1.20	0.35	0.050	0.050	---	---	---	---
BSI BS 6323-5: 1982 AMD 2:1989	ERW 4	---	---	0.25	1.20	0.35	0.050	0.050	---	---	---	---
BSI BS 6323-6:1982 AMD 2:1989	CEW 4	---	---	0.25	1.20	0.35	0.050	0.050	---	---	---	---
BSI BS 6323-4:1982 AMD 2:1989	CFS 3	---	---	0.20	0.90	0.35	0.050	0.050	---	---	---	---
	CFS 3A	---	---	0.20	0.60-1.00	0.10-0.35	0.050	0.050	---	---	---	---
BSI BS 6323-6:1982 AMD 2:1989	CEW 3	---	---	0.20	0.90	0.35	0.050	0.050	---	---	---	---
BSI BS 6323-5: 1982 AMD 2:1989	ERW 3	---	---	0.20	0.90	0.35	0.050	0.050	---	---	---	---
BSI BS 1717:1983	ERW C3	---	---	0.20	0.90	0.35	0.050	0.050	---	---	---	---
BSI BS 6323-6:1982 AMD 2:1989	CEW 1	---	---	0.13	0.60	---	0.050	0.050	---	---	---	---
JIS G 3444:1994	STK400	---	---	0.25	---	---	0.040	0.040	---	---	---	---
ASTM A 500-99	D	---	---	0.26	---	---	0.035	0.035	---	---	---	Cu ≥ 0.20
ASTM A 501-99	---	---	K03000	0.26	---	---	0.035	0.035	---	---	---	Cu ≥ 0.20
ASTM A 500-99	B	---	K03000	0.26	---	---	0.035	0.035	---	---	---	Cu ≥ 0.20
DIN 2393-2:1994	RSt 34-2	1.0034	---	0.15	0.60	0.30	0.025	0.025	---	---	---	---
AFNOR NF A 49-341:1975	TS 34-a	---	---	0.15	---	---	0.05	0.05	---	---	---	N 0.007
DIN 2394-2:1994	St 44-2	1.0044	---	0.21	1.10	0.30	0.025	0.025	---	---	---	---

Note: this section continued on next page.

5.1 Tubes for General and Structural Applications

5.1.1B Chemical Composition of Carbon Steel Tubes for General and Structural Applications (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
BSI BS 1717:1983	CFS C4	---	---	0.25	0.6-1.0	0.35	0.050	0.050	---	---	---	---
BSI BS 6323-3:1982 AMD 2:1989	HFW 4	---	---	---	---	---	---	---	---	---	---	---
BSI BS 6323-3:1982 AMD 2:1989	HFS 4	---	---	0.25	1.20	0.35	0.050	0.050	---	---	---	---
BSI BS 6323-7:1982 AMD 2:1989	SAW 4	---	---	0.25	1.20	0.35	0.050	0.050	---	---	---	---
AFNOR NF A 49-250:1979	TS E 26-b	---	---	0.20	1.30	0.40	0.045	0.045	---	---	---	---
ISO 2937:1974	TS 9	---	---	0.21	0.40-1.20	0.35	0.045	0.045	---	---	---	---
DIN 2393-2:1994	St 44-2	1.0044	---	0.21	1.10	0.30	0.025	0.025	---	---	---	---
JIS G 3445:1988	STKM 14 A	---	---	0.30	0.30-1.00	0.35	0.040	0.040	---	---	---	---
ASTM A 519-96	1035	---	G10350	0.32-0.38	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 513-00	1026	---	G10260	0.22-0.28	0.60-0.90	---	0.035	0.035	---	---	---	---
	1030	---	G10300	0.27-0.34	0.60-0.90	---	0.035	0.035	---	---	---	---
	1008	---	G10080	0.10 max	0.50 max	---	0.035	0.035	---	---	---	---
	1010	---	G10100	0.08-0.13	0.30-0.60	---	0.035	0.035	---	---	---	---
	1015	---	G10150	0.12-0.18	0.30-0.60	---	0.035	0.035	---	---	---	---
	1020	---	G10200	0.17-0.23	0.30-0.60	---	0.035	0.035	---	---	---	---
DIN 2391-2:1994	St 35	1.0308	---	0.17	≥ 0.40	0.35	0.025	0.025	---	---	---	---
AFNOR NF A 49-141:1978	TS 37-a (NE)	---	---	0.20	1.30	---	≤ 0.05	≤ 0.05	---	---	---	N 0.008
ISO 3304:1985	R33	---	---	0.16	0.70	---	0.050	0.050	---	---	---	---
ISO 3305:1985	R33	---	---	0.16	0.70	---	0.050	0.050	---	---	---	---
DIN 17204:1990	C 22	1.0402	---	0.17-0.24	0.30-0.60	0.40	0.045	0.045	---	---	---	---
	Ck 22	1.1151	---	0.17-0.24	0.30-0.60	0.40	0.035	0.035	---	---	---	---
	Cm 22	1.1149	---	0.17-0.24	0.30-0.60	0.40	0.035	0.020-0.035	---	---	---	---
BSI BS 6323-6:1982 AMD 2:1989	CEW 2	---	---	0.16	0.70	---	0.050	0.050	---	---	---	---
ASTM A 500-99	C	---	K02705	0.23	1.35	---	0.035	0.035	---	---	---	Cu ≥ 0.20
ASTM A 513-00	1021	---	G10210	0.17-0.23	0.60-0.90	---	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	---	---	---	---

Note: this section continued on next page.

5.1 Tubes for General and Structural Applications

5.1.1B Chemical Composition of Carbon Steel Tubes for General and Structural Applications (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
AFNOR NF A 49-341:1975	TS 42-a	---	---	0.21	1.30	0.40	0.05	0.05	---	---	---	---
BSI BS 1717:1983	ERW C5	---	---	0.15	1.20	0.35	0.040	0.040	---	---	---	---
ASTM A 512-96	MT 1010	---	G10100	0.05-0.15	0.30-0.60	---	0.04	0.045	---	---	---	---
	1110	---	G11100	0.08-0.15	0.30-0.60	---	0.040	0.130	---	---	---	---
DIN 2393-2:1994	RSt 37-2	1.0038	---	0.17	0.70	0.30	0.025	0.025	---	---	---	---
DIN 2394-2:1994	St 44-2	1.0044	---	0.21	1.10	0.30	0.025	0.025	---	---	---	---
AFNOR NF A 49-310:1994	TU 37 b	---	---	0.18	0.80	0.35	0.040	0.040	---	---	---	---
DIN 2391-2:1994	St 45	---	---	0.21	≥ 0.40	0.35	0.025	0.025	---	---	---	---
JIS G 3445:1988	STKM 18 A	---	---	0.18	1.50	0.55	0.040	0.040	---	---	---	---
BSI BS 6323-4:1982 AMD 2:1989	CFS 6	---	---	0.30-0.40	0.50-0.90	0.35	0.050	0.050	---	---	---	---
JIS G 3445:1988	STKM 13 B	---	---	0.25	0.30-0.90	0.35	0.040	0.040	---	---	---	---
JIS G 3472:1988	STAM 440 G	---	---	0.25	0.30-0.90	0.35	0.035	0.035	---	---	---	---
JIS G 3473:1988	STC 440	---	---	0.25	0.30-0.90	0.35	0.040	0.040	---	---	---	---
JIS G 3472:1988	STAM 440 H	---	---	0.25	0.30-0.90	0.35	0.035	0.035	---	---	---	---
AFNOR NF A 49-310:1994	S 100	---	---	0.12	0.70-1.10	0.10-0.35	0.030	0.080-0.130	---	---	---	---
ASTM A 519-96	1045	---	G10450	0.43-0.50	0.60-0.90	---	0.040	0.050	---	---	---	---
	1035	---	G10350	0.32-0.38	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 513-00	1035	---	G10350	0.31-0.38	0.60-0.90	---	0.035	0.035	---	---	---	---
	1040	---	G10400	0.36-0.44	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 519-96	1020	---	G10200	0.18-0.23	0.30-0.60	---	0.040	0.050	---	---	---	---
ASTM A 513-00	1025	---	G10250	0.22-0.28	0.30-0.60	---	0.035	0.035	---	---	---	---
ASTM A 512-96	MT 1030	---	G10300	---	---	---	---	---	---	---	---	---
	1011	---	G10110	---	---	---	---	---	---	---	---	---

5.1 Tubes for General and Structural Applications

5.1.1B Chemical Composition of Carbon Steel Tubes for General and Structural Applications (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ISO 3304:1985	R37	---	---	0.17	0.8	0.35	0.050	0.050	---	---	---	---
	R44	---	---	0.21	1.2	0.35	0.050	0.050	---	---	---	---
ISO 3305:1985	R37	---	---	0.17	0.8	0.35	0.050	0.050	---	---	---	---
	R44	---	---	0.21	1.2	0.35	0.050	0.050	---	---	---	---
BSI BS 6323-4:1982 AMD 2:1989	CFS 4	---	---	0.25	1.20	0.35	0.050	0.050	---	---	---	---
BSI BS 6323-6:1982 AMD 2:1989	CEW 4	---	---	0.25	1.20	0.35	0.050	0.050	---	---	---	---
BSI BS 6323-5: 1982 AMD 2:1989	ERW 4	---	---	0.25	1.20	0.35	0.050	0.050	---	---	---	---
BSI BS 1717:1983	CFS C3	---	---	0.20	0.90	0.35	0.050	0.050	---	---	---	---
	CEW C3	---	---	0.20	0.90	0.35	0.050	0.050	---	---	---	---
BSI BS 6323-4:1982 AMD 2:1989	CFS 3	---	---	0.20	0.90	0.35	0.050	0.050	---	---	---	---
	CFS 3A	---	---	0.20	0.60-1.00	0.10-0.35	0.050	0.050	---	---	---	---
BSI BS 6323-6:1982 AMD 2:1989	CEW 3	---	---	0.20	0.90	0.35	0.050	0.050	---	---	---	---
ASTM A 595-98	A	---	K02004	0.15-0.25	0.30-0.90	---	0.035	0.035	---	---	---	---
ASTM A 513-00	1035	---	G10350	0.31-0.38	0.60-0.90	---	0.035	0.035	---	---	---	---
	1524	---	G15240	0.18-0.25	1.35-1.65	---	0.040	0.050	---	---	---	---
	1040	---	G10400	0.36-0.44	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 512-96	MT 1015	---	G10150	0.10-0.20	0.30-0.60	---	0.04	0.045	---	---	---	---
AFNOR NF A 49-341:1975	TS 37-a	---	---	0.19	---	---	0.05	0.05	---	---	---	N 0.007
DIN 2393-2:1994	RSt 34-2	1.0034	---	0.15	0.60	0.30	0.025	0.025	---	---	---	---
BSI BS 6323-4:1982 AMD 2:1989	CFS 6	---	---	0.30-0.40	0.50-0.90	0.35	0.050	0.050	---	---	---	---
ASTM A 512-96*	1016	---	G10160	0.12-0.18	0.60-0.90	0.040	0.045	---	---	---	---	---
	MT 1017	---	G10170	---	---	---	---	---	---	---	---	---
ASTM A 519-96	1050	---	G10500	0.48-0.55	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 513-00	1021	---	G10210	0.17-0.23	0.30-0.90	---	0.035	0.035	---	---	---	---
ASTM A 512-96*	1018	---	G10180	0.14-0.20	0.60-0.90	---	0.040	0.045	---	---	---	---

Note: this section continued on next page.

5.1 Tubes for General and Structural Applications

5.1.1B Chemical Composition of Carbon Steel Tubes for General and Structural Applications (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
AFNOR NF A 49-341:1975	TS 42-a	---	---	0.21	1.30	0.40	0.05	0.05	---	---	---	---
JIS G 3445:1988	STKM 15 A	---	---	0.25-0.35	0.30-1.00	0.35	0.040	0.040	---	---	---	---
JIS G 3472:1988	STAM 470 G	---	---	0.25	0.30-0.90	0.35	0.035	0.035	---	---	---	---
JIS G 3445:1988	STKM 12 C	---	---	0.20	0.60	0.35	0.040	0.040	---	---	---	---
JIS G 3472:1988	STAM 470 H	---	---	0.25	0.30-0.90	0.35	0.035	0.035	---	---	---	---
ISO 3304:1985	R50	---	---	0.23	1.6	0.55	0.050	0.050	---	---	---	---
ISO 3305:1985	R50	---	---	0.23	1.6	0.55	0.050	0.050	---	---	---	---
ISO 3306:1985	R50	---	---	0.23	1.6	0.55	0.050	0.050	---	---	---	---
DIN 2391-2:1994	St 35	1.0308	---	0.17	≥ 0.40	0.35	0.025	0.025	---	---	---	---
AFNOR NF A 49-341:1975	TS 47-a	---	---	0.21	1.55	0.55	0.05	0.05	---	---	---	---
ASTM A 595-98	B	---	K02005	0.15-0.25	0.40-1.35	---	0.035	0.035	---	---	---	---
ASTM A 519-96	1025	---	G10250	0.22-0.28	0.30-0.60	---	0.040	0.050	---	---	---	---
ASTM A 513-00	1026	---	G10260	0.22-0.28	0.60-0.90	---	0.035	0.035	---	---	---	---
	1020	---	G10200	0.17-0.23	0.30-0.60	---	0.035	0.035	---	---	---	---
ASTM A 519-96	1020	---	G10200	0.18-0.23	0.30-0.60	---	0.040	0.050	---	---	---	---
ASTM A 513-00	1025	---	G10250	0.22-0.28	0.30-0.60	---	0.035	0.035	---	---	---	---
	1030	---	G10300	0.27-0.34	0.60-0.90	---	0.035	0.035	---	---	---	---
DIN 2393-2:1994	RSt 37-2	1.0038	---	0.17	0.70	0.30	0.025	0.025	---	---	---	---
	St 52-3	---	---	0.22	1.60	0.55	0.025	0.025	---	---	---	---
DIN 2394-2:1994	St 52-3	1.0570	---	0.22	1.60	0.55	0.025	0.025	---	---	---	---
AFNOR NF A 49-310:1994	TU 52 b	---	---	0.20	1.50	0.50	0.040	0.040	---	---	---	---
JIS G 3444:1994	STK 490	---	---	0.18	1.50	0.55	0.040	0.040	---	---	---	---
JIS G 3445:1988	STKM 18 B	---	---	0.18	1.50	0.55	0.040	0.040	---	---	---	---
	STKM 19 A	---	---	0.25	1.50	0.55	0.040	0.040	---	---	---	---
BSI BS 6323-4:1982 AMD 2:1989	CFS 5	---	---	0.23	1.50	0.50	0.050	0.050	---	---	---	---
BSI BS 6323-5: 1982 AMD 2:1989	ERW 5	---	---	0.23	1.50	0.50	0.050	0.050	---	---	---	---
BSI BS 6323-6:1982 AMD 2:1989	CEW 5	---	---	0.23	1.50	0.50	0.050	0.050	---	---	---	---

Note: this section continued on next page.

5.1 Tubes for General and Structural Applications

5.1.1B Chemical Composition of Carbon Steel Tubes for General and Structural Applications (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
BSI BS 6323-2:1982 AMD 2:1989	HFW 5	---	---	0.23	1.50	0.35	0.050	0.050	---	---	---	---
BSI BS 6323-3:1982 AMD 2:1989	HFS 5	---	---	0.23	1.50	0.50	0.050	0.050	---	---	---	---
BSI BS 6323-7:1982 AMD 2:1989	SAW 5	---	---	0.23	1.50	0.50	0.050	0.050	---	---	---	---
DIN 2391-2:1994	St 52	---	---	0.22	1.60	0.55	0.025	0.025	---	---	---	---
ISO 2937:1974	TS 18	---	---	0.23	0.80-1.50	0.35	0.045	0.045	---	---	---	---
ASTM A 512-96	MT 1020	---	G10200	0.15-0.25	0.30-0.60	---	0.04	0.045	---	---	---	---
ASTM A 513-00	1021	---	G10210	0.17-0.23	0.30-0.90	---	0.035	0.035	---	---	---	---
ASTM A 519-96	1025	---	G10250	0.22-0.28	0.30-0.60	---	0.040	0.050	---	---	---	---

5.1 Tubes for General and Structural Applications

5.1.1B Chemical Composition of Carbon Steel Tubes for General and Structural Applications (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
DIN 17204:1990	C 22	1.0402	---	0.17-0.24	0.30-0.60	0.40	0.045	0.045	---	---	---	---
	Ck 22	1.1151	---	0.17-0.24	0.30-0.60	0.40	0.035	0.035	---	---	---	---
	Cm 22	1.1149	---	0.17-0.24	0.30-0.60	0.40	0.035	0.020-0.035	---	---	---	---
JIS G 3444:1994	STK500	---	---	0.24	0.30-1.30	0.35	0.040	0.040	---	---	---	---
JIS G 3472:1988	STAM 500 G	---	---	0.30	0.30-1.00	0.35	0.035	0.035	---	---	---	---
JIS G 3445:1988	STKM 14 B	---	---	0.30	0.30-1.00	0.35	0.040	0.040	---	---	---	---
JIS G 3472:1988	STAM 500 H	---	---	0.30	0.30-1.00	0.35	0.035	0.035	---	---	---	---
BSI BS 6323-5: 1982 AMD 2:1989	ERW 5	---	---	0.23	1.50	0.50	0.050	0.050	---	---	---	---
AFNOR NF A 49-341:1975	TS 42-a	---	---	0.21	1.30	0.40	0.05	0.05	---	---	---	---
AFNOR NF A 49-310:1994	S 100	---	---	0.12	0.70-1.10	0.10-0.35	0.030	0.080-0.130	---	---	---	---
DIN 2393-2:1994	St 44-2	---	---	0.21	1.10	0.30	0.025	0.025	---	---	---	---
BSI BS 6323-4:1982 AMD 2:1989	CFS 8	---	---	0.40-0.55	0.50-0.90	0.35	0.050	0.050	---	---	---	---
JIS G 3445:1988	STKM 16 A	---	---	0.35-0.45	0.40-1.00	0.40	0.040	0.040	---	---	---	---
AFNOR NF A 49-311:1974	TU 52-b	---	---	0.20	1.5	0.50	0.04	0.04	---	---	---	---
AFNOR NF A 49-343:1980	TS 18 M 5	---	---	0.22	1.6	0.55	0.045	0.045	---	---	---	---
AFNOR NF A 49-310:1994	TU 52 b	---	---	0.20	1.50	0.50	0.040	0.040	---	---	---	---
JIS G 3445:1988	STKM 13 C	---	---	0.25	0.30-0.90	0.35	0.040	0.040	---	---	---	---
	STKM 18 C	---	---	0.18	1.50	0.55	0.040	0.040	---	---	---	---
JIS G 3473:1988	STC 510A	---	---	0.25	0.30-0.90	0.35	0.040	0.040	---	---	---	---
	STC 510B	---	---	0.18	1.50	0.55	0.040	0.040	---	---	---	---
ASTM A 519-96	1045	---	G10450	0.43-0.50	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 513-00	1025	---	G10250	0.22-0.28	0.30-0.60	---	0.035	0.035	---	---	---	---
ASTM A 519-96	1025	---	G10250	0.22-0.28	0.30-0.60	---	0.040	0.050	---	---	---	---
ASTM A 513-00	1026	---	G10260	0.22-0.28	0.60-0.90	---	0.035	0.035	---	---	---	---
ASTM A 519-96	1035	---	G10350	0.32-0.38	0.60-0.90	---	0.040	0.050	---	---	---	---
AFNOR NF A 49-341:1975	TS 47-a	---	---	0.21	1.55	0.55	0.05	0.05	---	---	---	---

Note: this section continued on next page.

5.1 Tubes for General and Structural Applications

5.1.1B Chemical Composition of Carbon Steel Tubes for General and Structural Applications (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ISO 3304:1985	R44	---	---	0.21	1.2	0.35	0.050	0.050	---	---	---	---
ISO 3305:1985	R44	---	---	0.21	1.2	0.35	0.050	0.050	---	---	---	---
ISO 3306:1985	R50	---	---	0.23	1.6	0.55	0.050	0.050	---	---	---	---
AFNOR NF A 49-310:1994	TU 20 MV 6	---	---	0.22	1.70	0.50	0.040	0.040	---	---	---	V 0.15
DIN 2391-2:1994	St 35	1.0308	---	0.17	≥ 0.40	0.35	0.025	0.025	---	---	---	---
DIN 17204:1990	C 35	1.0501	---	0.32-0.39	0.50-0.80	0.40	0.045	0.045	---	---	---	---
	Ck 35	1.1181	---	0.32-0.39	0.50-0.80	0.40	0.035	0.035	---	---	---	---
	Cm 35	1.1180	---	0.32-0.39	0.50-0.80	0.40	0.035	0.020-0.035	---	---	---	---
AFNOR NF A 49-310:1994	18 MF6	---	---	0.14-0.20	1.30-1.60	0.10-0.35	0.030	0.080-0.130	---	---	---	---
BSI BS 1717:1983	CFS C4	---	---	0.25	0.60-1.00	0.35	0.050	0.050	---	---	---	---
BSI BS 6323-4:1982 AMD 2:1989	CFS 4	---	---	0.25	1.20	0.35	0.050	0.050	---	---	---	---
BSI BS 6323-6:1982 AMD 2:1989	CEW 4	---	---	0.25	1.20	0.35	0.050	0.050	---	---	---	---
ASTM A 519-96	1050	---	G10500	0.48-0.55	0.60-0.90	---	0.040	0.050	---	---	---	---
AFNOR NF A 49-311:1974	TU XC 35	---	---	0.32-0.38	0.50-0.80	0.15-0.40	0.035	0.035	---	---	---	---
DIN 2394-2:1994	St 52-3	1.0570	---	0.22	1.60	0.55	0.025	0.025	---	---	---	---
ISO 2937:1974	C 35	---	---	0.32-0.39	0.50-0.80	0.15-0.40	0.035	0.035	---	---	---	---
BSI BS 1717:1983	HFS 8	---	---	0.40-0.55	0.50-0.90	0.35	0.050	0.050	---	---	---	---
BSI BS 6323-4:1982 AMD 2:1989	CFS 8	---	---	0.40-0.55	0.50-0.90	0.35	0.050	0.050	---	---	---	---
	CFS 6	---	---	0.30-0.40	0.50-0.90	0.35	0.050	0.050	---	---	---	---
JIS G 3444:1994	STK540	---	---	0.23	1.50	0.55	0.040	0.040	---	---	---	---
JIS G 3445:1988	STKM 20 A	---	---	0.25	1.60	0.55	0.040	0.040	---	---	---	Nb or V 0.15
JIS G 3473:1988	STC 540	---	---	0.25	1.60	0.55	0.040	0.040	---	---	---	Nb or V 0.15
JIS G 3474:1995	STKT 540	---	---	0.23	1.50	0.55	0.040	0.040	---	---	---	---
JIS G 3472:1988	STAM 540 H	---	---	0.30	0.30-1.00	0.35	0.035	0.035	---	---	---	---

5.1 Tubes for General and Structural Applications

5.1.1B Chemical Composition of Carbon Steel Tubes for General and Structural Applications (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ISO 3304:1985	R50	---	---	0.23	1.6	0.55	0.050	0.050	---	---	---	---
ISO 3305:1985	R50	---	---	0.23	1.6	0.55	0.050	0.050	---	---	---	---
AFNOR NF A 49-310:1994	TU 52 b	---	---	0.20	1.50	0.50	0.040	0.040	---	---	---	---
AFNOR NF A 49-311:1974	TU 56-b	---	---	0.42	0.95	0.35	0.04	0.04	---	---	---	---
JIS G 3445:1988	STKM 17 A	---	---	0.45-0.55	0.40-1.00	0.40	0.040	0.040	---	---	---	---
BSI BS 6323-4:1982 AMD 2:1989	CFS 5	---	---	0.23	1.50	0.50	0.050	0.050	---	---	---	---
BSI BS 6323-6:1982 AMD 2:1989	CEW 5	---	---	0.23	1.50	0.50	0.050	0.050	---	---	---	---
JIS G 3445:1988	STKM 14 C	---	---	0.30	0.30-1.00	0.35	0.040	0.040	---	---	---	---
	STKM 19 C	---	---	0.25	1.50	0.55	0.040	0.040	---	---	---	---
AFNOR NF A 49-310:1994	TU 20 MV 6	---	---	0.22	1.70	0.50	0.040	0.040	---	---	---	V 0.15
ASTM A 519-96	1050	---	G10500	0.48-0.55	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 513-00	1026	---	G10260	0.22-0.28	0.60-0.90	---	0.035	0.035	---	---	---	---
ASTM A 512-96	1030	---	G10300	0.27-0.34	0.60-0.90	---	0.040	0.045	---	---	---	---
ASTM A 513-00	1030	---	G10300	0.27-0.34	0.60-0.90	---	0.035	0.035	---	---	---	---
	1035	---	G10350	0.31-0.38	0.60-0.90	---	0.035	0.035	---	---	---	---
ASTM A 519-96	1045	---	G10450	0.43-0.50	0.60-0.90	---	0.040	0.050	---	---	---	---
AFNOR NF A 49-341:1975	TS 47-a	---	---	0.21	1.55	0.55	0.05	0.05	---	---	---	---
DIN 2393-2:1994	St 44-2	---	---	0.21	1.10	0.30	0.025	0.025	---	---	---	---
ASTM A 519-96	1050	---	G10500	0.48-0.55	0.60-0.90	---	0.040	0.050	---	---	---	---
DIN 2391-2:1994	St 45	---	---	0.21	≥ 0.40	0.35	0.025	0.025	---	---	---	---
	St 52	---	---	0.22	1.60	0.55	0.025	0.025	---	---	---	---
JIS G 3445:1988	STKM 15 C	---	---	0.25-0.35	0.30-1.00	0.35	0.040	0.040	---	---	---	---
ASTM A 513-00	1030	---	G10300	0.27-0.34	0.60-0.90	---	0.035	0.035	---	---	---	---
	1035	---	G10350	0.31-0.38	0.60-0.90	---	0.035	0.035	---	---	---	---
ASTM A 519-96	1035	---	G10350	0.32-0.38	0.60-0.90	---	0.040	0.050	---	---	---	---
ASTM A 513-00	1040	---	G10400	0.36-0.44	0.60-0.90	---	0.040	0.050	---	---	---	---
	1524	---	G15240	0.18-0.25	1.35-1.65	---	0.040	0.050	---	---	---	---
DIN 2393-2:1994	St 52-3	---	---	0.22	1.60	0.55	0.025	0.025	---	---	---	---

Note: this section continued on next page.

5.1 Tubes for General and Structural Applications

5.1.1B Chemical Composition of Carbon Steel Tubes for General and Structural Applications (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 3474:1995	STKT 590	---	---	0.12	2.00	0.40	0.030	0.030	---	---	---	Nb+V ≤ 0.15
BSI BS 6323-4:1982 AMD 2:1989	CFS 6	---	---	0.30-0.40	0.50-0.90	0.35	0.050	0.050	---	---	---	---
JIS G 3473:1988	STC 590A	---	---	0.25	0.30-0.90	0.35	0.040	0.040	---	---	---	---
	STC 590B	---	---	0.25	1.50	0.55	0.040	0.040	---	---	---	---

5.1 Tubes for General and Structural Applications

5.1.1B Chemical Composition of Carbon Steel Tubes for General and Structural Applications (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ISO 3304:1985	R50	---	---	0.23	1.6	0.55	0.050	0.050	---	---	---	---
ISO 3305:1985	R50	---	---	0.23	1.6	0.55	0.050	0.050	---	---	---	---
BSI BS 6323-4:1982 AMD 2:1989	CFS 5	---	---	0.23	1.50	0.50	0.050	0.050	---	---	---	---
BSI BS 6323-6:1982 AMD 2:1989	CEW 5	---	---	0.23	1.50	0.50	0.050	0.050	---	---	---	---
AFNOR NF A 49-310:1994	18 MF6	---	---	0.14-0.20	1.30-1.60	0.10-0.35	0.030	0.080-0.130	---	---	---	---
	TU 52 b	---	---	0.20	1.50	0.50	0.040	0.040	---	---	---	---
AFNOR NF A 49-343:1980	TS 18 MAD 5	---	---	0.22	1.5	0.30	0.045	0.045	---	---	0.3	---
AFNOR NF A 49-310:1994	TU 20 MV 6	---	---	0.22	1.70	0.50	0.040	0.040	---	---	---	V 0.15
JIS G 3445:1988	STKM 16 C	---	---	0.35-0.45	0.40-1.00	0.40	0.040	0.040	---	---	---	---
DIN 17204:1990	C 45	1.0503	---	0.42-0.50	0.50-0.80	0.40	0.045	0.045	---	---	---	---
	Ck 45	1.1191	---	0.42-0.50	0.50-0.80	0.40	0.035	0.035	---	---	---	---
	Cm 45	1.1201	---	0.42-0.50	0.50-0.80	0.40	0.035	0.020-0.035	---	---	---	---
ASTM A 513-00	1035	---	G10350	0.31-0.38	0.60-0.90	---	0.035	0.035	---	---	---	---
	1040	---	G10400	0.36-0.44	0.60-0.90	---	0.040	0.050	---	---	---	---
	1524	---	G15240	0.18-0.25	1.35-1.65	---	0.040	0.050	---	---	---	---
ASTM A 519-96	1045	---	G10450	0.43-0.50	0.60-0.90	---	0.040	0.050	---	---	---	---
DIN 17204:1990	C 35	1.0501	---	0.32-0.39	0.50-0.80	0.40	0.045	0.045	---	---	---	---
	Ck 35	1.1181	---	0.32-0.39	0.50-0.80	0.40	0.035	0.035	---	---	---	---
	Cm 35	1.1180	---	0.32-0.39	0.50-0.80	0.40	0.035	0.020-0.035	---	---	---	---
DIN 2393-2:1994	St 52-3	---	---	0.22	1.60	0.55	0.025	0.025	---	---	---	---
DIN 2391-2:1994	St 52	---	---	0.22	1.60	0.55	0.025	0.025	---	---	---	---

5.1 Tubes for General and Structural Applications

5.1.1B Chemical Composition of Carbon Steel Tubes for General and Structural Applications (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
AFNOR NF A 49-310:1994	18 MF6	---	---	0.14-0.20	1.30-1.60	0.10-0.35	0.030	0.080-0.130	---	---	---	---
	TU 52 b	---	---	0.20	1.50	0.50	0.040	0.040	---	---	---	---
BSI BS 6323-4:1982 AMD 2:1989	CFS 7	---	---	0.20-0.30	1.20-1.50	0.35	0.050	0.050	---	---	---	---
JIS G 3445:1988	STKM 17 C	---	---	0.45-0.55	0.40-1.00	0.40	0.040	0.040	---	---	---	---
AFNOR NF A 49-310:1994	37 MF6	---	---	0.32-0.39	1.35-1.65	0.10-0.35	0.030	0.080-0.130	---	---	---	---
DIN 17204:1990	C 55	1.0535	---	0.52-0.60	0.60-0.90	0.40	0.045	0.045	---	---	---	---
	Ck 55	1.1203	---	0.52-0.60	0.60-0.90	0.40	0.035	0.035	---	---	---	---
	Cm 55	1.1209	---	0.52-0.60	0.60-0.90	0.40	0.035	0.020-0.035	---	---	---	---
BSI BS 6323-4:1982 AMD 2:1989	CFS 8	---	---	0.40-0.55	0.50-0.90	0.35	0.050	0.050	---	---	---	---
AFNOR NF A 49-310:1994	TU 20 MV 6	---	---	0.22	1.70	0.50	0.040	0.040	---	---	---	V 0.15
DIN 17204:1990	C 45	1.0503	---	0.42-0.50	0.50-0.80	0.40	0.045	0.045	---	---	---	---
	Ck 45	1.1191	---	0.42-0.50	0.50-0.80	0.40	0.035	0.035	---	---	---	---
	Cm 45	1.1201	---	0.42-0.50	0.50-0.80	0.40	0.035	0.020-0.035	---	---	---	---
BSI BS 6323-4:1982 AMD 2:1989	CFS 7	---	---	0.20-0.30	1.20-1.50	0.35	0.050	0.050	---	---	---	---
AFNOR NF A 49-310:1994	37 MF6	---	---	0.32-0.39	1.35-1.65	0.10-0.35	0.030	0.080-0.130	---	---	---	---
DIN 17204:1990	C 60	1.0601	---	0.57-0.65	0.60-0.90	0.40	0.045	0.045	---	---	---	---
	Ck 60	1.1221	---	0.57-0.65	0.60-0.90	0.40	0.035	0.035	---	---	---	---
	Cm 60	1.1223	---	0.57-0.65	0.60-0.90	0.40	0.035	0.020-0.035	---	---	---	---
BSI BS 6323-4:1982 AMD 2:1989	CFS 8	---	---	0.40-0.55	0.50-0.90	0.35	0.050	0.050	---	---	---	---
AFNOR NF A 49-310:1994	TU 20 MV 6	---	---	0.22	1.70	0.50	0.040	0.040	---	---	---	V 0.15

5.1 Tubes for General and Structural Applications

5.1.2A Chemical Composition of Alloy Steel Tubes for General and Structural Applications

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 519-96	4028	---	G40280	0.25-0.30	0.70-0.90	0.15-0.35	0.040	0.035-0.050	---	---	0.20-0.30	---
BSI BS 1717:1983	CFS C6	---	---	0.29	1.5	0.35	0.050	0.050	---	---	0.15-0.25	---
BSI BS 6323-4:1982 AMD 2:1989	CFS 9	---	---	0.29	1.50	0.35	0.050	0.050	---	---	0.15-0.25	---
ASTM A 513-00	4118	---	G41180	0.18-0.23	0.70-0.90	0.15-0.35	0.035	0.040	0.40-0.60	---	0.08-0.15	---
ASTM A 519-96	4118	---	G41180	0.18-0.23	0.70-0.90	0.15-0.35	0.040	0.040	0.40-0.60	---	0.08-0.15	---
JIS G 3441:1988	SCM 418 TK	---	---	0.16-0.21	0.60-0.85	0.15-0.35	0.030	0.030	0.90-1.20	---	0.15-0.30	---
	SCM 420 TK	---	---	0.18-0.23	0.60-0.85	0.15-0.35	0.030	0.030	0.90-1.20	---	0.15-0.30	---
BSI BS 6323-4:1982 AMD 2:1989	CFS 10	---	---	0.26	0.80	0.35	0.050	0.050	0.80-1.20	---	0.15-0.30	---
DIN 17204:1990	25 CrMo 4	1.7218	---	0.22-0.29	0.60-0.90	0.40	0.035	0.035	0.90-1.20	---	0.15-0.30	---
ASTM A 513-00	4130	---	G41300	0.28-0.33	0.40-0.60	0.15-0.35	0.035	0.040	0.80-1.10	---	0.15-0.25	---
ASTM A 519-96	4130	---	G41300	0.28-0.33	0.40-0.60	0.15-0.35	0.040	0.040	0.80-1.10	---	0.15-0.25	---
JIS G 3441:1988	SCM 430 TK	---	---	0.28-0.33	0.60-0.85	0.25-0.35	0.030	0.030	0.90-1.20	---	0.15-0.30	---
ASTM A 519-96	4135	---	G41350	0.33-0.38	0.70-0.90	0.15-0.35	0.040	0.040	0.80-1.10	---	0.15-0.25	---
JIS G 3441:1988	SCM 435 TK	---	---	0.33-0.38	0.60-0.85	0.15-0.35	0.030	0.030	0.90-1.20	---	0.15-0.30	---
DIN 17204:1990	34 CrMo 4	1.7220	---	0.30-0.37	0.60-0.90	0.40	0.035	0.035	0.90-1.20	---	0.15-0.30	---
ASTM A 519-96	4137	---	G41370	0.35-0.40	0.70-0.90	0.15-0.35	0.040	0.040	0.80-1.10	---	0.15-0.25	---
ASTM A 513-00	4140	---	G41400	0.38-0.43	0.75-1.00	0.15-0.35	0.035	0.040	0.80-1.10	---	0.15-0.25	---
ASTM A 519-96	4140	---	G41400	0.38-0.43	0.75-1.00	0.15-0.35	0.040	0.040	0.80-1.10	---	0.15-0.25	---
JIS G 3441:1988	SCM 440 TK	---	---	0.38-0.43	0.60-0.85	0.15-0.35	0.030	0.030	0.90-1.20	---	0.15-0.30	---
DIN 17204:1990	42 CrMo 4	1.7225	---	0.38-0.45	0.60-0.90	0.40	0.035	0.035	0.90-1.20	---	0.15-0.30	---
ASTM A 519-96	4142	---	G41420	0.40-0.45	0.75-1.00	0.15-0.35	0.040	0.040	0.80-1.10	---	0.15-0.25	---
ASTM A 519-96	4145	---	G41450	0.43-0.48	0.75-1.00	0.15-0.35	0.040	0.040	0.80-1.10	---	0.15-0.25	---
BSI BS 6323-4:1982 AMD 2:1989	CFS 11	---	---	0.45	1.00	0.35	0.050	0.050	0.80-1.20	---	0.15-0.30	---

5.1 Tubes for General and Structural Applications

5.1.2B Mechanical Properties of Alloy Steel Tubes for General and Structural Applications

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 519-96*	4028	---	G40280	---	---	---	---	---	---	---	---	---
BSI BS 1717:1983	CFS C6	---	---	BK	---	---	620	---	720	---	4	---
BSI	CFS 9	---	---	BK	---	---	575	---	720	---	4	---
BS 6323-4:1982 AMD 2:1989				BKW	---	---	470	---	670	---	6	---
ASTM A 513-00*	4118	---	G41180	---	---	---	---	---	---	---	---	---
ASTM A 519-96*	4118	---	G41180	---	---	---	---	---	---	---	---	---
JIS G 3441:1988	SCM 418 TK	---	---	AM, CF or A	---	---	---	---	---	---	---	---
	SCM 420 TK	---	---	AM, CF or A	---	---	---	---	---	---	---	---
BSI	CFS 10	---	---	BK	---	---	575	---	720	---	4	---
BS 6323-4:1982 AMD 2:1989				BKW	---	---	470	---	670	---	6	---
DIN 17204:1990	25 CrMo 4	1.7218	---	QT (V)	≤ 8	---	700	---	900-1100	---	12 L; 10 T	50 J at RT
					8 < t ≤ 20	---	600	---	800-1000	---	14 L; 12 T	
					20 < t ≤ 50	---	450	---	700-900	---	15 L; 13 T	50 J at RT
					50 < t ≤ 80	---	400	---	650-850	---	16 L; 14 T	45 J at RT
ASTM A 513-00*	4130	---	G41300	AW	---	---	379	55	496	72	10	80 HRB min
				N	---	---	345	50	483	50	20	100 HRB max
				MD	---	---	586	85	655	95	5	90 HRB min
				MD SR	---	---	552	80	621	90	10	87 HRB min
ASTM A 519-96*	4130	---	G41300	HR	---	---	483	70	621	90	20	89 HRB
				SR	---	---	586	85	724	105	10	95 HRB
				A	---	---	379	55	517	75	30	81 HRB
				N	---	---	414	60	621	90	20	89 HRB
JIS G 3441:1988	SCM 430 TK	---	---	AM, CF or A	---	---	686	---	834	---	---	---
ASTM A 519-96*	4135	---	G41350	AM	---	---	---	---	---	---	---	---
JIS G 3441:1988	SCM 435 TK	---	---	AM, CF or A	---	---	785	---	932	---	---	---
DIN 17204:1990	34 CrMo 4	1.7220	---	QT (V)	≤ 8	---	800	---	1100-1200	---	11 L; 9 T	40 J at RT
					8 < t ≤ 20	---	650	---	900-1100	---	12 L; 10 T	
					20 < t ≤ 50	---	550	---	800-1000	---	14 L; 12 T	45 J at RT
					50 < t ≤ 80	---	500	---	750-950	---	15 L; 13 T	45 J at RT
ASTM A 519-96*	4137	---	G41370	---	---	---	---	---	---	---	---	---

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

5.1 Tubes for General and Structural Applications

5.1.2B Mechanical Properties of Alloy Steel Tubes for General and Structural Applications (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 513-00*	4140	---	G41400	AW	---	---	485	70	621	90	10	85 HRB min
				N	---	---	448	65	621	90	20	105 HRB max
				MD	---	---	690	100	758	110	5	90 HRB min
				MD SR	---	---	655	95	724	105	10	90 HRB min
ASTM A 519-96*	4140	---	G41400	HR	---	---	621	90	855	120	15	100 HRB
				SR	---	---	689	100	855	120	10	100 HRB
				A	---	---	414	60	552	80	25	85 HRB
				N	---	---	621	90	855	120	20	100 HRB
JIS G 3441:1988	SCM 440 TK	---	---	AM, CF or A	---	---	834	---	981	---	---	---
DIN 17204:1990	42 CrMo 4	1.7225	---	QT (V)	≤ 8	---	900	---	1100-1300	---	10 L; 8 T	35 J at RT
					8 < t ≤ 20	---	750	---	1000-1200	---	11 L; 9 T	
					20 < t ≤ 50	---	650	---	900-1100	---	12 L; 10 T	
					50 < t ≤ 80	---	550	---	800-1000	---	13 L; 11 T	
ASTM A 519-96*	4142	---	G41420	---	---	---	---	---	---	---	---	---
ASTM A 519-96*	4145	---	G41420	---	---	---	---	---	---	---	---	---
BSI BS 6323-4:1982	CFS 11	---	---	BK	---	---	575	---	720	---	4	---
AMD 2:1989				BKW	---	---	---	---	670	---	6	---

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

5.1 Tubes for General and Structural Applications

5.1.3.1A Chemical Composition of Ferritic and Martensitic Stainless Steel Tubes for General and Structural Applications

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 268/A 268M-00	TP405	---	S40500	0.08	1.00	1.00	0.040	0.030	11.5-14.5	0.50	---	Al 0.10-0.30
ASTM A 511-96	MT 405	---	---	0.08	1.00	1.00	0.040	0.030	11.5-14.5	0.50	---	Al 0.10-0.30
DIN 17456:1999	X6CrAl13	1.4002	---	0.08	1.00	1.00	0.040	0.015	12.00-14.00	---	---	Al 0.10-0.30
ASTM A 268/A 268M-00	TP410	---	S41000	0.15	1.00	1.00	0.040	0.030	11.5-13.5	---	---	---
ASTM A 511-96	MT 410	---	---	0.15	1.00	1.00	0.040	0.030	11.5-13.5	0.50	---	---
JIS G 3446:1994	SUS410TKA	---	---	0.15	1.00	1.00	0.040	0.030	11.50-13.50	---	---	---
	SUS410TKC	---	---	0.15	1.00	1.00	0.040	0.030	11.50-13.50	---	---	---
DIN 17456:1999	X12Cr13	1.4006	---	0.08-0.15	1.50	1.00	0.040	0.015	11.50-13.50	0.75	---	---
ASTM A 268/A 268M-00	TP409	---	S40900	0.08	1.00	1.00	0.045	0.030	10.5-11.7	0.50	---	Ti 6 x C to 0.75
BSI BS 6323-8:1982 AMD 2:1989	LW 12	---	---	0.06	0.60	0.90	0.040	0.020	11.0-13.0	0.50	---	N 0.025; Ti 5 x C to 0.70
BSI BS 6323-8:1982 AMD 2:1989	LW 19	---	---	0.08	1.00	1.00	0.040	0.030	10.5-12.5	1.00	---	Ti 6 x C to 1.00
DIN 17455:1999	X2CrTi12	1.4512	---	0.030	1.00	1.00	0.040	0.015	10.50-12.50	---	---	Ti 6 x (C+N) to 0.65
DIN 17456:1999	X2CrTi12	1.4512	---	0.030	1.00	1.00	0.040	0.015	10.50-12.50	---	---	Ti 6 x (C+N) to 0.65
ASTM A 268/A 268M-00	TP430	---	S43000	0.12	1.00	1.00	0.040	0.030	16.0-18.0	---	---	---
ASTM A 554-98	MT-430	---	---	0.12	1.00	1.00	0.040	0.030	16.0-18.0	0.50	---	---
ASTM A 511-96	MT 430	---	---	0.12	1.00	1.00	0.040	0.030	16.0-18.0	0.50	---	---
JIS G 3446:1994	SUS430TKA	---	---	0.12	1.00	0.75	0.040	0.030	16.00-18.00	---	---	---
	SUS430TKC	---	---	0.12	1.00	0.75	0.040	0.030	16.00-18.00	---	---	---
DIN 17455:1999	X6Cr17	1.4016	---	0.08	1.00	1.00	0.040	0.015	16.00-18.00	---	---	Al 0.10-0.30
DIN 17456:1999	X6Cr17	1.4016	---	0.08	1.00	1.00	0.040	0.015	16.00-18.00	---	---	---
AFNOR NF A 49-647:1979	TS Z 8 C 17	---	---	0.10	1.0	1.00	0.040	0.030	16-18	0.50	---	---
ASTM A 268/A 268M-00	TP439	---	S43035	0.07	1.00	1.00	0.040	0.030	17.00-19.00	0.50	---	Al 0.15; N 0.04; Ti 0.20 + 4 (C + N) to 1.10
DIN 17455:1999	X3CrTi17	1.4510	---	0.05	1.00	1.00	0.040	0.015	16.00-18.00	---	---	Ti 4 x (C+N)+0.15 to 0.80
DIN 17456:1999	X3CrTi17	1.4510	---	0.05	1.00	1.00	0.040	0.015	16.00-18.00	---	---	Ti 4 x (C+N)+0.15 to 0.80

5.1 Tubes for General and Structural Applications

5.1.3.2A Chemical Composition of Austenitic Stainless Steel Tubes for General and Structural Applications

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 269-01	TP304	---	S30400	0.08	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	---
ASTM A 511-96	MT 304	---	---	0.08	2.00	1.00	0.040	0.030	18.0-20.0	8.0-11.0	---	---
ASTM A 554-98	MT-304	---	---	0.08	2.00	1.00	0.040	0.030	18.0-20.0	8.0-11.0	---	---
ASTM A 632-98	TP 304	---	S30400	0.08	2.00	0.75	0.040	0.030	18.0-20.0	8.0-11.0	---	---
JIS G 3446:1994	SUS304TKA	---	---	0.08	2.00	1.00	0.040	0.030	18.00-20.00	8.00-11.00	---	---
	SUS304TKC	---	---	0.08	2.00	1.00	0.040	0.030	18.00-20.00	8.00-11.00	---	---
BSI BS 6323-8:1982 AMD 2:1989	LW 21	---	---	0.06	2.00	1.00	0.045	0.030	17.5-19.0	8.0-11.0	---	---
	LWCF 21	---	---	0.06	2.00	1.00	0.045	0.030	17.5-19.0	8.0-11.0	---	---
DIN 17455:1999	X5CrNi18-10	1.4301	---	0.07	2.00	1.00	0.045	0.015	17.00-19.50	8.00-10.50	---	N 0.11
DIN 17456:1999	X5CrNi18-10	1.4301	---	0.07	2.0	1.00	0.045	0.015	17.00-19.50	8.00-10.50	---	N 0.11
AFNOR NF A 49-647:1979	TS Z 6 CN 18-09	---	---	0.07	2.0	1.0	0.040	0.030	18-20	8-12	---	---
ASTM A 269-01	TP304L	---	S30403	0.035	2.00	1.00	0.045	0.030	18.0-20.0	8.0-12.0	---	---
ASTM A 511-96	MT 304L	---	---	0.035	2.00	1.00	0.040	0.030	18.0-20.0	8.0-13.0	---	---
ASTM A 554-98	MT-304L	---	---	0.035	2.00	1.00	0.040	0.030	18.0-20.0	8.0-13.0	---	---
ASTM A 632-98	TP 304L	---	S30403	0.040	2.00	0.75	0.040	0.030	18.0-20.0	8.0-13.0	---	---
ASTM A 778-98	TP 304L	---	S30403	0.030	2.00	1.00	0.045	0.030	18.0-20.0	8.0-13.0	---	N 0.10
BSI BS 6323-8:1982 AMD 2:1989	LW 20	---	---	0.03	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	---
	LWCF 20	---	---	0.03	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	---
DIN 17455:1999	X2CrNi19-11	1.4306	---	0.030	2.00	1.00	0.045	0.015	18.00-20.00	10.00-12.00	---	N 0.11
DIN 17456:1999	X2CrNi19-11	1.4306	---	0.030	2.0	1.00	0.045	0.015	18.00-20.00	10.00-12.00	---	N 0.11
AFNOR NF A 49-317:1980	TU Z 2 CN 18-10	---	---	0.030	2.00	1.00	0.040	0.030	17-20.0	9-12.00	---	---
AFNOR NF A 49-647:1979	TS Z 2 CN 18-10	---	---	0.030	2.0	1.0	0.040	0.030	18-20	8-12	---	---
ASTM A 269-01	TP304LN	---	S30453	0.035	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	N 0.10-0.16
DIN 17455:1999	X2CrNiN18-10	1.4311	---	0.030	2.00	1.00	0.045	0.015	17.00-19.50	8.50-11.50	---	N 0.12-0.22
DIN 17456:1999	X2CrNiN18-10	1.4311	---	0.030	2.0	1.00	0.045	0.015	17.00-19.50	8.50-11.50	---	N 0.12-0.22

5.1 Tubes for General and Structural Applications

5.1.3.2A Chemical Composition of Austenitic Stainless Steel Tubes for General and Structural Applications (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 269-01	TP316	---	S31600	0.08	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
ASTM A 511-96	MT 316	---	---	0.08	2.00	1.00	0.040	0.030	16.0-18.0	11.0-14.0	2.0-3.0	---
ASTM A 554-98	MT-316	---	---	0.08	2.00	1.00	0.040	0.030	16.0-18.0	10.0-14.0	2.0-3.0	---
ASTM A 632-98	TP 316	---	S31600	0.08	2.00	0.75	0.040	0.030	16.0-18.0	11.0-14.0	2.00-3.00	---
JIS G 3446:1994	SUS316TKA	---	---	0.08	2.00	1.00	0.040	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---
	SUS316TKC	---	---	0.08	2.00	1.00	0.040	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---
BSI BS 6323-8:1982 AMD 2:1989	LW 23	---	---	0.07	2.00	1.00	0.045	0.030	16.5-18.5	11.0-14.0	2.5-3.0	---
	LWCF 23	---	---	0.07	2.00	1.00	0.045	0.030	16.5-18.5	11.0-14.0	2.5-3.0	---
DIN 17455:1999	X5CrNiMo17-12-2	1.4401	---	0.07	2.00	1.00	0.045	0.015	16.50-18.50	10.00-13.00	2.00-2.50	N 0.11
	X3CrNiMo17-13-3	1.4436	---	0.05	2.00	1.00	0.045	0.015	16.50-18.50	10.50-13.00	2.50-3.00	N 0.11
DIN 17456:1999	X5CrNiMo17-12-2	1.4401	---	0.07	2.0	1.00	0.045	0.015	16.50-18.50	10.00-13.00	2.00-2.50	N 0.11
	X3CrNiMo17-13-3	1.4436	---	0.05	2.0	1.00	0.045	0.015	16.50-18.50	10.50-13.00	2.50-3.00	N 0.11
AFNOR NF A 49-647:1979	TS Z 6 CND 17-11	---	---	0.08	2.0	1.0	0.040	0.030	16-18	10-12.5	2-2.5	---
ASTM A 269-01	TP316L	---	S31603	0.035	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
ASTM A 511-96	MT 316L	---	---	0.035	2.00	1.00	0.040	0.030	16.0-18.0	10.0-15.0	2.0-3.0	---
ASTM A 554-98	MT-316L	---	---	0.035	2.00	1.00	0.040	0.030	16.0-18.0	10.0-15.0	2.0-3.0	---
ASTM A 632-98	TP 316L	---	S31603	0.040	2.00	0.75	0.040	0.030	16.0-18.0	10.0-15.0	2.00-3.00	---
ASTM A 778-98	TP 316L	---	S31603	0.030	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	N 0.10
BSI BS 6323-8:1982 AMD 2:1989	LW 22	---	---	0.03	2.00	1.00	0.045	0.030	16.5-18.5	11.5-14.5	2.5-3.0	---
	LWCF 22	---	---	0.03	2.00	1.00	0.045	0.030	16.5-18.5	11.5-14.5	2.5-3.0	---
DIN 17455:1999	X2CrNiMo17-12-2	1.4404	---	0.030	2.00	1.00	0.045	0.015	16.50-18.50	10.00-13.00	2.00-2.50	N 0.11
	X2CrNiMo18-14-3	1.4435	---	0.030	2.00	1.00	0.045	0.015	17.00-19.00	12.50-15.00	2.50-3.00	N 0.11
DIN 17456:1999	X2CrNiMo17-12-2	1.4404	---	0.030	2.0	1.00	0.045	0.015	16.50-18.50	10.00-13.00	2.00-2.50	N 0.11
	X2CrNiMo18-14-3	1.4435	---	0.030	2.0	1.00	0.045	0.015	17.00-19.00	12.50-15.00	2.50-3.00	N 0.11
AFNOR NF A 49-317:1980	TU Z 2 CND 17-12	---	---	0.030	2.00	1.00	0.040	0.030	16-18.0	10.5-13.00	2.00-2.40	---
ASTM A 269-01	TP316LN	---	S31653	0.035	2.00	1.00	0.045	0.030	16.0-18.0	10.0-13.0	2.00-3.00	N 0.10-0.16
DIN 17455:1999	X2CrNiMoN17-13-3	1.4429	---	0.030	2.00	1.00	0.045	0.015	16.50-18.50	11.00-14.00	2.50-3.00	N 0.12-0.22
DIN 17456:1999	X2CrNiMoN17-13-3	1.4429	---	0.030	2.0	1.00	0.045	0.015	16.50-18.50	11.00-14.00	2.50-3.00	N 0.12-0.22

5.1 Tubes for General and Structural Applications

5.1.3.2A Chemical Composition of Austenitic Stainless Steel Tubes for General and Structural Applications (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 269-01	TP321	---	S32100	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 5 x (C+N) to 0.70
ASTM A 511-96	MT 321	---	---	0.08	2.00	1.00	0.040	0.030	17.0-20.0	9.0-13.0	---	Ti 5 x C to 0.60
ASTM A 554-98	MT-321	---	---	0.08	2.00	1.00	0.040	0.030	17.0-20.0	9.0-13.0	---	Ti 5 x C to 0.60
ASTM A 632-98	TP 321	---	S32100	0.08	2.00	0.75	0.040	0.030	17.0-20.0	9.0-13.0	---	Ti 5 x C to 0.60
ASTM A 778-98	TP 321	---	S32100	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 5 x C to 0.70
JIS G 3446:1994	SUS321TKA	---	---	0.08	2.00	1.00	0.040	0.030	17.00-19.00	9.00-13.00	---	Ti 5 x C min
BSI	LW 24	---	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 5 x C to 0.80
BS 6323-8:1982 AMD 2:1989	LWCF 24	---	---	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 5 x C to 0.80
DIN 17455:1999	X6CrNiTi18-10	1.4541	---	0.08	2.00	1.00	0.045	0.015	17.00-19.00	9.00-12.00	---	Ti 5 x C to 0.70
DIN 17456:1999	X6CrNiTi18-10	1.4541	---	0.08	2.0	1.00	0.045	0.015	17.00-19.00	9.00-12.00	---	Ti 5 x C to 0.70
ASTM A 269-01	TP347	---	S34700	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Cb 10 x C min to 1.10
ASTM A 511-96	MT 347	---	---	0.08	2.00	1.00	0.040	0.030	17.0-20.0	9.0-13.0	---	Cb+Ta 10 x C to 1.00
ASTM A 554-98	MT-347	---	---	0.08	2.00	1.00	0.040	0.030	17.0-20.0	9.0-13.0	---	Cb+Ta 10 x C to 1.00
ASTM A 632-98	TP 347	---	S34700	0.08	2.00	0.75	0.040	0.030	17.0-20.0	9.0-13.0	---	Cb+Ta 10 x C to 1.0
ASTM A 778-98	TP 347	---	S34700	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Cb+Ta 10 x C to 1.10
JIS G 3446:1994	SUS347TKA	---	---	0.08	2.00	1.00	0.040	0.030	17.00-19.00	9.00-13.00	---	Nb 10 x C min
DIN 17455:1999	X6CrNiNb18-10	1.4550	---	0.08	2.00	1.00	0.045	0.015	17.00-19.00	9.00-12.00	---	Nb 10 x C to 1.00
DIN 17456:1999	X6CrNiNb18-10	1.4550	---	0.08	2.0	1.00	0.045	0.015	17.00-19.00	9.00-12.00	---	Nb 10 x C to 1.00
ASTM A 269-01	---	---	S31725	0.035	2.00	1.00	0.045	0.030	18.0-20.0	13.5-17.5	4.0-5.0	N 0.20 max
DIN 17455:1999	X2CrNiMoN17-13-5	1.4439	---	0.030	2.00	1.00	0.045	0.015	16.50-18.50	12.40-14.50	4.00-5.00	N 0.12-0.22
DIN 17456:1999	X2CrNiMoN17-13-5	1.4439	---	0.030	2.0	1.00	0.045	0.015	16.50-18.50	12.50-14.50	4.00-5.00	N 0.12-0.22

5.1 Tubes for General and Structural Applications

5.1.3.1B Mechanical Properties of Ferritic and Martensitic Stainless Steel Tubes for General and Structural Applications

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa min	ksi min	N/mm ² or MPa min	ksi min		
ASTM A 268/A 268M-00	TP405	---	S40500	HT	---	---	205	30	415	60	20	207 HB; 95 HRB max
ASTM A 511-96*	MT 405	---	S40500	A	---	---	207	30	414	60	20	207 HB; 95 HRB max
DIN 17456:1999	X6CrAl13	1.4002	---	A	---	---	250	---	400-600	---	20 L; 15 T	185 HB max
ASTM A 268/A 268M-00	TP410	---	S41000	HT	---	---	215	30	415	60	20	207 HB; 95 HRB max
ASTM A 511-96*	MT 410	---	S41000	A	---	---	207	30	414	60	20	207 HB; 95 HRB max
JIS G 3446:1994	SUS410TKA	---	---	A	---	---	205	---	410	---	20	---
	SUS410TKC	---	---	AM	---	---	205	---	410	---	20	---
DIN 17456:1999	X12Cr13	1.4006	---	A	---	---	250	---	450-650	---	20 L; 15 T	200 HB max
ASTM A 268/A 268M-00	TP409	---	S40900	HT	---	---	470	25	380	55	20	207 HB; 95 HRB max
BSI BS 6323-8:1982 AMD 2:1989	LW 12	---	---	KM	---	---	300	---	400	---	10	---
	LW 19	---	---	KM	---	---	300	---	400	---	10	---
DIN 17455:1999	X2CrTi12	1.4512	---	A	---	---	190	---	390-560	---	20 L; 18 T	175 HB max
DIN 17456:1999	X2CrTi12	1.4512	---	A	---	---	190	---	390-560	---	30 L; 25 T	175 HB max
ASTM A 268/A 268M-00	TP430	---	S43000	HT	---	---	240	35	415	60	20	190 HB; 90 HRB max
ASTM A 554-98*	MT 430	---	S43000	A	---	---	241	35	414	60	20	190 HB; 90 HRB max
ASTM A 511-96*	MT 430	---	S43000	A	---	---	241	35	414	60	20	190 HB; 90 HRB max
JIS G 3446:1994	SUS430TKA	---	---	A	---	---	245	---	410	---	20	---
	SUS430TKC	---	---	AM	---	---	245	---	410	---	20	---
DIN 17455:1999	X6Cr17	1.4016	---	A	---	---	270	---	450-600	---	20 L; 18 T	185 HB max
DIN 17456:1999	X6Cr17	1.4016	---	A	---	---	270	---	450-600	---	20 L; 15 T	185 HB max
AFNOR NF A 49-647:1979	TS Z 8 C 17	---	---	AM	---	---	300	---	450	---	16	---
ASTM A 268/A 268M-00	TP439	---	S43035	HT	---	---	205	30	415	60	20	190 HB; 90 HRB max
DIN 17455:1999	X3CrTi17	1.4510	---	A	---	---	270	---	430-600	---	20 L; 18 T	185 HB max
DIN 17456:1999	X3CrTi17	1.4510	---	A	---	---	270	---	450-600	---	20 L; 15 T	185 HB max

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

5.1 Tubes for General and Structural Applications

5.1.3.2B Mechanical Properties of Austenitic Stainless Steel Tubes for General and Structural Applications

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa min	ksi min	N/mm ² or MPa min	ksi min		
ASTM A 269-01	TP304	---	S30400	HT	---	---	---	---	---	---	---	192 HB 200 HV or 90 HRB max
ASTM A 511-96*	MT 304	---	---	A	---	---	207	30	517	75	35	192 HB; 90 HRB max
ASTM A 554-98*	MT 304	---	---	A	---	---	207	30	517	75	35	192 HB; 90 HRB max
ASTM A 632-98	TP 304	---	S30400	HT	---	---	205	30	515	75	35	---
JIS G 3446:1994	SUS304TKA	---	---	ST	---	---	205	---	520	---	35	---
	SUS304TKC	---	---	AM	---	---	205	---	520	---	35	---
BSI BS 6323-8:1982 AMD 2:1989	LW 21	---	---	KM	---	---	450	---	560	---	25	---
	LWCF 21	---	---	KM	---	---	450	---	560	---	25	---
DIN 17455:1999	X5CrNi18-10	1.4301	---	SA & Q	---	---	195	---	500-720	---	40 L; 35 T	---
DIN 17456:1999	X5CrNi18-10	1.4301	---	SA & Q	---	---	195	---	500-700	---	40 L; 35 T	---
AFNOR NF A 49-647:1979	TS Z 6 CN 18-09	---	---	AM	---	---	400	---	600	---	35	---
ASTM A 269-01	TP304L	---	S30403	HT	---	---	---	---	---	---	---	192 HB 200 HV or 90 HRB max
ASTM A 511-96*	MT 304L	---	---	A	---	---	207	30	517	75	35	192 HB; 90 HRB max
ASTM A 554-98*	MT 304L	---	---	A	---	---	172	25	483	70	35	192 HB; 90 HRB max
ASTM A 632-98	TP 304L	---	S30403	HT	---	---	170	25	485	70	35	---
ASTM A 778-98	TP 304L	---	S30403	AM	---	---	170	25	485	70	40	---
BSI BS 6323-8:1982 AMD 2:1989	LW 20	---	---	KM	---	---	420	---	520	---	25	---
	LWCF 20	---	---	KM	---	---	420	---	520	---	25	---
DIN 17455:1999	X2CrNi19-11	1.4306	---	SA & Q	---	---	180	---	460-680	---	40 L; 35 T	---
DIN 17456:1999	X2CrNi19-11	1.4306	---	SA & Q	---	---	180	---	460-680	---	40 L; 35 T	---
AFNOR NF A 49-317:1980	TU Z 2 CN 18-10	---	---	HQ	---	---	175	---	470	---	45	---
AFNOR NF A 49-647:1979	TS Z 2 CN 18-10	---	---	AM	---	---	400	---	600	---	35	---

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

5.1 Tubes for General and Structural Applications

5.1.3.2B Mechanical Properties of Austenitic Stainless Steel Tubes for General and Structural Applications (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa min	ksi min	N/mm ² or MPa min	ksi min		
ASTM A 269-01	TP304LN	---	S30453	HT	---	---	---	---	---	---	---	192 HB 200 HV or 90 HRB max
DIN 17455:1999	X2CrNiN18-10	1.4311	---	SA & Q	---	---	270	---	550-760	---	35 L; 30 T	---
DIN 17456:1999	X2CrNiN18-10	1.4311	---	SA & Q	---	---	270	---	550-760	---	35 L; 30 T	---
ASTM A 269-01	TP316	---	S31600	HT	---	---	---	---	---	---	---	192 HB 200 HV or 90 HRB max
ASTM A 511-96*	MT 316	---	---	A	---	---	207	30	517	75	35	192 HB; 90 HRB max
ASTM A 554-98*	MT 316	---	---	A	---	---	207	30	517	75	35	192 HB; 90 HRB max
ASTM A 632-98	TP 316	---	S31600	HT	---	---	205	30	515	75	35	---
JIS G 3446:1994	SUS316TKA	---	---	ST	---	---	205	---	520	---	35	---
	SUS316TKC	---	---	AM	---	---	205	---	520	---	35	---
BSI BS 6323-8:1982 AMD 2:1989	LW 23	---	---	KM	---	---	450	---	560	---	25	---
	LWCF 23	---	---	KM	---	---	450	---	560	---	25	---
DIN 17455:1999	X5CrNiMo17-12-2	1.4401	---	SA & Q	---	---	205	---	510-710	---	40 L; 35 T	---
	X3CrNiMo17-13-3	1.4436	---	SA & Q	---	---	205	---	510-710	---	40 L; 35 T	---
DIN 17456:1999	X5CrNiMo17-12-2	1.4401	---	SA & Q	---	---	205	---	510-710	---	40 L; 30 T	---
	X3CrNiMo17-13-3	1.4436	---	SA & Q	---	---	205	---	510-710	---	40 L; 30 T	---
AFNOR NF A 49-647:1979	TS Z 6 CND 17-11	---	---	AM	---	---	400	---	600	---	35	---

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

5.1 Tubes for General and Structural Applications

5.1.3.2B Mechanical Properties of Austenitic Stainless Steel Tubes for General and Structural Applications (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa min	ksi min	N/mm ² or MPa min	ksi min		
ASTM A 269-01	TP316L	---	S31603	HT	---	---	---	---	---	---	---	192 HB 200 HV or 90 HRB max
ASTM A 511-96*	MT 316L	---	---	A	---	---	207	30	517	75	35	192 HB; 90 HRB max
ASTM A 554-98*	MT 316L	---	---	A	---	---	172	25	483	70	35	192 HB; 90 HRB max
ASTM A 632-98	TP 316L	---	S31603	HT	---	---	170	25	485	70	35	---
ASTM A 778-98	TP 316L	---	S31603	AM	---	---	170	25	485	70	40	---
BSI BS 6323-8:1982 AMD 2:1989	LW 22	---	---	KM	---	---	420	---	520	---	25	---
BSI BS 6323-8:1982 AMD 2:1989	LWCF 22	---	---	KM	---	---	420	---	520	---	25	---
DIN 17455:1999	X2CrNiMo17-12-2	1.4404	---	SA & Q	---	---	190	---	490-690	---	40 L; 35 T	---
	X2CrNiMo18-14-3	1.4435	---	SA & Q	---	---	190	---	490-690	---	40 L; 35 T	---
DIN 17456:1999	X2CrNiMo17-12-2	1.4404	---	SA & Q	---	---	190	---	490-690	---	40 L; 30 T	---
	X2CrNiMo18-14-3	1.4435	---	SA & Q	---	---	190	---	490-690	---	40 L; 30 T	---
AFNOR NF A 49-317:1980	TU Z 2 CND 17-12	---	---	HQ	---	---	175	---	470	---	45	---
ASTM A 269-01	TP316LN	---	S31653	HT	---	---	---	---	---	---	---	192 HB 200 HV or 90 HRB max
DIN 17455:1999	X2CrNiMoN17-13-3	1.4429	---	SA & Q	---	---	295	---	580-800	---	35 L; 30 T	---
DIN 17456:1999	X2CrNiMoN17-13-3	1.4429	---	SA & Q	---	---	295	---	580-800	---	35 L; 30 T	---

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

5.1 Tubes for General and Structural Applications

5.1.3.2B Mechanical Properties of Austenitic Stainless Steel Tubes for General and Structural Applications (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa min	ksi min	N/mm ² or MPa min	ksi min		
ASTM A 269-01	TP321	---	S32100	HT	---	---	---	---	---	---	---	192 HB 200 HV or 90 HRB max
ASTM A 511-96*	MT 321	---	---	A	---	---	207	30	517	75	35	192 HB; 90 HRB max
ASTM A 554-98*	MT 321	---	---	A	---	---	207	30	517	75	35	192 HB; 90 HRB max
ASTM A 632-98	TP 321	---	S32100	HT	---	---	205	30	515	75	35	---
ASTM A 778-98	TP 321	---	S32100	AM	---	---	205	30	515	75	40	---
JIS G 3446:1994	SUS321TKA	---	---	ST	---	---	205	---	520	---	35	---
BSI BS 6323-8:1982 AMD 2:1989	LW 24	---	---	KM	---	---	450	---	560	---	25	---
	LWCF 24	---	---	KM	---	---	450	---	560	---	25	---
DIN 17455:1999	X6CrNiTi18-10	1.4541	---	SA & Q	---	---	200	---	500-730	---	35 L; 30 T	---
DIN 17456:1999	X6CrNiTi18-10	1.4541	---	SA & Q	---	---	200	---	500-730	---	35 L; 30 T	---
DIN 17456:1999	X6CrNiTi18-10	1.4541	---	SA & Q (HW) see standard	---	---	180	---	460-680	---	35 L; 30 T	---
ASTM A 269-01	TP347	---	S34700	HT	---	---	---	---	---	---	---	192 HB 200 HV or 90 HRB max
ASTM A 511-96*	MT 347	---	---	A	---	---	207	30	517	75	35	192 HB; 90 HRB max
ASTM A 554-98*	MT 347	---	---	A	---	---	207	30	517	75	35	192 HB; 90 HRB max
ASTM A 632-98	TP 347	---	S34700	HT	---	---	205	30	515	75	35	---
ASTM A 778-98	TP 347	---	S34700	AM	---	---	205	30	515	75	40	---
JIS G 3446:1994	SUS347TKA	---	---	ST	---	---	205	---	520	---	35	---
DIN 17455:1999	X6CrNiNb18-10	1.4550	---	SA & Q	---	---	205	---	510-740	---	35 L; 30 T	---
DIN 17456:1999	X6CrNiNb18-10	1.4550	---	SA & Q	---	---	205	---	510-740	---	35 L; 30 T	---
ASTM A 269-01	---	---	S31725	HT	---	---	---	---	---	---	---	192 HB 200 HV or 90 HRB max
DIN 17455:1999	X2CrNiMoN17-13-5	1.4439	---	SA & Q	---	---	285	---	580-800	---	35 L; 30 T	---
DIN 17456:1999	X2CrNiMoN17-13-5	1.4439	---	SA & Q	---	---	285	---	580-800	---	35 L; 30 T	---

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

5.2 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	TTSSt 35 N	1.0356	---	N	≤ 10	---	225	---	340-460	---	25 L; 23 T	L:40 J at -40°C
DIN 28181:1985	TTSSt 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

5.2.1A Mechanical Properties of Carbon Steel Tubes for Heat Transfer Applications (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa min	ksi min	N/mm ² or MPa min	ksi min		
DIN 28180:1985	St 37.0	1.0254	---	see standard	≤ 16	---	235	---	350-480	---	25 L; 23 T	---
					16 < t ≤ 40	---	225	---	350-480	---	25 L; 23 T	---
					40 < t ≤ 65	---	215	---	350-480	---	25 L; 23 T	---
DIN 28181:1985	St 37.0	1.0254	---	see standard	≤ 16	---	235	---	350-480	---	25 L; 23 T	---
					16 < t ≤ 40	---	225	---	350-480	---	25 L; 23 T	---
ISO 2604-II:1975	TS 4	---	---	HF, SCA, A, N	---	---	215	---	360-480	---	24	---
	TS 5	---	---	HF, N	---	---	215	---	360-480	---	24	---
	TS 6	---	---	HF, A, N	---	---	215	---	360-480	---	24	---
ISO 2604-III:1975	TW 4	---	---	W, HR, SCA, A, N	---	---	215	---	360-480	---	24	---
	TW 5	---	---	N	---	---	215	---	360-480	---	24	---
	TW 6	---	---	A, N	---	---	215	---	360-480	---	24	---
AFNOR NF A 49-215:1981	TU 37 c	---	---	N	---	---	220	---	360-450	---	16	---
AFNOR NF A 49-245:1986	TS 37 C	---	---	N	---	---	235	---	360-450	---	16	---
DIN 28180:1985	St 35.8	1.0305	---	N	≤ 16	---	235	---	360-480	---	25 L; 23 T	T: 34 J at RT
					16 < t ≤ 40	---	225	---	360-480	---	25 L; 23 T	T: 34 J at RT
					40 < t ≤ 60	---	215	---	360-480	---	25 L; 23 T	T: 34 J at RT
DIN 28181:1985	St 37.8	1.0315	---	AD	≤ 16	---	235	---	360-480	---	25 L; 23 T	---
BSI BS 3059-2:1990	360	---	---	see standard	---	---	235	---	360-500	---	24	---
DIN 28180:1985	TTSt 35 N	1.0356	---	V (QT)	≤ 25	---	255	---	360-490	---	23 L; 21 T	L:45 J at -40°C T:30 J at -40°C
					25 < t ≤ 40	---	235	---	360-490	---	23 L; 21 T	L:40 J at -40°C T:27 J at -40°C

5.2 Tubes for Heat Transfer Applications

5.2.1A Mechanical Properties of Carbon Steel Tubes for Heat Transfer Applications (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa min	ksi min	N/mm ² or MPa min	ksi min		
BSI BS 3606:1992	400	---	---	N	---	---	230	---	400-520	---	21	---
AFNOR NF A 49-215:1981	TU 42 c	---	---	N	---	---	235	---	410-510	---	16	---
ISO 2604-II:1975	TS 9	---	---	HF, N	---	---	235	---	410-530	---	22	---
	TS 9H	---	---	HF, N	---	---	235	---	410-530	---	22	---
	TS 10	---	---	HF, A, N	---	---	235	---	410-530	---	22	---
ISO 2604-III:1975	TW 9	---	---	W, HR, SCA, A, N	---	---	235	---	410-530	---	22	---
	TW 9H	---	---	N	---	---	235	---	410-530	---	22	---
	TW 10	---	---	A, N	---	---	235	---	410-530	---	22	---
JIS G 3467:1988	STF 410	---	---	HFS: AM CFS: LTA, N	---	---	245	---	410	---	25	---
JIS G 3461:1988	STB 410	---	---	see standard	---	---	255	---	410	---	25	---
AFNOR NF A 49-245:1986	TS 42 C	---	---	N	---	---	255	---	410-510	---	16	---
ASTM A 556/A 556M-96	B2	---	K02707	CD+1200°F min	---	---	260	37	410	60	30	79 HRB max
ASTM A 178/A 178M-95 (2000)	C	---	K03503	see standard	---	---	255	37	415	60	30	---
ASTM A 210/A 210M-96	A-1	---	K02707	HF or CF + SA, A, N	---	---	255	37	415	60	30	79 HRB max 143 HB max
BSI BS 3059-2:1990	440	---	---	see standard	---	---	245	---	440-580	---	21	---
BSI BS 3606:1992	440	---	---	N	---	---	265	---	440-560	---	21	---

5.2 Tubes for Heat Transfer Applications

5.2.1A Mechanical Properties of Carbon Steel Tubes for Heat Transfer Applications (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa min	ksi min	N/mm ² or MPa min	ksi min		
ISO 2604-II:1975	TS 13	---	---	HF, SCA, A, N	---	---	265	---	460-580	---	21	---
	TS 14	---	---	HF, N	---	---	265	---	460-580	---	21	---
	TS 15	---	---	HF, A, N	---	---	265	---	460-580	---	21	---
ISO 2604-III:1975	TW 13	---	---	W, HR, SCA, A, N	---	---	265	---	460-580	---	21	---
	TW 14	---	---	N	---	---	265	---	460-580	---	21	---
	TW 15	---	---	A, N	---	---	265	---	460-580	---	21	---
AFNOR NF A 49-215:1981	TU 48 c	---	---	N	---	---	275	---	470-570	---	16	---
AFNOR NF A 49-245:1986	TS 48 C	---	---	N	---	---	275	---	470-570	---	16	---
ASTM A 556/A 556M-96	C2	---	K03006	CD+1200°F min	---	---	280	40	480	70	30	89 HRB max
ASTM A 178/A 178M-95 (2000)	D	---	---	see standard	---	---	275	40	485	70	30	---
ASTM A 210/A 210M-96	C	---	K03501	HF or CF + SA, A, N	---	---	275	40	485	70	30	89 HRB max 179 HB max
ISO 2604-II:1975	TS 18	---	---	HF, N	---	---	285	---	490-610	---	21	---
JIS G 3461:1988	STB 510	---	---	N	---	---	295	---	510	---	25	---

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

5.2 Tubes for Heat Transfer Applications

5.2.1B Chemical Composition of Carbon Steel Tubes for Heat Transfer Applications (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
DIN 28180:1985	St 37.0	1.0254	---	0.17	---	---	0.040	0.040	---	---	---	N 0.009
DIN 28181:1985	St 37.0	1.0254	---	0.17	---	---	0.040	0.040	---	---	---	N 0.009
ISO 2604-II:1975	TS 4	---	---	0.17	0.40-0.80	0.35	0.045	0.045	---	---	---	---
	TS 5	---	---	0.17	0.40-0.80	0.35	0.045	0.045	---	---	---	---
	TS 6	---	---	0.17	0.40-1.00	0.35	0.045	0.045	---	---	---	Al 0.015
ISO 2604-III:1975	TW 4	---	---	0.17	0.40-0.80	0.35	0.045	0.045	---	---	---	---
	TW 5	---	---	0.17	0.40-0.80	0.35	0.045	0.045	---	---	---	---
	TW 6	---	---	0.17	0.40-1.00	0.35	0.045	0.045	---	---	---	Al 0.015
AFNOR NF A 49-215:1981	TU 37 c	---	---	0.18	0.30-0.80	0.05-0.27	0.045	0.045	---	---	---	Cu 0.25; Sn 0.03
AFNOR NF A 49-245:1986	TS 37 C	---	---	0.15	0.35-0.75	0.06-0.30	0.035	0.025	---	---	---	Cu 0.25; Sn 0.030
DIN 28180:1985	St 35.8	1.0305	---	0.17	0.40-0.80	0.10-0.35	0.040	0.040	---	---	---	---
DIN 28181:1985	St 37.8	1.0315	---	0.17	0.40-0.80	0.10-0.35	0.040	0.040	---	---	---	---
BSI BS 3059-2:1990	360	---	---	0.17	0.40-0.80	0.10-0.35	0.035	0.035	---	---	---	---
DIN 28180:1985	TTSt 35 N	1.0306	---	0.17	0.40	0.35	0.030	0.025	---	---	---	---

5.2 Tubes for Heat Transfer Applications

5.2.1B Chemical Composition of Carbon Steel Tubes for Heat Transfer Applications (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
BSI BS 3606:1992	400	---	---	0.20	0.90-1.20	0.10-0.35	0.020	0.020	0.20	0.30	0.10	Al 0.04; Cu 0.25; Sn 0.025
AFNOR NF A 49-215:1981	TU 42 c	---	---	0.22	0.40-1.05	0.07-0.40	0.045	0.045	---	---	---	Cu 0.25; Sn 0.03
ISO 2604-II:1975	TS 9	---	---	0.21	0.40-1.20	0.35	0.045	0.045	---	---	---	---
	TS 9H	---	---	0.21	0.40-1.20	0.35	0.045	0.045	---	---	---	---
	TS 10	---	---	0.19	0.60-1.20	0.35	0.045	0.045	---	---	---	Al 0.015
ISO 2604-III:1975	TW 9	---	---	0.21	0.40-1.20	0.35	0.045	0.045	---	---	---	---
	TW 9H	---	---	0.21	0.40-1.20	0.35	0.045	0.045	---	---	---	---
	TW 10	---	---	0.19	0.60-1.20	0.35	0.045	0.045	---	---	---	Al 0.015
JIS G 3467:1988	STF 410	---	---	0.30	0.30-1.00	0.10-0.35	0.035	0.035	---	---	---	---
JIS G 3461:1988	STB 410	---	---	0.32	0.30-0.80	0.35	0.035	0.035	---	---	---	---
AFNOR NF A 49-245:1986	TS 42 C	---	---	0.18	0.45-1.00	0.08-0.30	0.035	0.025	---	---	---	Cu 0.25; Sn 0.030
ASTM A 556/A 556M-96	B2	---	K02707	0.27	0.29-0.93	0.10	0.035	0.035	---	---	---	---
ASTM A 178/A 178M-95 (2000)	C	---	K03503	0.35	0.80	---	0.035	0.035	---	---	---	---
ASTM A 210/A 210M-96	A-1	---	K02707	0.27	0.93	0.10	0.035	0.035	---	---	---	---
BSI BS 3059-2:1990	440	---	---	0.12-0.18	0.90-1.20	0.10-0.35	0.035	0.035	---	---	---	---
BSI BS 3606:1992	440	---	---	0.12-0.18	0.90-1.20	0.10-0.35	0.035	0.035	---	---	---	---

5.2 Tubes for Heat Transfer Applications

5.2.1B Chemical Composition of Carbon Steel Tubes for Heat Transfer Applications (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ISO 2604-II:1975	TS 13	---	---	0.22	0.60-1.40	0.35	0.045	0.045	---	---	---	---
	TS 14	---	---	0.22	0.80-1.40	0.35	0.045	0.045	---	---	---	---
	TS 15	---	---	0.20	0.80-1.40	0.35	0.045	0.045	---	---	---	Al 0.015
ISO 2604-III:1975	TW 13	---	---	0.22	0.60-1.40	0.35	0.045	0.045	---	---	---	---
	TW 14	---	---	0.22	0.80-1.40	0.35	0.045	0.045	---	---	---	---
	TW 15	---	---	0.20	0.80-1.40	0.35	0.045	0.045	---	---	---	Al 0.015
AFNOR NF A 49-215:1981	TU 48 c	---	---	0.24	0.60-1.30	0.09-0.40	0.045	0.045	---	---	---	Cu 0.25; Sn 0.03
AFNOR NF A 49-245:1986	TS 48 C	---	---	0.20	0.65-1.25	0.10-0.35	0.035	0.025	---	---	---	Cu 0.25; Sn 0.030
ASTM A 556/A 556M-96	C2	---	K03006	0.30	0.29-1.06	0.10	0.035	0.035	---	---	---	---
ASTM A 178/A 178M-95 (2000)	D	---	---	0.27	1.00-1.50	0.10 min	0.030	0.015	---	---	---	---
ASTM A 210/A 210M-96	C	---	K03501	0.35	0.29-1.06	0.10	0.035	0.035	---	---	---	---
ISO 2604-II:1975	TS 18	---	---	0.23	0.80-1.50	0.35	0.045	0.045	---	---	---	---
JIS G 3461:1988	STB 510	---	---	0.25	1.00-1.50	0.35	0.035	0.035	---	---	---	---

5.2 Tubes for Heat Transfer Applications

5.2.2A Chemical Composition of Alloy 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
BSI BS 3059-2:1990	243	---	---	0.12-0.20	0.40-0.80	0.10-0.35	0.035	0.035	---	---	0.25-0.35	Al 0.012
ISO 2604-II:1975	TS 26	---	---	0.12-0.20	0.40-0.80	0.10-0.35	0.040	0.040	---	---	0.25-0.35	Al 0.012
ISO 2604-III:1975	TW 26	---	---	0.12-0.20	0.40-0.80	0.10-0.35	0.040	0.040	---	---	0.25-0.35	Al 0.012
DIN 28180:1985	15 Mo 3	1.5415	---	0.12-0.20	0.40-0.80	0.10-0.35	0.035	0.035	---	---	0.25-0.35	---
BSI BS 3606:1992	243	---	---	0.12-0.20	0.40-0.80	0.10-0.35	0.040	0.040	---	0.30	0.25-0.35	Al 0.012
AFNOR NF A 49-215:1981	TU 15 D 3	---	---	0.10-0.22	0.40-0.90	0.10-0.40	0.045	0.045	0.40	0.30	0.21-0.39	Cu 0.25; Sn 0.03; Al 0.25
AFNOR NF A 49-245:1986	TS 15 D 3	---	---	0.12-0.20	0.50-0.80	0.15-0.35	0.030	0.025	0.30	0.30	0.25-0.35	Cu 0.25; Sn 0.030; Al 0.025
ASTM A 209/A 209M-98	T1	---	K11522	0.10-0.20	0.30-0.80	0.10-0.50	0.025	0.025	---	---	0.44-0.65	---
	T1b	---	K11422	0.14	0.30-0.80	0.10-0.50	0.025	0.025	---	---	0.44-0.65	---
ASTM A 250/A 250M-99	T1	---	K11522	0.10-0.20	0.30-0.80	0.10-0.50	0.025	0.025	---	---	0.44-0.65	---
	T1b	---	K11422	0.14	0.30-0.80	0.10-0.50	0.025	0.025	---	---	0.44-0.65	---
JIS G 3462:1988	STBA 12	---	---	0.10-0.20	0.30-0.80	0.10-0.50	0.035	0.035	---	---	0.45-0.65	---
JIS G 3467:1988	STF A 12	---	---	0.10-0.20	0.30-0.80	0.10-0.50	0.035	0.035	---	---	0.45-0.65	---
ASTM A 209/A 209M-98	T1a	---	K12023	0.15-0.25	0.30-0.80	0.10-0.50	0.025	0.025	---	---	0.44-0.65	---
ASTM A 250/A 250M-99	T1a	---	K12023	0.15-0.25	0.30-0.80	0.10-0.50	0.025	0.025	---	---	0.44-0.65	---
JIS G 3462:1988	STBA 13	---	---	0.15-0.25	0.30-0.80	0.10-0.50	0.035	0.035	---	---	0.45-0.65	---
ASTM A 213/A 213M-99	T2	---	K11547	0.10-0.20	0.30-0.61	0.10-0.30	0.025	0.025	0.50-0.81	---	0.44-0.65	---
ASTM A 250/A 250M-99	T2	---	K11547	0.10-0.20	0.30-0.61	0.10-0.30	0.025	0.020	0.50-0.81	---	0.44-0.65	---
JIS G 3462:1988	STBA 20	---	---	0.10-0.20	0.30-0.60	0.10-0.50	0.035	0.035	0.50-0.80	---	0.40-0.65	---
AFNOR NF A 49-215:1981	TU 15 CD 2-05	---	---	0.08-0.20	0.40-1.00	0.05-0.40	0.035	0.035	0.30-0.75	0.30	0.41-0.64	Cu 0.25; Sn 0.03
AFNOR NF A 49-245:1986	TS 15 CD 2 05	---	---	0.10-0.18	0.50-0.90	0.10-0.35	0.030	0.025	0.40-0.65	0.30	0.45-0.60	Cu 0.25; Sn 0.030; Al 0.025
ISO 2604-II:1975	TS 33	---	---	0.10-0.18	0.40-0.70	0.10-0.35	0.040	0.040	0.30-0.60	---	0.50-0.70	Al 0.02; V 0.22-0.32

5.2 Tubes for Heat Transfer

5.2.2A Chemical Composition of Alloy Steel Tubes for Heat Transfer Applications (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 213/A 213M-99	T12	---	K11562	0.05-0.15	0.30-0.60	0.50	0.025	0.025	0.80-1.25	---	0.44-0.65	---
ASTM A 250/A 250M-99	T12	---	K11562	0.05-0.15	0.30-0.61	0.50	0.030	0.020	0.80-1.25	---	0.44-0.65	---
JIS G 3462:1988	STBA 22	---	---	0.15	0.30-0.60	0.50	0.035	0.035	0.80-1.25	---	0.45-0.65	---
JIS G 3467:1988	STF A 22	---	---	0.15	0.30-0.60	0.50	0.035	0.035	0.80-1.25	---	0.45-0.65	---
AFNOR NF A 49-245:1986	TS 15 CD 4 05	---	---	0.10-0.18	0.40-0.80	0.15-0.35	0.030	0.025	0.80-1.20	0.30	0.40-0.60	Cu 0.25; Sn 0.030; Al 0.025
BSI BS 3059-2:1990	620-460	---	---	0.10-0.15	0.40-0.70	0.10-0.35	0.030	0.030	0.70-1.10	---	0.45-0.65	Al 0.020
BSI BS 3606:1992	620	---	---	0.10-0.15	0.40-0.70	0.10-0.35	0.040	0.040	0.70-1.10	0.30	0.45-0.65	Al 0.020
DIN 28180:1985	13 CrMo 4 4	1.7335	---	0.10-0.18	0.40-0.70	0.10-0.35	0.035	0.035	0.70-1.10	---	0.45-0.65	---
ISO 2604-II:1975	TS 32	---	---	0.10-0.18	0.40-0.70	0.10-0.35	0.040	0.040	0.70-1.10	---	0.45-0.65	Al 0.02
ISO 2604-III:1975	TW 32	---	---	0.10-0.18	0.40-0.70	0.10-0.35	0.040	0.040	0.70-1.10	---	0.45-0.65	Al 0.020
ASTM A 213/A 213M-99	T11	---	K11597	0.05-0.15	0.30-0.60	0.50-1.00	0.025	0.025	1.00-1.50	---	0.44-0.65	---
ASTM A 250/A 250M-99	T11	---	K11597	0.05-0.15	0.30-0.60	0.50-1.00	0.025	0.020	1.00-1.50	---	0.44-0.65	---
JIS G 3462:1988	STBA 23	---	---	0.15	0.30-0.60	0.50-1.00	0.030	0.030	1.00-1.50	---	0.45-0.65	---
JIS G 3467:1988	STF A 23	---	---	0.15	0.30-0.60	0.50-1.00	0.030	0.030	1.00-1.50	---	0.45-0.65	---
BSI BS 3606:1992	621	---	---	0.10-0.15	0.30-0.60	0.50-1.00	0.040	0.040	1.00-1.50	0.30	0.45-0.65	Al 0.020
AFNOR NF A 49-215:1981	TU 10 CD 5-05	---	---	0.17	0.20-0.70	0.45-1.05	0.035	0.035	0.90-1.60	0.30	0.41-0.69	Cu 0.25; Sn 0.03
ASTM A 213/A 213M-99	T22	---	K21590	0.05-0.15	0.30-0.60	0.50	0.025	0.025	1.90-2.60	---	0.87-1.13	---
ASTM A 250/A 250M-99	T22	---	K21590	0.15	0.30-0.60	0.50	0.025	0.020	1.90-2.60	---	0.87-1.13	---
JIS G 3462:1988	STBA 24	---	---	0.15	0.30-0.60	0.50	0.030	0.030	1.90-2.60	---	0.87-1.13	---
JIS G 3467:1988	STF A 24	---	---	0.15	0.30-0.60	0.50	0.030	0.030	1.90-2.60	---	0.87-1.13	---
BSI BS 3059-2:1990	622-490	---	---	0.08-0.15	0.40-0.70	0.50	0.030	0.030	2.00-2.50	---	0.90-1.20	Al 0.020
BSI BS 3606:1992	622	---	---	0.08-0.15	0.40-0.70	0.50	0.040	0.040	2.00-2.50	0.30	0.90-1.20	Al 0.020
AFNOR NF A 49-215:1981	TU 10 CD 9-10	---	---	0.17	0.20-0.70	0.05-0.55	0.035	0.035	1.90-2.60	0.30	0.85-1.15	Cu 0.25; Sn 0.03
ISO 2604-II:1975	TS 34	---	---	0.08-0.15	0.40-0.70	0.50	0.040	0.040	2.00-2.50	---	0.90-1.20	Al 0.02

5.2 Tubes for Heat Transfer

5.2.2A Chemical Composition of Alloy Steel Tubes for Heat Transfer Applications (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 213/A 213M-99	T5	---	K41545	0.15	0.30-0.60	0.50	0.025	0.025	4.00-6.00	---	0.45-0.65	---
	T5b	---	K51545	0.15	0.30-0.60	1.00-2.00	0.025	0.025	4.00-6.00	---	0.45-0.65	---
JIS G 3462:1988	STBA 25	---	---	0.15	0.30-0.60	0.50	0.030	0.030	4.00-6.00	---	0.45-0.65	---
JIS G 3467:1988	STF A 25	---	---	0.15	0.30-0.60	0.50	0.030	0.030	4.00-6.00	---	0.45-0.65	---
BSI BS 3606:1992	625	---	---	0.15	0.30-0.60	0.50	0.030	0.030	4.00-6.00	0.30	0.45-0.65	Al 0.020
AFNOR NF A 49-215:1981	TU Z 10 CD 5 05	---	---	0.17	0.30-0.65	0.10-0.55	0.035	0.035	3.90-6.10	---	0.40-0.65	---
ISO 2604-II :1975	TS 37	---	---	0.15	0.30-0.60	0.50	0.030	0.030	4.00-6.00	---	0.45-0.65	Al 0.02
ASTM A 213/A 213M-99	T9	---	S50400	0.15	0.30-0.60	0.25-1.00	0.025	0.025	8.00-10.00	---	0.90-1.10	---
	STBA 26	---	---	0.15	0.30-0.60	0.25-1.00	0.030	0.030	8.00-10.00	---	0.90-1.10	---
JIS G 3467:1988	STF A 26	---	---	0.15	0.30-0.60	0.25-1.00	0.030	0.030	8.00-10.00	---	0.90-1.10	---
BSI BS 3059-2:1990	629-470	---	---	0.15	0.30-0.60	0.25-1.00	0.030	0.030	8.00-10.00	---	0.90-1.10	Al 0.020
BSI BS 3059-2:1990	629-590	---	---	0.15	0.30-0.60	0.25-1.00	0.030	0.030	8.00-10.00	---	0.90-1.10	Al 0.020
AFNOR NF A 49-215:1981	TU Z 10 CD 9	---	---	0.17	0.20-0.70	0.20-1.05	0.035	0.035	7.90-10.15	0.30	0.85-1.15	Cu 0.25; Sn 0.03
ISO 2604-II:1975	TS 38	---	---	0.15	0.30-0.60	0.25-1.00	0.030	0.030	8.00-10.00	---	0.90-1.10	Al 0.02
ASTM A 213/A 213M-99	T91	---	---	0.08-0.12	0.30-0.60	0.20-0.50	0.020	0.010	8.00-9.50	0.40	0.85-1.05	V 0.18-0.25; Cb 0.06-0.1; N 0.030-0.070; Al 0.04
	91	---	---	0.08-0.12	0.30-0.60	0.20-0.50	0.020	0.020	8.00-9.50	0.40	0.85-1.05	V 0.18-0.25; Nb 0.06-0.10; N 0.030-0.070; Al 0.030

5.2 Tubes for Heat Transfer Applications

5.2.2B Mechanical Properties of Alloy 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	ksi	N/mm ² or MPa	ksi		
BSI BS 3059-2:1990	243	---	---	all: N	---	---	275	---	480-630	---	22	---
ISO 2604-II:1975	TS 26	---	---	N, NT	---	---	250	---	450-600	---	22	---
ISO 2604-III:1975	TW 26	---	---	N, NT	---	---	250	---	450-600	---	22	---
DIN 28180:1985	15 Mo 3	1.5415	---	see standard	≤ 16	---	270	---	450-600	---	22 L; 20 T	T: 34 J at RT
					16 < t ≤ 40	---	270	---	450-600	---	22 L; 20 T	
					40 < t ≤ 60	---	260	---	450-600	---	22 L; 20 T	
BSI BS 3606:1992	243	---	---	N, N+T	---	---	275	---	480-630	---	22	---
AFNOR NF A 49-215:1981	TU 15 D 3	---	---	Heat	---	---	265	---	430-530	---	22	---
AFNOR NF A 49-245:1986	TS 15 D 3	---	---	HF	---	---	265	---	430-530	---	22	see standard
ASTM A 209/A 209M-98	T1	---	K11522	see standard	< 5.1	< 0.200	205	30	380	55	30	80 HRB max
					≥ 5.1	≥ 0.200						146 HB max
	T1b	---	K11422	see standard	< 5.1	< 0.200	220	32	415	60	30	77 HRB max
					≥ 5.1	≥ 0.200						137 HB max
ASTM A 250/A 250M-99	T1	---	K11522	A, IA, N or NT	---	---	205	30	380	55	30	146 HB max 80 HRB max
	T1b	---	K11422	A, IA, N or NT	---	---	195	28	365	53	30	137 HB max 77 HRB max
JIS G 3462:1988	STBA 12	---	---	LTA, IA, A, N or NT	O.D. < 10	---	205	---	380	---	22	---
					10 ≤ O.D. < 20	---					25	
					O.D. ≥ 20	---					30	
JIS G 3467:1988	STF A 12	---	---	LTA, IA, A, N or NT	---	---	205	---	380	---	30	---
ASTM A 209/A 209M-98	T1a	---	K12023	see standard	< 5.1	< 0.200	195	28	365	53	30	81 HRB max
					≥ 5.1	≥ 0.200						153 HB max
ASTM A 250/A 250M-99	T1a	---	K12023	A, IA, N or NT	---	---	220	32	415	60	30	153 HB max 81 HRB max
JIS G 3462:1988	STBA 13	---	---	LTA, IA, A, N or NT	O.D. < 10	---	205	---	410	---	22	---
					10 ≤ O.D. < 20	---					25	
					O.D. ≥ 20	---					30	

5.2 Tubes for Heat Transfer Applications

5.2.2B Mechanical Properties of Alloy Steel Tubes for Heat Transfer Applications (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 213/A 213M-99	T2	---	K11547	A, IA, NT	---	---	205	30	415	60	30	163 HB max 85 HRB max
ASTM A 250/A 250M-99	T2	---	K11547	A, IA, N or NT	---	---	205	30	415	60	30	163 HB max 85 HRB max
JIS G 3462:1988	STBA 20	---	---	LTA, IA, A, or NT	O.D. < 10	---	205	---	410	---	22	---
					10 ≤ O.D. < 20	---					25	
					O.D. ≥ 20	---					30	
AFNOR NF A 49-215:1981	TU 15 CD 2-05	---	---	Heat + T	---	---	275	---	440-570	---	22	---
AFNOR NF A 49-245:1986	TS 15 CD 2 05	---	---	HF + T	---	---	275	---	440-570	---	22	see standard
ISO 2604-II:1975	TS 33	---	---	NT	---	---	275	---	460-610	---	15	---
ASTM A 213/A 213M-99	T12	---	K11562	A, IA, NT	---	---	220	32	415	60	30	163 HB max 85 HRB max
ASTM A 250/A 250M-99	T12	---	K11562	A, IA, N or NT	---	---	220	32	415	60	30	163 HB max 85 HRB max
JIS G 3462:1988	STBA 22	---	---	LTA, IA, A, or NT	O.D. < 10	---	205	---	410	---	22	---
					10 ≤ O.D. < 20	---					25	
					O.D. ≥ 20	---					30	
JIS G 3467:1988	STF A 22	---	---	LTA, IA, A or NT	---	---	205	---	410	---	30	---
AFNOR NF A 49-245:1986	TS 15 CD 4 05	---	---	HF + T	---	---	295	---	470-610	---	20	see standard
BSI BS 3059-2:1990	620-460	---	---	all: N	---	---	180	---	460-610	---	22	---
BSI BS 3606:1992	620	---	---	N	---	---	180	---	460-610	---	22	---
DIN 28180:1985	13 CrMo 4 4	1.7335	---	see standard	≤ 16	---	290	---	440-590	---	22 L; 20 T	T: 34 J at RT
					16 < t ≤ 40	---	290	---	440-590	---	22 L; 20 T	
					40 < t ≤ 60	---	280	---	440-590	---	22 L; 20 T	
ISO 2604-II:1975	TS 32	---	---	NT	---	---	275	---	440-590	---	22	---
ISO 2604-III:1975	TW 32	---	---	NT	---	---	275	---	440-590	---	22	---

5.2 Tubes for Heat Transfer Applications

5.2.2B Mechanical Properties of Alloy Steel Tubes for Heat Transfer Applications (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 213/A 213M-99	T11	---	K11597	A, IA, NT	---	---	205	30	415	60	30	163 HB max 85 HRB max
ASTM A 250/A 250M-99	T11	---	K11597	A, IA, N or NT	---	---	205	30	415	60	30	163 HB max 85 HRB max
JIS G 3462:1988	STBA 23	---	---	IA, A or NT	O.D. < 10	---	205	---	410	---	22	---
					10 ≤ O.D. < 20	---					25	
					O.D. ≥ 20	---					30	
JIS G 3467:1988	STF A 23	---	---	IA, A, or NT	---	---	205	---	410	---	30	---
BSI BS 3606:1992	621	---	---	N, N+T	---	---	275	---	420-570	---	22	---
AFNOR NF A 49-215:1981	TU 10 CD 5-05	---	---	Heat + Slow Cool	---	---	225	---	440-590	---	22	---
				Heat + Air Cool + T	---	---	325	---	490-640	---	20	---
ASTM A 213/A 213M-99	T22	---	K21590	A, IA, NT	---	---	205	30	415	60	30	163 HB max 85 HRB max
ASTM A 250/A 250M-99	T22	---	K21590	A, IA, N or NT	---	---	205	30	415	60	30	163 HB max 85 HRB max
JIS G 3462:1988	STBA 24	---	---	IA, A or NT	O.D. < 10	---	205	---	410	---	22	---
					10 ≤ O.D. < 20	---					25	
					O.D. ≥ 20	---					30	
JIS G 3467:1988	STF A 24	---	---	IA, A, or NT	---	---	205	---	410	---	30	---
BSI BS 3059-2:1990	622-490	---	---	S: NT	---	---	275	---	490-640	---	20	---
BSI BS 3606:1992	622	---	---	N+T	---	---	275	---	490-640	---	16	---
AFNOR NF A 49-215:1981	TU 10 CD 9-10	---	---	Heat + Slow Cool	---	---	225	---	410-560	---	22	---
				Heat + Air Cool + T	---	---	325	---	490-640	---	20	---
ISO 2604-II:1975	TS 34	---	---	A	---	---	135	---	410-560	---	20	---
ASTM A 213/A 213M-99	T5	---	K41545	A, IA, NT	---	---	205	30	415	60	30	---
	T5b	---	K51545	A, IA, NT	---	---	205	30	415	60	30	---
JIS G 3462:1988	STBA 25	---	---	IA, A or NT	O.D. < 10	---	205	---	410	---	22	---
					10 ≤ O.D. < 20	---					25	
					O.D. ≥ 20	---					30	
JIS G 3467:1988	STF A 25	---	---	IA, A, or NT	---	---	205	---	410	---	30	---
BSI BS 3606:1992	625	---	---	A	---	---	170	---	450-600	---	20	---
AFNOR NF A 49-215:1981	TU Z 10 CD 5 05	---	---	Heat + Air Cool + T	---	---	390	---	590-710	---	17	---
ISO 2604-II:1975	TS 37	---	---	A	---	---	205	---	410-560	---	20	---

5.2 Tubes for Heat Transfer Applications

5.2.2B Mechanical Properties of Alloy Steel Tubes for Heat Transfer Applications (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 213/A 213M-99	T9	---	S50400	A, IA, NT	---	---	205	30	415	60	30	179 HB max 89 HRB max
JIS G 3462:1988	STBA 26	---	---	IA, A or NT	O.D. < 10	---	205	---	410	---	22	---
					10 ≤ O.D. < 20	---					25	
					O.D. ≥ 20	---					30	
JIS G 3467:1988	STF A 26	---	---	IA, A, or NT	---	---	205	---	410	---	30	---
BSI	629-470	---	---	S: A	---	---	185	---	470-620	---	20	---
BS 3059-2:1990	629-590	---	---	S: NT	---	---	400	---	590-740	---	18	---
AFNOR NF A 49-215:1981	TU Z 10 CD 9	---	---	Heat + Slow Cool	---	---	205	---	440-590	---	22	---
ISO 2604-II:1975	TS 38	---	---	A	---	---	135	---	410-560	---	20	---
ASTM A 213/A 213M-99	T91	---	---	NT	---	---	415	60	585	85	20	250 HB max 25 HRC max
BSI BS 3059-2:1990	91	---	---	S: NT	---	---	450	---	630-830	---	18	---

5.2 Tubes for Heat Transfer Applications

5.2.3.1A Chemical Composition of Ferritic and Martensitic Stainless 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 803/A 803M-01	TP409	---	S40900	0.08	1.00	1.00	0.045	0.030	10.5-11.7	0.50	---	Ti 6 x C to 0.75
JIS G 3463:1994	SUS409TB	---	---	0.08	1.00	1.00	0.040	0.030	10.50-11.75	---	---	Ti 6 x C to 0.75
AFNOR NF A 49-245:1986	TS Z 6 CT 12	---	---	0.08	1.00	1.00	0.040	0.030	10.5-12.5	---	---	Ti 6 x C to 1.0
AFNOR NF A 49-245:1986	TS Z 6 C 13	---	---	0.08	1.00	1.00	0.040	0.030	11.5-13.5	---	---	---
ISO 2604-II:1975	TS 39	---	---	0.08	1.00	1.00	0.040	0.030	11.5-14.0	0.50	---	---
JIS G 3463:1994	SUS410TB	---	---	0.015	1.00	1.00	0.040	0.030	11.50-13.50	---	---	---
AFNOR NF A 49-217:1987	TU Z 12 C 13	---	---	0.15	1.00	1.00	0.040	0.030	11.50-13.50	0.50	---	---
JIS G 3463:1994	SUS430TB	---	---	0.12	1.00	0.75	0.040	0.030	16.00-18.00	---	---	---
AFNOR NF A 49-217:1987	TU Z 10 C 17	---	---	0.12	1.00	1.00	0.040	0.030	16.00-18.00	0.50	---	---
AFNOR NF A 49-245:1986	TS Z 8 C 17	---	---	0.08	1.00	1.00	0.040	0.030	16-18	---	---	---
JIS G 3463:1994	SUS430LXTB	---	---	0.030	1.00	0.75	0.040	0.030	16.00-19.00	---	---	Ti or Nb 0.10-1.00
AFNOR NF A 49-245:1986	TS Z 8 CT 17	---	---	0.08	1.00	1.00	0.040	0.030	16-18	---	---	Ti 7 x C to 1.2
ASTM A 803/A 803M-01	TP439	---	S43035	0.07	1.00	1.00	0.040	0.030	17.0-19.0	0.50	---	Al 0.15; N 0.04; Ti 0.20 + 4 (C+N) to 1.10
BSI BS 3606:1992	439	---	---	C+N 0.040	1.00	1.00	0.040	0.020	17.00-19.00	0.50	---	Al 0.15; Cu 0.15; Ti 15 (C+N) to 0.75
BSI BS 3059-2:1990	762	---	---	0.17-0.23	1.00	0.50	0.030	0.030	10.00-12.50	0.3-0.8	0.80-1.20	V 0.25-0.35
ISO 2604-II:1975	TS 40	---	---	0.17-0.23	1.00	0.50	0.030	0.030	10.00-12.50	0.30-0.80	0.80-1.20	V 0.25-0.35

5.2 Tubes for Heat Transfer Applications

5.2.3.1B Mechanical Properties of Ferritic and Martensitic Stainless 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	ksi	N/mm ² or MPa	ksi		
ASTM A 803/A 803M-01	TP409	---	S40900	SA	---	---	205	30	380	55	20	207 HB max 95 HRB max
JIS G 3463:1994	SUS409TB	---	---	A	O.D. < 10	---	205	---	410	---	12	---
					10 ≤ O.D. < 20	---					15	---
					O.D. ≥ 20	---					20	---
AFNOR NF A 49-245:1986	TS Z 6 CT 12	---	---	H	---	---	200	---	380-580	---	20	---
AFNOR NF A 49-245:1986	TS Z 6 C 13	---	---	H	---	---	215	---	420-620	---	20	---
ISO 2604-II:1975	TS 39	---	---	A	---	---	245	---	440-590	---	20	---
				QT	---	---	390	---	590-740	---	18	---
JIS G 3463:1994	SUS410TB	---	---	A	O.D. < 10	---	205	---	410	---	12	---
					10 ≤ O.D. < 20	---					15	---
					O.D. ≥ 20	---					20	---
AFNOR NF A 49-217:1987	TU Z 12 C 13	---	---	HF + CR + T	---	---	210	---	420-670	---	17	---
JIS G 3463:1994	SUS430TB	---	---	A	O.D. < 10	---	245	---	410	---	12	---
					10 ≤ O.D. < 20	---					15	---
					O.D. ≥ 20	---					20	---
AFNOR NF A 49-217:1987	TU Z 10 C 17	---	---	HF + CR + T	---	---	250	---	420-670	---	17	---
AFNOR NF A 49-245:1986	TS Z 8 C 17	---	---	H	---	---	245	---	430-630	---	20	---
JIS G 3463:1994	SUS430LXTB	---	---	A	O.D. < 10	---	175	---	360	---	12	---
					10 ≤ O.D. < 20	---					15	---
					O.D. ≥ 20	---					20	---
AFNOR NF A 49-245:1986	TS Z 8 CT 17	---	---	H	---	---	240	---	400-600	---	20	---
ASTM A 803/A 803M-01	TP439	---	S43035	SA	---	---	205	30	415	60	20	207 HB max 95 HRB max
BSI BS 3606:1992	439	---	---	A	---	---	205	---	415-700	---	15	---
BSI BS 3059-2:1990	762	---	---	S: NT	---	---	470	---	720-870	---	15	---
ISO 2604-II:1975	TS 40	---	---	NT	---	---	435	---	690-840	---	15	---

5.2 Tubes for Heat Transfer Applications

5.2.3.2A Chemical Composition of Austenitic Stainless 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 249/A 249M-98	TP304	---	S30400	0.08	2.00	0.75	0.040	0.030	18.0-20.0	8.00-11.0	---	---
ASTM A 688/A 688M-00	TP304	---	S30400	0.08	2.00	0.75	0.040	0.030	18.00-20.00	8.00-11.00	---	---
ASTM A 851-96	TP304	---	S30400	0.08	2.00	0.75	0.040	0.030	18.0-20.0	8.00-11.0	---	---
JIS G 3463:1994	SUS304TB	---	---	0.08	2.00	1.00	0.040	0.030	18.00-20.00	8.00-11.00	---	---
JIS G 3467:1988	SUS 304 TF	---	---	0.08	2.00	1.00	0.040	0.030	18.00-20.00	8.00-11.00	---	---
BSI BS 3606:1992	304S31	---	---	0.07	2.00	1.00	0.040	0.030	17.00-19.00	8.00-11.00	---	---
DIN 28180:1985	X 5 CrNi 18 10	1.4301	---	0.07	---	---	---	---	17.0-19.0	8.5-10.5	---	---
DIN 28181:1985	X 5 CrNi 18 10	1.4301	---	0.07	---	---	---	---	17.0-19.0	8.5-10.5	---	---
AFNOR NF A 49-217:1987	TU Z 6 CN 18 09	---	---	0.080	2.00	1.00	0.040	0.030	17.00-20.00	8.00-11.00	---	---
AFNOR NF A 49-247:1981	TS Z 6 CN 18-09	---	---	0.080	2.00	1.00	0.040	0.030	17-20.0	8-11.00	---	---
ISO 2604-II:1975	TS 47	---	---	0.07	2.00	1.00	0.045	0.030	17.00-19.00	8.00-12.00	---	---
ISO 2604-V:1978	TW 47	---	---	0.07	2.00	1.00	0.045	0.030	17.00-19.00	8.00-11.00	---	---
ASTM A 249/A 249M-98	TP304L	---	S30403	0.035	2.00	0.75	0.040	0.030	18.0-20.0	8.00-13.0	---	---
ASTM A 688/A 688M-00	TP304L	---	S30403	0.035	2.00	0.75	0.040	0.030	18.00-20.00	8.00-13.00	---	---
ASTM A 851-96	TP304L	---	S30403	0.035	2.00	0.75	0.040	0.030	18.0-20.0	8.00-13.0	---	---
JIS G 3463:1994	SUS304LTB	---	---	0.030	2.00	1.00	0.040	0.030	18.00-20.00	9.00-13.00	---	---
BSI BS 3606:1992	304S11	---	---	0.030	2.00	1.00	0.040	0.030	17.00-19.00	9.00-12.00	---	---
AFNOR NF A 49-217:1987	TU Z 2 CN 18 10	---	---	0.030	2.00	1.00	0.040	0.030	17.00-20.00	9.00-12.00	---	---
AFNOR NF A 49-247:1981	TS Z 2 CN 18-10	---	---	0.030	2.00	1.00	0.040	0.030	17-20.0	9-13.00	---	---
ISO 2604-II:1975	TS 46	---	---	0.03	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	---
ISO 2604-V:1978	TW 46	---	---	0.03	2.00	1.00	0.045	0.030	17.00-19.00	9.00-12.00	---	---
ASTM A 249/A 249M-98	TP304H	---	S30409	0.04-0.10	2.00	0.75	0.040	0.030	18.0-20.0	8.00-11.0	---	---
JIS G 3463:1994	SUS304HTB	---	---	0.04-0.10	2.00	0.75	0.040	0.030	18.00-20.00	8.00-11.00	---	---
JIS G 3467:1988	SUS 304H TF	---	---	0.04-0.10	2.00	0.75	0.040	0.030	18.00-20.00	8.00-11.00	---	---
BSI BS 3059-2:1990	304S51	---	---	0.04-0.10	2.00	1.00	0.040	0.030	17.0-19.0	8.0-11.0	---	---
ISO 2604-II:1975	TS 48	---	---	0.04-0.09	2.00	0.75	0.045	0.030	17.00-20.00	8.00-12.00	---	---

5.2 Tubes for Heat Transfer Applications

5.2.3.2A Chemical Composition of Austenitic Stainless Steel Tubes for Heat Transfer Applications (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 249/A 249M-98	TP304N	---	S30451	0.08	2.00	0.75	0.040	0.030	18.0-20.0	8.00-11.0	---	N 010-0.16
ASTM A 688/A 688M-00	TP304N	---	S30451	0.08	2.00	0.75	0.040	0.030	18.0-20.0	8.00-11.0	---	N 0.10-0.16
ASTM A 249/A 249M-98	TP304LN	---	S30453	0.035	2.00	0.75	0.040	0.030	18.0-20.0	8.00-13.0	---	N 010-0.16
ASTM A 688/A 688M-00	TP304LN	---	S30453	0.035	2.00	0.75	0.040	0.030	18.00-20.00	8.00-13.00	---	N 0.10-0.16
AFNOR NF A 49-217:1987	TU Z 2 CN 18 10 AZ	---	---	0.030	2.00	1.00	0.040	0.030	17.00-19.00	9.00-11.00	---	N 0.10-0.20
ASTM A 249/A 249M-98	TP309S	---	S30908	0.08	2.00	0.75	0.045	0.030	22.0-24.0	12.0-15.0	0.75	---
JIS G 3463:1994	SUS309STB	---	---	0.08	2.00	1.00	0.040	0.030	22.00-24.00	12.00-15.00	---	---
ASTM A 249/A 249M-98	TP309H	---	S30909	0.04-0.10	2.00	0.75	0.040	0.030	22.0-24.0	12.0-15.0	---	---
JIS G 3463:1994	SUS309TB	---	---	0.15	2.00	1.00	0.040	0.030	22.00-24.00	12.00-15.00	---	---
ASTM A 249/A 249M-98	TP310S	---	S31008	0.08	2.00	0.75	0.045	0.030	26.0	22.0	0.75	---
JIS G 3463:1994	SUS310STB	---	---	0.08	2.00	1.50	0.040	0.030	24.00-26.00	19.00-22.00	---	---
JIS G 3463:1994	SUS310TB	---	---	0.15	2.00	1.50	0.040	0.030	24.00-26.00	19.00-22.00	---	---
JIS G 3467:1988	SUS 310 TF	---	---	0.15	2.00	1.50	0.040	0.030	24.00-26.00	19.00-22.00	---	---
ISO 2604-II:1975	TS 68	---	---	0.15	2.00	0.75	0.045	0.030	24.00-26.00	19.00-22.00	---	---

5.2 Tubes for Heat Transfer Applications

5.2.3.2A Chemical Composition of Austenitic Stainless Steel Tubes for Heat Transfer Applications (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								Others
				C	Mn	Si	P	S	Cr	Ni	Mo	
ASTM A 249/A 249M-98	TP316	---	S31600	0.08	2.00	0.75	0.040	0.030	18.0	14.0	2.00-3.00	---
ASTM A 688/A 688M-00	TP316	---	S31600	0.08	2.00	0.75	0.040	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---
JIS G 3463:1994	SUS316TB	---	---	0.08	2.00	1.00	0.040	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---
JIS G 3467:1988	SUS 316 TF	---	---	0.08	2.00	1.00	0.040	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---
BSI BS 3606:1992	316S31	---	---	0.07	2.00	1.00	0.040	0.030	16.50-18.50	10.50-13.50	2.00-2.50	---
	316S33	---	---	0.07	2.00	1.00	0.040	0.030	16.50-18.50	11.00-14.00	2.50-3.00	---
DIN 28180:1985	X 5 CrNiMo 17 12 2	1.4401	---	0.07	---	---	---	---	16.5-18.5	10.5-13.5	2.0-2.5	---
DIN 28181:1985	X 5 CrNiMo 17 12 2	1.4401	---	0.07	---	---	---	---	16.5-18.5	10.5-13.5	2.0-2.5	---
AFNOR NF A 49-217:1987	TU Z 6 CND 17 11	---	---	0.070	2.00	1.00	0.040	0.030	16.00-18.00	10.00-12.50	2.00-2.40	---
AFNOR NF A 49-247:1981	TS Z 6 CND 17-11	---	---	0.070	2.00	1.00	0.040	0.030	16-18.0	10-12.50	2.00-2.40	---
ISO 2604-II:1975	TS 60	---	---	0.07	2.00	1.00	0.045	0.030	16.00-18.50	11.00-14.00	2.00-2.50	---
	TS 61	---	---	0.07	2.00	1.00	0.045	0.030	16.00-18.50	11.00-14.50	2.50-3.00	---
ISO 2604-V:1978	TW 60	---	---	0.07	2.00	1.00	0.045	0.030	16.00-18.50	10.50-14.00	2.00-2.50	---
	TW 61	---	---	0.07	2.00	1.00	0.045	0.030	16.00-18.50	11.00-14.50	2.50-3.00	---
ASTM A 249/A 249M-98	TP316L	---	S31603	0.035	2.00	0.75	0.040	0.030	18.0	15.0	2.00-3.00	---
ASTM A 688/A 688M-00	TP316L	---	S31603	0.035	2.00	0.75	0.040	0.030	16.00-18.00	10.00-15.00	2.00-3.00	---
JIS G 3463:1994	SUS316LTB	---	---	0.030	2.00	1.00	0.040	0.030	16.00-18.00	12.00-16.0	2.00-3.00	---
BSI BS 3606:1992	316S11	---	---	0.030	2.00	1.00	0.040	0.030	16.50-18.50	11.00-14.00	2.00-2.50	---
	316S13	---	---	0.030	2.00	1.00	0.040	0.030	16.50-18.50	11.50-14.50	2.50-3.00	---
AFNOR NF A 49-217:1987	TU Z 2 CND 17 12	---	---	0.030	2.00	1.00	0.040	0.030	16.00-18.00	10.50-13.00	2.00-2.40	---
	TU Z 2 CND 18 14	---	---	0.030	2.00	1.00	0.020	0.015	17.00-18.50	13.00-16.00	2.20-3.00	---
AFNOR NF A 49-247:1981	TS Z 2 CND 17-12	---	---	0.030	2.00	1.00	0.040	0.030	16-18.0	10.5-13.00	2.00-2.40	---
ISO 2604-II:1975	TS 57	---	---	0.03	2.00	1.00	0.045	0.030	16.00-18.50	11.00-14.00	2.00-2.50	---
	TS 58	---	---	0.03	2.00	1.00	0.045	0.030	16.00-18.50	11.50-14.50	2.50-3.00	---
ISO 2604-V:1978	TW 57	---	---	0.03	2.00	1.00	0.045	0.030	16.00-18.50	11.00-14.00	2.00-2.50	---
	TW 58	---	---	0.03	2.00	1.00	0.045	0.030	16.00-18.50	11.50-14.50	2.50-3.00	---

5.2 Tubes for Heat Transfer Applications

5.2.3.2A Chemical Composition of Austenitic Stainless Steel Tubes for Heat Transfer Applications (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								Others
				C	Mn	Si	P	S	Cr	Ni	Mo	
ASTM A 249/A 249M-98	TP316H	---	S31609	0.04-0.10	2.00	0.75	0.040	0.030	18.0	14.0	2.00-3.00	---
JIS G 3463:1994	SUS316HTB	---	---	0.04-0.10	2.00	0.75	0.030	0.030	16.00-18.00	11.00-14.00	2.00-3.00	---
JIS G 3467:1988	SUS 316H TF	---	---	0.04-0.10	2.00	0.75	0.030	0.030	16.00-18.00	11.00-14.00	2.00-3.00	---
BSI	316S51	---	---	0.04-0.10	2.00	1.00	0.040	0.030	16.5-18.5	10.5-13.5	2.00-2.50	---
BS 3059-2:1990	316S52	---	---	0.04-0.10	2.00	1.00	0.040	0.030	16.5-18.5	10.5-13.5	2.00-2.50	B 0.0015-0.006
ISO 2604-II:1975	TS 63	---	---	0.04-0.09	1.00-2.00	0.75	0.045	0.030	16.00-18.00	12.00-14.00	2.00-2.75	---
ASTM A 249/A 249M-98	TP316LN	---	S31653	0.035	2.00	0.75	0.040	0.030	18.0	15.0	2.00-3.00	N 0.10-0.16
ASTM A 688/A 688M-00	TP316LN	---	S31653	0.035	2.00	0.75	0.040	0.030	16.00-18.00	10.00-15.00	2.00-3.00	N 0.10-0.16
AFNOR NF A 49-217:1987	TU Z 2 CND 17 12 AZ	---	---	0.030	2.00	1.00	0.040	0.030	16.00-18.00	11.00-13.50	2.00-2.40	N 0.10-0.20
JIS G 3463:1994	SUS316TiTB	---	---	0.08	2.00	1.00	0.040	0.030	16.00-18.00	10.00-14.00	2.00-3.00	Ti 5 x C min
DIN 28180:1985	X 6 CrNiMoTi 17 12 2	1.4571	---	0.08	---	---	---	---	16.5-18.5	10.5-13.5	2.0-2.5	Ti 5 x C to 0.80
DIN 28181:1985	X 6 CrNiMoTi 17 12 2	1.4571	---	0.08	---	---	---	---	16.5-18.5	10.5-13.5	2.0-2.5	Ti 5 x C to 0.80
ASTM A 249/A 249M-98	TP317	---	S31700	0.08	2.00	0.75	0.04	0.03	18.0-20.0	11.0-14.0	3.00-4.00	---
JIS G 3463:1994	SUS317TB	---	---	0.08	2.00	1.00	0.040	0.030	18.00-20.00	11.00-15.00	3.00-4.00	---
ASTM A 249/A 249M-98	TP317L	---	S31703	0.035	2.00	0.75	0.04	0.03	18.0-20.0	11.0-15.0	3.00-4.00	---
JIS G 3463:1994	SUS317LTB	---	---	0.030	2.00	1.00	0.040	0.030	18.00-20.00	11.00-15.00	3.00-4.00	---
AFNOR NF A 49-247:1981	TS Z 2 CND 19-15	---	---	0.030	2.00	1.00	0.040	0.030	17.5-19.5	14-16	3.0-4.0	---
ASTM A 249/A 249M-98	TP321	---	S32100	0.08	2.00	0.75	0.04	0.03	17.0-20.0	9.00-13.0	---	Ti 5 x C to 0.70
JIS G 3463:1994	SUS321TB	---	---	0.08	2.00	1.00	0.040	0.030	17.00-19.00	9.00-13.00	---	Ti 5 x C min
JIS G 3467:1988	SUS 321 TF	---	---	0.08	2.00	1.00	0.040	0.030	17.00-19.00	9.00-13.00	---	Ti 5 x C min
BSI BS 3606:1992	321S31	---	---	0.08	2.00	1.00	0.040	0.030	17.00-19.00	9.00-12.00	---	Ti 5 x C to 0.80
DIN 28180:1985	X 6 CrNiTi 18 10	1.4541	---	0.08	---	---	---	---	17.0-19.0	9.0-12.0	---	Ti 5 x C to 0.80
DIN 28181:1985	X 6 CrNiTi 18 10	1.4541	---	0.08	---	---	---	---	17.0-19.0	9.0-12.0	---	Ti 5 x C to 0.80
AFNOR NF A 49-217:1987	TU Z 6 CNT 18 10	---	---	0.080	2.00	1.00	0.040	0.030	17.00-20.00	9.00-12.00	---	Ti 5 x C to 0.6
AFNOR NF A 49-247:1981	TS Z 6 CNT 18-10	---	---	0.080	2.00	1.00	0.040	0.030	17-20.0	9-12.00	---	Ti 5 x C to 0.6
ISO 2604-II:1975	TS 53	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Ti 5 x C to 0.80
ISO 2604-V:1978	TW 53	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-12.00	---	Ti 5 x C to 0.80

5.2 Tubes for Heat Transfer Applications

5.2.3.2A Chemical Composition of Austenitic Stainless Steel Tubes for Heat Transfer Applications (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 249/A 249M-98	TP321H	---	S32109	0.04-0.10	2.00	0.75	0.04	0.03	17.0-20.0	9.00-13.0	---	Ti 4 x C to 0.60
JIS G 3463:1994	SUS321HTB	---	---	0.04-0.10	2.00	0.75	0.030	0.030	17.00-20.00	9.00-13.00	---	Ti 4 x C to 0.60
JIS G 3467:1988	SUS 321H TF	---	---	0.04-0.10	2.00	0.75	0.030	0.030	17.00-20.00	9.00-13.00	---	Ti 4 x C to 0.60
BSI BS 3059-2:1990	321S51 (1010)	---	---	0.04-0.10	2.00	1.00	0.040	0.030	17.0-19.0	9.0-12.00	---	Ti 5 x C to 0.80
	321S51 (1105)	---	---	0.04-0.10	2.00	1.00	0.040	0.030	17.0-19.0	9.0-12.00	---	Ti 5 x C to 0.80
ISO 2604-II:1975	TS 54	---	---	0.04-0.10	2.00	0.20-0.80	0.045	0.030	17.00-20.00	9.00-13.00	---	Ti 4 x C to 0.60
JIS G 3463:1994	SUS329J3LTB	---	---	0.030	1.50	1.00	0.040	0.030	21.00-24.00	4.50-6.50	2.50-3.50	N 0.08-0.20
AFNOR NF A 49-217:1987	TU Z 2 CND 22 05 03	---	---	0.030	2.00	1.00	0.030	0.020	21.00-23.00	4.50-6.50	2.50-3.50	N 0.08-0.20
JIS G 3463:1994	SUS329J4LTB	---	---	0.030	1.50	1.00	0.040	0.030	24.00-26.00	5.50-7.50	2.50-3.50	N 0.08-0.30
AFNOR NF A 49-217:1987	TU Z 2 CND 25 07 03	---	---	0.030	1.70	0.70	0.030	0.020	23.50-25.50	5.50-7.50	2.50-3.50	N 0.15-0.25
ASTM A 249/A 249M-98	TP347	---	S34700	0.08	2.00	0.75	0.04	0.03	17.0-20.0	9.00-13.0	---	(Cb+Ta) 10 x C to 1.0
ISO 2604-II:1975	TS 50	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Nb 10 x C to 1.00
ISO 2604-V:1978	TW 50	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-12.00	---	Nb 10 x C to 1.00
JIS G 3463:1994	SUS347TB	---	---	0.08	2.00	1.00	0.040	0.030	17.00-19.00	9.00-13.00	---	Nb 10 x C min
JIS G 3467:1988	SUS 347 TF	---	---	0.08	2.00	1.00	0.040	0.030	17.00-19.00	9.00-13.00	---	Nb 10 x C min
BSI BS 3606:1992	347S31	---	---	0.08	2.00	1.00	0.040	0.030	17.00-19.00	9.00-13.00	---	Nb 10 x C to 1.00
ASTM A 249/A 249M-98	TP347H	---	S34709	0.04-0.10	2.00	0.75	0.04	0.03	17.0-20.0	9.00-13.0	---	(Cb+Ta) 8 x C to 1.0
JIS G 3463:1994	SUS347HTB	---	---	0.04-0.10	2.00	1.00	0.030	0.030	17.00-20.00	9.00-13.00	---	Nb 8 x C to 1.00
JIS G 3467:1988	SUS 347H TF	---	---	0.04-0.10	2.00	0.75	0.030	0.030	17.00-20.00	9.00-13.00	---	Nb 8 x C to 1.00
BSI BS 3059-2:1990	347S51	---	---	0.04-0.10	2.00	1.00	0.040	0.030	17.0-19.0	9.0-13.0	---	Nb 10 x C to 1.2
ISO 2604-II:1975	TS 56	---	---	0.04-0.10	2.00	0.20-0.80	0.045	0.030	16.00-20.00	11.00-14.00	---	Nb 10 x C to 1.4
ASTM A 803/A 803M-01	TP XM-27	---	S44627	0.01	0.40	0.40	0.02	0.02	25.0-27.5	0.5	0.75-1.50	Cu 0.20; N 0.015; Cb 0.05-0.20
JIS G 3463:1994	SUSXM27TB	---	---	0.010	0.40	0.40	0.030	0.020	25.00-27.50	---	1.75-1.50	N 0.015
ASTM A 249/A 249M-98	---	---	S31050	0.025	2.00	0.4	0.020	0.015	24.0-26.0	20.5-23.5	1.6-2.6	N 0.09-0.15
AFNOR NF A 49-217:1987	TU Z 1 CND 25 22 AZ	---	---	0.020	1.50-2.00	0.40	0.020	0.015	24.50-26.00	21.50-23.00	1.90-2.40	N 0.10-0.15

5.2 Tubes for Heat Transfer Applications

5.2.3.2A Chemical Composition of Austenitic Stainless Steel Tubes for Heat Transfer Applications (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 249/A 249M-98	---	---	N08904	0.020	2.00	1.00	0.045	0.035	19.0-23.0	23.0-28.0	4.0-5.0	N 0.10; Cu 1.0-2.0
JIS G 3463:1994	SUS890LTB	---	---	0.020	2.00	1.00	0.040	0.030	19.00-23.00	23.00-28.00	4.00-5.00	Cu 1.00-2.00
ASTM A 249/A 249M-98	---	---	S31254	0.02	1.00	0.80	0.03	0.01	19.5-20.5	17.5-18.5	6.00-6.50	N 0.18-0.22; Cu 0.50-1.00
ASTM A 688/A 688M-00	---	---	S31254	0.02	1.00	0.80	0.03	0.01	19.5-20.5	17.5-18.5	6.00-6.50	N 0.18-0.22; Cu 0.50-1.00
AFNOR NF A 49-217:1987	TU Z 1 CNDU 20 18 06 AZ	---	---	0.020	1.00	0.80	0.030	0.010	19.50-20.50	17.50-18.50	6.00-6.50	Cu 0.50-1.00
ASTM A 249/A 249M-98	---	---	N08367	0.030	2.00	1.00	0.040	0.030	20.00-22.00	23.50-25.50	6.00-7.00	N 0.18-0.25; Cu 0.75
	---	---	N08926	0.020	2.00	0.5	0.03	0.01	19.00-21.00	24.00-26.00	6.0-7.0	N 0.15-0.25; Cu 0.5-1.5
ASTM A 688/A 688M-00	---	---	N08367	0.030	2.00	1.00	0.040	0.030	20.00-22.00	23.50-25.50	6.00-7.00	N 0.18-0.25; Cu 0.75
	---	---	N08926	0.020	2.00	0.5	0.03	0.01	19.00-21.00	24.00-26.00	6.0-7.0	N 0.15-0.25; Cu 0.5-1.5
JIS G 3463:1994	SUS836LTB	---	---	0.030	2.00	1.00	0.040	0.030	19.00-24.00	24.00-26.00	5.00-7.00	N 0.25
ASTM A 249/A 249M-98	---	---	S30615	0.16-0.24	2.00	3.2-4.0	0.03	0.03	17.0-19.5	13.5-16.0	---	Al 0.8-1.5
AFNOR NF A 49-217:1987	TU Z 1 CNS 18 15	---	---	0.015	2.00	3.50-4.50	0.030	0.020	16.50-18.50	13.80-16.00	0.50	---

5.2 Tubes for Heat Transfer Applications

5.2.3.2B Mechanical Properties of Austenitic Stainless 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	ksi	N/mm ² or MPa	ksi		
ASTM A 249/A 249M-98	TP304	---	S30400	H + RC	---	---	205	30	515	75	35	90 HRB max
ASTM A 688/A 688M-00	TP304	---	S30400	SA	---	---	205	30	515	75	35	90 HRB max
ASTM A 851-96	TP304	---	S30400	H+WQ or RC	---	---	205	30	515	75	35	---
JIS G 3463:1994	SUS304TB	---	---	ST	O.D. < 10	---	205	---	520	---	27	---
					10 ≤ O.D. < 20	---					30	---
					O.D. ≥ 20	---					35	---
JIS G 3467:1988	SUS 304 TF	---	---	ST	---	---	205	---	520	---	35	---
BSI BS 3606:1992	304S31	---	---	S	---	---	235	---	490-690	---	30	---
DIN 28180:1985	X 5 CrNi 18 10	1.4301	---	SA & Q	≤ 50	---	195	---	500-700	---	40 L; 35 T	L: 85 J at RT T: 55 J at RT
DIN 28181:1985	X 5 CrNi 18 10	1.4301	---	SA & Q	≤ 50	---	195	---	500-720	---	40 L; 35 T	85 J at RT, L 55 J at RT, T
AFNOR NF A 49-217:1987	TU Z 6 CN 18 09	---	---	HF + CR + Q (HY)	---	---	200	---	490-740	---	45	90 HRB max
AFNOR NF A 49-247:1981	TS Z 6 CN 18-09	---	---	Q (HY)	---	---	215	---	530-730	---	40	---
ISO 2604-II:1975	TS 47	---	---	Q	---	---	195	---	490-690	---	30	---
ISO 2604-V:1978	TW 47	---	---	Q	---	---	195	---	490-690	---	30	---
ASTM A 249/A 249M-98	TP304L	---	S30403	H + RC	---	---	170	25	485	70	35	90 HRB max
ASTM A 688/A 688M-00	TP304L	---	S30403	SA	---	---	175	25	485	70	35	90 HRB max
ASTM A 851-96	TP304L	---	S30403	H+WQ or RC	---	---	170	25	485	70	35	---
JIS G 3463:1994	SUS304LTB	---	---	ST	O.D. < 10	---	175	---	480	---	27	---
					10 ≤ O.D. < 20	---					30	---
					O.D. ≥ 20	---					35	---
BSI BS 3606:1992	304S11	---	---	S	---	---	205	---	490-690	---	30	---
AFNOR NF A 49-217:1987	TU Z 2 CN 18 10	---	---	HF + CR + Q (HY)	---	---	175	---	470-720	---	45	90 HRB max
AFNOR NF A 49-247:1981	TS Z 2 CN 18-10	---	---	Q (HY)	---	---	205	---	520-720	---	40	---
ISO 2604-II:1975	TS 46	---	---	Q	---	---	175	---	490-690	---	30	---
ISO 2604-V:1978	TW 46	---	---	Q	---	---	175	---	490-690	---	30	---

5.2 Tubes for Heat Transfer Applications

5.2.3.2B Mechanical Properties of Austenitic Stainless Steel Tubes for Heat Transfer Applications (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 249/A 249M-98	TP304H	---	S30409	ST	---	---	205	30	515	75	35	90 HRB max
JIS G 3463:1994	SUS304HTB	---	---	ST	O.D. < 10	---	205	---	520	---	27	---
					10 ≤ O.D. < 20	---					30	---
					O.D. ≥ 20	---					35	---
JIS G 3467:1988	SUS 304HTF	---	---	ST	---	---	205	---	520	---	35	---
BSI BS 3059-2:1990	304S51	---	---	S: ST	---	---	230	---	490-690	---	35	---
ISO 2604-II:1975	TS 48	---	---	Q	---	---	195	---	490-690	---	30	---
ASTM A 249/A 249M-98	TP304N	---	S30451	H + RC	---	---	240	35	550	80	35	90 HRB max
ASTM A 688/A 688M-00	TP304N	---	S30451	SA	---	---	240	35	550	80	35	90 HRB max
ASTM A 249/A 249M-98	TP304LN	---	S30453	H + RC	---	---	205	30	515	75	35	90 HRB max
ASTM A 688/A 688M-00	TP304LN	---	S30453	SA	---	---	205	30	515	75	35	90 HRB max
AFNOR NF A 49-217:1987	TU Z 2 CN 18 10 AZ	---	---	---	---	---	240	---	550-800	---	40	---
ASTM A 249/A 249M-98	TP309S	---	S30908	H + RC	---	---	205	30	515	75	35	90 HRB max
JIS G 3463:1994	SUS309STB	---	---	ST	O.D. < 10	---	205	---	520	---	27	---
					10 ≤ O.D. < 20	---					30	---
					O.D. ≥ 20	---					35	---
ASTM A 249/A 249M-98	TP309H	---	S30909	ST	---	---	205	30	515	75	35	90 HRB max
JIS G 3463:1994	SUS309TB	---	---	ST	O.D. < 10	---	205	---	520	---	27	---
					10 ≤ O.D. < 20	---					30	---
					O.D. ≥ 20	---					35	---
ASTM A 249/A 249M-98	TP310S	---	S31008	H + RC	---	---	205	30	515	75	35	90 HRB max
JIS G 3463:1994	SUS310STB	---	---	ST	O.D. < 10	---	205	---	20	---	27	---
					10 ≤ O.D. < 20	---					30	---
					O.D. ≥ 20	---					35	---

5.2 Tubes for Heat Transfer Applications

5.2.3.2B Mechanical Properties of Austenitic Stainless Steel Tubes for Heat Transfer Applications (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
JIS G 3463:1994	SUS310TB	---	---	ST	O.D. < 10	---	205	---	520	---	27	---
					10 ≤ O.D. < 20	---					30	---
					O.D. ≥ 20	---					35	---
JIS G 3467:1988	SUS 310 TF	---	---	ST	---	---	205	---	520	---	35	---
ISO 2604-II:1975	TS 68	---	---	Q	---	---	205	---	510-710	---	30	---
ASTM A 249/A 249M-98	TP316	---	S31600	H + RC	---	---	205	30	515	75	35	90 HRB max
ASTM A 688/A 688M-00	TP316	---	S31600	SA	---	---	205	30	515	75	35	90 HRB max
JIS G 3463:1994	SUS316TB	---	---	ST	O.D. < 10	---	205	---	520	---	27	---
					10 ≤ O.D. < 20	---					30	---
					O.D. ≥ 20	---					35	---
JIS G 3467:1988	SUS 316 TF	---	---	ST	---	---	205	---	520	---	35	---
BSI BS 3606:1992	316S31	---	---	S	---	---	245	---	510-710	---	30	---
	316S33	---	---	S	---	---	245	---	510-710	---	30	---
DIN 28180:1985	X 5 CrNiMo 17 12 2	1.4401	---	SA & Q	≤ 50	---	205	---	510-710	---	40 L; 30 T	L: 85 J at RT T: 55 J at RT
DIN 28181:1985	X 5 CrNiMo 17 12 2	1.4401	---	SA & Q	≤ 50	---	205	---	510-710	---	40 L; 35 T	L: 85 J at RT T: 55 J at RT
AFNOR NF A 49-217:1987	TU Z 6 CND 17 11	---	---	HF + CR + Q (HY)	---	---	190	---	490-740	---	45	90 HRB max
AFNOR NF A 49-247:1981	TS Z 6 CND 17-11	---	---	Q (HY)	---	---	225	---	540-740	---	40	---
ISO 2604-II:1975	TS 60	---	---	Q	---	---	205	---	510-710	---	30	---
	TS 61	---	---	Q	---	---	205	---	510-710	---	30	---
ISO 2604-V:1978	TW 60	---	---	Q	---	---	205	---	510-710	---	30	---
	TW 61	---	---	Q	---	---	205	---	510-710	---	30	---

5.2 Tubes for Heat Transfer Applications

5.2.3.2B Mechanical Properties of Austenitic Stainless Steel Tubes for Heat Transfer Applications (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 249/A 249M-98	TP316L	---	S31603	H + RC	---	---	170	25	485	70	35	90 HRB max
ASTM A 688/A 688M-00	TP316L	---	S31603	SA	---	---	175	25	485	70	35	90 HRB max
JIS G 3463:1994	SUS316LTB	---	---	ST	O.D. < 10	---	175	---	480	---	27	---
					10 ≤ O.D. < 20	---					30	---
					O.D. ≥ 20	---					35	---
BSI BS 3606:1992	316S11	---	---	S	---	---	215	---	490-690	---	30	---
	316S13	---	---	S	---	---	215	---	490-690	---	30	---
AFNOR NF A 49-217:1987	TU Z 2 CND 17 12	---	---	HF + CF + Q (HY)	---	---	175	---	470-720	---	45	90 HRB max
	TU Z 2 CND 18 14	---	---	HF + CF + Q (HY)	---	---	210	---	490-690	---	45	---
AFNOR NF A 49-247:1981	TS Z 2 CND 17-12	---	---	Q (HY)	---	---	215	---	520-720	---	40	---
ISO 2604-II:1975	TS 57	---	---	Q	---	---	185	---	490-690	---	30	---
	TS 58	---	---	Q	---	---	185	---	490-690	---	30	---
ISO 2604-V:1978	TW 57	---	---	Q	---	---	185	---	490-690	---	30	---
	TW 58	---	---	Q	---	---	185	---	490-690	---	30	---
ASTM A 249/A 249M-98	TP316H	---	S31609	ST	---	---	205	30	515	75	35	90 HRB max
JIS G 3463:1994	SUS316HTB	---	---	ST	O.D. < 10	---	205	---	520	---	27	---
					10 ≤ O.D. < 20	---					30	---
					O.D. ≥ 20	---					35	---
JIS G 3467:1988	SUS 316H TF	---	---	ST	---	---	205	---	520	---	35	---
BSI BS 3059-2:1990	316S51	---	---	S: ST	---	---	240	---	510-710	---	35	---
	316S52	---	---	S: ST	---	---	240	---	510-710	---	35	---
ISO 2604-II:1975	TS 63	---	---	Q	---	---	205	---	510-710	---	30	---
ASTM A 249/A 249M-98	TP316LN	---	S31653	H + RC	---	---	205	30	515	75	35	90 HRB max
ASTM A 688/A 688M-00	TP316LN	---	S31653	SA	---	---	205	30	515	75	35	90 HRB max
AFNOR NF A 49-217:1987	TU Z 2 CND 17 12 AZ	---	---	HF + CF + Q (HY)	---	---	280	---	600-800	---	40	---

5.2 Tubes for Heat Transfer Applications

5.2.3.2B Mechanical Properties of Austenitic Stainless Steel Tubes for Heat Transfer Applications (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
JIS G 3463:1994	SUS316TiTB	---	---	ST	O.D. < 10	---	205	---	520	---	27	---
					10 ≤ O.D. < 20	---					30	---
					O.D. ≥ 20	---					35	---
DIN 28180:1985	X 6 CrNiMoTi 17 12 2	1.4571	---	SA & Q	≤ 50	---	210	---	500-730	---	35 L; 30 T	L: 85 J at RT T: 55 J at RT
				SA & Q	≤ 50	---	190	---	490-690	---	35 L; 30 T	L: 85 J at RT T: 55 J at RT
DIN 28181:1985	X 6 CrNiMoTi 17 12 2	1.4571	---	SA & Q	≤ 50	---	210	---	500-730	---	35 L; 30 T	L: 85 J at RT T: 55 J at RT
ASTM A 249/A 249M-98	TP317	---	S31700	H + RC	---	---	205	30	515	75	35	90 HRB max
JIS G 3463:1994	SUS317TB	---	---	ST	O.D. < 10	---	205	---	520	---	27	---
					10 ≤ O.D. < 20	---					30	---
					O.D. ≥ 20	---					35	---
ASTM A 249/A 249M-98	TP317L	---	S31703	H + RC	---	---	205	30	515	75	35	90 HRB max
JIS G 3463:1994	SUS317LTB	---	---	ST	O.D. < 10	---	175	---	480	---	27	---
					10 ≤ O.D. < 20	---					30	---
					O.D. ≥ 20	---					35	---
AFNOR NF A 49-247:1981	TS Z 2 CND 19-15	---	---	Q (HY)	---	---	225	---	520-720	---	35	---
ASTM A 249/A 249M-98	TP321	---	S32100	H + RC	---	---	205	30	515	75	35	90 HRB max
JIS G 3463:1994	SUS321TB	---	---	ST	O.D. < 10	---	205	---	520	---	27	---
					10 ≤ O.D. < 20	---					30	---
					O.D. ≥ 20	---					35	---
JIS G 3467:1988	SUS 321 TF	---	---	ST	---	---	205	---	520	---	35	---
BSI BS 3606:1992	321S31	---	---	S	---	---	235	---	510-710	---	30	---
DIN 28180:1985	X 6 CrNiTi 18 10	1.4541	---	SA & Q	≤ 50	---	200	---	500-730	---	35 L; 30 T	L: 85 J at RT T: 55 J at RT
				SA & Q	≤ 50	---	180	---	460-680	---	35 L; 30 T	L: 85 J at RT T: 55 J at RT
DIN 28181:1985	X 6 CrNiTi 18 10	1.4541	---	SA & Q	≤ 50	---	200	---	500-730	---	35 L; 30 T	L: 85 J at RT T: 55 J at RT
AFNOR NF A 49-217:1987	TU Z 6 CNT 18 10	---	---	HF + CR + Q (HY)	---	---	190	---	490-740	---	45	90 HRB max
AFNOR NF A 49-247:1981	TS Z 6 CNT 18-10	---	---	Q (HY)	---	---	220	---	530-730	---	35	---
ISO 2604-II:1975	TS 53	---	---	Q	---	---	195	---	510-710	---	30	---
ISO 2604-V:1978	TW 53	---	---	Q	---	---	195	---	510-710	---	30	---

5.2 Tubes for Heat Transfer Applications

5.2.3.2B Mechanical Properties of Austenitic Stainless Steel Tubes for Heat Transfer Applications (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 249/A 249M-98	TP321H	---	S32109	ST	---	---	205	30	515	75	35	90 HRB max
JIS G 3463:1994	SUS321HTB	---	---	ST	O.D. < 10	---	205	---	520	---	27	---
					10 ≤ O.D. < 20	---					30	---
					O.D. ≥ 20	---					35	---
JIS G 3467:1988	SUS 321H TF	---	---	CF or HF, ST	---	---	205	---	520	---	35	---
BSI	321S51 (1010)	---	---	S: ST	---	---	235	---	510-710	---	35	---
BS 3059-2:1990	321S51 (1105)	---	---	S: ST	---	---	190	---	490-690	---	35	---
ISO 2604-II:1975	TS 54	---	---	Q	---	---	155	---	490-690	---	30	---
JIS G 3463:1994	SUS329J3LTB	---	---	ST	O.D. < 10	---	450	---	620	---	10	---
					10 ≤ O.D. < 20	---					13	---
					O.D. ≥ 20	---					18	---
AFNOR NF A 49-217:1987	TU Z 2 CND 22 05 03	---	---	HF + CR + Q (HY)	---	---	450	---	680-880	---	25	---
JIS G 3463:1994	SUS329J4LTB	---	---	ST	O.D. < 10	---	450	---	620	---	10	---
					10 ≤ O.D. < 20	---					13	---
					O.D. ≥ 20	---					18	---
AFNOR NF A 49-217:1987	TU Z 2 CND 25 07 03	---	---	HF + CR + Q (HY)	---	---	450	---	700-900	---	25	---
ASTM A 249/A 249M-98	TP347	---	S34700	H + RC	---	---	205	30	515	75	35	90 HRB max
ISO 2604-II:1975	TS 50	---	---	Q	---	---	205	---	510-710	---	30	---
ISO 2604-V:1978	TW 50	---	---	Q	---	---	205	---	510-710	---	30	---
JIS G 3463:1994	SUS347TB	---	---	ST	O.D. < 10	---	205	---	520	---	27	---
					10 ≤ O.D. < 20	---					30	---
					O.D. ≥ 20	---					35	---
JIS G 3467:1988	SUS 347 TF	---	---	ST	---	---	205	---	520	---	35	---
BSI BS 3606:1992	347S31	---	---	S	---	---	245	---	510-710	---	30	---
ASTM A 249/A 249M-98	TP347H	---	S34709	ST	---	---	205	30	515	75	35	90 HRB max
JIS G 3463:1994	SUS347HTB	---	---	ST	O.D. < 10	---	205	---	520	---	27	---
					10 ≤ O.D. < 20	---					30	---
					O.D. ≥ 20	---					35	---
JIS G 3467:1988	SUS 347H TF	---	---	CF or HF, ST	---	---	205	---	520	---	35	---
BSI	347S51	---	---	S: ST	---	---	240	---	510-710	---	35	---
BS 3059-2:1990		---	---		---	---		---		---		
ISO 2604-II:1975	TS 56	---	---	Q	---	---	205	---	510-710	---	30	---

5.2 Tubes for Heat Transfer Applications

5.2.3.2B Mechanical Properties of Austenitic Stainless Steel Tubes for Heat Transfer Applications (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 803/A 803M-01	TP XM-27	---	S44627	SA	---	---	275	40	450	65	20	241 HB max 100 HRB max
JIS G 3463:1994	SUSXM27TB	---	---	A	O.D. < 10	---	245	---	410	---	12	---
					10 ≤ O.D. < 20	---					15	---
					O.D. ≥ 20	---					20	---
ASTM A 249/A 249M-98	---	---	S31050	H + RC	---	t ≤ 0.25	270	39	580	84	25	95 HRB max
AFNOR NF A 49-217:1987	TU Z 1 CND 25 22 AZ	---	---	HF + CR + Q (HY)	---	---	260	---	540-740	---	30	---
ASTM A 249/A 249M-98	---	---	N08904	H + WQ or RC	---	---	215	31	490	71	35	90 HRB max
JIS G 3463:1994	SUS890LTB	---	---	ST	O.D. < 10	---	215	---	490	---	27	---
					10 ≤ O.D. < 20	---					30	---
					O.D. ≥ 20	---					35	---
ASTM A 249/A 249M-98	---	---	S31254	H + WQ or RC	---	---	300	44	650	94	35	96 HRB max
ASTM A 688/A 688M-00	---	---	S31254	H + WQ or RC	---	---	310	45	655	95	35	---
AFNOR NF A 49-217:1987	TU Z 1 CNDU 20 18 06 AZ	---	---	HF + CR + Q (HY)	---	---	300	---	650-850	---	35	---
ASTM A 249/A 249M-98	---	---	N08367	SA	---	t ≤ 0.187	310	45	690	100	30	100 HRB max
	---	---	N08926	SA	---	t > 0.187	310	45	655	95	30	100 HRB max
ASTM A 688/A 688M-00	---	---	N08367	SA	---	t ≤ 0.187	295	43	650	94	35	---
	---	---	N08367	SA	---	t > 0.187	310	45	655	95	30	100 HRB max
	---	---	N08926	SA	---	---	295	43	650	94	35	---
	---	---	N08926	SA	---	---	295	43	650	94	35	---
JIS G 3463:1994	SUS836LTB	---	---	ST	O.D. < 10	---	205	---	520	---	27	---
					10 ≤ O.D. < 20	---					30	---
					O.D. ≥ 20	---					35	---
ASTM A 249/A 249M-98	---	---	S30615	H + RC	---	---	275	40	620	90	35	95 HRB max
AFNOR NF A 49-217:1987	TU Z 1 CNS 18 15	---	---	HF + CR + Q (HY)	---	---	220	---	540-740	---	40	---

5.3 Tubes for Low Temperature Service

5.3.1A Mechanical Properties of Carbon Steel Tubes for Low Temperature Service

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
AFNOR NF A 49-245:1986	TS 34 BT	---	---	N	---	---	185	---	330-410	---	26	10 J at -46°C
DIN 17173:1985	TTSt 35 N	1.0356	---	N	≤ 10	---	225	---	340-460	---	L: 25 T: 23	L: 40 J at -40°C
DIN 17174:1985	TTSt 35 N	1.0356	---	N or NG	≤ 10	---	225	---	340-460	---	L: 25 T: 23	L: 40 J at -40°C
ISO 9329-3:1997	PL 21	---	---	N	≤ 13	---	215	---	360-480	---	24	t ≤ 10 mm L: 40 J at -40°C
					13 < t ≤ 25	---	215	---				
ISO 9330-3:1997	PL 21	---	---	N	---	---	215	---	360-480	---	24	L: 40 J at -40°C
ISO 9330-5:2000	PL 21	---	---	N	≤ 13	---	215	---	360-480	---	24	≤ 10 mm L: 40 J at -40°C
					13 < t ≤ 25	---	215	---				
DIN 17173:1985	TTSt 35 v	1.0356	---	QT (V)	≤ 25	---	255	---	360-490	---	L: 23 T: 21	L: 40 J at -50°C T: 27 J at -50°C
DIN 17174:1985	TTSt 35 v	1.0356	---	QT (V)	≤ 25	---	255	---	360-490	---	L: 23 T: 21	L: 40 J at -50°C T: 27 J at -50°C
ISO 9329-3:1997	PL 25	---	---	QT	≤ 13	---	255	---	360-490	---	21	L: 40 J at -50°C L: 40 J at -40°C L: 40 J at -50°C
					13 < t ≤ 25	---	255	---				
					25 < t ≤ 40	---	235	---				
ISO 9330-3:1997	PL 25	---	---	QT	---	---	255	---	360-490	---	21	L: 40 J at -50°C
ISO 9330-5:2000	PL 25	---	---	N	≤ 13	---	255	---	360-490	---	21	L: 40 J at -50°C L: 40 J at -40°C
					13 < t ≤ 25	---	255	---				
					25 < t ≤ 40	---	235	---				
ASTM A 334/A 334M-99	1	---	K03008	N, NT	---	---	205	30	380	55	t ≥ 5/16 in. (8 mm): 35	85 HRB max 163 HB max 18 J at -45°C
JIS G 3464:1988	STBL 380	---	---	N or NT	O.D. < 10	---	205	---	380	---	27	21 J at -45°C
					10 ≤ O.D. < 20	---					30	
					O.D. ≥ 20	---					35	

5.3 Tubes for Low Temperature Service

5.3.1A Mechanical Properties of Carbon Steel Tubes for Low Temperature Service (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ISO 9330-3:1997	PL 23	---	---	N	---	---	235	---	410-530	---	22	L: 27 J at -50°C
ISO 9330-5:2000	PL 23	---	---	N	≤ 13	---	235	---	410-530	---	22	L: 27 J at -50°C
					13 < t ≤ 25	---	235	---				
ISO 9329-3:1997	PL 23	---	---	N	≤ 13	---	235	---	410-530	---	22	L: 27 J at -50°C
					13 < t ≤ 25	---	235	---				
AFNOR NF A 49-215:1981	TU 42 BT	---	---	N	---	---	235	---	410-510	---	23	35 J at -46°C
AFNOR NF A 49-245:1986	TS 42 BT	---	---	N	---	---	235	---	410-510	---	23	35 J at -46°C
ASTM A 334/A 334M-99	6	---	K03006	N, NT	---	---	240	35	415	60	t ≥ 5/16 in. (8 mm): 30	90 HRB max 190 HB max 18 J at -45°C
BSI BS 3603:1991	Carbon, 430 LT	---	---	HF, N	≤ 16	---	275	---	430-470	---	---	t ≤ 25 mm 27 J at -50°C
					16 < t ≤ 40	---	265	---			---	
					40 < t ≤ 65	---	255	---			---	

5.3 Tubes for Low Temperature Service

5.3.1B Chemical Composition of Carbon 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
AFNOR NF A 49-245:1986	TS 34 BT	---	---	0.14	0.30-0.60	0.06-0.30	0.035	0.025	---	---	---	Cu 0.25; Sn 0.030
DIN 17173:1985	TTSt 35 N	1.0356	---	0.17	0.40 min	0.35	0.030	0.025	---	---	---	Al 0.020 min
DIN 17174:1985	TTSt 35 N	1.0356	---	0.17	0.40 min	0.35	0.030	0.025	---	---	---	Al 0.020 min
ISO 9329-3:1997	PL 21	---	---	0.17	0.40-1.00	0.35	0.030	0.025	---	---	---	Al 0.015 min
ISO 9330-3:1997	PL 21	---	---	0.17	0.40-1.00	0.35	0.030	0.025	---	---	---	Al 0.015 min
ISO 9330-5:2000	PL 21	---	---	0.17	0.40-1.00	0.35	0.030	0.025	---	---	---	Al 0.015 min
DIN 17173:1985	TTSt 35 V	1.0356	---	0.17	0.40 min	0.35	0.030	0.025	---	---	---	Al 0.020 min
DIN 17174:1985	TTSt 35 V	1.0356	---	0.17	0.40 min	0.35	0.030	0.025	---	---	---	Al 0.020 min
ISO 9329-3:1997	PL 25	---	---	0.17	0.40-1.00	0.35	0.030	0.025	---	---	---	Al 0.015 min
ISO 9330-3:1997	PL 25	---	---	0.17	0.60-1.20	0.35	0.030	0.025	---	---	---	Al 0.015 min
ISO 9330-5:2000	PL 25	---	---	0.17	0.40-1.00	0.35	0.030	0.025	---	---	---	Al 0.015 min
ASTM A 334/A 334M-99	1	---	K03008	0.30	0.40-1.06	---	0.025	0.025	---	---	---	---
JIS G 3464:1988	STBL 380	---	---	0.25	1.35	0.35	0.035	0.035	---	---	---	---
ISO 9329-3:1997	PL 23	---	---	0.19	0.60-1.20	0.35	0.030	0.025	---	---	---	Al 0.015 min
ISO 9330-3:1997	PL 23	---	---	0.19	0.60-1.20	0.35	0.030	0.025	---	---	---	Al 0.015 min
ISO 9330-5:2000	PL 23	---	---	0.19	0.60-1.20	0.35	0.030	0.025	---	---	---	Al 0.015 min
AFNOR NF A 49-215:1981	TU 42 BT	---	---	0.22	1.15	0.40	0.04	0.04	---	---	---	Cu 0.30
AFNOR NF A 49-245:1986	TS 42 BT	---	---	0.18	0.45-1.00	0.08-0.35	0.035	0.025	---	---	---	Cu 0.25; Sn 0.030
ASTM A 334/A 334M-99	6	---	K03006	0.30	0.29-1.06	0.10 min	0.025	0.025	---	---	---	---
BSI BS 3603:1991	Carbon, 430 LT	---	---	0.20	0.60-1.20	0.35	0.035	0.035	---	---	---	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

5.3 Tubes for Low Temperature Service

5.3.2A Chemical Composition of Alloy Steel Tubes for Low Temperature Service (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 334/A 334M-99	8	---	K81340	0.13	0.90	0.13-0.32	0.025	0.025	---	8.40-9.60	---	---
JIS G 3464:1988	STBL 690	---	---	0.13	0.90	0.10-0.35	0.030	0.030	---	8.50-9.50	---	---
BSI BS 3603:1991	9% Ni, 509 LT	---	---	0.10	0.30-0.80	0.10-0.30	0.025	0.020	---	8.50-9.50	---	Al 0.020 min
DIN 17173:1985	X 8 Ni 9	1.5662	---	0.10	0.30-0.80	0.35	0.025	0.020	---	8.00-10.00	0.10	V 0.05
DIN 17174:1985	X 8 Ni 9	1.5662	---	0.10	0.30-0.80	0.35	0.025	0.020	---	8.00-10.00	0.10	V 0.05
AFNOR NF A 49-215:1981	TU Z 6 N 9	---	---	0.12	1.00	0.35	0.035	0.035	---	8.5-9.6	---	---
ISO 9329-3:1997	X 10 Ni 9	---	---	0.13	0.30-0.80	0.15-0.35	0.025	0.020	---	8.50-9.50	0.10	V 0.05
ISO 9330-5:2000	X 10 Ni 9	---	---	0.13	0.30-0.80	0.15-0.35	0.025	0.020	---	8.50-9.50	0.10	V 0.05
DIN 17173:1985	26 CrMo 4	1.7219	---	0.22-0.29	0.50-0.80	0.35	0.030	0.025	0.90-1.20	---	0.15-0.30	---
ISO 9329-3:1997	26 CrMo 4	---	---	0.22-0.29	0.50-0.80	0.35	0.030	0.025	0.90-1.20	---	0.15-0.30	---

5.3 Tubes for Low Temperature Service

5.3.2B Mechanical Properties of Alloy Steel Tubes for Low Temperature Service

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
DIN 17173:1985	11 MnNi 5 3	1.6212	---	N	≤ 13	---	285	---	410-530	---	L: 24 T: 22	L: 40 J at -60°C T: 27 J at -60°C
					13 < t ≤ 25	---	275	---				
					25 < t ≤ 40	---	265	---				
DIN 17174:1985	11 MnNi 5 3	1.6212	---	N or NG	≤ 13	---	285	---	410-530	---	L: 24 T: 22	L: 40 J at -60°C T: 27 J at -60°C
					13 < t ≤ 25	---	275	---				
					25 < t ≤ 40	---	265	---				
ISO 9329-3:1997	11 MnNi 5-3	---	---	N	≤ 13	---	285	---	410-530	---	22	L: 40 J at -60°C
					13 < t ≤ 25	---	275	---				
					25 < t ≤ 40	---	265	---				
ISO 9330-3:1997	11 MnNi 5-3	---	---	N	≤ 13	---	285	---	410-530	---	22	L: 40 J at -60°C
ISO 9330-5:2000	11 MnNi 5-3	---	---	N	≤ 13	---	285	---	410-530	---	22	L: 40 J at -60°C
					13 < t ≤ 25	---	275	---				
					25 < t ≤ 40	---	265	---				
DIN 17173:1985	13 MnNi 6 3	1.6217	---	N	≤ 13	---	355	---	490-610	---	L: 22 T: 20	L: 40 J at -60°C T: 27 J at -60°C
					13 < t ≤ 25	---	345	---				
					25 < t ≤ 40	---	335	---				
DIN 17174:1985	13 MnNi 6 3	1.6217	---	N or NG	≤ 13	---	355	---	490-610	---	L: 22 T: 20	L: 40 J at -60°C T: 27 J at -60°C
					13 < t ≤ 25	---	345	---				
					25 < t ≤ 40	---	335	---				
ISO 9329-3:1997	13 MnNi 6-3	---	---	N	≤ 13	---	355	---	490-610	---	20	L: 40 J at -60°C
					13 < t ≤ 25	---	345	---				
					25 < t ≤ 40	---	335	---				
ISO 9330-3:1997	13 MnNi 6-3	---	---	N	≤ 13	---	355	---	490-610	---	20	L: 40 J at -60°C
ISO 9330-5:2000	13 MnNi 6-3	---	---	N	≤ 13	---	355	---	490-610	---	20	L: 40 J at -60°C
					13 < t ≤ 25	---	345	---				
					25 < t ≤ 40	---	335	---				
AFNOR NF A 49-215:1981	TU 17 N 2	---	---	N or NT	---	---	325	---	490	---	22	50 J at -60°C
AFNOR NF A 49-245:1986	TS 17 N 2	---	---	NT	---	---	325	---	490-640	---	22	50 J at -60°C

5.3 Tubes for Low Temperature Service

5.3.2B Mechanical Properties of Alloy Steel Tubes for Low Temperature Service (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 334/A 334M-99	7	---	K21903	N, NT	---	---	240	35	450	65	$t \geq \frac{5}{16}$ in. (8 mm): 30	90 HRB max 190 HB max 18 J at -75°C
AFNOR NF A 49-215:1981	TU 10 N 9	---	---	N or NT	---	---	245	---	450	---	20	50 J at -80°C
AFNOR NF A 49-245:1986	TS 10 N 9	---	---	NT	---	---	245	---	450-600	---	20	50 J at -80°C
ASTM A 334/A 334M-99	3	---	K31918	N, NT	---	---	240	35	450	65	$t \geq \frac{5}{16}$ in. (8 mm): 30	90 HRB max 190 HB max 18 J at -100°C
JIS G 3464:1988	STBL 450	---	---	N or NT	O.D. < 10	---	245	---	450	---	22	21 J at -100°C
					$10 \leq \text{O.D.} < 20$	---					25	
					O.D. ≥ 20	---					30	
BSI BS 3603:1991	3½% Ni, 503 LT	---	---	N or NT	---	---	245	---	440-590	---	---	$t \leq 25$ mm 39 J at -80°C 27 J at -100°C
DIN 17173:1985	10 Ni 14	1.5637	---	V	≤ 25	---	345	---	470-640	---	L: 20 T: 18	L:40 J at -100°C T:27 J at -100°C
					$25 < t \leq 40$	---	335	---				L:40 J at -90°C T:27 J at -90°C
DIN 17174:1985	10 Ni 14	1.5637	---	V	≤ 25	---	345	---	470-640	---	L: 20 T: 18	L:40 J at -100°C T:27 J at -100°C
					$25 < t \leq 40$	---	335	---				L:40 J at -90°C T:27 J at -90°C
AFNOR NF A 49-215:1981	TU 10 N 14	---	---	N or NT	---	---	245	---	450	---	20	50 J at -100°C
ISO 9329-3:1997	12 Ni 14	---	---	QT	≤ 13	---	245	---	440-590	---	16	L:40 J at -100°C
					$13 < t \leq 25$	---	245	---				L:40 J at -90°C
					$25 < t \leq 40$	---	245	---				L:40 J at -100°C
ISO 9330-3:1997	12 Ni 14	---	---	QT	≤ 13	---	245	---	440-590	---	16	L:40 J at -100°C
ISO 9330-5:2000	12 Ni 14	---	---	QT	≤ 13	---	245	---	440-590	---	16	L:40 J at -100°C
					$13 < t \leq 25$	---	245	---				L:40 J at -100°C
					$25 < t \leq 40$	---	245	---				L:40 J at -90°C

5.3 Tubes for Low Temperature Service

5.3.2B Mechanical Properties of Alloy Steel Tubes for Low Temperature Service (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
DIN 17173:1985	12 Ni 19	1.5680	---	V	≤ 25	---	390	---	510-710	---	L: 19 T: 17	L:40 J at -120°C T:27 J at -120°C L:40 J at -110°C T:27 J at -110°C
					25 < t ≤ 40	---	380	---				
DIN 17174:1985	12 Ni 19	1.5680	---	V	≤ 25	---	390	---	510-710	---	L: 19 T: 17	L:40 J at -120°C T:27 J at -120°C L:40 J at -110°C T:27 J at -110°C
					25 < t ≤ 40	---	380	---				
ISO 9329-3:1997	X 12 Ni 5	---	---	QT	≤ 13	---	390	---	510-710	---	17	L:40 J at -120°C L:40 J at -110°C
					13 < t ≤ 25	---	390	---				
					25 < t ≤ 40	---	380	---				
ISO 9330-3:1997	X 12 Ni 5	---	---	QT	≤ 13	---	390	---	510-710	---	17	L:40 J at -120°C
ISO 9330-5:2000	X 12 Ni 5	---	---	QT	≤ 13	---	390	---	510-710	---	17	L:40 J at -120°C L:40 J at -110°C
					13 < t ≤ 25	---	390	---				
					25 < t ≤ 40	---	380	---				
ASTM A 334/A 334M-99	8	---	K81340	QT or NNT	---	---	520	75	690	100	t ≥ 5/16 in. (8 mm): 22	18 J at -195°C
JIS G 3464:1988	STBL 690	---	---	NNT or QT	O.D. < 10	---	520	---	690	---	13	21 J at -196°C
					10 ≤ O.D. < 20	---					16	
					O.D. ≥ 20	---					21	
BSI BS 3603:1991	9% Ni, 509 LT	---	---	QT or N ₁ N ₂ T	---	---	510	---	690-840	---	---	≤ 25 mm 55 J at -100°C 47 J at -150°C 40 J at -196°C
DIN 17173:1985	X 8 Ni 9	1.5662	---	V	≤ 25	---	490	---	640-840	---	L: 18 T: 16	L:40 J at -196°C T:27 J at -196°C
					25 < t ≤ 40	---	480	---				
DIN 17174:1985	X 8 Ni 9	1.5662	---	V	≤ 25	---	490	---	640-840	---	L: 18 T: 16	L:40 J at -196°C T:27 J at -196°C
					25 < t ≤ 40	---	480	---				
AFNOR NF A 49-215:1981	TU Z 6 N 9	---	---	NT or WQT	---	---	520	---	650	---	16	60 J at -196°C
ISO 9329-3:1997	X 10 Ni 9	---	---	QT	≤ 13	---	510	---	690-840	---	15	L:40 J at -196°C
					13 < t ≤ 25	---	510	---				
					25 < t ≤ 40	---	510	---				
ISO 9330-5:2000	X 10 Ni 9	---	---	QT	≤ 13	---	510	---	690-840	---	15	L:40 J at -196°C
					13 < t ≤ 25	---	510	---				
					25 < t ≤ 40	---	510	---				

5.3 Tubes for Low Temperature Service

5.3.2B Mechanical Properties of Alloy Steel Tubes for Low Temperature Service (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
DIN 17173:1985	26 CrMo 4	1.7219	---	V	≤ 25	---	440	---	560-740	---	L: 18 T: 16	L:40 J at -60°C T:27 J at -60°C
					25 < t ≤ 40	---	420	---				
ISO 9329-3:1997	26 CrMo 4	---	---	QT	≤ 13	---	440	---	560-740	---	16	L:40 J at -60°C
					13 < t ≤ 25	---	440	---				
					25 < t ≤ 40	---	420	---				

5.4 Tubes and Pipes for Pressure Service

5.4.1A Mechanical Properties of Carbon Steel Tubes and Pipes for Pressure Service at Room and Elevated 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		
BSI BS 3601:1987	320 (BW and ERW)	---	---	see standard	≤ 16	---	195	---	320-460	---	25	---
AFNOR NF A 49-142:1987	TS E 185 A	---	---	HF or CF+N	---	---	185	---	330-410	---	28	---
ASTM A 53/A 53M-99	E Gr A	---	K02504	AM	---	---	205	30	330	48	see standard	---
	F Gr A	---	---	AM	---	---	205	30	330	48	see standard	---
	S Gr A	---	K02504	AM	---	---	205	30	330	48	see standard	---
ASTM A 106-99	A	---	K02501	HF or CD + 1200°F min	---	---	205	30	330	48	35 L; 25 T	---
ASTM A 139-00	A	---	---	---	---	---	205	30	330	48	≥ 7.9 mm ($\frac{5}{16}$ in) 35	---
ASTM A 135-97	A	---	---	AM	---	---	207	30	331	48	≥ 7.9 mm ($\frac{5}{16}$ in) 35	---

5.4 Tubes and Pipes for Pressure Service

5.4.1A Mechanical Properties of Carbon Steel Tubes and Pipes for Pressure Service at Room and Elevated Temperatures (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
DIN 1626:1984	USt 37.0	1.0253	---	see standard	≤ 16	---	235	---	350-480	---	25 L; 23 T	---
	St 37.0	1.0254	---	see standard	≤ 16	---	235	---	350-480	---	25 L; 23 T	---
DIN 1628:1984	St 37.4	1.0255	---	AD	16 < t ≤ 40	---	225	---				
					≤ 16	---	235	---				
DIN 1629:1984	St 37.0	1.0254	---	see standard	16 < t ≤ 40	---	225	---	350-480	---	25 L; 23 T	---
					40 < t ≤ 65	---	215	---				
					≤ 16	---	235	---				
DIN 1630:1984	St 37.4	1.0255	---	AD	16 < t ≤ 40	---	225	---	350-480	---	25 L; 23 T	L:43 J at 20°C T:27 J at 20°C
					> 40	---	215	---				
					≤ 16	---	235	---				
AFNOR NF A 49-112:1987	TU E 220 A	---	---	see standard	≤ 16	---	220	---	360-500	---	23	---
				> 16	---	200	---					
AFNOR NF A 49-213:1990	TU 37 C	---	---	N	---	---	220	---	360-460	---	---	32 J at 0°C
AFNOR NF A 49-219:1990	TU 37 F	---	---	N	---	---	220	---	360-460	---	25	32 J at 0°C
AFNOR NF A 49-220:1990	TU 37 C	---	---	N	---	---	220	---	360-460	---	---	32 J at 0°C
AFNOR NF A 49-253:1982	TS 37 CP	---	---	N	≤ 30	---	225	---	360-480	---	28	see standard
					> 30	---	205	---	360-480	---	27	see standard
AFNOR NF A 49-252:1982	TS 37 CP	---	---	---	≤ 30	---	225	---	360-480	---	---	see standard
					> 30	---	205	---				
DIN 17175:1979	St 35.8	1.0305	---	see standard	≤ 16	---	235	---	360-480	---	25 L; 23 T	T: 34 J at RT
					16 < t ≤ 40	---	225	---				
					40 < t ≤ 60	---	215	---				
DIN 17177:1979	St 37.8	1.0315	---	AD	≤ 16	---	235	---	360-480	---	25 L; 23 T	---
BSI BS 3601:1987	360 ERW	---	---	see standard	≤ 16	---	235	---	360-500	---	25	---
	360 S	---	---	see standard	≤ 16	---	235	---	360-500	---	25	---
					16 < t ≤ 40	---	225	---				
BSI BS 3602-1:1987	360 Seamless	---	---	HF or HF+N or CF+N	40 < t ≤ 65	---	215	---	360-500	---	25	---
					≤ 16	---	235	---				
					16 < t ≤ 40	---	225	---				
					40 < t ≤ 65	---	215	---				
		360 Welded			HF or AW+N or CF+N	≤ 16	---	235	---	360-500	---	25

NOTE: This section continued on next page.

5.4 Tubes and Pipes for Pressure Service

5.4.1A Mechanical Properties of Carbon Steel Tubes and Pipes for Pressure Service at Room and Elevated Temperatures (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
AFNOR NF A 49-142:1987	TS E 235 A	---	---	HF or CF+N	---	---	235	---	360-450	---	26	---
AFNOR NF A 49-242:1985	TS 37 C	---	---	---	---	---	235	---	360-460	---	---	---
AFNOR NF A 49-243:1985	TS 37 C	---	---	N	---	---	235	---	360-460	---	16	see standard
DIN 17178:1986	StE 255	1.0461	---	N	≤ 20	---	255	---	360-480	---	25 L; 23 T	see standard
					20 < t ≤ 40	---	245	---				
	WtE 255	1.0462	---	N	≤ 20	---	255	---	360-480	---	25 L; 23 T	see standard
					20 < t ≤ 40	---	245	---				
DIN 17179:1986	StE 255	1.0461	---	N	≤ 20	---	255	---	360-480	---	25 L; 23 T	see standard
					20 < t ≤ 40	---	245	---				
					40 < t ≤ 50	---	235	---				
					50 < t ≤ 65	---	225	---				
	WtE 255	1.0462	---	N	≤ 20	---	255	---	360-480	---	25 L; 23 T	see standard
					20 < t ≤ 40	---	245	---				
					40 < t ≤ 50	---	235	---				
					50 < t ≤ 65	---	225	---				
JIS G 3454:1988	STPG 370	---	---	AM or CF + A	---	---	215	---	370	---	30	---
JIS G 3455:1988	STS 370	---	---	HFS: AM CFS: LTA or N	---	---	215	---	370	---	30	---
JIS G 3456:1988	STPT 370	---	---	see standard	---	---	215	---	370	---	30	---
DIN 17178:1986	StE 285	1.0486	---	N	≤ 20	---	285	---	390-510	---	24 L; 22 T	see standard
					20 < t ≤ 40	---	275	---				
	WtE 285	1.0487	---	N	≤ 20	---	285	---	390-510	---	24 L; 22 T	see standard
					20 < t ≤ 40	---	275	---				
DIN 17179:1986	StE 285	1.0486	---	N	≤ 20	---	285	---	390-510	---	24 L; 22 T	see standard
					20 < t ≤ 40	---	275	---				
					40 < t ≤ 50	---	265	---				
					50 < t ≤ 65	---	255	---				
	WtE 285	1.0487	---	N	≤ 20	---	285	---	390-510	---	24 L; 22 T	see standard
					20 < t ≤ 40	---	275	---				
					40 < t ≤ 50	---	265	---				
					50 < t ≤ 65	---	255	---				

5.4 Tubes and Pipes for Pressure Service

5.4.1A Mechanical Properties of Carbon Steel Tubes and Pipes for Pressure Service at Room and Elevated Temperatures (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
JIS G 3457:1988	STPY 400	---	---	As welded or as cold expanded	---	---	225	---	400	---	18	---
AFNOR NF A 49-112:1987	TU E 235 A	---	---	see standard	≤ 16	---	235	---	410-550	---	21	---
AFNOR NF A 49-213:1990	TU 42 C	---	---	N	> 16	---	215	---	---	---	---	32 J at 0°C
AFNOR NF A 49-219:1990	TU 42 CR	---	---	SR	---	---	235	---	410-510	---	---	32 J at 0°C
AFNOR NF A 49-220:1990	TU 42 F	---	---	N	---	---	235	---	410-510	---	21	32 J at 0°C
AFNOR NF A 49-220:1990	TU 42 C	---	---	N	---	---	235	---	410-510	---	---	32 J at 0°C
JIS G 3454:1988	STPG 410	---	---	AM or CF+A	---	---	245	---	410	---	25	---
JIS G 3455:1988	STS 410	---	---	HFS: AM CFS: LTA or N	---	---	245	---	410	---	25	---
DIN 17175:1979	St 45.8	1.0405	---	see standard	≤ 16	---	255	---	410-530	---	21 L; 19 T	T: 27 J at RT
DIN 17177:1979	St 42.8	1.0498	---	AD	16 < t ≤ 40	---	245	---	---	---	---	---
JIS G 3456:1988	STPT 410	---	---	see standard	40 < t ≤ 60	---	235	---	410	---	25	---
AFNOR NF A 49-252:1982	TS 42 CP	---	---	---	≤ 30	---	245	---	410-520	---	---	see standard
AFNOR NF A 49-253:1982	TS 42 CP	---	---	N	> 30	---	225	---	---	---	---	see standard
AFNOR NF A 49-142:1987	TS E 250 A	---	---	HF or CF+N	≤ 30	---	245	---	410-520	---	27	see standard
AFNOR NF A 49-242:1985	TS 42 C	---	---	---	> 30	---	225	---	410-520	---	25	see standard
AFNOR NF A 49-243:1985	TS 42 C	---	---	N	---	---	250	---	410-510	---	24	---
AFNOR NF A 49-243:1985	TS 42 C	---	---	N	---	---	255	---	410-510	---	---	---
AFNOR NF A 49-243:1985	TS 42 C	---	---	N	---	---	255	---	410-510	---	16	see standard

NOTE: This section continued on next page.

5.4 Tubes and Pipes for Pressure Service

5.4.1A Mechanical Properties of Carbon Steel Tubes and Pipes for Pressure Service at Room and Elevated Temperatures (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 135-97	B	---	---	Tempered	---	---	241	35	414	60	≥ 7.9mm (5/16 in) 30	---
ASTM A 53/A 53M-99	E Gr B	---	K03005	Tempered	---	---	240	35	415	60	see standard	---
	S Gr B	---	K03005	AM	---	---	240	35	415	60	see standard	---
ASTM A 106-99	B	---	K03006	HF or CD + 1200°F min	---	---	240	35	415	60	30 L; 16.5 T	---
ASTM A 139-00	B	---	K03003	---	---	---	240	35	415	60	≥ 7.9mm (5/16 in) 35	---
	C	---	K03004	---	---	---	290	42	415	60	≥ 7.9mm (5/16 in) 25	---
	D	---	K03010	---	---	---	315	46	415	60	≥ 7.9mm (5/16 in) 23	---
AFNOR NF A 49-213:1990	TU 42 CR	---	---	N	---	---	235	---	420-520	---	---	32 J at 0°C
DIN 1626:1984	St 44.0	1.0256	---	see standard	≤ 16	---	275	---	420-550	---	21 L; 19 T	---
					16 < t ≤ 40	---	265	---				
DIN 1628:1984	St 44.4	1.0257	---	AD	≤ 16	---	275	---	420-550	---	21 L; 19 T	L:43 J at 20°C T:27 J at 20°C
					16 < t ≤ 40	---	265	---				
DIN 1629:1984	St 44.0	1.0256	---	see standard	≤ 16	---	275	---	420-550	---	21 L; 19 T	---
					16 < t ≤ 40	---	265	---				
					40 < t ≤ 65	---	255	---				
DIN 1630:1984	St 44.4	1.0257	---	AD	≤ 16	---	275	---	420-550	---	21 L; 19 T	L:43 J at 20°C T:27 J at 20°C
					16 < t ≤ 40	---	265	---				
					40 < t ≤ 65	---	255	---				
BSI BS 3602-2:1991	430	---	---	AW or W+SR or W+N	≤ 16	---	250	---	430-550	---	23	---
					16 < t ≤ 40	---	240	---	430-550	---	23	---
					> 30	---	265	---	430-550	---	23	see standard

NOTE: This section continued on next page.

5.4 Tubes and Pipes for Pressure Service

5.4.1A Mechanical Properties of Carbon Steel Tubes and Pipes for Pressure Service at Room and Elevated Temperatures (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
BSI BS 3601:1987	430 ERW	---	---	see standard	≤ 16	---	275	---	430-570	---	22	---
	430 SAW	---	---	see standard	≤ 16	---	275	---	430-570	---	22	---
					16 < t ≤ 40	---	265	---				
					40 < t ≤ 65	---	255	---				
	430 S	---	---	see standard	≤ 16	---	275	---	430-570	---	22	---
					16 < t ≤ 40	---	265	---				
					40 < t ≤ 65	---	255	---				
BSI BS 3602-1:1987	430 Seamless	---	---	HF or HF+N or CF+N	≤ 16	---	275	---	430-570	---	22	---
					16 < t ≤ 40	---	265	---				
					40 < t ≤ 65	---	255	---				
	430 Welded			HF or AW+N or CF+N	≤ 16	---	275	---	430-570	---	22	---

5.4 Tubes and Pipes for Pressure Service

5.4.1A Mechanical Properties of Carbon Steel Tubes and Pipes for Pressure Service at Room and Elevated Temperatures (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 139-00	E	---	K03012	---	---	---	360	52	455	66	≥ 7.9mm (5/16 in) 22	---
DIN 17175:1979	17 Mn 4	1.0481	---	see standard	≤ 16	---	270	---	460-580	---	23 L; 21 T	T: 34 J at RT
					16 < t ≤ 40	---	270	---				
					40 < t ≤ 60	---	260	---				
AFNOR NF A 49-142:1987	TS E 275 A	---	---	HF or CF+N	---	---	275	---	470-570	---	23	---
AFNOR NF A 49-213:1990	TU 48 C	---	---	N	---	---	275	---	470-570	---	---	40 J at 0°C
	TU 48 CR	---	---	SR	---	---	275	---	470-590	---	---	40 J at 0°C
AFNOR NF A 49-220:1990	TU 48 C	---	---	N	---	---	275	---	470-570	---	---	40 J at 0°C
AFNOR NF A 49-243:1985	TS 48 C	---	---	N	---	---	275	---	470-570	---	16	see standard
AFNOR NF A 49-252:1982	TS 48 CP	---	---	---	≤ 30	---	285	---	470-590	---	---	see standard
					> 30	---	265	---				
AFNOR NF A 49-253:1982	TS 48 CP	---	---	N	≤ 30	---	285	---	470-590	---	23	see standard
					> 30	---	265	---			22	
JIS G 3455:1988	STS 480	---	---	LTA or N	---	---	275	---	480	---	25	---
JIS G 3456:1988	STPT 480	---	---	see standard	---	---	275	---	480	---	25	---
ASTM A 106-99	C	---	K03501	HF or CD + 1200°F min	---	---	275	40	485	70	30 L; 16.5 T	---
AFNOR NF A 49-213:1990	TU 48 CR	---	---	N	---	---	275	---	490-610	---	---	40 J at 0°C
BSI BS 3602-2:1991	490	---	---	AW or W+SR or W+N	≤ 16	---	325	---	490-610	---	21	---
					16 < t ≤ 40	---	315	---	490-610	---	21	---
DIN 17178:1986	StE 355	1.0562	---	N	≤ 20	---	355	---	490-630	---	22 L; 20 T	see standard
					20 < t ≤ 40	---	345	---				
	WtE 355	1.0565	---	N	≤ 20	---	355	---	490-630	---	22 L; 20 T	see standard
					20 < t ≤ 40	---	345	---				
DIN 17179:1986	StE 355	1.0562	---	N	≤ 20	---	355	---	490-630	---	22 L; 20 T	see standard
					20 < t ≤ 40	---	345	---				
					40 < t ≤ 50	---	335	---				
					50 < t ≤ 65	---	325	---				
	WtE 355	1.0565	---	N	≤ 20	---	355	---	490-630	---	22 L; 20 T	see standard
					20 < t ≤ 40	---	345	---				
					40 < t ≤ 50	---	335	---				
					50 < t ≤ 65	---	325	---				

5.4 Tubes and Pipes for Pressure Service

5.4.1A Mechanical Properties of Carbon Steel Tubes and Pipes for Pressure Service at Room and Elevated Temperatures (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
BSI BS 3602-1:1987	500 Nb Seamless	---	---	HFS+N or CFS+N	≤ 16	---	355	---	500-650	---	21	---
					16 < t ≤ 40	---	345	---				
					40 < t ≤ 65	---	335	---				
DIN 1626:1984	St 52.0	1.0421	---	see standard	≤ 16	---	355	---	500-650	---	21 L; 19 T	---
					16 < t ≤ 40	---	345	---				
DIN 1628:1984	St 52.4	1.0581	---	AD	≤ 16	---	355	---	500-650	---	21 L; 19 T	L:43 J at 20°C T:27 J at 20°C
					16 < t ≤ 40	---	345	---				
DIN 1629:1984	St 52.0	1.0421	---	see standard	≤ 16	---	355	---	500-650	---	21 L; 19 T	---
					16 < t ≤ 40	---	345	---				
					40 < t ≤ 65	---	335	---				
DIN 1630:1984	St 52.4	1.0581	---	AD	≤ 16	---	355	---	500-650	---	21 L; 19 T	L:43 J at 20°C T:27 J at 20°C
					16 < t ≤ 40	---	345	---				
					40 < t ≤ 65	---	335	---				
DIN 17175:1979	19 Mn 5	1.0482	---	see standard	≤ 16	---	310	---	510-610	---	19 L; 17 T	T: 34 J at RT
					16 < t ≤ 40	---	310	---				
					40 < t ≤ 60	---	300	---				
AFNOR NF A 49-252:1982	TS 52 CP	---	---	---	≤ 30	---	335	---	510-630	---	---	see standard
					> 30	---	315	---				
AFNOR NF A 49-253:1982	TS 52 CP	---	---	N	≤ 30	---	335	---	510-630	---	22	see standard
					> 30	---	315	---	510-630	---	21	
AFNOR NF A 49-213:1990	TU 52 C	---	---	N	≤ 20	---	350	---	510-630	---	---	40 J at 0°C
					> 20	---	310	---				
AFNOR NF A 49-220:1990	TU 52 C	---	---	N	---	---	350	---	510-630	---	---	40 J at 0°C
AFNOR NF A 49-243:1985	TS 52 C	---	---	N	---	---	355	---	510-630	---	16	see standard
DIN 17178:1986	StE 420	1.8902	---	N	≤ 12	---	420	---	530-680	---	21 L; 19 T	see standard
					12 < t ≤ 20	---	410	---				
					20 < t ≤ 40	---	400	---				
	WtE 420	1.8932	---	N	≤ 12	---	420	---	530-680	---	21 L; 19 T	see standard
					12 < t ≤ 20	---	410	---				
					20 < t ≤ 40	---	400	---				

NOTE: This section continued on next page.

5.4 Tubes and Pipes for Pressure Service

5.4.1A Mechanical Properties of Carbon Steel Tubes and Pipes for Pressure Service at Room and Elevated Temperatures (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
DIN 17179:1986	StE 420	1.8902	---	N	≤ 12	---	420	---	530-680	---	21 L; 19 T	see standard
					12 < t ≤ 20	---	410	---				
					20 < t ≤ 40	---	400	---				
					40 < t ≤ 50	---	385	---				
					50 < t ≤ 65	---	375	---				
	WtE 420	1.8932	---	N	≤ 12	---	420	---	530-680	---	21 L; 19 T	see standard
					12 < t ≤ 20	---	410	---				
					20 < t ≤ 40	---	400	---				
					40 < t ≤ 50	---	385	---				
					50 < t ≤ 65	---	375	---				

5.4 Tubes and Pipes for Pressure Service

5.4.1B Chemical Composition of Carbon Steel Tubes and Pipes for Pressure Service at Room and Elevated 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
BSI BS 3601:1987	320 Welded (BW and ERW)	---	---	0.16	0.30-0.70	---	0.040	0.040	---	---	---	---
AFNOR NF A 49-142:1987	TS E 185 A	---	---	0.14	0.55	0.30	0.040	0.035	---	---	---	---
ASTM A 53/A 53M-99	E Gr. A	---	K02504	0.25	0.95	---	0.05	0.045	0.40	0.40	0.15	Cu 0.40; V 0.08; Cu+Ni+Cr+Mo+V 1.00
	F Gr. A	---	---	0.30	1.20	---	0.05	0.045	0.40	0.40	0.15	Cu 0.40; V 0.08; Cu+Ni+Cr+Mo+V 1.00
	S Gr. A	---	K02504	0.25	0.95	---	0.05	0.045	0.40	0.40	0.15	Cu 0.40; V 0.08; Cu+Ni+Cr+Mo+V 1.00
ASTM A 106-99	A	---	K02501	0.25	0.27-0.93	≥ 0.10	0.035	0.035	0.40	0.40	0.15	Cu 0.40; V 0.08; Cu+Ni+Cr+Mo+V 1.00
ASTM A 139-00	A	---	---	0.25	1.00	---	0.035	0.035	---	---	---	---
ASTM A 135-97	A	---	---	0.25	0.95	---	0.035	0.035	---	---	---	---

5.4 Tubes and Pipes for Pressure Service

5.4.1B Chemical Composition of Carbon Steel Tubes and Pipes for Pressure Service at Room and Elevated Temperatures (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
DIN 1626:1984	USt 37.0	1.0253	---	0.20	---	---	0.040	0.040	---	---	---	N 0.007
	St 37.0	1.0254	---	0.17	---	---	0.004	0.004	---	---	---	N 0.009
DIN 1628:1984	St 37.4	1.0255	---	0.17	≥ 0.35	0.35	0.040	0.040	---	---	---	N fixing elements
DIN 1629:1984	St 37.0	1.0254	---	0.17	---	---	0.040	0.040	---	---	---	N 0.009
DIN 1630:1984	St 37.4	1.0255	---	0.17	≥ 0.35	0.35	0.040	0.040	---	---	---	Al 0.02 min
AFNOR NF A 49-112:1987	TU E 220 A	---	---	0.18	0.75	0.35	0.040	0.040	---	---	---	---
AFNOR NF A 49-213:1990	TU 37 C	---	---	0.16	0.35-0.75	0.06-0.30	0.035	0.035	---	---	---	Cu 0.25; Sn 0.030
AFNOR NF A 49-219:1990	TU 37 F	---	---	0.16	0.40-0.80	0.10-0.30	0.025	0.025	0.40	0.40	0.15	Cu 0.25; Sn 0.030; V 0.08
AFNOR NF A 49-220:1990	TU 37 C	---	---	0.16	0.35-0.75	0.06-0.30	0.025	0.025	---	---	---	---
AFNOR NF A 49-253:1982	TS 37 CP	---	---	0.16	≥ 0.40	0.30	0.035	0.030	---	---	---	---
AFNOR NF A 49-252:1982	TS 37 CP	---	---	0.16	0.40	0.30	0.035	0.030	---	---	---	---
DIN 17175:1979	St 35.8	1.0305	---	0.17	0.40-0.80	0.10-0.35	0.040	0.040	---	---	---	---
DIN 17177:1979	St 37.8	1.0315	---	0.17	0.40-0.80	0.10-0.35	0.040	0.040	---	---	---	---
BSI BS 3601:1987	360 ERW	---	---	0.17	0.40-0.80	0.35	0.040	0.040	---	---	---	---
	360 S	---	---	0.17	0.40-0.80	0.35	0.040	0.040	---	---	---	---
BSI BS 3602-1:1987	360 Seamless	---	---	0.17	0.30-0.80	0.10-0.35	0.035	0.035	---	---	---	Al 0.06
	360 Welded	---	---	0.17	0.30-0.80	0.35	0.035	0.035	---	---	---	Al 0.06
AFNOR NF A 49-142:1987	TS E 235 A	---	---	0.15	0.70	0.30	0.040	0.035	---	---	---	---
AFNOR NF A 49-242:1985	TS 37 C	---	---	0.15	0.35-0.75	0.06-0.30	0.035	0.025	---	---	---	Cu 0.25; Sn 0.030
AFNOR NF A 49-243:1985	TS 37 C	---	---	0.15	0.35-0.75	0.06-0.30	0.035	0.025	---	---	---	Cu 0.25; Sn 0.030
DIN 17178:1986	StE 255	1.0461	---	0.18	0.50-1.30	0.40	0.035	0.030	0.30	0.30	0.08	N 0.020; Al 0.020; Cu 0.20; Nb 0.03; Nb+Ti+V 0.05
	WStE 255	1.0462	---	0.18	0.50-1.30	0.40	0.035	0.030	0.30	0.30	0.08	N 0.020; Al 0.020; Cu 0.20; Nb 0.03; Nb+Ti+V 0.05
DIN 17179:1986	StE 255	1.0461	---	0.18	0.50-1.30	0.40	0.035	0.030	0.30	0.30	0.08	N 0.020; Al 0.020; Cu 0.20; Nb 0.03; Nb+Ti+V 0.05
	WStE 255	1.0462	---	0.18	0.50-1.30	0.40	0.035	0.030	0.30	0.30	0.08	N 0.020; Al 0.020; Cu 0.20; Nb 0.03; Nb+Ti+V 0.05

NOTE: This section continued on next page.

5.4 Tubes and Pipes for Pressure Service

5.4.1B Chemical Composition of Carbon Steel Tubes and Pipes for Pressure Service at Room and Elevated Temperatures (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 3454:1988	STPG 370	---	---	0.25	0.30-0.90	0.35	0.040	0.040	---	---	---	---
JIS G 3455:1988	STS 370	---	---	0.25	0.30-1.10	0.10-0.35	0.035	0.035	---	---	---	---
JIS G 3456:1988	STPT 370	---	---	0.25	0.30-0.90	0.10-0.35	0.035	0.035	---	---	---	---
DIN 17178:1986	StE 285	1.0486	---	0.18	0.60-1.40	0.40	0.035	0.030	0.30	0.30	0.08	N 0.020; Al 0.020; Cu 0.20; Nb 0.03; Nb+Ti+V 0.05
	WStE 285	1.0487	---	0.18	0.60-1.40	0.40	0.035	0.030	0.30	0.30	0.08	N 0.020; Al 0.020; Cu 0.20; Nb 0.03; Nb+Ti+V 0.05
DIN 17179:1986	StE 285	1.0486	---	0.18	0.60-1.40	0.40	0.035	0.030	0.30	0.30	0.08	N 0.020; Al 0.020; Cu 0.20; Nb 0.03; Nb+Ti+V 0.05
	WStE 285	1.0487	---	0.18	0.60-1.40	0.40	0.035	0.030	0.30	0.30	0.08	N 0.020; Al 0.020; Cu 0.20; Nb 0.03; Nb+Ti+V 0.05
JIS G 3457:1988	STPY 400	---	---	0.25	---	---	0.040	0.040	---	---	---	---
AFNOR NF A 49-112:1987	TU E 235 A	---	---	0.22	0.95	0.35	0.040	0.040	---	---	---	---
AFNOR	TU 42 C	---	---	0.20	0.45-1.00	0.08-0.35	0.035	0.035	---	---	---	Cu 0.25; Sn 0.030
AFNOR NF A 49-213:1990	TU 42 CR	---	---	0.20	0.65-1.15	0.08-0.35	0.035	0.035	---	---	---	Cu 0.25; Sn 0.030
AFNOR NF A 49-219:1990	TU 42 F	---	---	0.20	0.45-1.00	0.10-0.35	0.025	0.025	0.40	0.40	0.15	Cu 0.25; Sn 0.030; V 0.08
AFNOR NF A 49-220:1990	TU 42 C	---	---	0.20	0.45-1.00	0.08-0.35	0.025	0.025	---	---	---	---
JIS G 3454:1988	STPG 410	---	---	0.30	0.30-1.00	0.35	0.040	0.040	---	---	---	---
JIS G 3455:1988	STS 410	---	---	0.30	0.30-1.40	0.10-0.35	0.035	0.035	---	---	---	---
DIN 17175:1979	St 45.8	1.0405	---	0.21	0.40-1.20	0.10-0.35	0.040	0.040	---	---	---	---
DIN 17177:1979	St 42.8	1.0498	---	0.21	0.40-1.20	0.10-0.35	0.040	0.040	---	---	---	---
JIS G 3456:1988	STPT 410	---	---	0.30	0.30-1.00	0.10-0.35	0.035	0.035	---	---	---	---
AFNOR NF A 49-252:1982	TS 42 CP	---	---	0.18	0.60	0.30	0.035	0.030	---	---	---	---
AFNOR NF A 49-253:1982	TS 42 CP	---	---	0.18	≥ 0.60	0.30	0.035	0.030	---	---	---	---
AFNOR NF A 49-142:1987	TS E 250 A	---	---	0.18	0.95	0.30	0.040	0.035	---	---	---	---
AFNOR NF A 49-242:1985	TS 42 C	---	---	0.18	0.45-1.00	0.08-0.35	0.035	0.025	---	---	---	Cu 0.25; Sn 0.030
AFNOR NF A 49-243:1985	TS 42 C	---	---	0.18	0.45-1.00	0.08-0.35	0.035	0.025	---	---	---	Cu 0.25; Sn 0.030
ASTM A 135-97	B	---	---	0.30	1.20	---	0.035	0.035	---	---	---	---

NOTE: This section continued on next page.

5.4 Tubes and Pipes for Pressure Service

5.4.1B Chemical Composition of Carbon Steel Tubes and Pipes for Pressure Service at Room and Elevated Temperatures (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								Others
				C	Mn	Si	P	S	Cr	Ni	Mo	
ASTM A 53/A 53M-99	E Gr. B	---	K03005	0.30	1.20	---	0.05	0.045	0.40	0.40	0.15	Cu 0.40; V 0.08; Cu+Ni+Cr+Mo+V 1.00
	S Gr. B	---	K03005	0.30	1.20	---	0.05	0.045	0.40	0.40	0.15	Cu 0.40; V 0.08; Cu+Ni+Cr+Mo+V 1.00
ASTM A 106-99	B	---	K03006	0.30	0.29-1.06	≥ 0.10	0.035	0.035	0.40	0.40	0.15	Cu 0.40; V 0.08; Cu+Ni+Cr+Mo+V 1.0
ASTM A 139-00	B	---	K03003	0.26	1.00	---	0.035	0.035	---	---	---	---
	C	---	K03004	0.28	1.20	---	0.035	0.035	---	---	---	---
	D	---	K03010	0.30	1.30	---	0.035	0.035	---	---	---	---
AFNOR NF A 49-213:1990	TU 42 CR	---	---	0.20	0.65-1.15	0.08-0.35	0.035	0.035	---	---	---	Cu 0.25; Sn 0.030
DIN 1626:1984	St 44.0	1.0256	---	0.21	---	---	0.040	0.040	---	---	---	N 0.009
DIN 1628:1984	St 44.4	1.0257	---	0.20	≥ 0.40	0.35	0.040	0.040	---	---	---	N fixing elements
DIN 1629:1984	St 44.0	1.0256	---	0.21	---	---	0.040	0.040	---	---	---	N 0.009
DIN 1630:1984	St 44.4	1.0257	---	0.20	≥ 0.40	0.35	0.040	0.040	---	---	---	Al 0.02 min
BSI BS 3602-2:1991	430	---	---	0.25	0.60-1.40	0.10-0.35	0.030	0.030	0.25	0.30	0.10	Cu 0.30
BSI BS 3601:1987	430 ERW	---	---	0.21	0.40-1.20	0.35	0.040	0.040	---	---	---	---
	430 SAW	---	---	0.25	1.20	0.50	0.040	0.040	---	---	---	---
	430 Seamless	---	---	0.21	0.40-1.20	0.35	0.040	0.040	---	---	---	---
BSI BS 3602-1:1987	430 Seamless	---	---	0.21	0.40-1.20	0.10-0.35	0.035	0.035	---	---	---	Al 0.06
	430 Welded	---	---	0.21	0.40-1.20	0.35	0.035	0.035	---	---	---	Al 0.06

5.4 Tubes and Pipes for Pressure Service

5.4.1B Chemical Composition of Carbon Steel Tubes and Pipes for Pressure Service at Room and Elevated Temperatures (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 139-00	E	---	K03012	0.30	1.40	---	0.035	0.035	---	---	---	---
DIN 17175:1979	17 Mn 4	1.0481	---	0.14-0.20	0.90-1.20	0.20-0.40	0.040	0.040	0.30	---	---	---
AFNOR NF A 49-142:1987	TS E 275 A	---	---	0.20	1.20	0.30	0.040	0.035	---	---	---	---
AFNOR NF A 49-213:1990	TU 48 C	---	---	0.22	0.65-1.25	0.10-0.35	0.035	0.035	---	---	---	Cu 0.25; Sn 0.030
	TU 48 CR	---	---	0.20	1.00-1.50	0.15-0.50	0.035	0.035	---	---	---	Cu 0.25; Sn 0.030
AFNOR NF A 49-220:1990	TU 48 C	---	---	0.22	0.65-1.25	0.10-0.35	0.025	0.025	---	---	---	---
AFNOR NF A 49-243:1985	TS 48 C	---	---	0.20	0.65-1.25	0.10-0.35	0.035	0.025	---	---	---	Cu 0.25; Sn 0.030
AFNOR NF A 49-252:1982	TS 48 CP	---	---	0.20	0.80-1.50	0.35	0.035	0.030	---	---	---	---
AFNOR NF A 49-253:1982	TS 48 CP	---	---	0.20	0.80-1.50	0.35	0.035	0.030	---	---	---	---
JIS G 3455:1988	STS 480	---	---	0.33	0.30-1.50	0.10-0.35	0.035	0.035	---	---	---	---
JIS G 3456:1988	STPT 480	---	---	0.33	0.30-1.00	0.10-0.35	0.035	0.035	---	---	---	---
ASTM A 106-99	C	---	K03501	0.35	0.29-1.06	≥ 0.10	0.035	0.035	0.40	0.40	0.15	Cu 0.40; V 0.08; Cu+Ni+Cr+Mo+V 1.0
AFNOR NF A 49-213:1990	TU 48 CR	---	---	0.20	1.00-1.50	0.15-0.50	0.035	0.035	---	---	---	Cu 0.25; Sn 0.030
BSI BS 3602-2:1991	490	---	---	0.22	0.90-1.60	0.10-0.40	0.030	0.030	0.25	0.75	0.10	Cu 0.30
DIN 17178:1986	WStE 355	1.0565	---	0.20	0.90-1.65	0.10-0.50	0.035	0.030	0.30	0.30	0.08	N 0.020; Al 0.020; Cu 0.20; Nb 0.05; V 0.10; Nb+Ti+V 0.12
	TStE 355	1.0566	---	0.18	0.90-1.65	0.10-0.50	0.030	0.025	0.30	0.30	0.08	N 0.020; Al 0.020; Cu 0.20; Nb 0.05; V 0.10; Nb+Ti+V 0.12
DIN 17179:1986	StE 355	1.0562	---	0.20	0.90-1.65	0.10-0.50	0.035	0.030	0.30	0.30	0.08	N 0.020; Al 0.020; Cu 0.20; Nb 0.05; V 0.10; Nb+Ti+V 0.12
	WStE 355	1.0565	---	0.20	0.90-1.65	0.10-0.50	0.035	0.030	0.30	0.30	0.08	N 0.020; Al 0.020; Cu 0.20; Nb 0.05; V 0.10; Nb+Ti+V 0.12

5.4 Tubes and Pipes for Pressure Service

5.4.1B Chemical Composition of Carbon Steel Tubes and Pipes for Pressure Service at Room and Elevated Temperatures (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
BSI BS 3602-1:1987	500 Nb Seamless	---	---	0.22	1.00-1.50	0.15-0.35	0.035	0.030	---	---	---	Al 0.06; Nb 0.015-0.10
DIN 1626:1984	St 52.0	1.0421	---	0.22	---	---	0.040	0.035	---	---	---	Al 0.020 min
DIN 1628:1984	St 52.4	1.0581	---	0.22	1.60	0.55	0.040	0.035	---	---	---	N fixing elements
DIN 1629:1984	St 52.0	1.0421	---	0.22	---	---	0.040	0.035	---	---	---	Al 0.020 min
DIN 1630:1984	St 52.4	1.0581	---	0.22	1.60	0.55	0.040	0.035	---	---	---	Al 0.02 min
DIN 17175:1979	19 Mn 5	1.0482	---	0.17-0.22	1.00-1.30	0.30-1.60	0.040	0.040	0.30	---	---	---
AFNOR NF A 49-252:1982	TS 52 CP	---	---	0.20	1.00-1.60	0.50	0.035	0.030	---	---	---	---
AFNOR NF A 49-253:1982	TS 52 CP	---	---	0.20	1.0-1.60	0.50	0.035	0.030	---	---	---	---
AFNOR NF A 49-213:1990	TU 52 C	---	---	0.20	1.00-1.50	0.15-0.50	0.035	0.035	---	---	---	Cu 0.25; Sn 0.030
AFNOR NF A 49-220:1990	TU 52 C	---	---	0.20	1.00-1.50	0.15-0.50	0.025	0.025	---	---	---	---
AFNOR NF A 49-243:1985	TS 52 C	---	---	0.20	1.00-1.50	0.15-0.50	0.035	0.025	---	---	---	Cu 0.25; Sn 0.030
DIN 17178:1986	StE 420	1.8902	---	0.20	1.00-1.70	0.10-0.60	0.035	0.030	0.30	1.00	0.10	N 0.020; Al 0.020; Cu 0.20; Nb 0.05; V 0.20; Nb+Ti+V 0.22
	WStE 420	1.8932	---	0.20	1.00-1.70	0.10-0.60	0.035	0.030	0.30	1.00	0.10	N 0.020; Al 0.020; Cu 0.20; Nb 0.05; V 0.20; Nb+Ti+V 0.22
DIN 17179:1986	StE 420	1.8902	---	0.20	1.00-1.70	0.10-0.60	0.035	0.030	0.30	1.00	0.10	N 0.020; Al 0.020; Cu 0.20; Nb 0.05; V 0.20; Nb+Ti+V 0.22
	WStE 420	1.8932	---	0.20	1.00-1.70	0.10-0.60	0.035	0.030	0.30	1.00	0.10	N 0.020; Al 0.020; Cu 0.20; Nb 0.05; V 0.20; Nb+Ti+V 0.22

5.4 Tubes and Pipes for Pressure Service

5.4.2A Chemical Composition of Alloy Steel Tubes and Pipes for Pressure Service at Room and Elevated 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
DIN 17175:1979	15 Mo 3	1.5415	---	0.12-0.20	0.40-0.80	0.10-0.35	0.035	0.035	---	---	0.25-0.35	---
DIN 17177:1979	15 Mo 3	1.5415	---	0.12-0.20	0.40-0.80	0.10-0.35	0.035	0.035	---	---	0.25-0.35	---
AFNOR NF A 49-213:1990	TU 15 D 3	---	---	0.12-0.20	0.50-0.80	0.15-0.35	0.035	0.035	0.30	0.30	0.25-0.35	Cu 0.25; Sn 0.030
AFNOR NF A 49-220:1990	TU 15 D 3	---	---	0.12-0.20	0.50-0.80	0.15-0.35	0.025	0.025	0.30	---	0.25-0.35	---
AFNOR NF A 49-253:1982	TS 15 D 3	---	---	0.18	0.50-0.80	0.15-0.30	0.035	0.030	0.30	---	0.25-0.35	---
ASTM A 335/A 335M-99	P1	---	K11522	0.10-0.20	0.30-0.80	0.10-0.50	0.025	0.025	---	---	0.44-0.65	---
JIS G 3458:1988	STPA 12	---	---	0.10-0.20	0.30-0.80	0.10-0.50	0.035	0.035	---	---	0.45-0.65	---
ASTM A 335/A 335M-99	P2	---	K11547	0.10-0.20	0.30-0.61	0.10-0.30	0.025	0.025	0.50-0.81	---	0.44-0.65	---
JIS G 3458:1988	STPA 20	---	---	0.10-0.20	0.30-0.60	0.10-0.50	0.035	0.035	0.50-0.80	---	0.40-0.65	---
AFNOR NF A 49-213:1990	TU 15 CD 2-05	---	---	0.10-0.18	0.50-0.90	0.10-0.35	0.030	0.030	0.40-0.65	0.30	0.45-0.60	Cu 0.25; Sn 0.030
AFNOR NF A 49-220:1990	TU 15 CD 2-05	---	---	0.100.18	0.50-0.90	0.10-0.35	0.025	0.025	0.40-0.65	---	0.45-0.60	---
AFNOR NF A 49-243:1985	TS 15 CD 2-05	---	---	0.10-0.18	0.50-0.90	0.10-0.35	0.030	0.025	0.40-0.65	0.30	0.45-0.60	Cu 0.25; Sn 0.030; Al 0.025
AFNOR NF A 49-253:1982	TS 15 CD 2-05	---	---	0.18	0.50-0.90	0.15-0.30	0.030	0.030	0.40-0.60	---	0.40-0.60	---
BSI BS 3604-1:1990 AMD 2: 1997	660 (0.5Cr-0.5Mo-0.25V)	---	---	0.10-1.05	0.40-0.70	0.10-0.35	0.030	0.030	0.30-0.60	---	0.50-0.70	V 0.22-0.28; Al 0.02
DIN 17175:1979	14 MoV 6 3	1.7715	---	0.10-0.18	0.40-0.70	0.10-0.35	0.035	0.035	0.30-0.60	---	0.50-0.70	V 0.22-0.32

5.4 Tubes and Pipes for Pressure Service

5.4.2A Chemical Composition of Alloy Steel Tubes and Pipes for Pressure Service at Room and Elevated Temperatures (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 335/A 335M-99	P12	---	K11562	0.05-0.15	0.30-0.61	0.50	0.025	0.025	0.80-1.25	---	0.44-0.65	---
JIS G 3458:1988	STPA 22	---	---	0.15	0.30-0.60	0.50	0.035	0.035	0.80-1.25	---	0.45-0.65	---
BSI BS 3604-1:1990 AMD 2: 1997	620-440 (1Cr-0.5Mo)	---	---	0.10-0.15	0.40-0.70	0.10-0.35	0.030	0.030	0.70-1.10	---	0.45-0.65	Al 0.02
BSI BS 3604-2:1991	620	---	---	0.09-0.18	0.40-0.65	0.15-0.40	0.025	0.015	0.80-1.15	0.30	0.45-0.60	Cu 0.30; Al 0.02
DIN 17175:1979	13 CrMo 4 4	1.7335	---	0.10-0.18	0.40-0.70	0.10-0.35	0.035	0.035	0.70-1.10	---	0.45-0.65	---
AFNOR NF A 49-213:1990	TU 13 CD 4-04	---	---	0.10-0.18	0.40-0.70	0.10-0.35	0.030	0.030	0.70-1.10	0.30	0.45-0.65	Cu 0.25; Sn 0.030
AFNOR NF A 49-219:1990	TU 13 CD 4-04	---	---	0.10-0.18	0.40-0.70	0.10-0.35	0.030	0.030	0.70-1.10	0.30	0.45-0.65	Cu 0.25; Sn 0.030
AFNOR NF A 49-220:1990	TU 10 CD 5-05	---	---	0.15	0.30-0.60	0.50-1.00	0.030	0.030	1.00-1.50	0.30	0.45-0.65	Cu 0.25; Sn 0.030
AFNOR NF A 49-243:1985	TU 10 CD 5-05	---	---	0.15	0.30-0.60	0.50-1.00	0.025	0.025	1.00-1.50	---	0.45-0.65	---
AFNOR NF A 49-243:1985	TS 15 CD 4-05	---	---	0.10-0.18	0.40-0.80	0.15-0.35	0.030	0.025	0.80-1.20	0.30	0.40-0.60	Cu 0.25; Sn 0.030; Al 0.025
ASTM A 335/A 335M-99	P11	---	K11597	0.05-0.15	0.30-0.60	0.50-1.00	0.025	0.025	1.00-1.50	---	0.45-0.65	---
JIS G 3458:1988	STPA 23	---	---	0.15	0.30-0.60	0.50-1.00	0.030	0.030	1.00-1.50	---	0.45-0.65	---
BSI BS 3604-1:1990 AMD 2: 1997	621 (1.25Cr-0.5Mo)	---	---	0.15	0.30-0.60	0.50-1.00	0.030	0.030	1.00-1.50	---	0.45-0.65	Al 0.02
BSI BS 3604-2:1991	621	---	---	0.09-0.17	0.40-0.65	0.50-0.80	0.025	0.015	1.00-1.50	0.30	0.45-0.60	Cu 0.30; Al 0.02
AFNOR NF A 49-213:1990	TU 10 CD 5-05	---	---	0.15	0.30-0.60	0.50-1.00	0.030	0.030	1.00-1.50	0.30	0.45-0.65	Cu 0.25; Sn 0.030
AFNOR NF A 49-220:1990	TU 13 CD 4-04 (1)	---	---	0.100.18	0.40-0.70	0.10-0.35	0.025	0.025	0.70-1.10	---	0.45-0.65	---

5.4 Tubes and Pipes for Pressure Service

5.4.2A Chemical Composition of Alloy Steel Tubes and Pipes for Pressure Service at Room and Elevated Temperatures (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 335/A 335M-99	P22	---	K21590	0.05-0.15	0.30-0.60	0.50	0.025	0.025	1.90-2.60	---	0.87-1.13	---
JIS G 3458:1988	STPA 24	---	---	0.15	0.30-0.60	0.50	0.030	0.030	1.90-2.60	---	0.87-1.13	---
BSI BS 3604-1:1990 AMD 2: 1997	622 (2.25Cr-1Mo)	---	---	0.08-0.15	0.40-0.70	0.50	0.030	0.030	2.00-2.50	---	0.90-1.20	Al 0.02
BSI BS 3604-2:1991	622	---	---	0.09-0.15	0.30-0.60	0.50	0.025	0.015	2.00-2.50	0.30	0.90-1.10	Cu 0.30; Al 0.02
DIN 17175:1979	10 CrMo 9 10	1.7380	---	0.08-0.15	0.40-0.70	0.50	0.035	0.035	2.00-2.50	---	0.90-1.20	---
AFNOR NF A 49-213:1990	TU 10 CD 9-10	---	---	0.15	0.30-0.60	0.10-0.50	0.030	0.030	2.00-2.50	0.30	0.90-1.10	Cu 0.25; Sn 0.030
AFNOR NF A 49-219:1990	TU 10 CD 9-10	---	---	0.15	0.30-0.60	0.10-0.50	0.030	0.030	2.00-2.50	0.30	0.90-1.10	Cu 0.25; Sn 0.030
AFNOR NF A 49-220:1990	TU 10 CD 9-10	---	---	0.15	0.30-0.60	0.10-0.50	0.025	0.025	2.00-2.50	---	0.90-1.10	---
AFNOR NF A 49-253:1982	TS 10 CD 9-10	---	---	0.15	0.40-0.80	0.15-0.35	0.030	0.030	2.0-2.50	---	0.90-1.10	---
ASTM A 335/A 335M-99	P5	---	K41545	0.15	0.30-0.60	0.50	0.025	0.025	4.00-6.00	---	0.45-0.65	---
JIS G 3458:1988	STPA 25	---	---	0.15	0.30-0.60	0.50	0.030	0.030	4.00-6.00	---	0.45-0.65	---
BSI BS 3604-1:1990 AMD 2: 1997	625 (5Cr-0.5Mo)	---	---	0.15	0.30-0.60	0.50	0.030	0.030	4.00-6.00	---	0.45-0.65	Al 0.02
AFNOR NF A 49-213:1990	TU Z 12 CD 05-05	---	---	0.15	0.30-0.60	0.05-0.50	0.030	0.030	4.00-6.00	---	0.45-0.65	Cu 0.25; Sn 0.030
AFNOR NF A 49-219:1990	TU Z 12 CD 05-05	---	---	0.15	0.30-0.60	0.05-0.50	0.030	0.030	4.00-6.00	---	0.45-0.65	Cu 0.25; Sn 0.030
AFNOR NF A 49-253:1982	TS Z 10 CD 5-05	---	---	0.15	0.30-0.60	0.15-0.50	0.030	0.030	4.00-6.00	---	0.45-0.65	---
ASTM A 335/A 335M-99	P9	---	S50400	0.15	0.30-0.60	0.25-1.00	0.025	0.025	8.00-10.00	---	0.90-1.10	---
JIS G 3458:1988	STPA 26	---	---	0.15	0.30-0.60	0.25-1.00	0.030	0.030	8.00-10.00	---	0.90-1.10	---
BSI BS 3604-1:1990 AMD 2: 1997	629-470 (9Cr-1Mo)	---	---	0.15	0.30-0.60	0.25-1.00	0.030	0.030	8.00-10.00	---	0.90-1.10	Al 0.02
AFNOR NF A 49-213:1990	TU Z 10 CD 09	---	---	0.15	0.30-0.60	0.25-1.00	0.030	0.030	8.00-10.00	0.30	0.90-1.10	Cu 0.25; Sn 0.030
AFNOR NF A 49-219:1990	TU Z 10 CD 09	---	---	0.15	0.30-0.60	0.25-1.00	0.030	0.030	8.00-10.00	0.30	0.90-1.10	Cu 0.25; Sn 0.030

5.4 Tubes and Pipes for Pressure Service

5.4.2A Chemical Composition of Alloy Steel Tubes and Pipes for Pressure Service at Room and Elevated Temperatures (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
BSI BS 3604-1:1990 AMD 2: 1997	762 (12Cr-1Mo-V)	---	---	0.17-0.23	1.00	0.50	0.030	0.030	10.00-12.50	0.30-0.80	0.80-1.20	V 0.25-0.35; Al 0.02
DIN 17175:1979	X 20 CrMoV 12 1	1.4922	---	0.17-0.23	1.00	0.50	0.030	0.030	10.00-12.50	0.30-0.80	0.80-1.20	V 0.25-0.35

5.4 Tubes and Pipes for Pressure Service

5.4.2B Mechanical Properties of Alloy Steel Tubes and Pipes for Pressure Service at Room and Elevated 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		
DIN 17175:1979	15 Mo 3	1.5415	---	see standard	≤ 16	---	270	---	450-600	---	22 L; 20 T	T: 34 J at RT
					16 < t ≤ 40	---	270	---				
					40 < t ≤ 60	---	260	---				
DIN 17177:1979	15 Mo 3	1.5415	---	AD	≤ 16	---	270	---	450-600	---	22 L; 20 T	---
AFNOR NF A 49-213:1990	TU 15 D 3	---	---	see standard	---	---	265	---	430-550	---	22	---
AFNOR NF A 49-220:1990	TU 15 D 3	---	---	heat + air cool	---	---	265	---	430-550	---	22	---
AFNOR NF A 49-253:1982	TS 15 D 3	---	---	NT	≤ 30	---	265	---	430-550	---	25	see standard
					> 30	---					23	
ASTM A 335/A 335M-99	P1	---	K11522	FA, IA or NT	---	---	205	30	380	55	≥ 8mm (5/16 in) 30 L; 20 T	---
JIS G 3458:1988	STPA 12	---	---	LTA, IA, FA, N, or NT	---	---	205	---	380 min	---	30	---
ASTM A 335/A 335M-99	P2	---	K11547	FA, IA or NT	---	---	205	30	380	55	≥ 8mm (5/16 in) 30 L; 20 T	---
JIS G 3458:1988	STPA 20	---	---	LTA, IA, FA, or NT	---	---	205	---	410 min	---	30	---
AFNOR NF A 49-213:1990	TU 15 CD 2-05	---	---	heat + air cool + T	---	---	275	---	440-570	---	22	32 J at 0°C
AFNOR NF A 49-220:1990	TU 15 CD 2-05	---	---	heat + air cool + T	---	---	275	---	440-570	---	22	32 J at 0°C
AFNOR NF A 49-243:1985	TS 15 CD 2-05	---	---	heat + air cool + T	---	---	275	---	440-570	---	22	see standard
AFNOR NF A 49-253:1982	TS 15 CD 2-05	---	---	NT	≤ 30	---	275	---	450-570	---	25	see standard
BSI BS 3604-1:1990 AMD 2: 1997	660 (0.5Cr-0.5Mo-0.25V)	---	---	NT	---	---	300	---	460-610	---	20	---
DIN 17175:1979	14 MoV 6 3	1.7715	---	see standard	≤ 16	---	320	---	460-610	---	20 L; 18 T	T: 41 J at RT
					16 < t ≤ 40	---	320	---				
					40 < t ≤ 60	---	310	---				

5.4 Tubes and Pipes for Pressure Service

5.4.2B Mechanical Properties of Alloy Steel Tubes and Pipes for Pressure Service at Room and Elevated Temperatures (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 335/A 335M-99	P12	---	K11562	FA, IA or NT	---	---	220	32	415	60	≥ 8mm (5/16 in) 30 L; 20 T	---
JIS G 3458:1988	STPA 22	---	---	LTA, IA, FA, or NT	---	---	205	---	410 min	---	30	---
BSI BS 3604-1:1990 AMD 2: 1997	620-440 (1Cr-0.5Mo)	---	---	NT	---	---	290	---	440-590	---	22.	---
BSI BS 3604-2:1991	620	---	---	see standard	---	---	340	---	480-600	---	18	---
DIN 17175	13 CrMo 4 4	1.7335	---	see standard	≤ 16	---	290	---	440-590	---	22 L; 20 T	T: 34 J at RT
					16 < t ≤ 40	---	290	---				
					40 < t ≤ 60	---	280	---				
AFNOR NF A 49-213:1990	TU 13 CD 4-04	---	---	heat + air cool + T	---	---	290	---	440-590	---	22	32 J at 0°C
AFNOR NF A 49-219:1990	TU 13 CD 4-04	---	---	heat + air cool + T	---	---	290	---	440-590	---	22	32 J at 0°C
	TU 10 CD 5-05	---	---	see standard	---	---	225	---	440-590	---	22	---
AFNOR NF A 49-220:1990	TU 10 CD 5-05	---	---	see standard	---	---	225	---	440-590	---	22	---
AFNOR NF A 49-243:1985	TS 15 CD 4-05	---	---	heat + air cool + T	---	---	295	---	470-610	---	20	see standard
ASTM A 335/A 335M-99	P11	---	K11597	FA, IA or NT	---	---	205	30	415	60	≥ 8mm (5/16 in) 30 L; 20 T	---
JIS G 3458:1988	STPA 23	---	---	IA, FA or NT	---	---	205	---	410 min	---	30	---
BSI BS 3604-1:1990 AMD 2: 1997	621 (1.25Cr-0.5Mo)	---	---	NT	---	---	275	---	420-570	---	22	---
BSI BS 3604-2:1991	621	---	---	see standard	---	---	340	---	515-690	---	18	---
AFNOR NF A 49-213:1990	TU 10 CD 5-05	---	---	see standard	---	---	225	---	440-590	---	22	---
				heat + air cool + T	---	---	325	---	490-640	---	20	32 J at 0°C
AFNOR NF A 49-220:1990	TU 13 CD 4-04 (1)	---	---	heat + air cool + T	---	---	290	---	440-590	---	22	32 J at 0°C

5.4 Tubes and Pipes for Pressure Service

5.4.2B Mechanical Properties of Alloy Steel Tubes and Pipes for Pressure Service at Room and Elevated Temperatures (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 335/A 335M-99	P22	---	K21590	FA, IA or NT	---	---	205	30	415	60	≥ 8mm (5/16 in) 30 L; 20 T	---
JIS G 3458:1988	STPA 24	---	---	IA, FA or NT	---	---	205	---	410 min	---	30	---
BSI BS 3604-1:1990 AMD 2: 1997	622 (2.25Cr-1Mo)	---	---	NT	---	---	275	---	490-620	---	20	---
BSI BS 3604-2:1991	622	---	---	see standard	---	---	310	---	515-690	---	16	---
DIN 17175	10 CrMo 9 10	1.7380	---	see standard	≤ 16	---	280	---	450-600	---	20 L; 18 T	T: 34 J at RT
AFNOR NF A 49-213:1990	TU 10 CD 9-10	---	---	see standard	---	---	225	---	410-560	---	22	---
				Heat + air cool + T	---	---	325	---	490-640	---	20	32 J at 0°C
AFNOR NF A 49-219:1990	TU 10 CD 9-10	---	---	see standard	---	---	225	---	410-560	---	22	---
				Heat + air cool + T	---	---	325	---	490-640	---	20	32 J at 0°C
AFNOR NF A 49-220:1990	TU 10 CD 9-10	---	---	see standard	---	---	225	---	410-560	---	22	---
				Heat + air cool + T	---	---	325	---	490-640	---	20	32 J at 0°C
AFNOR NF A 49-253:1982	TS 10 CD 9-10	---	---	NT	≤ 20	---	310	---	540-660	---	21	see standard
					> 20	---			520-640	---	20	
ASTM A 335/A 335M-99	P5	---	K41545	FA, IA or NT	---	---	205	30	415	60	≥ 8mm (5/16 in) 30 L; 20 T	---
JIS G 3458:1988	STPA 25	---	---	IA, FA or NT	---	---	205	---	410 min	---	30	---
BSI BS 3604-1:1990 AMD 2: 1997	625 (5Cr-0.5Mo)	---	---	A	---	---	170	---	450-600	---	20	---
AFNOR NF A 49-213:1990	TU Z 12 CD 05-05	---	---	see standard	---	---	205	---	410-560	---	22	---
				Heat + air cool + T	---	---	280	---	520-640	---	20	32 J at 20°C
AFNOR NF A 49-219:1990	TU Z 12 CD 05-05	---	---	see standard	---	---	205	---	410-560	---	22	---
				Heat + air cool + T	---	---	280	---	520-640	---	20	40 J at 20°C
AFNOR NF A 49-253:1982	TS Z 10 CD 5-05	---	---	NT	≤ 30	---	390	---	590-730	---	15	see standard
					> 30	---						see standard

5.4 Tubes and Pipes for Pressure Service

5.4.2B Mechanical Properties of Alloy Steel Tubes and Pipes for Pressure Service at Room and Elevated Temperatures (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 335/A 335M-99	P9	---	S50400	FA, IA or NT	---	---	205	30	415	60	≥ 8mm (5/16 in) 30 L; 20 T	---
JIS G 3458:1988	STPA 26	---	---	IA, FA or NT	---	---	205	---	410 min	---	30	---
BSI BS 3604-1:1990 AMD 2: 1997	629-470 (9Cr-1Mo)	---	---	A	---	---	185	---	470-620	---	20	---
AFNOR NF A 49-213:1990	TU Z 10 CD 09	---	---	see standard	---	---	205	---	440-590	---	22	---
AFNOR NF A 49-219:1990	TU Z 10 CD 09	---	---	see standard	---	---	205	---	440-590	---	22	---
BSI BS 3604-1:1990 AMD 2: 1997	762 (12Cr-1Mo-V)	---	---	NT	---	---	490	---	690-840	---	15	---
DIN 17175:1979	X 20 CrMoV 12 1	1.4922	---	see standard	≤ 16	---	490	---	690-840	---	17 L; 14 T	T: 34 J at RT
					16 < t ≤ 40	---	490	---				
					40 < t ≤ 60	---	490	---				

5.4 Tubes and Pipes for Pressure Service

5.4.3A Chemical Composition of Stainless Steel Tubes and Pipes for Pressure Service at Room and Elevated Temperatures

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 312/A 312M-00	TP304	---	S30400	0.08	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	---
ASTM A 358/A 358M-98	304	---	S30400	0.08	2.00	0.75	0.045	0.030	18.0-20.0	8.0-10.5	---	N 0.10
ASTM A 376/A 376M-98	TP304	---	---	0.08	2.00	0.75	0.040	0.030	18.0-20.0	8.00-11.0	---	---
ASTM A 409/A 409M-95	TP304	---	S30400	0.08	2.00	0.75	0.045	0.030	18.0-20.0	8.00-11.0	---	---
JIS G 3459:1997	SUS304TP	---	---	0.08	2.00	1.00	0.040	0.030	18.00-20.00	8.00-11.00	---	---
JIS G 3468:1994	SUS304	---	---	0.08	2.00	1.00	0.045	0.030	18.00-20.0	8.00-10.50	---	---
BSI BS 3605-1:1991 Issue 2, 1997	304S31	---	---	0.070	2.00	1.00	0.040	0.030	17.00-19.00	8.00-11.00	---	---
BSI BS 3605-2:1992 Issue 2, 1997	304S31	---	---	0.070	2.00	1.00	0.040	0.030	17.00-19.00	8.00-11.00	---	---
DIN 17457:1985	X 5 CrNi 18 10	1.4301	---	0.07	---	---	---	---	17.0-19.0	8.5-10.5	---	---
DIN 17458:1985	X 5 CrNi 18 10	1.4301	---	0.07	---	---	---	---	17.0-19.0	8.5-10.5	---	---
AFNOR NF A 49-244:1993	X7CrNi18-9	---	---	0.070	2.00	0.75	0.040	0.015	17.0-19.0	8.0-10.0	---	---
ASTM A 312/A 312M-00	TP304L	---	S30403	0.035	2.00	1.00	0.045	0.030	18.0-20.0	8.00-11.0	---	---
ASTM A 358/A 358M-98	304L	---	S30403	0.030	2.00	0.75	0.045	0.030	18.0-20.0	8.0-12.0	---	N 0.10
ASTM A 409/A 409M-95	TP304L	---	S30403	0.035	2.00	0.75	0.045	0.030	18.0-20.0	8.00-13.0	---	---
JIS G 3459:1997	SUS304LTP	---	---	0.030	2.00	1.00	0.040	0.030	18.00-20.00	9.00-13.00	---	---
JIS G 3468:1994	SUS304L	---	---	0.030	2.00	1.00	0.045	0.030	18.00-20.00	9.00-13.00	---	---
BSI BS 3605-1:1991 Issue 2, 1997	304S11	---	---	0.030	2.00	1.00	0.040	0.030	17.00-19.00	9.00-12.00	---	---
BSI BS 3605-2:1992 Issue 2 1997	304S11	---	---	0.030	2.00	1.00	0.040	0.030	17.00-19.00	9.00-12.00	---	---
DIN 17457:1985	X 2 CrNi 19 11	1.4306	---	0.030	---	---	---	---	18.0-20.0	10.0-12.5	---	---
DIN 17458:1985	X 2 CrNi 19 11	1.4306	---	0.030	---	---	---	---	18.0-20.0	10.0-12.5	---	---
AFNOR NF A 49-244:1993	X3CrNi18-10	---	---	0.030	2.00	0.75	0.040	0.015	17.0-19.0	9.0-11.0	---	---

5.4 Tubes and Pipes for Pressure Service

5.4.3A Chemical Composition of Stainless Steel Tubes and Pipes for Pressure Service at Room and Elevated Temperatures (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 376/A 376M-98	TP304LN	---	---	0.035	2.00	0.75	0.040	0.030	18.0-20.0	8.00-11.0	---	N 0.10-0.16
DIN 17457:1985	X 2 CrNiN 18 10	1.4311	---	0.030	---	---	---	---	17.0-19.0	8.5-11.5	---	N 0.12-0.22
DIN 17458:1985	X 2 CrNiN 18 10	1.4311	---	0.030	---	---	---	---	17.0-19.0	8.5-11.5	---	N 0.12-0.22
AFNOR NF A 49-244:1993	X3CrNiN18-10	---	---	0.030	2.00	0.75	0.040	0.015	17.0-19.0	9.0-11.0	---	N 0.12-0.20
	X6CrNiN19-9	---	---	0.030	2.0	0.75	0.040	0.015	18.0-20.0	8.0-11.0	---	N 0.12-0.20
ASTM A 312/A 312M-00	TP304H	---	S30409	0.04-0.10	2.00	1.00	0.045	0.030	18.0-20.0	8.0-11.0	---	---
ASTM A 358/A 358M-98	304H	---	S30409	0.04-0.10	2.00	0.75	0.045	0.030	18.0-20.0	8.0-10.5	---	---
ASTM A 376/A 376M-98	TP304H	---	S30409	0.04-0.10	2.00	0.75	0.040	0.030	18.0-20.0	8.00-11.0	---	---
JIS G 3459:1997	SUS304HTP	---	---	0.04-0.10	2.00	0.75	0.040	0.030	18.00-20.00	8.00-11.00	---	---
BSI BS 3605-1:1991 Issue 2, 1997	304S51	---	---	0.04-0.10	2.00	1.00	0.040	0.030	17.00-19.00	8.00-11.00	---	---
DIN 17459:1992	X 6 CrNi 18 11	1.4948	---	0.04-0.08	2.0	0.75	0.035	0.015	17.0-19.0	10.0-12.0	---	---
AFNOR NF A 49-214:1978	Z 6 CN 19-10	---	---	0.04-0.08	2.0	1.0	0.035	0.030	18-20	8-11	---	---
ASTM A 312/A 312M-00	TP309S	---	S30908	0.08	2.00	1.00	0.045	0.030	22.0-24.0	12.0-15.0	0.75	
ASTM A 358/A 358M-98	309S	---	S30908	0.08	2.00	0.75	0.045	0.030	22.0-24.0	12.0-15.0	---	---
JIS G 3459:1997	SUS309STP	---	---	0.08	2.00	1.00	0.040	0.030	22.00-24.00	12.00-15.00	---	---
JIS G 3468:1994	SUS309S	---	---	0.08	2.00	1.00	0.045	0.030	22.00-24.00	12.00-15.00	---	---
JIS G 3459:1997	SUS309TP	---	---	0.15	2.00	1.00	0.040	0.030	22.00-24.00	12.00-15.00	---	---
AFNOR NF A 49-244:1993	X15CrNi24-13	---	---	0.15	2.00	0.75	0.035	0.015	22.0-24.0	12.0-14.0	---	---
ASTM A 312/A 312M-00	TP310S	---	S31008	0.08	2.00	1.00	0.045	0.030	24.0-26.0	19.0-22.0	0.75	
ASTM A 358/A 358M-98	310S	---	S31008	0.08	2.00	1.50	0.045	0.030	24.0-26.0	19.0-22.0	---	---
JIS G 3459:1997	SUS310STP	---	---	0.08	2.00	1.50	0.040	0.030	24.00-26.00	19.00-22.00	---	---
JIS G 3468:1994	SUS310S	---	---	0.08	2.00	1.50	0.045	0.030	24.00-26.00	19.00-22.00	---	---
AFNOR NF A 49-244:1993	X1CrNi25-20	---	---	0.015	2.00	0.40	0.025	0.010	24.0-26.0	19.0-22.0	0.5	---

5.4 Tubes and Pipes for Pressure Service

5.4.3A Chemical Composition of Stainless Steel Tubes and Pipes for Pressure Service at Room and Elevated Temperatures (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 312/A 312M-00	TP316	---	S31600	0.08	2.00	1.00	0.045	0.030	16.0-18.0	11.0-14.0	2.00-3.00	---
ASTM A 358/A 358M-98	316	---	S31600	0.08	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	N 0.10
ASTM A 376/A 376M-98	TP316	---	---	0.08	2.00	0.75	0.040	0.030	16.0-18.0	11.0-14.0	2.00-3.00	---
ASTM A 409/A 409M-95	TP316	---	S31600	0.08	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.0-3.0	---
JIS G 3459:1997	SUS316TP	---	---	0.08	2.00	1.00	0.040	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---
JIS G 3468:1994	SUS316	---	---	0.08	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---
BSI BS 3605-1:1991 Issue 2, 1997	316S31	---	---	0.070	2.00	1.00	0.040	0.030	16.50-18.50	10.50-13.50	2.00-2.50	---
	316S33	---	---	0.070	2.00	1.00	0.040	0.030	16.50-18.50	11.00-14.00	2.50-3.00	---
BSI BS 3605-2:1992 Issue 2, 1997	316S31	---	---	0.070	2.00	1.00	0.040	0.030	16.50-18.50	10.50-13.50	2.00-2.50	---
	316S33	---	---	0.070	2.00	1.00	0.040	0.030	16.50-18.50	11.00-14.00	2.50-3.00	---
DIN 17457:1985	X 5 CrNiMo 17 12 2	1.4401	---	0.07	---	---	---	---	16.5-18.5	10.5-13.5	2.0-2.5	---
DIN 17458:1985	X 5 CrNiMo 17 12 2	1.4401	---	0.07	---	---	---	---	16.5-18.5	10.5-13.5	2.0-2.5	---
DIN 17457:1985	X 5 CrNiMo17 13 3	1.4436	---	0.07	---	---	---	0.025	16.5-18.5	11.0-14.0	2.5-3.0	---
DIN 17458:1985	X 5 CrNiMo17 13 3	1.4436	---	0.07	---	---	---	0.025	16.5-18.5	11.0-14.0	2.5-3.0	---
AFNOR NF A 49-244:1993	X7CrNiMo17-11-2	---	---	0.070	2.00	0.75	0.040	0.015	16.0-18.0	10.0-12.0	2.00-2.50	---

5.4 Tubes and Pipes for Pressure Service

5.4.3A Chemical Composition of Stainless Steel Tubes and Pipes for Pressure Service at Room and Elevated Temperatures (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 312/A 312M-00	TP316L	---	S31603	0.035	2.00	1.00	0.045	0.030	16.0-18.0	10.0-15.0	2.00-3.00	---
ASTM A 358/A 358M-98	316L	---	S31603	0.030	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	N 0.10
ASTM A 409/A 409M-95	TP316L	---	S31603	0.035	2.00	0.75	0.045	0.030	16.0-18.0	10.0-15.0	2.0-3.0	---
JIS G 3459:1997	SUS316LTP	---	---	0.030	2.00	1.00	0.040	0.030	16.00-18.00	12.00-16.00	2.00-3.00	---
JIS G 3468:1994	SUS316L	---	---	0.030	2.00	1.00	0.045	0.030	16.00-18.00	12.00-15.00	2.00-3.00	---
BSI BS 3605-1:1991 Issue 2, 1997	316S11	---	---	0.030	2.00	1.00	0.040	0.030	16.50-18.50	11.00-14.00	2.00-2.50	---
BSI BS 3605-2:1992 Issue 2, 1997	316S13	---	---	0.030	2.00	1.00	0.040	0.030	16.50-18.50	11.50-14.50	2.50-3.00	---
	316S11	---	---	0.030	2.00	1.00	0.040	0.030	16.50-18.50	11.00-14.00	2.00-2.50	---
DIN 17457:1985	316S13	---	---	0.030	2.00	1.00	0.040	0.030	16.50-18.50	11.50-14.50	2.50-3.00	---
	X 2 CrNiMo 17 13 2	1.4404	---	0.030	---	---	---	---	16.5-18.5	11.0-14.0	2.0-2.5	---
DIN 17458:1985	X 2 CrNiMo 17 13 2	1.4404	---	0.030	---	---	---	---	16.5-18.5	11.0-14.0	2.0-2.5	---
DIN 17457:1985	X 2 CrNiMo 18 14 3	1.4435	---	0.030	---	---	---	0.025	17.0-18.5	12.5-15.0	2.5-3.0	---
DIN 17458:1985	X 2 CrNiMo 18 14 3	1.4435	---	0.030	---	---	---	0.025	17.0-18.5	12.5-15.0	2.5-3.0	---
AFNOR NF A 49-244:1993	X3CrNiMo17-11-2	---	---	0.030	2.00	0.75	0.040	0.015	16.0-18.0	10.0-12.0	2.00-2.50	---
	X3CrNiMo17-12-3	---	---	0.030	2.00	0.75	0.040	0.015	16.5-18.5	11.0-13.0	2.5-3.00	---
	X3CrNiMo18-12-3	---	---	0.030	2.00	0.75	0.040	0.015	16.5-18.5	11.0-13.0	2.25-2.75	---
ASTM A 376/A 376M-98	TP316LN	---	---	0.035	2.00	0.75	0.040	0.030	16.0-18.0	11.0-14.0	2.00-3.00	N 0.10-0.16
DIN 17457:1985	X 2 CrNiMoN 17 13 3	1.4429	---	0.030	---	---	---	---	16.5-18.5	11.5-14.5	2.5-3.0	N 0.14-0.22; S 0.025
DIN 17458:1985	X 2 CrNiMoN 17 13 3	1.4429	---	0.030	---	---	---	---	16.5-18.5	11.5-14.5	2.5-3.0	N 0.14-0.22; S 0.025
AFNOR NF A 49-244:1993	X3CrNiMoN17-11	---	---	0.030	2.00	0.75	0.040	0.015	16.0-18.0	10.0-12.0	2.00-2.5	N 0.12-0.20
	X3CrNiMoN17-12	---	---	0.030	2.00	0.75	0.040	0.015	16.0-18.0	11.0-13.0	2.5-3.0	N 0.12-0.20

5.4 Tubes and Pipes for Pressure Service

5.4.3A Chemical Composition of Stainless Steel Tubes and Pipes for Pressure Service at Room and Elevated Temperatures (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 312/A 312M-00	TP316H	---	S31609	0.04-0.10	2.00	1.00	0.045	0.030	16.0-18.0	11.0-14.0	2.00-3.00	---
ASTM A 358/A 358M-98	316H	---	S31609	0.04-0.10	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
ASTM A 376/A 376M-98	TP316H	---	S31609	0.04-0.10	2.00	0.75	0.040	0.030	16.0-18.0	11.0-14.0	2.00-3.00	---
JIS G 3459:1997	SUS316HTP	---	---	0.04-0.10	2.00	0.75	0.030	0.030	16.00-18.00	11.00-14.00	2.00-3.00	---
BSI BS 3605-1:1991 Issue 2, 1997	316S51	---	---	0.04-0.10	2.00	1.00	0.040	0.030	16.50-18.50	10.50-13.50	2.00-2.50	---
DIN 17459:1992	X 6 CrNiMo 17 13	1.4919	---	0.04-0.08	2.0	0.75	0.035	0.015	16.0-18.0	12.0-14.0	2.0-2.5	---
AFNOR NF A 49-214:1978	Z 6 CND 17-12 B	---	---	0.04-0.08	2.0	1.0	0.035	0.030	16-18	11-14	2.0-3.0	---
BSI BS 3605-1:1991 Issue 2, 1997	316S52	---	---	0.04-0.10	2.00	1.00	0.040	0.030	16.50-18.50	10.50-13.50	2.00-2.50	B 0.0015-0.006
DIN 17459:1992	X 3 CrNiMoN 17 13	1.4910	---	0.04	2.0	0.75	0.035	0.015	16.0-18.0	12.0-14.0	2.0-2.8	B 0.0015-0.0050; N 0.10-0.18
JIS G 3459:1997	SUS316TiTP	---	---	0.08	2.00	1.00	0.040	0.030	16.00-18.00	10.00-14.00	2.00-3.00	Ti 5 x C min
DIN 17457:1985	X 6 CrNiMoTi 17 12 2	1.4571	---	0.08	---	---	---	---	16.5-18.5	10.5-13.5	2.0-2.5	Ti 5 x C to 0.80
DIN 17458:1985	X 6 CrNiMoTi 17 12 2	1.4571	---	0.08	---	---	---	---	16.5-18.5	10.5-13.5	2.0-2.5	Ti 5 x C to 0.80
AFNOR NF A 49-214:1978	Z 8 CNDT 17-13 B	---	---	0.05-0.10	2.0	1.0	0.035	0.030	16-18	12-15	2.0-3.0	Ti 4 x C to 0.75
AFNOR NF A 49-244:1993	X6CrNiMo17-11-2	---	---	0.060	2.00	0.75	0.040	0.015	16.0-18.0	10.5-12.5	2.00-2.5	Ti 5 (C+N) to 0.70; Ti/C+N to 15
ASTM A 312/A 312M-00	TP317	---	S31700	0.08	2.00	1.00	0.045	0.030	18.0-20.0	11.0-14.0	3.0-4.0	---
ASTM A 409/A 409M-95	TP317	---	S31700	0.08	2.00	0.75	0.045	0.030	18.0-20.0	11.0-14.0	3.0-4.0	---
JIS G 3459:1997	SUS317TP	---	---	0.08	2.00	1.00	0.040	0.030	18.00-20.00	11.00-15.00	3.00-4.00	---
JIS G 3468:1994	SUS317	---	---	0.08	2.00	1.00	0.045	0.030	18.00-20.00	11.00-15.00	3.00-4.00	---
ASTM A 312/A 312M-00	TP317L	---	S31703	0.035	2.00	1.00	0.045	0.030	18.0-20.0	11.0-15.0	3.0-4.0	---
JIS G 3459:1997	SUS317LTP	---	---	0.030	2.00	1.00	0.040	0.030	18.00-20.00	11.00-15.00	3.00-4.00	---
JIS G 3468:1994	SUS317L	---	---	0.030	2.00	1.00	0.045	0.030	18.00-20.00	11.00-15.00	3.00-4.00	---
AFNOR NF A 49-244:1993	X3CrNiMo19-15-4	---	---	0.030	2.00	0.75	0.035	0.010	17.5-19.5	14.0-16.0	3.00-4.00	---

5.4 Tubes and Pipes for Pressure Service

5.4.3A Chemical Composition of Stainless Steel Tubes and Pipes for Pressure Service at Room and Elevated Temperatures (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 312/A 312M-00	TP321	---	S32100	0.08	2.00	1.00	0.045	0.030	17.0-20.0	9.0-13.0	---	Ti 5 x C to 0.70
ASTM A 358/A 358M-98	321	---	S32100	0.08	2.00	0.75	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 5 x (C+N) to 0.70; N 0.10
ASTM A 376/A 376M-98	TP321	---	---	0.08	2.00	0.75	0.040	0.030	17.0-20.0	9.00-13.0	---	Ti 5 x C to 0.60
ASTM A 409/A 409M-95	TP321	---	S32100	0.08	2.00	0.75	0.045	0.030	17.0-20.0	9.00-13.0	---	Ti 5 x C to 0.70
JIS G 3459:1997	SUS321TP	---	---	0.08	2.00	1.00	0.040	0.030	17.00-19.00	9.00-13.00	---	Ti 5 x C min
JIS G 3468:1994	SUS321	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Ti 5 x C min
BSI BS 3605-1:1991 Issue 2, 1997	321S31	---	---	0.080	2.00	1.00	0.040	0.030	17.00-19.00	9.00-12.00	---	Ti 5 x C to 0.80
BSI BS 3605-2:1992 Issue 2, 1997	321S31	---	---	0.080	2.00	1.00	0.040	0.030	17.00-19.00	9.00-12.00	---	Ti 5 x C to 0.80
DIN 17457:1985	X 6 CrNiTi 18 10	1.4541	---	0.08	---	---	---	---	17.0-19.0	9.0-12.0	---	Ti 5 x C to 0.80
DIN 17458:1985	X 6 CrNiTi 18 10	1.4541	---	0.08	---	---	---	---	17.0-19.0	9.0-12.0	---	Ti 5 x C to 0.80
AFNOR NF A 49-244:1993	X6CrNiTi18-10	---	---	0.060	2.00	0.75	0.040	0.015	17.0-19.0	9.0-11.0	---	Ti 5 x (C+N) to 0.70; Ti/C+N to 15
ASTM A 312/A 312M-00	TP321H	---	S32109	0.04-0.10	2.00	1.00	0.0450	0.030	17.0-20.0	9.0-13.0	---	Ti 5 x C to 0.60
ASTM A 376/A 376M-98	TP321H	---	S32109	0.04-0.10	2.00	0.75	0.040	0.030	17.0-20.0	9.00-13.0	---	Ti 4 x C to 0.60
JIS G 3459:1997	SUS321HTP	---	---	0.04-0.10	2.00	0.75	0.030	0.030	17.00-20.00	9.00-13.00	---	Ti 4 x C to 0.60
BSI BS 3605-1:1991 Issue 2, 1997	321S51	---	---	0.04-0.10	2.00	1.00	0.040	0.030	17.00-19.00	9.00-12.00	---	Ti 5 x C to 0.80
AFNOR NF A 49-214:1978	Z 6 CNT 18-12 B	---	---	0.04-0.08	2.0	1.0	0.035	0.030	17-19	10-13	---	Ti 4 x C to 0.60

5.4 Tubes and Pipes for Pressure Service

5.4.3A Chemical Composition of Stainless Steel Tubes and Pipes for Pressure Service at Room and Elevated Temperatures (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 312/A 312M-00	TP347	---	S34700	0.08	2.00	1.00	0.045	0.030	17.0-20.0	9.0-13.0	---	(Nb+Ta) 10 x C to 1.00
ASTM A 358/A 358M-98	347	---	S34700	0.08	2.00	0.75	0.045	0.030	17.0-19.0	9.0-13.0	---	Cb 10 x C to 1.00
ASTM A 376/A 376M-98	TP347	---	---	0.08	2.00	0.75	0.040	0.030	17.0-20.0	9.00-13.0	---	(Nb+Ta) 10 x C to 1.00
ASTM A 409/A 409M-95	TP347	---	S34700	0.08	2.00	0.75	0.045	0.030	17.0-20.0	9.00-13.0	---	(Cb+Ta) 10 x C to 1.0
JIS G 3459:1997	SUS347TP	---	---	0.08	2.00	1.00	0.040	0.030	17.00-19.00	9.00-13.00	---	Nb 10 x C min
JIS G 3468:1994	SUS347	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Nb 10 x C min
BSI BS 3605-1:1991 Issue 2, 1997	347S31	---	---	0.080	2.00	1.00	0.040	0.030	17.00-19.00	9.00-13.0	---	Nb 10 x C to 1.00
BSI BS 3605-2:1990 Issue 2, 1997	347S31	---	---	0.080	2.00	1.00	0.040	0.030	17.00-19.00	9.00-13.0	---	Nb 10 x C to 1.00
DIN 17457:1985	X 6 CrNiNb 18 10	1.4550	---	0.08	---	---	---	---	17.0-19.0	9.0-12.0	---	Nb 10 x C to 1.00
DIN 17458:1985	X 6 CrNiNb 18 10	1.4550	---	0.08	---	---	---	---	17.0-19.0	9.0-12.0	---	Nb 10 x C to 1.00
ASTM A 312/A 312M-00	TP347H	---	S34709	0.04-0.10	2.00	1.00	0.045	0.030	17.0-20.0	9.0-13.0	---	(Nb+Ta) 8 x C to 1.00
ASTM A 376/A 376M-98	TP347H	---	S34709	0.04-0.10	2.00	0.75	0.040	0.030	17.0-20.0	9.00-13.0	---	(Nb+Ta) 8 x C to 1.00
JIS G 3459:1997	SUS347HTP	---	---	0.04-0.10	2.00	1.00	0.030	0.030	17.00-20.00	9.00-13.00	---	Nb 8 x C to 1.00
BSI BS 3605-1:1991 Issue 2, 1997	347S51	---	---	0.04-0.10	2.00	1.00	0.040	0.030	17.00-19.00	9.00-13.00	---	Nb 10 x C to 1.20
DIN 17459:1992	X 8 CrNiNb 16 13	1.4961	---	0.04-0.10	1.5	0.30-0.60	0.035	0.015	15.0-17.0	12.0-14.0	---	Nb 10 x C to 1.2
AFNOR NF A 49-214:1978	Z 6 CN Nb 18-12 B	---	---	0.04-0.08	2.0	1.0	0.035	0.030	17-19	10-13	---	(Nb+Ta) 8 x C to 1.00
ASTM A 312/A 312M-00	---	---	S31725	0.03	2.00	1.00	0.040	0.030	18.0-20.0	13.5-17.5	4.0-5.0	N 0.10; Cu 0.75
ASTM A 358/A 358M-98	---	---	S31725	0.03	2.00	0.75	0.045	0.030	18.0-20.0	13.5-17.5	4.0-5.0	N 0.20
ASTM A 409/A 409M-95	---	---	S31725	0.03	2.00	0.75	0.045	0.030	18.0-20.0	13.5-17.5	4.0-5.0	N 0.10; Cu 0.75
DIN 17457:1985	X 2 CrNiMoN 17 13 5	1.4439	---	0.030	---	---	---	0.025	16.5-18.5	12.5-14.5	4.0-5.0	N 0.12-0.22
DIN 17458:1985	X 2 CrNiMoN 17 13 5	1.4439	---	0.030	---	---	---	0.025	16.5-18.5	12.5-14.5	4.0-5.0	N 0.12-0.22
AFNOR NF A 49-244:1993	X3CrNiMoN18-14-5	---	---	0.030	2.00	0.75	0.035	0.010	17.0-19.0	13.0-15.0	4.0-5.0	N 0.12-0.20

5.4 Tubes and Pipes for Pressure Service

5.4.3A Chemical Composition of Stainless Steel Tubes and Pipes for Pressure Service at Room and Elevated Temperatures (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 358/A 358M-98	---	---	N08904	0.020	2.00	1.00	0.045	0.035	19.0-23.0	23.0-28.0	4.0-5.0	Cu 1.0-2.0; N 0.10
JIS G 3459:1997	SUS890LTP	---	---	0.020	2.00	1.00	0.040	0.030	19.00-23.00	23.00-28.00	4.00-5.00	Cu 1.00-2.00
AFNOR NF A 49-244:1993	X2NiCrMoCu25-20	---	---	0.020	2.00	0.40	0.035	0.010	19.0-21.0	24.0-26.0	4.0-5.0	Cu 1.00-2.00
DIN 17459:1992	X 5 NiCrAlTi 31 20	1.4958	---	0.03-0.08	1.5	0.70	0.015	0.010	19.0-22.0	30.0-32.5	---	Al 0.20-0.50; Ti 0.20-0.50; Al+Ti 0.70; Co 0.5; Ni+Co 30.0-32.5; Cu 0.5; Nb 0.1
AFNOR NF A 49-244:1993	X5NiCr32-21	---	---	0.05	1.50	0.75	0.035	0.015	19.0-24.0	30.0-33.0	---	Al 0.15-0.60; Ti 0.15-0.60
DIN 17459:1992	X 8 NiCrAlTi 32 21	1.4959	---	0.05-0.10	1.5	0.70	0.015	0.010	19.0-22.0	30.0-34.0	---	Al 0.25-0.65; Ti 0.25-0.65; Co 0.5; Ni+Co 30.0-34.0; Cu 0.5

5.4 Tubes and Pipes for Pressure Service

5.4.3B Mechanical Properties of Stainless Steel Tubes and Pipes for Pressure Service at Room and Elevated Temperatures

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 312/A 312M-00	TP304	---	S30400	HF or CF + A	---	---	205	30	515	75	35	---
ASTM A 358/A 358M-98	304	---	S30400	H, HT, HT-O or HT-SO	---	---	205	30	515 min	75 min	40	---
ASTM A 376/A 376M-98	TP304	---	---	see standard	---	---	205	30	515	75	35	---
ASTM A 409/A 409M-95	TP304	---	S30400	H, HT, HT-O or HT-SO	---	---	205	30	515 min	75 min	---	---
JIS G 3459:1997	SUS304TP	---	---	ST	---	---	205	---	520 min	---	35	---
JIS G 3468:1994	SUS304	---	---	AM	---	---	205	---	520 min	---	35	---
BSI BS 3605-1:1990 Issue 2, 1997	304S31	---	---	ST or HF	---	---	230	---	490-690	---	35.	---
BSI BS 3605-2:1992 Issue 2, 1997	304S31	---	---	AW or ST	---	---	230	---	490-690	---	35	---
DIN 17457:1985	X 5 CrNi 18 10	1.4301	---	SA & Q	≤ 50	---	195	---	500-720	---	40 L; 35 T	L: 85 J at RT T: 55 J at RT
DIN 17458:1985	X 5 CrNi 18 10	1.4301	---	SA & Q	≤ 50	---	195	---	500-700	---	40 L; 35 T	L: 85 J at RT T: 55 J at RT
AFNOR NF A 49-244:1993	X7CrNi18-9	---	---	ST or TT	< 3	---	215	---	520-720	---	40	L: 90 J at -196°C T: 70 J at -196°C
					3 ≤ t ≤ 5	---	215	---			45	
					5 < t ≤ 75	---	205	---			45	

5.4 Tubes and Pipes for Pressure Service

5.4.3B Mechanical Properties of Stainless Steel Tubes and Pipes for Pressure Service at Room and Elevated Temperatures (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 312/A 312M-00	TP304 L	---	S30403	HF or CF + A	---	---	170	25	485	70	35	---
ASTM A 358/A 358M-98	304L	---	S30403	H, HT, HT-O or HT-SO	---	---	170	25	485 min	70 min	40	---
ASTM A 409/A 409M-95	TP304L	---	S30403	H, HT, HT-O or HT-SO	---	---	170	25	485 min	70 min	---	---
JIS G 3459:1997	SUS304LTP	---	---	ST	---	---	175	---	480 min	---	35	---
JIS G 3468:1994	SUS304L	---	---	AM	---	---	175	---	480 min	---	35	---
BSI BS 3605-1:1990 Issue 2, 1997	304S11	---	---	ST or HF	---	---	215	---	480-680	---	35	---
BSI BS 3605-2:1992 Issue 2, 1997	304S11	---	---	AW or ST	---	---	215	---	480-680	---	35	---
DIN 17457:1985	X 2 CrNi 19 11	1.4306	---	SA & Q	≤ 50	---	180	---	460-680	---	40 L; 35 T	L: 85 J at RT T: 55 J at RT
DIN 17458:1985	X 2 CrNi 19 11	1.4306	---	SA & Q	≤ 50	---	180	---	460-680	---	40 L; 35 T	L: 85 J at RT T: 55 J at RT
AFNOR NF A 49-244:1993	X3CrNiN18-10	---	---	ST or TT	< 3	---	280	---	570-770	---	40	L: 100 J at -196°C T: 80 J at -196°C
					3 ≤ t ≤ 5	---	280	---			45	
					5 < t ≤ 75	---	270	---			45	
ASTM A 376/A 376M-98	TP304LN	---	---	see standard	---	---	205	30	515	75	35	---
DIN 17457:1985	X 2 CrNiN 18 10	1.4311	---	SA & Q	≤ 50	---	270	---	550-760	---	35 L; 30 T	L: 85 J at RT T: 55 J at RT
DIN 17458:1985	X 2 CrNiN 18 10	1.4311	---	SA & Q	≤ 50	---	270	---	550-760	---	35 L; 30 T	L: 85 J at RT T: 55 J at RT
AFNOR NF A 49-244:1993	X3CrNiN18-10	---	---	ST or TT	< 3	---	280	---	570-770	---	40	L: 100 J at -196°C T: 80 J at -196°C
					3 ≤ t ≤ 5	---	280	---			45	
					5 < t ≤ 75	---	270	---			45	
	X6CrNiN19-9	---	---	ST or TT	< 3	---	300	---	590-790	---	35	L: 100 J at -196°C T: 80 J at -196°C
					3 ≤ t ≤ 5	---	300	---			40	
					5 < t ≤ 75	---	290	---			40	

5.4 Tubes and Pipes for Pressure Service

5.4.3B Mechanical Properties of Stainless Steel Tubes and Pipes for Pressure Service at Room and Elevated Temperatures (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 312/A 312M-00	TP304H	---	S30409	HF or CF + A	---	---	205	30	515	75	35	---
ASTM A 358/A 358M-98	304H	---	S30409	H, HT, HT-O or HT-SO	---	---	205	30	515 min	75 min	40	---
ASTM A 376/A 376M-98	TP304H	---	S30409	see standard	---	---	205	30	515	75	35	---
JIS G 3459:1997	SUS304HTP	---	---	ST	---	---	205	---	520 min	---	35	---
BSI BS 3605-1:1990 Issue 2, 1997	304S51	---	---	ST or HF	---	---	230	---	490-690	---	35	---
DIN 17459:1992	X 6 CrNi 18 11	1.4948	---	SHT	≤ 50	---	185	---	500-700	---	40 L; 30 T	L: 90 J at RT T: 60 J at RT
AFNOR NF A 49-214:1978	Z 6 CN 19-10	---	---	L or F H + RC	---	---	195	---	490-690	---	40	---
ASTM A 312/A 312M-00	TP309S	---	S30908	HF or CF + A	---	---	205	30	515	75	35	---
ASTM A 358/A 358M-98	309S	---	S30908	H, HT, HT-O or HT-SO	---	---	205	30	515 min	75 min	40	---
JIS G 3459:1997	SUS309STP	---	---	ST	---	---	205	---	520 min	---	35	---
JIS G 3468:1994	SUS309S	---	---	AM	---	---	205	---	520 min	---	35	---
JIS G 3459:1997	SUS309TP	---	---	ST	---	---	205	---	520 min	---	35	---
AFNOR NF A 49-244:1993	X15Cr-Ni24-13	---	---	ST or TT	< 3	---	240	---	540-740	---	30	---
					3 ≤ t ≤ 5	---	240	---			35	
					5 < t ≤ 75	---	240	---			35	
ASTM A 312/A 312M-00	TP310S	---	S31008	HF or CF + A	---	---	205	30	515	75	35	---
ASTM A 358/A 358M-98	310S	---	S31008	H, HT, HT-O or HT-SO	---	---	205	30	515 min	75 min	40	---
JIS G 3459:1997	SUS310STP	---	---	ST	---	---	205	---	520 min	---	35	---
JIS G 3468:1994	SUS310S	---	---	AM	---	---	205	---	520 min	---	35	---
AFNOR NF A 49-244:1993	X1CrNi25-20	---	---	ST or TT	< 3	---	205	---	480-680	---	35	L: 90 J at -196°C T: 70 J at -196°C
					3 ≤ t ≤ 5	---	205	---			40	
					5 < t ≤ 75	---	205	---			40	

5.4 Tubes and Pipes for Pressure Service

5.4.3B Mechanical Properties of Stainless Steel Tubes and Pipes for Pressure Service at Room and Elevated Temperatures (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 312/A 312M-00	TP316	---	S31600	HF or CF + A	---	---	205	30	515	75	35	---
ASTM A 358/A 358M-98	316	---	S31600	H, HT, HT-O or HT-SO	---	---	205	30	515 min	75 min	40	---
ASTM A 376/A 376M-98	TP316	---	---	see standard	---	---	205	30	515	75	35	---
ASTM A 409/A 409M-95	TP316	---	S31600	H, HT, HT-O or HT-SO	---	---	205	30	515 min	75 min	---	---
JIS G 3459:1997	SUS316TP	---	---	ST	---	---	205	---	520 min	---	35	---
JIS G 3468:1994	SUS316	---	---	AM	---	---	205	---	520 min	---	35	---
BSI BS 3605-1:1990 Issue 2, 1997	316S31	---	---	ST or HF	---	---	240	---	510-710	---	35	---
BSI BS 3605-2:1992 Issue 2, 1997	316S33	---	---	ST or HF	---	---	240	---	510-710	---	35	---
	316S31	---	---	AW or ST	---	---	240	---	510-710	---	35	---
	316S33	---	---	AW or ST	---	---	240	---	510-710	---	35	---
DIN 17457:1985	X 5 CrNiMo 17 12 2	1.4401	---	SA & Q	≤ 50	---	205	---	510-710	---	40 L; 35 T	L: 85 J at RT T: 55 J at RT
DIN 17458:1985	X 5 CrNiMo 17 12 2	1.4401	---	SA & Q	≤ 50	---	205	---	510-710	---	40 L; 30 T	L: 85 J at RT T: 55 J at RT
DIN 17457:1985	X 5 CrNiMo17 13 3	1.4436	---	SA & Q	≤ 50	---	205	---	510-710	---	40 L; 35 T	L: 85 J at RT T: 55 J at RT
DIN 17458:1985	X 5 CrNiMo17 13 3	1.4436	---	SA & Q	≤ 50	---	205	---	510-710	---	40 L; 30 T	L: 85 J at RT T: 55 J at RT
AFNOR NF A 49-244:1993	X7CrNiMo17-11-2	---	---	ST or TT	< 3	---	225	---	540-740	---	40	L: 90 J at -196°C T: 70 J at -196°C
					3 ≤ t ≤ 5	---	225	---			45	
					5 < t ≤ 75	---	215	---			45	

5.4 Tubes and Pipes for Pressure Service

5.4.3B Mechanical Properties of Stainless Steel Tubes and Pipes for Pressure Service at Room and Elevated Temperatures (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 312/A 312M-00	TP316L	---	S31603	HF or CF + A	---	---	170	25	485	70	35	---
ASTM A 358/A 358M-98	316L	---	S31603	H, HT, HT-O or HT-SO	---	---	170	25	485 min	70 min	40	---
ASTM A 409/A 409M-95	TP316L	---	S31603	H, HT, HT-O or HT-SO	---	---	170	25	485 min	70 min	---	---
JIS G 3459:1997	SUS316LTP	---	---	ST	---	---	175	---	480 min	---	35	---
JIS G 3468:1994	SUS316L	---	---	AM	---	---	175	---	480 min	---	35	---
BSI BS 3605-1:1990 Issue 2, 1997	316S11	---	---	ST or HF	---	---	225	---	490-690	---	35	---
BSI BS 3605-2:1992 Issue 2, 1997	316S13	---	---	ST or HF	---	---	225	---	490-690	---	35	---
BSI BS 3605-2:1992 Issue 2, 1997	316S11	---	---	AW or ST	---	---	225	---	490-690	---	35	---
BSI BS 3605-2:1992 Issue 2, 1997	316S13	---	---	AW or ST	---	---	225	---	490-690	---	35	---
DIN 17457:1985	X 2 CrNiMo 17 13 2	1.4404	---	SA & Q	≤ 50	---	190	---	490-690	---	40 L; 35 T	L: 85 J at RT T: 55 J at RT
DIN 17458:1985	X 2 CrNiMo 17 13 2	1.4404	---	SA & Q	≤ 50	---	190	---	490-690	---	40 L; 30 T	L: 85 J at RT T: 55 J at RT
DIN 17457:1985	X 2 CrNiMo 18 14 3	1.4435	---	SA & Q	≤ 50	---	190	---	490-690	---	40 L; 35 T	L: 85 J at RT T: 55 J at RT
DIN 17458:1985	X 2 CrNiMo 18 14 3	1.4435	---	SA & Q	≤ 50	---	190	---	490-690	---	40 L; 30 T	L: 85 J at RT T: 55 J at RT
AFNOR NF A 49-244:1993	X3CrNiMo17-11-2	---	---	ST or TT	< 3	---	215	---	510-710	---	40	L: 90 J at -196°C T: 70 J at -196°C
					3 ≤ t ≤ 5	---	215	---			45	
					5 < t ≤ 75	---	205	---			45	
	X3CrNiMo17-12-3	---	---	ST or TT	< 3	---	215	---	510-710	---	40	L: 90 J at -196°C T: 70 J at -196°C
					3 ≤ t ≤ 5	---	215	---			45	
					5 < t ≤ 75	---	205	---			45	
	X3CrNiMo18-12-3	---	---	ST or TT	< 3	---	215	---	510-710	---	40	L: 90 J at -196°C T: 70 J at -196°C
					3 ≤ t ≤ 5	---	215	---			45	
					5 < t ≤ 75	---	205	---			45	

5.4 Tubes and Pipes for Pressure Service

5.4.3B Mechanical Properties of Stainless Steel Tubes and Pipes for Pressure Service at Room and Elevated Temperatures (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 376/A 376M-98	TP316LN	---	---	see standard	---	---	205	30	515	75	35	---
DIN 17457:1985	X 2 CrNiMoN 17 13 3	1.4429	---	SA & Q	≤ 50	---	295	---	580-800	---	35 L; 30 T	L: 85 J at RT T: 55 J at RT
DIN 17458:1985	X 2 CrNiMoN 17 13 3	1.4429	---	SA & Q	≤ 50	---	295	---	580-800	---	35 L; 30 T	L: 85 J at RT T: 55 J at RT
AFNOR NF A 49-244:1993	X3CrNiMoN17-11	---	---	ST or TT	< 3	---	290	---	590-790	---	35	L: 100 J at -196°C T: 80 J at -196°C
					3 ≤ t ≤ 5	---	290	---			40	
					5 < t ≤ 75	---	290	---			40	
	X3CrNiMoN17-12	---	---	ST or TT	< 3	---	290	---	590-790	---	35	L: 100 J at -196°C T: 80 J at -196°C
					3 ≤ t ≤ 5	---	290	---			40	
					5 < t ≤ 75	---	290	---			40	
ASTM A 312/A 312M-00	TP316H	---	S31609	HF or CF + A	---	---	205	30	515	75	35	---
ASTM A 358/A 358M-98	316H	---	S31609	H, HT, HT-O or HT-SO	---	---	207	30	515 min	75 min	40	---
ASTM A 376/A 376M-98	TP316H	---	S31609	see standard	---	---	205	30	515	75	35	---
JIS G 3459:1997	SUS316HTP	---	---	ST	---	---	205	---	520 min	---	35	---
BSI BS 3605-1:1990 Issue 2, 1997	316S51	---	---	ST or HF	---	---	240	---	510-710	---	35	---
DIN 17459:1992	X 6 CrNiMo 17 13	1.4919	---	SHT	≤ 50	---	205	---	490-690	---	35 L; 30 T	L: 90 J at RT T: 60 J at RT
AFNOR NF A 49-214:1978	Z 6 CND 17-12 B	---	---	L or F H + RC	---	---	195	---	490-690	---	40	---
BSI BS 3605-1:1990 Issue 2, 1997	316S52	---	---	ST or HF	---	---	240	---	510-710	---	35	---
DIN 17459:1992	X 3 CrNiMoN 17 13	1.4910	---	SHT	≤ 50	---	260	---	550-750	---	35 L; 30 T	L: 120 J at RT T: 80 J at RT

5.4 Tubes and Pipes for Pressure Service

5.4.3B Mechanical Properties of Stainless Steel Tubes and Pipes for Pressure Service at Room and Elevated Temperatures (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
JIS G 3459:1997	SUS316TiTP	---	---	ST	---	---	205	---	520 min	---	35	---
DIN 17457:1985	X 6 CrNiMoTi 17 12 2	1.4571	---	SA & Q	≤ 50	---	210	---	500-730	---	35 L; 30 T	L: 85 J at RT T: 55 J at RT
DIN 17458:1985	X 6 CrNiMoTi 17 12 2	1.4571	---	SA & Q	≤ 50	---	210	---	500-730	---	35 L; 30 T	L: 85 J at RT T: 55 J at RT
					≤ 50	---	190	---	490-690	---	35 L; 30 T	L: 85 J at RT T: 55 J at RT
AFNOR NF A 49-214:1978	Z 8 CNDT 17-13 B	---	---	L or F H + RC	---	---	195	---	540-740	---	40	---
AFNOR NF A 49-244:1993	X6CrNiMo17-11-2	---	---	ST or TT	< 3	---	230	---	540-740	---	35	L: 90 J at -196°C T: 70 J at -196°C
					3 ≤ t ≤ 5	---	230	---			40	
					5 < t ≤ 75	---	220	---			40	
ASTM A 312/A 312M-00	TP317	---	S31700	HF or CF + A	---	---	205	30	515	75	35	---
ASTM A 409/A 409M-95	TP317	---	S31700	H, HT, HT-O or HT-SO	---	---	205	30	515 min	75 min	---	---
JIS G 3459:1997	SUS317TP	---	---	ST	---	---	205	---	520 min	---	35	---
JIS G 3468:1994	SUS317	---	---	AM	---	---	205	---	520 min	---	35	---
ASTM A 312/A 312M-00	TP317L	---	S31703	HF or CF + A	---	---	205	30	515	75	35	---
JIS G 3459:1997	SUS317LTP	---	---	ST	---	---	175	---	480 min	---	35	---
JIS G 3468:1994	SUS317L	---	---	AM	---	---	175	---	480 min	---	35	---
AFNOR NF A 49-244:1993	X3CrNiMo19-15-4	---	---	ST or TT	< 3	---	215	---	510-710	---	40	L: 90 J at -196°C T: 70 J at -196°C
					3 ≤ t ≤ 5	---	215	---			45	
					5 < t ≤ 75	---	205	---			45	

5.4 Tubes and Pipes for Pressure Service

5.4.3B Mechanical Properties of Stainless Steel Tubes and Pipes for Pressure Service at Room and Elevated Temperatures (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 312/A 312M-00	TP321 Seamless	---	S32100	A	---	$\leq \frac{3}{8}$	205	30	515 min	75 min	35	---
ASTM A 358/A 358M-98	321	---	S32100	H, HT, HT-O or HT-SO	---	---	205	30	515 min	75 min	40	---
ASTM A 376/A 376M-98	TP321	---	---	see standard	---	$\leq \frac{3}{8}$	205	30	515 min	75 min	35	---
ASTM A 409/A 409M-95	TP321	---	S32100	H, HT, HT-O or HT-SO	---	---	205	30	515 min	75 min	---	---
JIS G 3459:1997	SUS321TP	---	---	ST	---	---	205	---	520 min	---	35	---
JIS G 3468:1994	SUS321	---	---	AM	---	---	205	---	520 min	---	35	---
BSI BS 3605-1:1990 Issue 2, 1997	321S31	---	---	ST or HF	---	---	235	---	510-710	---	35	---
BSI BS 3605-2:1992 Issue 2, 1997	321S31	---	---	AW or ST	---	---	235	---	510-710	---	35	---
DIN 17457:1985	X 6 CrNiTi 18 10	1.4541	---	SA & Q	≤ 50	---	200	---	500-730	---	35 L; 30 T	L: 85 J at RT T: 55 J at RT
DIN 17458:1985	X 6 CrNiTi 18 10	1.4541	---	SA & Q	≤ 50	---	200	---	500-730	---	35 L; 30 T	L: 85 J at RT T: 55 J at RT
					≤ 50	---	180	---	460-680	---	35 L; 30 T	L: 85 J at RT T: 55 J at RT
AFNOR NF A 49-244:1993	X6CrNiTi18-10	---	---	ST or TT	< 3	---	220	---	530-730	---	35	L: 90 J at -196°C T: 70 J at -196°C
					$3 \leq t \leq 5$	---	220	---			40	
					$5 < t \leq 75$	---	210	---			40	
ASTM A 312/A 312M-00	TP321H Welded	---	S32109	HF or CF + A	---	---	205	30	515 min	75 min	35.	---
ASTM A 376/A 376M-98	TP321H	---	S32109	see standard	---	$\leq \frac{3}{8}$	205	30	515 min	75 min	35	---
					---	$> \frac{3}{8}$	170	25	480 min	70 min	35	---
JIS G 3459:1997	SUS321HTP	---	---	CF or HF + ST	---	---	205	---	520 min	---	35	---
BSI BS 3605-1:1990 Issue 2, 1997	321S51	---	---	ST or HF	---	---	235	---	510-710	---	35	---
AFNOR NF A 49-214:1978	Z 6 CNT 18-12 B	---	---	L or F H + RC	---	---	195	---	490-690	---	40	---

5.4 Tubes and Pipes for Pressure Service

5.4.3B Mechanical Properties of Stainless Steel Tubes and Pipes for Pressure Service at Room and Elevated Temperatures (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 312/A 312M-00	TP347	---	S34700	HF or CF + A	---	---	205	30	515	75	35	---
ASTM A 358/A 358M-98	347	---	S34700	H, HT, HT-O or HT-SO	---	---	205	30	515 min	75 min	40	---
ASTM A 376/A 376M-98	TP347	---	---	see standard	---	---	205	30	515	---	35	---
ASTM A 409/A 409M-95	TP347	---	S34700	H, HT, HT-O or HT-SO	---	---	205	30	515 min	75 min	---	---
JIS G 3459:1997	SUS347TP	---	---	ST	---	---	205	---	520 min	---	35	---
JIS G 3468:1994	SUS347	---	---	AM	---	---	205	---	520	---	35	---
BSI BS 3605-1:1990 Issue 2, 1997	347S31	---	---	ST or HF	---	---	240	---	510-710	---	35.	---
BSI BS 3605-2:1990 Issue 2, 1997	347S31	---	---	ST	---	---	240	---	510-710	---	35.	---
DIN 17457:1985	X 6 CrNiNb 18 10	1.4550	---	SA & Q	≤ 50	---	205	---	510-740	---	35 L; 30 T	L: 85 J at RT T: 55 J at RT
DIN 17458:1985	X 6 CrNiNb 18 10	1.4550	---	SA & Q	≤ 50	---	205	---	510-740	---	35 L; 30 T	L: 85 J at RT T: 55 J at RT
ASTM A 312/A 312M-00	TP347H	---	S34709	HF or CF + A	---	---	205	30	515	75	35	---
ASTM A 376/A 376M-98	TP347H	---	S34709	see standard	---	---	205	30	515	75	35	---
JIS G 3459:1997	SUS347HTP	---	---	CF or HF + ST	---	---	205	---	520 min	---	35	---
BSI BS 3605-1:1990 Issue 2, 1997	347S51	---	---	ST or HF	---	---	240	---	510-710	---	35	---
DIN 17459:1992	X 8 CrNiNb 16 13	1.4961	---	SHT	≤ 50	---	205	---	510-690	---	35 L; 22 T	65 J at RT, L 45 J at RT, T
AFNOR NF A 49-214:1978	Z 6 CN Nb 18-12 B	---	---	L or F H + RC	---	---	195	---	490-690	---	40	---

5.4 Tubes and Pipes for Pressure Service

5.4.3B Mechanical Properties of Stainless Steel Tubes and Pipes for Pressure Service at Room and Elevated Temperatures (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 312/A 312M-00	---	---	S31725	SA	---	---	205	30	515 min	75 min	---	---
ASTM A 358/A 358-98	---	---	S31725	see standard	---	---	205	30	515 min	75 min	---	---
ASTM A 409/A 409M-95	---	---	S31725	H, HT, HT-O or HT-SO	---	---	205	30	515 min	75 min	---	---
DIN 17457:1985	X 2 CrNiMoN 17 13 5	1.4439	---	SA & Q	≤ 50	---	285	---	580-800	---	35 L; 30 T	L: 85 J at RT T: 55 J at RT
DIN 17458:1985	X 2 CrNiMoN 17 13 5	1.4439	---	SA & Q	≤ 50	---	285	---	580-800	---	35 L; 30 T	L: 85 J at RT T: 55 J at RT
AFNOR NF A 49-244:1993	X3CrNiMoN18-14-5	---	---	ST or TT	< 3	---	290	---	580-780	---	35	L: 100 J at -196°C T: 80 J at -196°C
					3 ≤ t ≤ 5	---	290	---			40	
					5 < t ≤ 75	---	280	---			40	
ASTM A 358/A 358M-98	---	---	N08904	H, HT, HT-O or HT-SO	---	---	220	31	490 min	71 min	35	---
JIS G 3459:1997	SUS890LTP	---	---	ST	---	---	215	---	490 min	---	35	---
AFNOR NF A 49-244:1993	X2NiCrMoCu25-20	---	---	ST or TT	< 3	---	230	---	530-730	---	30	L: 90 J at -196°C T: 70 J at -196°C
					3 ≤ t ≤ 5	---	230	---			35	
					5 < t ≤ 75	---	230	---			35	
DIN 17459:1992	X 5 NiCrAlTi 31 20 RK	1.4958 RK	---	A/R	≤ 50	---	210	---	500-750	---	35 L; 30 T	L: 120 J at RT T: 80 J at RT
	X 5 NiCrAlTi 31 20	1.4958	---	SHT	≤ 50	---	170	---	500-750	---	35 L; 30 T	L: 120 J at RT T: 80 J at RT
AFNOR NF A 49-244:1993	X5NiCr32-21	---	---	ST or TT	< 3	---	200	---	490-690	---	25	---
					3 ≤ t ≤ 5	---	200	---			30	
					5 < t ≤ 75	---	200	---			30	
DIN 17459:1992	X 8 NiCrAlTi 32 21	1.4959	---	SHT	≤ 50	---	170	---	500-750	---	35 L; 30 T	L: 120 J at RT T: 80 J at RT

5.4 Tubes and Pipes for Pressure Service

5.4.4A Mechanical Properties of Carbon Steel Tubes and Pipes for Pressure Service at Low Temperatures

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
DIN 17178:1986	TStE 255	1.0463	---	N	≤ 20	---	255	---	360-480	---	25 L; 23 T	see standard
					20 < t ≤ 40	---	245	---				
	EStE 255	1.1103	---	N	≤ 20	---	255	---	360-480	---	25 L; 23 T	see standard
					20 < t ≤ 40	---	245	---				
DIN 17179:1986	TStE 255	1.0463	---	N	≤ 20	---	255	---	360-480	---	25 L; 23 T	see standard
					20 < t ≤ 40	---	245	---				
					40 < t ≤ 50	---	235	---				
					50 < t ≤ 65	---	225	---				
	EStE 255	1.1103	---	N	≤ 20	---	255	---	360-480	---	25 L; 23 T	see standard
					20 < t ≤ 40	---	245	---				
					40 < t ≤ 50	---	235	---				
					50 < t ≤ 65	---	225	---				
ASTM A 333/A 333M-99	1	---	K03008	see standard	---	---	205	30	380	55	≥ 8mm (5/16 in) 35 L; 25 T	18 J at -45°C
JIS G 3460:1988	STPL 380	---	---	N or NT	---	---	205	---	380	---	35	21 J at -45°C
DIN 17178:1986	TStE 285	1.0488	---	N	≤ 20	---	285	---	390-510	---	24 L; 22 T	see standard
					20 < t ≤ 40	---	275	---				
	EStE 285	1.1104	---	N	≤ 20	---	285	---	390-510	---	24 L; 22 T	see standard
					20 < t ≤ 40	---	275	---				
DIN 17179:1986	TStE 285	1.0488	---	N	≤ 20	---	285	---	390-510	---	24 L; 22 T	see standard
					20 < t ≤ 40	---	275	---				
					40 < t ≤ 50	---	265	---				
					50 < t ≤ 65	---	255	---				
	EStE 285	1.1104	---	N	≤ 20	---	285	---	390-510	---	24 L; 22 T	see standard
					20 < t ≤ 40	---	275	---				
					40 < t ≤ 50	---	265	---				
					50 < t ≤ 65	---	255	---				
ASTM A 333/A 333M-99	6	---	K03006	see standard	---	---	240	35	415	60	≥ 8mm (5/16 in) 30 L; 16.5 T	18 J at -45°C
	3	---	K31918	see standard	---	---	240	35	450	65	≥ 8mm (5/16 in) 30 L; 20 T	18 J at -100°C
JIS G 3460:1988	STPL 450	---	---	N or NT	---	---	245	---	450 min	---	30	21 J at -100°C

5.4 Tubes and Pipes for Pressure Service

5.4.4A Mechanical Properties of Carbon Steel Tubes and Pipes for Pressure Service at Low Temperatures (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
DIN 17178:1986	TStE 355	1.0566	---	N	≤ 20	---	355	---	490-630	---	22 L; 20 T	see standard
					20 < t ≤ 40	---	345	---				
	EStE 355	1.1106	---	N	≤ 20	---	355	---	490-630	---	22 L; 20 T	see standard
					20 < t ≤ 40	---	345	---				
DIN 17179:1986	TStE 355	1.0566	---	N	≤ 20	---	355	---	490-630	---	22 L; 20 T	see standard
					20 < t ≤ 40	---	345	---				
					40 < t ≤ 50	---	335	---				
					50 < t ≤ 65	---	325	---				
	EStE 355	1.1106	---	N	≤ 20	---	355	---	490-630	---	22 L; 20 T	see standard
					20 < t ≤ 40	---	345	---				
					40 < t ≤ 50	---	335	---				
					50 < t ≤ 65	---	325	---				
DIN 17178:1986	TStE 420	1.8912	---	N	≤ 12	---	420	---	530-680	---	21 L; 19 T	see standard
					12 < t ≤ 20	---	410	---				
					20 < t ≤ 40	---	400	---				
	EStE 420	1.8913	---	N	≤ 12	---	420	---	530-680	---	21 L; 19 T	see standard
					12 < t ≤ 20	---	410	---				
					20 < t ≤ 40	---	400	---				
DIN 17179:1986	TStE 420	1.8912	---	N	≤ 12	---	420	---	530-680	---	21 L; 19 T	see standard
					12 < t ≤ 20	---	410	---				
					20 < t ≤ 40	---	400	---				
					40 < t ≤ 50	---	385	---				
					50 < t ≤ 65	---	375	---				
	EStE 420	1.8913	---	N	≤ 12	---	420	---	530-680	---	21 L; 19 T	see standard
					12 < t ≤ 20	---	410	---				
					20 < t ≤ 40	---	400	---				
					40 < t ≤ 50	---	385	---				
					50 < t ≤ 65	---	375	---				
ASTM A 333/A 333M-99	10	---	---	see standard	---	---	450	65	550	80	≥ 8mm (5/16 in) 22 L	18 J at -60°C

5.4 Tubes and Pipes for Pressure Service

5.4.4A Mechanical Properties of Carbon Steel Tubes and Pipes for Pressure Service at Low Temperatures (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
DIN 17178:1986	TStE 460	1.8915	---	N	≤ 12	---	460	---	560-730	---	19 L; 17 T	see standard
					12 < t ≤ 20	---	450	---				
					20 < t ≤ 40	---	440	---				
	EStE 460	1.8918	---	N	≤ 12	---	460	---	560-730	---	19 L; 17 T	see standard
					12 < t ≤ 20	---	450	---				
					20 < t ≤ 40	---	440	---				
DIN 17179:1986	TStE 460	1.8915	---	N	≤ 12	---	460	---	560-730	---	19 L; 17 T	see standard
					12 < t ≤ 20	---	450	---				
					20 < t ≤ 40	---	440	---				
					40 < t ≤ 50	---	425	---				
					50 < t ≤ 65	---	410	---				
	EStE 460	1.8918	---	N	≤ 12	---	460	---	560-730	---	19 L; 17 T	see standard
					12 < t ≤ 20	---	450	---				
					20 < t ≤ 40	---	440	---				
					40 < t ≤ 50	---	425	---				
					50 < t ≤ 65	---	410	---				
ASTM A 333/A 333M-99	8	---	K81340	QT or NNT	---	---	515	75	690	100	≥ 8mm (⁵ / ₁₆ in) 22 L	see standard
JIS G 3460:1988	STPL 690	---	---	N1N2T or QT	---	---	520	---	690	---	21	21 J at -196°C

5.4 Tubes and Pipes for Pressure Service

5.4.4B Chemical Composition of Carbon Steel Tubes and Pipes for Pressure Service at Low Temperatures

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
DIN 17178:1986	TStE 255	1.0463	---	0.16	0.50-1.30	0.40	0.030	0.025	0.30	0.30	0.08	N 0.020; Al 0.020; Cu 0.20; Nb 0.03; Nb+Ti+V 0.05
	EStE 255	1.1103	---	0.16	0.50-1.30	0.40	0.025	0.015	0.30	0.30	0.08	N 0.020; Al 0.020; Cu 0.20; Nb 0.03; Nb+Ti+V 0.05
DIN 17179:1986	TStE 255	1.0463	---	0.16	0.50-1.30	0.40	0.030	0.025	0.30	0.30	0.08	N 0.020; Al 0.020; Cu 0.20; Nb 0.03; Nb+Ti+V 0.05
	EStE 255	1.1103	---	0.16	0.50-1.30	0.40	0.025	0.015	0.30	0.30	0.08	N 0.020; Al 0.020; Cu 0.20; Nb 0.03; Nb+Ti+V 0.05
ASTM A 333/A 333M-99	1	---	K03008	0.30	0.40-1.06	---	0.025	0.025	---	---	---	---
JIS G 3460:1988	STPL 380	---	---	0.25	1.35	0.35	0.035	0.035	---	---	---	---
DIN 17178:1986	TStE 285	1.0488	---	0.16	0.60-1.40	0.40	0.030	0.025	0.30	0.30	0.08	N 0.020; Al 0.020; Cu 0.20; Nb 0.03; Nb+Ti+V 0.05
	EStE 285	1.1104	---	0.16	0.60-1.40	0.40	0.025	0.015	0.30	0.30	0.08	N 0.020; Al 0.020; Cu 0.20; Nb 0.03; Nb+Ti+V 0.05
DIN 17179:1986	TStE 285	1.0488	---	0.16	0.60-1.40	0.40	0.030	0.025	0.30	0.30	0.08	N 0.020; Al 0.020; Cu 0.20; Nb 0.03; Nb+Ti+V 0.05
	EStE 285	1.1104	---	0.16	0.60-1.40	0.40	0.025	0.015	0.30	0.30	0.08	N 0.020; Al 0.020; Cu 0.20; Nb 0.03; Nb+Ti+V 0.05
ASTM A 333/A 333M-99	6	---	K03006	0.30	0.29-1.06	0.10 min	0.025	0.025	---	---	---	---
	3	---	K31918	0.19	0.31-0.64	0.18-0.37	0.025	0.025	---	3.18-3.82	---	---
JIS G 3460:1988	STPL 450	---	---	0.18	0.30-0.60	0.10-0.35	0.030	0.030	---	3.20-3.80	---	---
DIN 17178:1986	TStE 355	1.0566	---	0.18	0.90-1.65	0.10-0.50	0.030	0.025	0.30	0.30	0.08	N 0.020; Al 0.020; Cu 0.20; Nb 0.05; V 0.10; Nb+Ti+V 0.12
	EStE 355	1.1106	---	0.18	0.90-1.65	0.10-0.50	0.025	0.015	0.30	0.30	0.08	N 0.020; Al 0.020; Cu 0.20; Nb 0.05; V 0.10; Nb+Ti+V 0.12
DIN 17179:1986	TStE 355	1.0566	---	0.18	0.90-1.65	0.10-0.50	0.030	0.025	0.30	0.30	0.08	N 0.020; Al 0.020; Cu 0.20; Nb 0.05; V 0.10; Nb+Ti+V 0.12
	EStE 355	1.1106	---	0.18	0.90-1.65	0.10-0.50	0.025	0.015	0.30	0.30	0.08	N 0.020; Al 0.020; Cu 0.20; Nb 0.05; V 0.10; Nb+Ti+V 0.12
DIN 17178:1986	TStE 420	1.8912	---	0.20	1.00-1.70	0.10-0.60	0.030	0.025	0.30	1.00	0.10	N 0.020; Al 0.020; Cu 0.20; Nb 0.05; V 0.20; Nb+Ti+V 0.22
	EStE 420	1.8913	---	0.20	1.00-1.70	0.10-0.60	0.025	0.015	0.30	1.00	0.10	N 0.020; Al 0.020; Cu 0.20; Nb 0.05; V 0.20; Nb+Ti+V 0.22
DIN 17179:1986	TStE 420	1.8912	---	0.20	1.00-1.70	0.10-0.60	0.030	0.025	0.30	1.00	0.10	N 0.020; Al 0.020; Cu 0.20; Nb 0.05; V 0.20; Nb+Ti+V 0.22
DIN 17179:1986	EStE 420	1.8913	---	0.20	1.00-1.70	0.10-0.60	0.025	0.015	0.30	1.00	0.10	N 0.020; Al 0.020; Cu 0.20; Nb 0.05; V 0.20; Nb+Ti+V 0.22
ASTM A 333/A 333M-99	10	---	---	0.20	1.15-1.50	0.10-0.35	0.035	0.015	0.15	0.25	0.05	Al 0.06; V 0.12; Cb 0.05; Cu 0.15

5.4 Tubes and Pipes for Pressure Service

5.4.4B Chemical Composition of Carbon Steel Tubes and Pipes for Pressure Service at Low Temperatures (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								Others
				C	Mn	Si	P	S	Cr	Ni	Mo	
DIN 17178:1986	TStE 460	1.8915	---	0.20	1.00-1.70	0.10-0.60	0.030	0.025	0.30	1.00	0.10	N 0.020; Al 0.020; Cu 0.20; Nb 0.05; V 0.20; Nb+Ti+V 0.22
	EStE 460	1.8918	---	0.20	1.00-1.70	0.10-0.60	0.025	0.015	0.30	1.00	0.10	N 0.020; Al 0.020; Cu 0.20; Nb 0.05; V 0.20; Nb+Ti+V 0.22
DIN 17179:1986	TStE 460	1.8915	---	0.20	1.00-1.70	0.10-0.60	0.030	0.025	0.30	1.00	0.10	N 0.020; Al 0.020; Cu 0.20; Nb 0.05; V 0.20; Nb+Ti+V 0.22
	EStE 460	1.8918	---	0.20	1.00-1.70	0.10-0.60	0.025	0.015	0.30	1.00	0.10	N 0.020; Al 0.020; Cu 0.20; Nb 0.05; V 0.20; Nb+Ti+V 0.22
ASTM A 333/A 333M-99	8	---	K81340	0.13	0.90	0.13-0.32	0.025	0.025	---	8.40-9.60	---	---
JIS G 3460:1988	STPL 690	---	---	0.13	0.90	0.10-0.35	0.030	0.030	---	8.50-9.50	---	---

5.5 Line Pipe Steels

5.5.1A Mechanical Properties of Line Pipe Steels Without Notch Toughness Requirements

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
API 5L-2000	A25 CI I, CI II - PSL 1	---	---	see standard	---	---	172	25	310	45	see standard	---
CSA Z245.1-98	172 - Category I	---	---	see standard	---	---	172	---	310	---	see standard	---
ISO 3183-1:1996	L175 CI I, CI II	---	---	see standard	---	---	175	---	315	---	27	---
API 5L-2000	A - PSL 1	---	---	see standard	---	---	207	30	331	48	see standard	---
CSA Z245.1-98	207 - Category I	---	---	see standard	---	---	207	---	331	---	see standard	---
EN 10208-1:1997	L210GA	1.0319	---	see standard	---	---	210	---	335-475	---	25	---
ISO 3183-1:1996	L210	---	---	see standard	---	---	210	---	335	---	25	---
API 5L-2000	B - PSL 1	---	---	see standard	---	---	241	35	414	60	see standard	---
CSA Z245.1-98	241 - Category I	---	---	see standard	---	---	241	---	414	---	see standard	---
EN 10208-1:1997	L245GA	1.0459	---	see standard	---	---	245	---	415-555	---	22	---
ISO 3183-1:1996	L245	---	---	see standard	---	---	245	---	415	---	21	---
API 5L-2000	X42 - PSL 1	---	---	see standard	---	---	290	42	414	60	see standard	---
CSA Z245.1-98	290 - Category I	---	---	see standard	---	---	290	---	414	---	see standard	---
EN 10208-1:1997	L290GA	1.0483	---	see standard	---	---	290	---	415-555	---	21	---
ISO 3183-1:1996	L290	---	---	see standard	---	---	290	---	415	---	21	---
API 5L-2000	X46 - PSL 1	---	---	see standard	---	---	317	46	434	63	see standard	---
CSA Z245.1-98	317 - Category I	---	---	see standard	---	---	317	---	434	---	see standard	---
ISO 3183-1:1996	L320	---	---	see standard	---	---	320	---	435	---	20	---
API 5L-2000	X52 - PSL 1	---	---	see standard	---	---	359	52	455	66	see standard	---
CSA Z245.1-98	359 - Category I	---	---	see standard	---	---	359	---	455	---	see standard	---
EN 10208-1:1997	L360GA	1.0499	---	see standard	---	---	360	---	460-620	---	20	---
ISO 3183-1:1996	L360	---	---	see standard	---	---	360	---	460	---	19	---
API 5L-2000	X56 - PSL 1	---	---	see standard	---	---	386	56	490	71	see standard	---
CSA Z245.1-98	386 - Category I	---	---	see standard	---	---	386	---	490	---	see standard	---
ISO 3183-1:1996	L390	---	---	see standard	---	---	390	---	490	---	18	---

5.5 Line Pipe Steels

5.5.1A Mechanical Properties of Line Pipe Steels Without Notch Toughness Requirements (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
API 5L-2000	X60 - PSL 1	---	---	see standard	---	---	414	60	517	75	see standard	---
CSA Z245.1-98	414 - Category I	---	---	see standard	---	---	414	---	517	---	see standard	---
ISO 3183-1:1996	L415	---	---	see standard	---	---	415	---	520	---	17	---
API 5L-2000	X65 - PSL 1	---	---	see standard	---	---	448	65	531	77	see standard	---
CSA Z245.1-98	448 - Category I	---	---	see standard	---	---	448	---	531	---	see standard	---
ISO 3183-1:1996	L450	---	---	see standard	---	---	450	---	535	---	17	---
API 5L-2000	X70 - PSL 1	---	---	see standard	---	---	483	70	565	82	see standard	---
CSA Z245.1-98	483 - Category I	---	---	see standard	---	---	483	---	565	---	see standard	---
ISO 3183-1:1996	L485	---	---	see standard	---	---	485	---	570	---	16	---
CSA Z245.1-98	550 - Category I	---	---	see standard	---	---	550	---	620	---	see standard	---
ISO 3183-1:1996	L555	---	---	see standard	---	---	555	---	625-825	---	15	27 J at 0°C see standard

5.5 Line Pipe Steels

5.5.1B Chemical Composition of Line Pipe Steels Without Notch Toughness Requirements

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								Others
				C	Mn	Si	P	S	Cr	Ni	Mo	
API 5L-2000	A25, CI I, PSL 1 seamless	---	---	0.21	0.60	---	0.030	0.030	---	---	---	---
	A25, CI II, PSL 1 seamless	---	---	0.21	0.60	---	0.045-0.080	0.030	---	---	---	---
	A25, CI I, PSL 1 welded	---	---	0.21	0.60	---	0.030	0.030	---	---	---	---
	A25, CI II, PSL 1 welded	---	---	0.21	0.60	---	0.045-0.080	0.030	---	---	---	---
CSA Z245.1-98	172 - Cat I	---	---	0.26	2.00	0.50	0.030	0.035	---	---	---	Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard)
ISO 3183-1:1996	L175, CI I S/NE/CE*	---	---	0.21	0.30-0.60	---	0.030	0.030	---	---	---	see standard
	L175, CI II S/NE/CE*	---	---	0.21	0.30-0.60	---	0.045-0.080	0.030	---	---	---	see standard
	L175, CI I W/EW/CW*	---	---	0.21	0.30-0.60	---	0.030	0.030	---	---	---	see standard
	L175, CI II W/EW/CW*	---	---	0.21	0.30-0.60	---	0.045-0.080	0.030	---	---	---	see standard
API 5L-2000	A, PSL 1 seamless	---	---	0.22	0.90	---	0.030	0.030	---	---	---	---
	A, PSL 1 welded	---	---	0.22	0.90	---	0.030	0.030	---	---	---	---
CSA Z245.1-98	207 - Cat I	---	---	0.26	2.00	0.50	0.030	0.035	---	---	---	Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard)
EN 10208-1:1997	L210GA	1.0319	---	0.21	0.90	0.40	0.030	0.030	---	---	---	AL 0.015-0.060; Nb+V+Ti 0.15
ISO 3183-1:1996	L210 S/NE/CE*	---	---	0.22	0.90	---	0.030	0.030	---	---	---	see standard
	L210 W/NE/CE*	---	---	0.21	0.90	---	0.030	0.030	---	---	---	see standard
API 5L-2000	B, PSL 1 seamless	---	---	0.28	1.20	---	0.030	0.030	---	---	---	Cb+V+Ti 0.15
	B, PSL 1 welded	---	---	0.26	1.20	---	0.030	0.030	---	---	---	Cb+V+Ti 0.15
CSA Z245.1-98	241 - Cat I	---	---	0.26	2.00	0.50	0.030	0.035	---	---	---	Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard)
EN 10208-1:1997	L245GA	1.0459	---	0.20	1.15	0.40	0.030	0.030	---	---	---	AL 0.015-0.060; Nb+V+Ti 0.15
ISO 3183-1:1996	L245 S/NE/CE*	---	---	0.27	1.15	---	0.030	0.030	---	---	---	see standard
	L245 W/NE/CE*	---	---	0.26	1.15	---	0.030	0.030	---	---	---	see standard
API 5L-2000	X 42, PSL 1 seamless	---	---	0.28	1.30	---	0.030	0.030	---	---	---	Cb+V+Ti 0.15
	X 42, PSL 1 welded	---	---	0.26	1.30	---	0.030	0.030	---	---	---	Cb+V+Ti 0.15
CSA Z245.1-98	290 - Cat I	---	---	0.26	2.00	0.50	0.030	0.035	---	---	---	Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard)
EN 10208-1:1997	L290GA	1.0483	---	0.20	1.40	0.40	0.030	0.030	---	---	---	AL 0.015-0.060; Nb+V+Ti 0.15
ISO 3183-1:1996	L290 S/NE*	---	---	0.29	1.25	---	0.030	0.030	---	---	---	see standard
	L290 S/CE*	---	---	0.29	1.25	---	0.030	0.030	---	---	---	see standard
	L290 W/NE/CE*	---	---	0.28	1.25	---	0.030	0.030	---	---	---	see standard

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

5.5 Line Pipe Steels

5.5.1B Chemical Composition of Line Pipe Steels Without Notch Toughness Requirements (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
API 5L-2000	X46, PSL 1 seamless	---	---	0.28	1.40	---	0.030	0.030	---	---	---	Cb+V+Ti 0.15
	X46, PSL 1 welded	---	---	0.26	1.40	---	0.030	0.030	---	---	---	Cb+V+Ti 0.15
CSA Z245.1-98	317 - Cat I	---	---	0.26	2.00	0.50	0.030	0.035	---	---	---	Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard)
ISO 3183-1:1996	L320, S/NE*	---	---	0.31	1.35	---	0.030	0.030	---	---	---	see standard
	L320 S/CE*	---	---	0.29	1.25	---	0.030	0.030	---	---	---	see standard
	L320 W/NE*	---	---	0.30	1.25	---	0.030	0.030	---	---	---	see standard
	L320 W/CE*	---	---	0.28	1.25	---	0.030	0.030	---	---	---	see standard
API 5L-2000	X52, PSL 1 seamless	---	---	0.28	1.40	---	0.030	0.030	---	---	---	Cb+V+Ti 0.15
	X52, PSL 1 welded	---	---	0.26	1.40	---	0.030	0.030	---	---	---	Cb+V+Ti 0.15
CSA Z245.1-98	359 - Cat I	---	---	0.26	2.00	0.50	0.030	0.035	---	---	---	Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard)
EN 10208-1:1997	L360GA	1.0499	---	0.22	1.45	0.55	0.030	0.030	---	---	---	AL 0.015-0.060; Nb+V+Ti 0.15
ISO 3183-1:1996	L360 S/CE*	---	---	0.29	1.25	---	0.030	0.030	---	---	---	see standard
	L360 W/NE*	---	---	0.30	1.25	---	0.030	0.030	---	---	---	see standard
	L360 W/CE*	---	---	0.28	1.25	---	0.030	0.030	---	---	---	see standard
API 5L-2000	X56, PSL 1 seamless	---	---	0.28	1.40	---	0.030	0.030	---	---	---	Cb+V+Ti 0.15
	X56, PSL 1 welded	---	---	0.26	1.40	---	0.030	0.030	---	---	---	Cb+V+Ti 0.15
CSA Z245.1-98	386 - Cat I	---	---	0.26	2.00	0.50	0.030	0.035	---	---	---	Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard)
ISO 3183-1:1996	L390, S/NE/CE*	---	---	0.26	1.35	---	0.030	0.030	---	---	---	see standard
	L390, W/NE/CE*	---	---	0.26	1.35	---	0.030	0.030	---	---	---	see standard
API 5L-2000	X60, PSL 1 seamless	---	---	0.28	1.40	---	0.030	0.030	---	---	---	Cb+V+Ti 0.15
	X60, PSL 1 welded	---	---	0.26	1.40	---	0.030	0.030	---	---	---	Cb+V+Ti 0.15
CSA Z245.1-98	414 - Cat I	---	---	0.26	2.00	0.50	0.030	0.035	---	---	---	Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard)
ISO 3183-1:1996	L415 S/NE/CE*	---	---	0.26	1.35	---	0.030	0.030	---	---	---	see standard
	L415 W/NE/CE*	---	---	0.26	1.35	---	0.030	0.030	---	---	---	see standard
API 5L-2000	X65, PSL 1 seamless	---	---	0.28	1.40	---	0.030	0.030	---	---	---	Cb+V+Ti 0.15
	X65, PSL 1 welded	---	---	0.26	1.45	---	0.030	0.030	---	---	---	Cb+V+Ti 0.15
CSA Z245.1-98	448 - Cat I	---	---	0.26	2.00	0.50	0.030	0.035	---	---	---	Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard)
ISO 3183-1:1996	L450 S/NE/CE*	---	---	by agreement								
	L450 W/NE/CE*	---	---	0.26	1.40	---	0.030	0.030	---	---	---	see standard

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

5.5 Line Pipe Steels

5.5.1B Chemical Composition of Line Pipe Steels Without Notch Toughness Requirements (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
API 5L-2000	X70, PSL 1 seamless	---	---	0.28	1.40	---	0.030	0.030	---	---	---	Cb+V+Ti 0.15
	X70, PSL 1 welded	---	---	0.26	1.65	---	0.030	0.030	---	---	---	Cb+V+Ti 0.15
CSA Z245.1-98	483 - Cat I	---	---	0.26	2.00	0.50	0.030	0.035	---	---	---	Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard)
ISO 3183-1:1996	L485, S/NE/CE*	---	---	by agreement								
	L485 W/NE/CE*	---	---	0.23	1.60	---	0.030	0.030	---	---	---	see standard
CSA Z245.1-98	550 - Cat I	---	---	0.26	2.00	0.50	0.030	0.035	---	---	---	Nb 0.11; Ti 0.11; V 0.11; B 0.001 CE 0.40 (see standard)
ISO 3183-1:1996	L555 S/NE/CE*	---	---	by agreement								
	L555 W/NE/CE*	---	---	0.18	1.80	---	0.030	0.030	---	---	---	see standard

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

5.5 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

5.5.2A Mechanical Properties of Line Pipe Steels With Notch Toughness Requirements (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
API 5L-2000	X52 - PSL 2	---	---	see standard	---	---	359-531	52-77	455-758	66-110	see standard	L: 41 J at 0°C; T: 27J at 0°C see standard
CSA Z245.1-98	359 - Category II or III	---	---	see standard	---	---	359	---	455	---	see standard	OD < 457 mm: 27 J at temp OD ≥ 457 mm: 40 J at temp see standard
EN 10208-2:1996	L360NB	1.0582	---	see standard	---	---	360-510	---	460	---	20	see standard
	L360QB	1.8948										
	L360MB	1.0578										
ISO 3183-2:1996	L360NB	---	---	see standard	---	---	360-510	---	460	---	20	see standard
	L360QB											
	L360MB											
ASTM A 984/A 984M-00	55	---	---	see standard	---	NPS < 8	380	55	485	70	see standard	see standard
					---	NPS ≤ 8	380-520	55-80				
API 5L-2000	X56 - PSL 2	---	---	see standard	---	---	386-544	56-79	490-758	71-110	see standard	L: 41 J at 0°C; T: 27J at 0°C see standard
CSA Z245.1-98	386 - Category II or III	---	---	see standard	---	---	386	---	490	---	see standard	OD < 457 mm: 27 J at temp OD ≥ 457 mm: 40 J at temp see standard
API 5L-2000	X60 - PSL 2	---	---	see standard	---	---	414-565	60-82	517-758	75-110	see standard	L: 41 J at 0°C; T: 27J at 0°C see standard
CSA Z245.1-98	414 - Category II or III	---	---	see standard	---	---	414	---	517	---	see standard	OD < 457 mm: 27 J at temp OD ≥ 457 mm: 40 J at temp see standard
ASTM A 1005/A 1005M-00	60	---	---	---	---	---	415-550	60-80	515	75	see standard	see standard
EN 10208-2:1996	L415NB	1.8972	---	see standard	---	---	415-565	---	520	---	18	see standard
	L415QB	1.8947										
	L415MB	1.8973										
ISO 3183-2:1996	L415NB	---	---	see standard	---	---	415-565	---	520	---	18	see standard
	L415QB											
	L415MB											

5.5 Line Pipe Steels

5.5.2A Mechanical Properties of Line Pipe Steels With Notch Toughness Requirements (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
API 5L-2000	X65 - PSL 2	---	---	see standard	---	---	448-600	65-87	531-758	77-110	see standard	L: 41 J at 0°C; T: 27J at 0°C see standard
CSA Z245.1-98	448 - Category II or III	---	---	see standard	---	---	448	---	531	---	see standard	OD < 457 mm: 27 J at temp OD ≥ 457 mm: 40 J at temp see standard
ASTM A 984/A 984M-00	65	---	---	see standard	---	NPS < 8	450	65	520	75	see standard	see standard
					---	NPS ≤ 8	450-570	65-85				
EN 10208-2:1996	L450QB	1.8952	---	see standard	---	---	450-570	---	535	---	18	see standard
	L450MB	1.8975										
ISO 3183-2:1996	L450QB	---	---	see standard	---	---	450-570	---	535	---	18	see standard
	L450MB											
API 5L-2000	X70 - PSL 2	---	---	see standard	---	---	483-621	70-90	565-758	82-110	see standard	L: 41 J at 0°C; T: 27J at 0°C see standard
CSA Z245.1-98	483 - Category II or III	---	---	see standard	---	---	483	---	565	---	see standard	OD < 457 mm: 27 J at temp OD ≥ 457 mm: 40 J at temp see standard
ASTM A 1005/A 1005M-00	70	---	---	---	---	---	485-600	70-87	550	80	see standard	see standard
EN 10208-2:1996	L485QB	1.8955	---	see standard	---	---	485-605	---	570	---	18	see standard
	L485MB	1.8977										
ISO 3183-2:1996	L485QB	---	---	see standard	---	---	485-605	---	570	---	18	see standard
	L485MB											
ASTM A 984/A 984M-00	80	---	---	see standard	---	NPS < 8	550	80	625	90	see standard	see standard
					---	NPS ≤ 8	550-670	80-97				
CSA Z245.1-98	550 - Category II or III	---	---	see standard	---	---	550	---	620	---	see standard	OD < 457 mm: 27 J at temp OD ≥ 457 mm: 40 J at temp see standard
API 5L-2000	X80 - PSL 2	---	---	see standard	---	---	552-690	80-100	621-827	90-110	see standard	L: 101 J at 0°C; T: 68 J at 0°C see standard
EN 10208-2:1996	L555QB	1.8957	---	see standard	---	---	555-675	---	625	---	18	see standard
	L555MB	1.8978										
ISO 3183-2:1996	L555QB	---	---	see standard	---	---	555-675	---	625	---	18	see standard
	L555MB											
ASTM A 1005/A 1005M-00	80	---	---	---	---	---	550-670	80-97	620	90	see standard	see standard

5.5 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)

5.5 Line Pipe Steels

5.5.2B Chemical Composition of Line Pipe Steels With Notch Toughness Requirements (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								Others
				C	Mn	Si	P	S	Cr	Ni	Mo	
API 5L-2000	X52, 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)
	X52, 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	359 - 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	L360NB seamless and welded	1.0582	---	0.20	1.6	0.45	0.025	0.020	0.30	0.30	0.10	Al 0.015-0.060; N 0.0012; Cu 0.25; Nb+V+Ti 0.15 CEV 0.45 (see standard)
	L360QB seamless	1.8948	---	0.16	1.4	0.45	0.025	0.020	0.30	0.30	0.10	Al 0.015-0.060; N 0.0012; Cu 0.25 CEV 0.42 (see standard)
	L360MB welded	1.0578	---	0.16	1.6	0.45	0.025	0.020	0.30	0.30	0.10	Al 0.015-0.060; N 0.0012; Cu 0.25; CEV 0.41 (see standard)
ISO 3183-2:1996	L360NB seamless and welded	---	---	0.20	1.6	0.45	0.025	0.020	0.30	0.30	0.10	Al 0.015-0.060; N 0.0012; Cu 0.25; Nb+V+Ti 0.15 CEV 0.45 (see standard)
	L360QB seamless	---	---	0.16	1.4	0.45	0.025	0.020	0.30	0.30	0.10	Al 0.015-0.060; N 0.0012; Cu 0.25 CEV 0.42 (see standard)
	L360MB welded	---	---	0.16	1.6	0.45	0.025	0.020	0.30	0.30	0.10	Al 0.015-0.060; N 0.0012; Cu 0.25; CEV 0.41 (see standard)
ASTM A 984/A 984M-00	55	---	---	0.22	---	---	0.025	0.015	---	---	---	B 0.0007; CE 0.40 (see standard)
API 5L-2000	X56, 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)
	X56, 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	386 - 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)

5.5 Line Pipe Steels

5.5.2B Chemical Composition of Line Pipe Steels With Notch Toughness Requirements (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								Others
				C	Mn	Si	P	S	Cr	Ni	Mo	
API 5L-2000	X60, 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)
	X60, 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	414 - 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 1005/A 1005M-00	60	---	---	0.16	---	---	---	---	---	---	---	B 0.0007; CE 0.40 (see standard)
EN 10208-2:1996	L415NB seamless and welded	1.8972	---	0.21	1.6	0.45	0.025	0.020	0.30	0.30	0.35	Al 0.015-0.060; N 0.0012; Cu 0.25; Nb+V+Ti 0.15 CEV by agreement (see standard)
	L415QB seamless	1.8947	---	0.16	1.6	0.45	0.025	0.020	0.30	0.30	0.35	Al 0.015-0.060; N 0.0012; Cu 0.25; Nb+V+Ti 0.15 CEV 0.43 (see standard)
	L415MB welded	1.8973	---	0.16	1.6	0.45	0.025	0.020	0.30	0.30	0.10	Al 0.015-0.060; N 0.0012; Cu 0.25; Nb+V+Ti 0.15 CEV 0.42 (see standard)
ISO 3183-2:1996	L415NB seamless and welded	---	---	0.21	1.6	0.45	0.025	0.020	0.30	0.30	0.35	Al 0.015-0.060; N 0.0012; Cu 0.25; Nb+V+Ti 0.15 CEV by agreement (see standard)
	L415QB seamless	---	---	0.16	1.6	0.45	0.025	0.020	0.30	0.30	0.35	Al 0.015-0.060; N 0.0012; Cu 0.25; Nb+V+Ti 0.15 CEV 0.43 (see standard)
	L415MB welded	---	---	0.16	1.6	0.45	0.025	0.020	0.30	0.30	0.10	Al 0.015-0.060; N 0.0012; Cu 0.25; Nb+V+Ti 0.15 CEV 0.42 (see standard)
API 5L-2000	X65, 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)
	X65, PSL 2 welded	---	---	0.22	1.45	---	0.025	0.015	---	---	---	Cb+V+Ti 0.15 CE(Pcm) 0.25 or CE(IIW) 0.43 (see standard)
CSA Z245.1-98	448 - 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	65	---	---	0.22	---	---	0.025	0.015	---	---	---	B 0.0007; CE 0.40 (see standard)
EN 10208-2:1996	L450QB seamless	1.8952	---	0.16	1.6	0.45	0.025	0.020	0.30	0.30	0.35	Al 0.015-0.060; N 0.0012; Cu 0.25; Nb+V+Ti 0.15 CEV 0.45 (see standard)
	L450MB welded	1.8975	---	0.16	1.6	0.45	0.025	0.020	0.30	0.30	0.10	Al 0.015-0.060; N 0.0012; Cu 0.25; Nb+V+Ti 0.15 CEV 0.43 (see standard)
ISO 3183-2:1996	L450QB seamless	---	---	0.16	1.6	0.45	0.025	0.020	0.30	0.30	0.35	Al 0.015-0.060; N 0.0012; Cu 0.25; Nb+V+Ti 0.15 CEV 0.45 (see standard)
	L450MB welded	---	---	0.16	1.6	0.45	0.025	0.020	0.30	0.30	0.10	Al 0.015-0.060; N 0.0012; Cu 0.25; Nb+V+Ti 0.15 CEV 0.43 (see standard)

5.5 Line Pipe Steels

5.5.2B Chemical Composition of Line Pipe Steels With Notch Toughness Requirements (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								Others
				C	Mn	Si	P	S	Cr	Ni	Mo	
API 5L-2000	X70, 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)
	X70, PSL 2 welded	---	---	0.22	1.65	---	0.025	0.015	---	---	---	Cb+V+Ti 0.15 CE(Pcm) 0.25 or CE(IIW) 0.43 (see standard)
CSA Z245.1-98	483 - 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 1005/A 1005M-00	70	---	---	0.16	---	---	---	---	---	---	---	B 0.0007; CE 0.40 (see standard)
EN 10208-2:1996	L485QB seamless	1.8955	---	0.16	1.7	0.45	0.025	0.020	0.30	0.30	0.35	Al 0.015-0.060; N 0.0012; Cu 0.25; Nb+V+Ti 0.15 CEV 0.45 (see standard)
	L485MB welded	1.8977	---	0.16	1.7	0.45	0.025	0.020	0.30	0.30	0.10	Al 0.015-0.060; N 0.0012; Cu 0.25; Nb+V+Ti 0.15 CEV 0.43 (see standard)
ISO 3183-2:1996	L485QB seamless	---	---	0.16	1.7	0.45	0.025	0.020	0.30	0.30	0.35	Al 0.015-0.060; N 0.0012; Cu 0.25; Nb+V+Ti 0.15 CEV 0.45 (see standard)
	L485MB welded	---	---	0.16	1.7	0.45	0.025	0.020	0.30	0.30	0.10	Al 0.015-0.060; N 0.0012; Cu 0.25; Nb+V+Ti 0.15 CEV 0.43 (see standard)
ASTM A 984/A 984M-00	80	---	---	0.22	---	---	0.025	0.015	---	---	---	B 0.0007; CE 0.40 (see standard)
CSA Z245.1-98	550 - 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)
API 5L-2000	X80, 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)
	X80, PSL 2 welded	---	---	0.22	1.85	---	0.025	0.015	---	---	---	Cb+V+Ti 0.15 CE(Pcm) 0.25 or CE(IIW) 0.43 (see standard)
EN 10208-2:1996	L555QB seamless	1.8957	---	0.16	1.8	0.45	0.025	0.020	0.50	0.60	0.35	Nb+V+Ti 0.15; CEV by agreement (see standard)
	L555MB welded	1.8978	---	0.16	1.8	0.45	0.025	0.020	0.30	0.30	0.10	Al 0.015-0.060; N 0.0012; Cu 0.25; Nb+V+Ti 0.15 CEV by agreement (see standard)
ISO 3183-2:1996	L555QB seamless	---	---	0.16	1.8	0.45	0.025	0.020	0.50	0.60	0.35	Nb+V+Ti 0.15; CEV by agreement (see standard)
	L555MB welded	---	---	0.16	1.8	0.45	0.025	0.020	0.30	0.30	0.10	Al 0.015-0.060; N 0.0012; Cu 0.25; Nb+V+Ti 0.15 CEV by agreement (see standard)
ASTM A 1005/A 1005M-00	80	---	---	0.16	---	---	---	---	---	---	---	B 0.0007; CE 0.40 (see standard)

5.6 Non-Comparable Tubes for General and Structural Applications

ASTM A 513-00 - Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing												
Grade, Class, Type	5130	8620	8630	---	---	---	---	---	---	---	---	---
UNS Number	G51300	G86200	G86300	---	---	---	---	---	---	---	---	---
ASTM A 519-96 - Seamless Carbon and Alloy Steel Mechanical Tubing												
Grade, Class, Type	1330	1335	1340	1345	3140	E3310	4012	4023	4024	4027	4037	4042
UNS Number	G13300	G13350	G13400	G13450	G31400	G33106	G40120	G40230	G40240	G40270	G40370	G40420
Grade, Class, Type	4047	4063	4142	4147	4150	4320	4337	E4337	4340	E4340	4422	4427
UNS Number	G40470	G40630	G41420	G41470	G41500	G43200	G43370	G43376	G43400	G43406	G44220	G44270
Grade, Class, Type	4520	4615	4617	4620	4621	4718	4720	4815	4817	4820	5015	5046
UNS Number	G45200	G46150	G46170	G46200	G46210	G47180	G47200	G48150	G48170	G48200	G50150	G50460
Grade, Class, Type	5115	5120	5130	5132	5135	5140	5145	5147	5150	5155	5160	E50100
UNS Number	G51150	G51200	G51300	G51320	G51350	G51400	G51450	G51470	G51500	G51550	G51600	G
Grade, Class, Type	E51100	E52100	6118	6120	6150	E7140	8115	8615	8617	8620	8622	8625
UNS Number	G51986	G52986	G61180	G61200	G61500	K24065	G81150	G86150	G86170	G86200	G86220	G86250
Grade, Class, Type	8627	8630	8637	8640	8642	8645	8650	8655	8660	8720	8735	8740
UNS Number	G86270	G86300	G86370	G86400	G86420	G86450	G86500	G86550	G86600	G87200	G87350	G87400
Grade, Class, Type	8742	8822	9255	9260	9262	E9310	9840	9850	50B40	50B44	50B46	50B50
UNS Number	G87420	G88220	G92550	G92600	G92620	G	G98400	G98500	G50401	G50441	G50461	G50501
Grade, Class, Type	50B60	50B61	81B45	86B45	94B15	94B17	94B30	94B40	---	---	---	---
UNS Number	G50601	G50611	G81451	G86451	G94151	G94171	G94301	G94401	---	---	---	---
ASTM A 268/A 268M-00 - Seamless and Welded Ferritic and Martensitic Stainless Steel Tubing for General Service												
Grade, Class, Type	TP429	TP443	TP446-1	TP446-2	TP403Ti	TPXM-27	TPXM-33	12Cr-2Mo	29-4	29-4-2	26-3-3	25-4-4
UNS Number	S42900	S44300	S44600	S44600	S43036	S44627	S44626	S44400	S44700	S44800	S44660	S44635
Grade, Class, Type	---	---	---	---	---	---	---	---	---	---	---	---
UNS Number	S40800	S41500	S44735	S32803	---	---	---	---	---	---	---	---
ASTM A 269-01 - Seamless and Welded Austenitic Stainless Steel Tubing for General Service												
Grade, Class, Type	TP317	TP348	TPXM-10	TPXM-11	TPXM-15	TPXM-19	TPXM29	---	---	---	---	---
UNS Number	S31700	S34800	S21900	S21904	S38100	S20910	S24000	S31254	S31726	S30600	S24565	S32654
Grade, Class, Type	---	---	---	---	---	---	---	---	---	---	---	---
UNS Number	N08367	N08926	N08904	---	---	---	---	---	---	---	---	---

5.6 Non-Comparable Tubes for Tubes for General and Structural Applications (Continued)

ASTM A 511-96 - Seamless Stainless Steel Mechanical Tubing												
Grade, Class, Type	MT 302	MT 303Se	MT 305	MT 309S	MT 310S	MT 317	MT 403	MT 414	MT 414Se	MT 431	MT 440A	MT 429
UNS Number	S30200	---	S30500	S30908	S31008	S31700	S40300	S41400	S41623	S43100	S44002	S42900
Grade, Class, Type	MT 443	MT 446-1	MT 446-2	29-4	29-4-2	---	---	---	---	---	---	---
UNS Number	S44300	S44600	S44600	S44700	S44800	---	---	---	---	---	---	---
ASTM A 554-98 - Welded Stainless Steel Mechanical Tubing												
Grade, Class, Type	MT-301	MT-302	MT-305	MT-309S	MT-309S-Cb	MT-310S	MT-317	MT-330	MT-429	MT-430-Ti	---	---
UNS Number	S30100	S30200	---	S30908	S30940	S31008	S31700	---	S42900	S43036	---	---
ASTM A 632-98 - Seamless and Welded Austenitic Stainless Steel Tubing (Small-Diameter) for General Service												
Grade, Class, Type	TP 310	TP 317	TP 348	---	---	---	---	---	---	---	---	---
UNS Number	S31000	S31700	S34800	---	---	---	---	---	---	---	---	---
ASTM A 778-00 - Welded, Unannealed Austenitic Stainless Steel Tubular Products												
Grade, Class, Type	P 317I	---	---	---	---	---	---	---	---	---	---	---
UNS Number	S31703	---	---	---	---	---	---	---	---	---	---	---
JIS G 3441:1988 - Alloy Steel Tubes for Machine Purposes												
Grade Designation	S Cr 420 TK	S CM 415 TK	---	---	---	---	---	---	---	---	---	---
DIN 17204:1990 - Seamless Circular Tubes Made from Steels for Quenching and Tempering; Technical Delivery Conditions												
Steel Name	28 Mn 6	36 Mn 4	36 Mn 5	41 Cr 4	36 CrNiMo 4	34 CrNiMo 6	30 CrNiMo 8	30 CrMoV 9	---	---	---	---
Steel Number	1.1170	1.0561	1.1167	1.7035	1.6511	1.6582	1.6580	1.7707	---	---	---	---
AFNOR NF A 49-647:1979 - Structural Welded Tubes, Circular, Square, Rectangular or Oval, in Ferritic or Austenitic Stainless Steels - Dimensions - Technical Delivery Conditions												
Designation	TS Z 12 CN 17-07	---	---	---	---	---	---	---	---	---	---	---

5.7 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	SUSXM15J1T B	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, Austenitic 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	---	---	---	---	---	---	---	---	---	---	---

5.8 Non-Comparable Tubes for Low Temperature Service

ASTM A 334/A 334M-99 - Seamless and Welded Carbon and Alloy-Steel Tubes for Low-Temperature Service												
Grade, Class, Type	9	11	---	---	---	---	---	---	---	---	---	---
UNS Number	K22035	--	---	---	---	---	---	---	---	---	---	---

5.9 Non-Comparable Tubes and Pipes for Pressure Service

ASTM A 312/A 312M-00 - Seamless and Welded Austenitic Stainless Steel Pipes												
Grade	TP304N	TP304LN	TP309Cb	TP309H	TP309HCB	TP310Cb	TP310H	TP310HCB	TP316N	TP316LN	TP347LN	TP348
UNS Number	S30451	S30453	S30940	S30909	S30941	S31040	S31009	S31041	S31651	S31653	S31751	S34800
Grade	TP348H	TPXM-10	TPXM-11	TPXM-15	TPXM-19	TPXM-29	---	---	---	---	---	---
UNS Number	S34809	S21900	S21904	S38100	S20910	S24000	S31254	S30615	S30815	S31050	S30600	S31725
Grade	---	---	---	---	---	---	---	---	---	---	---	---
UNS Number	S31726	S32615	S33228	S34565	S30415	S32654	S35315	N08367	N08904	---	---	---
ASTM A 333/A 333M-99 -Seamless and Welded Steel Pipe for Low-Temperature Service												
Grade	4	7	9	11		---	---	---	---	---	---	---
UNS Number	K11267	K21903	K22035	---		---	---	---	---	---	---	---
ASTM A 335/A 335M-99 - Seamless Ferritic Alloy-steel Pipe for High-Temperature Service												
Grade	P5b	P5c	P15	P21	P91	---	---	---	---	---	---	---
UNS Number	K51545	K41245	K11578	K31545	K91560	---	---	---	---	---	---	---
ASTM A 358/A 358M-98 - Electric-Fusion-Welded Austenitic Chromium-Nickel Alloy Steel Pipe for High-Temperature Service												
Grade	304N	304LN	309Cb	310Cb	316N	316LN	348	XM-19	XM-29	---	---	---
UNS Number	S30451	S30453	S30940	S31040	S31651	S31653	S34800	S20910	S28300	S31254	S30815	S30600
Grade	---	---	---	---	---	---	---	---	---	---	---	---
UNS Number	S31725	S31726	S24565	S30415	S32654	S31266	S32050	N08367	N08926	N08800	N08810	N08020
ASTM A 409/A 409M-95 - Welded Large Diameter Austenitic Steel Pipe for Corrosive or High-Temperature Service												
Grade	TP309Cb	TP309S	TP310Cb	TP310S	TP348	---	---	---	---	---	---	---
UNS Number	S30940	S30908	S31040	S31008	S34800	S31254	S30815	S31726	S24565	N08367	---	---
JIS G 3459: 1997 - Stainless Steel Pipes												
Symbol of Grade	SUS310TP	SUS836LTP	SUS321J1TP	SUS321J3LTP	SUS321J4LTP	SUS405TO	SUS409LTP	SUS430TP	SUS430LXTP	SUS430J1LTP	SUS436LTP	SUS444TP
JIS G 3468: 1994 - Large Diameter Welded Stainless Steel Pipes												
Symbol of Grade	SUS329J1	---	---	---	---	---	---	---	---	---	---	---
BSI BS 3604-1:1990 Issue 2, 1997 - Steel Pipes and Tubes for Pressure Purposes: Ferritic Alloy Steel with Specified Elevated Temperature Properties - Part 1. Specification for Seamless and Electric Resistance Welded Tubes												
Type Number	629-590	591	91	---	---	---	---	---	---	---	---	---

5.9 Non-Comparable Tubes and Pipes for Pressure Service (Continued)

BSI BS 3605-1:1991 AMD 2:1997 - Austenitic Stainless Steel Pipes and Tubes for Pressure Purposes. Part 1. Specification for Seamless Tubes												
Steel Type	215S15	---	---	---	---	---	---	---	---	---	---	---
DIN 17178:1986 - Welded Circular Fine Grain Steel Tubes Subject to Special Requirements; Technical Delivery Conditions												
Symbol	StE 460	WStE 460	---	---	---	---	---	---	---	---	---	---
Material Number	1.8905	1.8935	---	---	---	---	---	---	---	---	---	---
DIN 17179:1986 - Seamless Circular Fine Grain Steel Tubes Subject to Special Requirements; Technical Delivery Conditions												
Symbol	StE 460	WStE 460	---	---	---	---	---	---	---	---	---	---
Material Number	1.8905	1.8935	---	---	---	---	---	---	---	---	---	---
DIN 17458:1985 - Seamless Circular Austenitic Stainless Steel Tubes Subject to Special Requirements - Technical Delivery Conditions												
Symbol	X 6 CrNiMoNb 17 12 2	---	---	---	---	---	---	---	---	---	---	---
Material Number	1.4580	---	---	---	---	---	---	---	---	---	---	---
DIN 17459:1992 - Seamless Circular High-Temperature Austenitic Steel Tubes - Technical Delivery Conditions												
Symbol	X 3 CrNiN 18 11	X 8 CrNiTi 18 10	X 8 CrNiMoNb 16 16	X 8 CrNiMoVNb 16 13	---	---	---	---	---	---	---	---
Material Number	1.4949	1.4941	1.4981	1.4988	---	---	---	---	---	---	---	---
AFNOR NF A 49-213:1990 - Seamless Unalloyed and Mo and Cr-Mo Alloyed Steel Tubes for Use at High Temperatures - Dimensions (With Normal Tolerances) - Technical Delivery Conditions												
Designation	TU Z 10 CDVNb 09-01	TU Z 10 CDNbV 09-02	---	---	---	---	---	---	---	---	---	---
AFNOR NF A 49-214:1978 - Seamless Austenitic Steel Tubes for Use at High Temperatures. Dimensions (With Normal Tolerances) - Technical Conditions of Delivery												
Designation	Z 10 CNWT 17-13 B	---	---	---	---	---	---	---	---	---	---	---
AFNOR NF A 49-219:1990 - Non-Alloy and Mo and Cr-Mo Alloy Steel Seamless Tubes for Furnaces - Dimensions - Technical Delivery Conditions												
Designation	TU Z 10 CDVNb 09-01	---	---	---	---	---	---	---	---	---	---	---
AFNOR NF A 49-242:1985 - Longitudinally Pressure Welded Tubes D Inferior or Equal to 168,3 mm in Non Alloyed and Low Alloyed Steels Used at Medium Elevated Temperatures - Dimensions - Technical Delivery Conditions												
Designation	TS E 24 W 3	TS E 36 WB3	---	---	---	---	---	---	---	---	---	---

5.10 Non-Comparable Line Pipe Steels

ASTM A 1005/A 1005M-00 - Steel Line Pipe, Black, Plain End, Longitudinal and Helical Seam, Double Submerged-Arc Welded												
Grade	50	---	---	---	---	---	---	---	---	---	---	---
UNS Number	---	---	---	---	---	---	---	---	---	---	---	---
CSA Z245.1-98 - Steel Line Pipe												
Grade	172 Category II or III	207 Category II or III	---	---	---	---	---	---	---	---	---	---
EN 10208-1:1998 - Steel Pipes for Pipelines for Combustible Fluids. Technical Delivery Conditions. Part 1 : Pipes of Requirement Class A												
Steel Name	L235GA	---	---	---	---	---	---	---	---	---	---	---
Steel Number	1.0458	---	---	---	---	---	---	---	---	---	---	---

CHAPTER

6

STEEL FORGINGS

ASTM Standards

ASTM A 105/A 105M-98	Carbon Steel Forgings for Piping Applications
ASTM A 181/A 181M-00	Carbon Steel Forgings, for General-Purpose Piping
ASTM A 182/A 182M-00	Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
ASTM A 266/A 266M-99	Carbon Steel Forgings for Pressure Vessel Components
ASTM A 336/A 336M-99	Alloy Steel Forgings for Pressure and High-Temperature Parts
ASTM A 350/A 350M-00	Carbon and Low-Alloy Steel Forgings, Requiring Notch Toughness Testing for Piping Components
ASTM A 508/A 508M-95 (1999)	Quenched and Tempered Vacuum-Treated Carbon and Alloy Steel Forgings for Pressure Vessels
ASTM A 541/A 541M-95 (1999)	Quenched and Tempered Carbon and Alloy Steel Forgings for Pressure Vessel Components
ASTM A 668/A 668M-96	Steel Forgings, Carbon and Alloy, for General Industrial Use

JIS Standards

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

CEN Standards

EN 10222-2:2000	Steel Forgings for Pressure Purposes - Part 2: Ferritic and Martensitic Steels with Specified Elevated Temperature Properties
EN 10222-3:1999	Steel Forgings for Pressure Purposes - Part 3: Nickel Steels with Specified Low-Temperature Properties
EN 10222-4:1999	Steel Forgings for Pressure Purposes - Part 4: Weldable Fine-Grain Steels with High Proof Strength
EN 10222-5:1999	Steel Forgings for Pressure Purposes - Part 5: Martensitic, Austenitic and Austenitic-Ferritic Stainless Steels
EN 10250-2:2000	Open Die Steel Forgings for General Engineering Purposes - Part 2: Non-Alloy Quality and Special Steels
EN 10250-3:1999	Open Die Steel Forgings for General Engineering Purposes - Part 3: Alloy Special Steels
EN 10250-4:1999	Open Die Steel Forgings for General Engineering Purposes - Part 4: Stainless Steels

ISO Standards

ISO 9327-2:1999	Steel Forgings and Rolled or Forged Bars for Pressure Purposes. Technical Delivery Conditions. Part 2: Non-Alloy and Alloy (Mo, Cr and CrMo) Steels with Specified Elevated Temperature Properties
ISO 9327-3:1999	Steel Forgings and Rolled or Forged Bars for Pressure Purposes. Technical Delivery Conditions. Part 3 : Nickel Steels with Specified Low Temperature Properties
ISO 9327-4:1999	Steel Forgings and Rolled or Forged Bars for Pressure Purposes. Technical Delivery Conditions. Part 4 : Weldable Fine Grain Steels with High Proof Strength
ISO 9327-5:1999	Steel Forgings and Rolled or Forged Bars for Pressure Purposes. Technical Delivery Conditions. Part 5 : Stainless Steels

Heat Treatment Terms Applicable to this Chapter

Standard	Heat Treatment Terms
ASTM A 105/A 105M-98	---
ASTM A 181/A 181M-00	---
ASTM A 182/A 182M-00	A: annealed; NT: normalized and tempered; QT: quenched and tempered; ST+Q: solution treated and quenched
ASTM A 266/A 266M-99	A: annealed; N: normalized; NT: normalized and tempered; QT: quenched and tempered
ASTM A 336/A 336M-99	A: annealed; NT: normalized and tempered
ASTM A 350/A 350M-00	N: normalized; NT: normalized and tempered; QT: quenched and tempered
ASTM A 508/A 508M-95 (1999)	QT: quenched and tempered
ASTM A 541/A 541M-95 (1999)	QT: quenched and tempered
ASTM A 668/A 668M-96	A: annealed; N: normalized; NT: normalized and tempered; NNT: double-normalized and tempered; QT: quenched and tempered; NQT: normalized, quenched and tempered
JIS G 3201:1988	A: annealed; N: normalized; NT: normalized and tempered; QT: quenched and tempered
JIS G 3202:1988	A: annealed; N: normalized; NT: normalized and tempered; QT: quenched and tempered
JIS G 3203:1988	A: annealed; NT: normalized and tempered
JIS G 3204:1988	QT: quenched and tempered
JIS G 3205:1988	A: annealed; NT: normalized and tempered; QT: quenched and tempered
JIS G 3206:1993	NT: normalized and tempered; QT: quenched and tempered
JIS G 3214:1991	QT: quenched and tempered; S: solution treated; HXXXX: precipitation hardened at specified temperature
JIS G 3221:1988	HT: hardening and tempering
EN 10222-2:2000	A: annealed; N: normalized; NT: normalized and tempered; QT: quenched and tempered
EN 10222-3:1999	N: normalized; NT: normalized and tempered; QT: quenched and tempered
EN 10222-4:1999	N: normalized; QT: quenched and tempered
EN 10222-5:1999	QT: quenched and tempered; QT+T: quenched and double tempered; AT: solution treated
EN 10250-2:2000	N: normalized; NT: normalized and tempered; QT: quenched and tempered
EN 10250-3:1999	QT: quenched and tempered
EN 10250-4:1999	A: annealed; QTXXX: quenched, tempered at specified temperature; PXXX: precipitation hardened at specified temperature; SA: solution annealed
ISO 9327-2:1999	A: annealed; N: normalized; NT: normalized and tempered; QT: quenched and tempered
ISO 9327-3:1999	N: normalized; NT: normalized and tempered; NNT: double-normalized and tempered; N(+T): normalized and (if appropriate) tempered; QT: quenched and tempered
ISO 9327-4:1999	N: normalized; QT: quenched and tempered
ISO 9327-5:1999	Q: quenched

6.1 Carbon Steel Forgings

6.1.1A Mechanical Properties of Carbon Steel Forgings for General Use

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 668/A 668M-96	A	---	---	---	≤ 500	≤ 20	---	---	325	47	---	183 HB max
JIS G 3201:1988 (1991)	SF 340 A	---	---	A, N, or NT	---	---	175	---	340-440	---	27	90 HB min
EN 10250-2:1999	S235JRG2	1.0038	---	N	≤ 100	---	215	---	340	---	24	35 J at -20°C
					100 < t ≤ 250	---	175	---	340	---	23	30 J at -20°C
					250 < t ≤ 500	---	165	---	340	---	23	27 J at -20°C
	S235J2G3	1.0116	---	N	≤ 100	---	215	---	340	---	24	35 J at -20°C
					100 < t ≤ 250	---	175	---	340	---	23	30 J at -20°C
					250 < t ≤ 500	---	165	---	340	---	23	27 J at -20°C
JIS G 3201:1988 (1991)	SF 390 A	---	---	A, N, or NT	---	---	195	---	390-490	---	25	105 HB min
EN 10250-2:1999	C22	1.0402	---	N or NT	≤ 100	---	210	---	410	---	25	---
ISO 9327-2:1999	PH 26	---	---	N or QT	≤ 16	---	265	---	410-530	---	26	40 J at 0°C
					16 < t ≤ 40	---	255	---			26	
					40 < t ≤ 60	---	245	---			25	
					60 < t ≤ 100	---	215	---			24	
					100 < t ≤ 150	---	200	---	390-520	---	24	
					150 < t ≤ 250	---	200	---			23	
ASTM A 668/A 668M-96	B	---	---	A, N, or NT	≤ 508	≤ 20	205	30	415	60	24	120-174 HB

6.1 Carbon Steel Forgings

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
JIS G 3201:1988 (1991)	SF 440 A	---	---	A, N, or NT	---	---	225	---	440-540	---	24	121 HB min
EN 10250-2:1999	C25	1.0406	---	N or NT	≤ 100	---	230	---	440	---	23	35 J at 23°C
					100 < t ≤ 250	---	210	---	420	---	23	30 J at 23°C
					250 < t ≤ 500	---	190	---	400	---	23	25 J at 23°C
					500 < t ≤ 1000	---	180	---	390	---	22	20 J at 23°C
	C25E	1.1158	---	N or NT	≤ 100	---	230	---	440	---	23	35 J at 23°C
					100 < t ≤ 250	---	210	---	420	---	23	30 J at 23°C
					250 < t ≤ 500	---	190	---	400	---	23	25 J at 23°C
					500 < t ≤ 1000	---	180	---	390	---	22	20 J at 23°C
				QT	≤ 70	---	270	---	450	---	25	45 J at 23°C
					70 < t ≤ 160	---	220	---	410	---	25	38 J at 23°C
					160 < t ≤ 330	---	210	---	390	---	24	33 J at 23°C
ASTM A 668/A 668M-96	C	---	---	A, N, or NT	≤ 203	≤ 12	230	33	455	66	23	137-183 HB
					305 < t ≤ 508	12 < t ≤ 20	230	33	455	66	22	137-183 HB
ISO 9327-2:1999	PH 29	---	---	N or QT	≤ 16	---	290	---	460-580	---	24	40 J at 0°C
					16 < t ≤ 40	---	285	---			24	
					40 < t ≤ 60	---	280	---			24	
					60 < t ≤ 100	---	255	---			23	
					100 < t ≤ 150	---	230	---	440-570	---	23	
					150 < t ≤ 250	---	220	---			22	
EN 10250-2:1999	C30	1.0528	---	N or NT	≤ 100	---	250	---	480	---	21	---
					100 < t ≤ 250	---	230	---	460	---	21	---
JIS G 3201:1988 (1991)	SF 490 A	---	---	A, N, or NT	---	---	245	---	490-590	---	22	134 HB min
ISO 9327-2:1999	PH 31	---	---	N or QT	≤ 16	---	315	---	490-610	---	23	40 J at 0°C
					16 < t ≤ 40	---	310	---			23	
					40 < t ≤ 60	---	305	---			23	
					60 < t ≤ 100	---	280	---			22	
					100 < t ≤ 150	---	255	---	460-590	---	22	
					150 < t ≤ 250	---	245	---			21	

6.1 Carbon Steel Forgings

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 668/A 668M-96	D	---	---	A, N, or NT	≤ 203	≤ 8	260	37.5	515	75	24	149-207 HB
					203 < t ≤ 305	8 < t ≤ 12					22	
					305 < t ≤ 508	12 < t ≤ 20					20	
					≥ 508	≥ 20					19	
EN 10250-2:1999	C35	1.0501	---	N or NT	≤ 100	---	270	---	520	---	19	30 J at 23°C
					100 < t ≤ 250	---	245	---	500	---	19	25 J at 23°C
					250 < t ≤ 500	---	220	---	480	---	19	20 J at 23°C
					500 < t ≤ 1000	---	210	---	470	---	18	17 J at 23°C
	C35E	1.1181	---	N or NT	≤ 100	---	270	---	520	---	19	30 J at 23°C
					100 < t ≤ 250	---	245	---	500	---	19	25 J at 23°C
					250 < t ≤ 500	---	220	---	480	---	19	20 J at 23°C
					500 < t ≤ 1000	---	210	---	470	---	18	17 J at 23°C
JIS G 3201:1988 (1991)	SF 540 A	---	---	A, N, or NT	---	---	275	---	540-640	---	20	152 HB min
	SF 540 B	---	---	QT	< 100	---	335	---	540-690	---	21	152 HB min
					100 ≤ t < 250	---	315	---			21	
					250 ≤ t < 400	---	295	---			20	
EN 10250-2:1999	C35E	1.1181	---	QT	≤ 70	---	320	---	550	---	20	35 J at 23°C
					70 < t ≤ 160	---	290	---	490	---	22	31 J at 23°C
					160 < t ≤ 330	---	270	---	470	---	21	25 J at 23°C
	C40	1.0511	---	N or NT	≤ 100	---	290	---	550	---	17	---
					100 < t ≤ 250	---	260	---	530	---	17	---
					---	---	---	---	---	---	---	---
EN 10250-2:1999	C45	1.0503	---	N or NT	≤ 100	---	305	---	580	---	16	---
					100 < t ≤ 250	---	275	---	560	---	16	25 J at 23°C
					250 < t ≤ 500	---	240	---	540	---	16	20 J at 23°C
					500 < t ≤ 1000	---	230	---	530	---	15	17 J at 23°C
	C45E	1.1191	---	N or NT	≤ 100	---	305	---	580	---	16	---
					100 < t ≤ 250	---	275	---	560	---	16	18 J at 23°C
					250 < t ≤ 500	---	240	---	540	---	16	15 J at 23°C
ASTM A 668/A 668M-96	E	---	---	NT or NNT	≤ 203	≤ 8	305	44	585	85	25	174-217 HB
					203 < t ≤ 305	8 < t ≤ 12	295	43	570	83	23	
					305 < t ≤ 508	12 < t ≤ 20	295	43	570	83	22	
					---	---	---	---	---	---	---	
JIS G 3201:1988 (1991)	SF 590 A	---	---	A, N, or NT	---	---	295	---	590-690	---	18	167 HB min
	SF 590 B	---	---	QT	< 100	---	360	---	590-740	---	19	167 HB min
					100 ≤ t < 250	---	335	---			19	
					250 ≤ t < 400	---	325	---			18	

6.1 Carbon Steel Forgings

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
EN 10250-2:1999	C50	1.0540	---	N or NT	≤ 100	---	320	---	610	---	14	---
					100 < t ≤ 250	---	290	---	590	---	14	---
ASTM A 668/A 668M-96	F	---	---	QT or NQT	≤ 102	≤ 4	380	55	620	90	20	187-235 HB
					102 < t ≤ 178	4 < t ≤ 7	345	50	585	85	20	174-217 HB
					178 < t ≤ 254	7 < t ≤ 10	345	50	585	85	19	174-217 HB
					254 < t ≤ 508	10 < t ≤ 20	330	48	565	82	19	174-217 HB
EN 10250-2:1999	C45E	1.1191	---	QT	≤ 70	---	370	---	630	---	17	25 J at 23°C
					70 < t ≤ 160	---	340	---	590	---	18	22 J at 23°C
					160 < t ≤ 330	---	320	---	540	---	17	20 J at 23°C
JIS G 3201:1988 (1991)	SF 640 B	---	---	QT	< 100	---	390	---	640-780	---	16	183 HB min
					100 ≤ t < 250	---	360	---			16	
					250 ≤ t < 400	---	345	---			15	
EN 10250-2:1999	C55	1.0535	---	N or NT	≤ 100	---	330	---	640	---	12	---
					100 < t ≤ 250	---	300	---	620	---	12	---
					250 < t ≤ 500	---	260	---	600	---	12	---
					500 < t ≤ 1000	---	250	---	590	---	11	---
	C55E	1.0535	---	N or NT	≤ 100	---	330	---	640	---	12	---
					100 < t ≤ 250	---	300	---	620	---	12	---
					250 < t ≤ 500	---	260	---	600	---	12	---
					500 < t ≤ 1000	---	250	---	590	---	11	---

6.1.1B Chemical Composition of Carbon Steel Forgings for General Use

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 668/A 668M-96	A	---	---	---	1.35	---	0.050	0.050	---	---	---	---
JIS G 3201:1988 (1991)	SF 340 A	---	---	0.60	0.30-1.20	0.15-0.50	0.030	0.030	---	---	---	---
EN 10250-2:1999	S235JRG2	1.0038	---	0.20	1.40	0.55	0.045	0.045	0.30	0.30	0.08	Al 0.020 min; Cr+Mo+Ni to 0.48
	S235J2G3	1.0116	---	0.17	1.40	0.55	0.035	0.035	0.30	0.30	0.08	Al 0.020 min; Cr+Mo+Ni to 0.48
JIS G 3201:1988 (1991)	SF 390 A	---	---	0.60	0.30-1.20	0.15-0.50	0.030	0.035	---	---	---	---
EN 10250-2:1999	C22	1.0402	---	0.17-0.24	0.40-0.70	0.40	0.045	0.045	0.40	0.40	0.10	Cr+Mo+Ni to 0.63
ISO 9327-2:1999	PH 26	---	---	0.20	0.50-1.40	0.35	0.035	0.030	0.30	0.30	0.08	Al 0.020; Cu 0.30; Cr+Cu+Mo+Ni to 0.70
ASTM A 668/A 668M-96	B	---	---	---	1.35	---	0.050	0.050	---	---	---	---
JIS G 3201:1988 (1991)	SF 440 A	---	---	0.60	0.30-1.20	0.15-0.50	0.030	0.035	---	---	---	---
EN 10250-2:1999	C25	1.0406	---	0.22-0.29	0.40-0.70	0.40	0.045	0.045	0.40	0.40	0.10	Cr+Mo+Ni to 0.63
	C25E	1.1158	---	0.22-0.29	0.40-0.70	0.40	0.035	0.035	0.40	0.40	0.10	Cr+Mo+Ni to 0.63
ASTM A 668/A 668M-96	C	---	---	---	1.35	---	0.050	0.050	---	---	---	---
ISO 9327-2:1999	PH 29	---	---	0.20	0.90-1.50	0.40	0.035	0.030	0.30	0.30	0.08	Al 0.020; Cu 0.30; Cr+Cu+Mo+Ni to 0.70
EN 10250-2:1999	C30	1.0528	---	0.27-0.34	0.50-0.80	0.40	0.045	0.045	0.40	0.40	0.10	Cr+Mo+Ni to 0.63
JIS G 3201:1988 (1991)	SF 490 A	---	---	0.60	0.30-1.20	0.15-0.50	0.030	0.035	---	---	---	---
ISO 9327-2:1999	PH 31	---	---	0.20	0.90-1.60	0.10-0.50	0.035	0.030	0.30	0.30	0.08	Al 0.020; Cu 0.30; Cr+Cu+Mo+Ni to 0.70
ASTM A 668/A 668M-96	D	---	---	---	1.35	---	0.050	0.050	---	---	---	---
EN 10250-2:1999	C35	1.0501	---	0.32-0.39	0.50-0.80	0.40	0.045	0.045	0.40	0.40	0.10	Cr+Mo+Ni to 0.63
	C35E	1.1181	---	0.32-0.39	0.50-0.80	0.40	0.035	0.035	0.40	0.40	0.10	Cr+Mo+Ni to 0.63
JIS G 3201:1988 (1991)	SF 540 A	---	---	0.60	0.30-1.20	0.15-0.50	0.030	0.035	---	---	---	---
	SF 540 B	---	---	0.60	0.30-1.20	0.15-0.50	0.030	0.035	---	---	---	---
EN 10250-2:1999	C35E	1.1181	---	0.32-0.39	0.50-0.80	0.40	0.035	0.035	0.40	0.40	0.10	Cr+Mo+Ni to 0.63
	C40	1.0511	---	0.37-0.44	0.50-0.80	0.40	0.045	0.045	0.40	0.40	0.10	Cr+Mo+Ni to 0.63
EN 10250-2:1999	C45	1.0503	---	0.42-0.50	0.50-0.80	0.40	0.045	0.045	0.40	0.40	0.10	Cr+Mo+Ni to 0.63
	C45E	1.1191	---	0.42-0.50	0.50-0.80	0.40	0.035	0.035	0.40	0.40	0.10	Cr+Mo+Ni to 0.63
ASTM A 668/A 668M-96	E	---	---	---	1.35	---	0.050	0.050	---	---	---	---
JIS G 3201:1988 (1991)	SF 590 A	---	---	0.60	0.30-1.20	0.15-0.50	0.030	0.035	---	---	---	---
	SF 590 B	---	---	0.60	0.15-0.50	0.30-1.20	0.030	0.035	---	---	---	---

6.1 Carbon Steel Forgings

6.1.1B Chemical Composition of Carbon Steel Forgings for General Use (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								Others
				C	Mn	Si	P	S	Cr	Ni	Mo	
EN 10250-2:1999	C50	1.0540	---	0.47-0.55	0.60-0.90	0.40	0.045	0.045	0.40	0.40	0.10	Cr+Mo+Ni to 0.63
ASTM A 668/A 668M-96	F	---	---	---	1.35	---	0.050	0.050	---	---	---	---
EN 10250-2:1999	C45E	1.1191	---	0.42-0.50	0.50-0.80	0.40	0.045	0.045	0.40	0.40	0.10	Cr+Mo+Ni to 0.63
JIS G 3201:1988 (1991)	SF 640 B	---	---	0.60	0.30-1.20	0.15-0.50	0.030	0.035	---	---	---	---
EN 10250-2:1999	C55	1.0535	---	0.52-0.60	0.60-0.90	0.40	0.045	0.045	0.40	0.40	0.10	Cr+Mo+Ni to 0.63
	C55E	1.0535	---	0.52-0.60	0.60-0.90	0.40	0.035	0.035	0.40	0.40	0.10	Cr+Mo+Ni to 0.63

6.1 Carbon Steel Forgings

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
EN 10222-4:1999	P285QH	1.0478	---	QT	70 < t ≤ 100	---	245	---	370-510	---	22	63 J at 22°C 55 J at 0°C 47 J at -20°C 34 J at -40°C
					100 < t ≤ 250	---	225	---				
					250 < t ≤ 400	---	205	---				
	P285NH	1.0477	---	N	≤ 16	---	285	---	390-510	---	24	55 J at 22°C 47 J at 0°C 40 J at -20°C 28 J at -40°C
					16 < t ≤ 35	---	285	---				
					35 < t ≤ 70	---	265	---				
ISO 9327-4:1999	P 28, PH 28	---	---	N	≤ 16	---	285	---	390-510	---	26	55 J at 22°C 47 J at 0°C 40 J at -20°C
					16 < t ≤ 35	---	285	---				
	PL 28	---	---	QT	35 < t ≤ 50	---	275	---	390-510	---	26	63 J at 22°C 55 J at 0°C
					50 < t ≤ 70	---	265	---				
					70 < t ≤ 100	---	245	---	370-510	---	25	47 J at -20°C
					100 < t ≤ 250	---	225	---			24	35 J at -40°C 27 J at -50°C
JIS G 3202:1988 (1991)	SFVC 1	---	---	A, N, NT, or QT	---	---	205	---	410-560	---	21	---
EN 10222-2:1999	P245GH	1.0352	---	A, N, NT, or QT	≤ 35	---	245	---	410-530	---	25	---
					35 < t ≤ 160	---	220	---	410-530	---	25	---
ASTM A 181/A 181M-00	60	---	K03502	---	---	---	205	30	415	60	22	---
ASTM A 266/A 266M-99	1	---	---	A, N, NT, or QT	---	---	205	30	415-585	60-85	23	---
ASTM A 350/A 350M-00	LF1, CI 1	---	K03009	N, NT, or QT	---	---	205	30	415-585	60-85	25	20 J at -28.9°C
JIS G 3205:1988	SFL 1	---	---	A, NT, or QT	---	---	225	---	440-590	---	22	21 J at -30°C

6.1 Carbon Steel Forgings

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
EN 10222-2:1999	P280GH	1.0426	---	N, NT, or QT	≤ 35	---	280	---	460-580	---	23	---
					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, CI 1	---	K03011	N, NT, or QT	---	---	250	36	485-655	70-95	22	20 J at -45.6°C
	LF2, CI 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

6.1.2A 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		
ISO 9327-4:1999	P 35, PH 35	---	---	N	≤ 16	---	355	---	490-610	---	22	55 J at 22°C
					16 < t ≤ 35	---	355	---	490-610	---	22	47 J at 0°C
				QT	35 < t ≤ 50	---	345	---	490-610	---	22	40 J at -20°C
	PL 35, PLH 35	---	---	QT	50 < t ≤ 70	---	325	---	490-610	---	22	63 J at 22°C
					70 < t ≤ 100	---	315	---	470-610	---	21	55 J at 0°C
					100 < t ≤ 250	---	295	---	470-610	---	20	47 J at -20°C
EN 10222-4:1999	P420QH	1.8936	---	QT	70 < t ≤ 100	---	365	---	510-670	---	18	63 J at 22°C
					100 < t ≤ 250	---	345	---				55 J at 0°C
					250 < t ≤ 400	---	325	---				47 J at -20°C
	P420NH	1.8932	---	N	≤ 16	---	420	---	530-580	---	20	34 J at -40°C
					16 < t ≤ 35	---	410	---				55 J at 22°C
					35 < t ≤ 70	---	385	---				47 J at 0°C
ISO 9327-4:1999	P 42, PH 42	---	---	N	≤ 16	---	420	---	540-680	---	21	40 J at -20°C
					16 < t ≤ 35	---	410	---				28 J at -40°C
	PL 42, PLH 42	---	---	QT	35 < t ≤ 50	---	400	---	540-680	---	21	55 J at 22°C
					50 < t ≤ 70	---	380	---				63 J at 22°C
					70 < t ≤ 100	---	365	---	510-670	---	20	55 J at 0°C
					100 < t ≤ 250	---	345	---	510-670	---	19	47 J at -20°C
												35 J at -40°C
												27 J at -50°C

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				

6.1 Carbon Steel Forgings

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

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

6.2 Alloy Steel Forgings

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

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								Others
				C	Mn	Si	P	S	Cr	Ni	Mo	
JIS G 3221:1988	SFCM 690 S	---	---	0.48	0.30-0.85	0.15-0.35	0.030	0.030	0.90-1.50	---	0.15-0.30	---
EN 10250-3:1999	25CrMo4	1.7218	---	0.22-0.29	0.60-0.90	0.40	0.035	0.035	0.90-1.20	---	0.15-30	---
JIS G 3221:1988	SFCM 740 S	---	---	0.48	0.30-0.85	0.15-0.35	0.030	0.030	0.90-1.50	---	0.15-0.30	---
EN 10250-3:1999	42CrMo4	1.7225	---	0.38-0.45	0.60-0.90	0.40	0.035	0.035	0.90-1.20	---	0.15-30	---
JIS G 3221:1988	SFCM 780 S	---	---	0.48	0.30-0.85	0.15-0.35	0.030	0.030	0.90-1.50	---	0.15-0.30	---
EN 10250-3:1999	34CrMo4	1.7220	---	0.30-0.37	0.60-0.90	0.40	0.035	0.035	0.90-1.20	---	0.15-30	---
	50CrMo4	1.7228	---	0.46-0.54	0.60-0.90	0.40	0.035	0.035	0.90-1.20	---	0.15-30	---

6.2 Alloy Steel Forgings

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

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

6.2 Alloy Steel Forgings

6.2.1B Mechanical Properties of 1¼Cr-¼Mo Alloy Steels for General Use (Continued)

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

6.2 Alloy Steel Forgings

6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

6.2.2.1A Chemical Composition of Mo Alloy Steel

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10222-2:1999	16Mo3	1.5415	---	0.12-0.20	0.40-0.90	0.35	0.025	0.015	---	---	0.025-0.35	---
ISO 9327-2:1999	16Mo3	---	---	0.12-0.20	0.40-0.90	0.35	0.035	0.030	0.30	---	0.025-0.35	Cu 0.30
JIS G 3203:1988	SFVA F 1	---	---	0.30	0.60-0.90	0.35	0.030	0.030	---	---	0.45-0.65	---
ASTM A 182/A 182M-00	F 1	---	K12822	0.28	0.60-0.90	0.15-0.35	0.045	0.045	---	---	0.44-0.65	---
ASTM A 336/A 336M-99	F1	---	K12520	0.20-0.30	0.60-0.80	0.20-0.35	0.025	0.025	---	---	0.40-0.60	---

6.2.2.1B Mechanical Properties of Mo Alloy Steel

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
EN 10222-2:1999	16Mo3	1.5415	---	N, QT	≤ 35	---	295	---	440-570	---	23 L; 21 T	L: 50 J at 0°C T: 34 J at 0°C
					35 < t ≤ 70	---	285	---				
					70 < t ≤ 100	---	275	---				
				QT	≤ 250	---	265	---	440-570	---	23 L; 21 T	L: 50 J at 0°C T: 34 J at 0°C
					250 < t ≤ 500	---	250	---	420-550	---		
ISO 9327-2:1999	16Mo3	---	---	N or NT or QT	≤ 40	---	270	---	450-600	---	26 L; 24 T	L: 40 J at 20°C T: 27 J at 20°C
					40 < t ≤ 60	---	260	---	450-600	---	25 L; 23 T	
					60 < t ≤ 100	---	240	---	430-580	---	24 L; 22 T	
					100 < t ≤ 250	---	220	---	420-570	---	21 L; 19 T	
JIS G 3203:1988	SFVA F 1	---	---	A or NT	---	---	275	---	480-660	---	18	---
ASTM A 182/A 182M-00	F 1	---	K12822	A, NT	---	---	275	40	485	70	20.0	143-192 HB
ASTM A 336/A 336M-99	F1	---	K12520	A, NT	---	---	275	40	485-660	70-95	20	---

6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

6.2.2.2A Chemical Composition of ½Cr-½Mo Alloy 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 2	---	---	0.20	0.30-0.80	0.60	0.030	0.030	0.50-0.80	---	0.45-0.65	---
ASTM A 182/A 182M-00	F 2	---	K12122	0.05-0.21	0.30-0.80	0.10-0.60	0.040	0.040	0.50-0.81	---	0.44-0.65	---

6.2.2.2B Mechanical Properties of ½Cr-½Mo Alloy 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 3203:1988	SFVA F 2	---	---	A or NT	---	---	275	---	480-660	---	18	---
ASTM A 182/A 182M-00	F 2	---	K12122	A, NT	---	---	275	40	485	70	20.0	143-192 HB

6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

6.2.2.3A Chemical Composition of 1Cr-½Mo Alloy 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
EN 10222-2:1999	13CrMo4-5	1.7335	---	0.08-0.18	0.40-1.00	0.35	0.025	0.015	0.70-1.15	---	0.40-0.60	---
ISO 9327-2:1999	14CrMo4-5	---	---	0.08-0.18	0.40-1.00	0.35	0.035	0.030	0.70-1.15	---	0.40-0.60	Cu 0.30
JIS G 3203:1988	SFVA F 12	---	---	0.20	0.30-0.80	0.60	0.030	0.030	0.80-1.25	---	0.45-0.65	---
ASTM A 182/A 182M-00	F 12, Cl 2	---	K11564	0.10-0.20	0.30-0.80	0.10-0.60	0.040	0.040	0.80-1.25	---	0.44-0.65	---
ASTM A 336/A 336M-99	F12	---	K11564	0.10-0.20	0.30-0.80	0.10-0.60	0.025	0.025	0.80-1.10	---	0.45-0.65	---

6.2.2.3B Mechanical Properties 1Cr-½Mo Alloy 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		
EN 10222-2:1999	13CrMo4-5	1.7335	---	NT	≤ 35	---	295	---	440-590	---	20 L; 18 T	L: 44 J at 0°C T: 27 J at 0°C
					35 < t ≤ 70	---	285	---				
				NT or QT	70 < t ≤ 100	---	275	---	440-590	---	20 L; 18 T	L: 44 J at 0°C T: 27 J at 0°C
					100 < t ≤ 250	---	265	---	440-590	---		
					250 < t ≤ 500	---	240	---	420-570	---		
ISO 9327-2:1999	14CrMo4-5	---	---	NT or QT	≤ 40	---	300	---	450-600	---	22 L; 20 T	L: 40 J at 20°C T: 27 J at 20°C
					40 < t ≤ 60	---	300	---			21 L; 19 T	
					60 < t ≤ 100	---	275	---	440-590	---	20 L; 18 T	
					100 < t ≤ 250	---	255	---	430-580	---	20 L; 18 T	
JIS G 3203:1988	SFVA F 12	---	---	A or NT	---	---	275	---	480-660	---	18	---
ASTM A 182/A 182M-00	F 12, Cl 2	---	K11564	A, NT	---	---	275	40	485	70	20.0	143-207 HB
ASTM A 336/A 336M-99	F12	---	K11564	A, NT	---	---	275	40	485-660	70-95	20	---

6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

6.2.2.4A Chemical Composition of 1¼Cr-½Mo Alloy 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 11 A	---	---	0.20	0.30-0.80	0.50-1.00	0.030	0.030	1.00-1.50	---	0.45-0.65	---
ASTM A 182/A 182M-00	F 11, Cl 2	---	K11572	0.10-0.20	0.30-0.80	0.50-1.00	0.040	0.040	1.00-1.50	---	0.44-0.65	---
ASTM A 336/A 336M-99	F11, Cl 2	---	K11572	0.10-0.20	0.30-0.80	0.50-1.00	0.025	0.025	1.00-1.50	---	0.45-0.65	---
	F11, Cl 3											
JIS G 3203:1988	SFVA F 11 B	---	---	0.20	0.30-0.80	0.50-1.00	0.030	0.030	1.00-1.50	---	0.45-0.65	---

6.2.2.4B Mechanical Properties 1¼Cr-½Mo Alloy 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 3203:1988	SFVA F 11 A	---	---	A or NT	---	---	275	---	480-660	---	18	---
ASTM A 182/A 182M-00	F 11, Cl 2	---	K11572	A, NT	---	---	275	40	485	70	20.0	143-207 HB
ASTM A 336/A 336M-99	F11, Cl 2	---	K11572	A, NT	---	---	275	40	485-660	70-95	20	---
	F11, Cl 3	---					310	45	515-690	75-100	18	---
JIS G 3203:1988	SFVA F 11 B	---	---	A or NT	---	---	315	---	520-690	---	18	---

6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

6.2.2.5A Chemical Composition of 2¼Cr-1Mo Alloy 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/mm ² or MPa	ksi	N/mm ² 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, CI 1	---	K21590	A, NT	---	---	205	30	415	60	20.0	170 HB max
ASTM A 336/A 336M-99	F22, CI 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, CI 3			A, NT	---	---	310	45	515	75	20.0	156-207 HB
ASTM A 336/A 336M-99	F22, CI 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, CI 3	---	K21590	QT	---	---	380	55	585-760	85-110	18	---
ASTM A 541/A 541M-95 (1999)	22, CI 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

6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

6.2.2.6A Chemical Composition of 3Cr-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 21 A	---	---	0.15	0.30-0.60	0.50	0.030	0.030	2.65-3.35	---	0.80-1.00	---
ASTM A 336/A 336M-99	F21, Cl 1	---	K31545	0.05-0.15	0.30-0.60	0.50	0.025	0.025	2.7-3.3	---	0.80-1.06	---
ASTM A 182/A 182M-00	F 21	---	K31545	0.05-0.15	0.30-0.60	0.50	0.040	0.040	2.7-3.3	---	0.80-1.06	---
ASTM A 336/A 336M-99	F21, Cl 3	---	K31545	0.05-0.15	0.30-0.60	0.50	0.025	0.025	2.7-3.3	---	0.80-1.06	---
JIS G 3203:1988	SFVA F 21 B	---	---	0.15	0.30-0.60	0.50	0.030	0.030	2.65-3.35	---	0.80-1.00	---
JIS G 3206:1993	SFVCM F3V	---	---	0.17	0.30-0.60	0.10	0.015	0.010	2.75-3.25	---	0.90-1.10	V 0.20-0.30
ASTM A 182/A 182M-00	F 3V	---	K31830	0.05-0.18	0.30-0.60	0.10	0.020	0.020	2.8-3.2	---	0.90-1.10	V 0.20-0.30; Ti 0.015-0.035; B 0.001-0.003
ASTM A 336/A 336M-99	F3V	---	---	0.10-0.15	0.30-0.60	0.10	0.020	0.020	2.7-3.3	---	0.90-1.10	V 0.20-0.30; Ti 0.015-0.035; B 0.001-0.003
ASTM A 508/A 508-95 (1999)	3V	---	K31830	0.10-0.15	0.30-0.60	0.10	0.020	0.020	2.8-3.3	---	0.90-1.10	V 0.20-0.30; Ti 0.015-0.035; B 0.001-0.003
ASTM A 541/A 541M-95 (1999)	3V	---	K31830	0.10-0.15	0.30-0.60	0.10	0.020	0.020	2.8-3.3	---	0.90-1.10	V 0.20-0.30; Ti 0.015-0.035; B 0.001-0.003

6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

6.2.2.6B Mechanical Properties of 3Cr-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/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
JIS G 3203:1988	SFVA F 21 A	---	---	A or NT	---	---	205	---	410-590	---	18	---
ASTM A 336/A 336M-99	F21, CI 1	---	K31545	A, NT	---	---	205	30	415-585	60-85	20	---
ASTM A 182/A 182M-00	F 21	---	K31545	A, NT	---	---	310	45	515	75	20.0	156-207 HB
ASTM A 336/A 336M-99	F21, CI 3	---	K31545	A, NT	---	---	310	45	515-690	75-100	19	---
JIS G 3203:1988	SFVA F 21 B	---	---	A or NT	---	---	315	---	520-690	---	18	---
JIS G 3206:1993	SFVCM F3V	---	---	NT	---	---	415	---	580-760	---	16	54 J at -18°C
ASTM A 182/A 182M-00	F 3V	---	K31830	A, NT	---	---	415	60	585-760	85-110	18	174-237 HB
ASTM A 336/A 336M-99	F3V	---	---	A, NT	---	---	415	60	585-760	85-110	18	---
ASTM A 508/A 508 M-95 (1999)	3V	---	K31830	QT	---	---	415	60	585-760	85-110	18	---
ASTM A 541/A 541M-95 (1999)	3V	---	K31830	QT	---	---	415	60	585-760	85-110	18	55 J at -18°C

6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

6.2.2.7A Chemical Composition of 5Cr-½Mo Alloy 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
EN 10222-2:1999	X16CrMo5-1	1.7366	---	0.18	0.30-0.80	0.40	0.025	0.015	4.00-6.00	---	0.45-0.65	---
JIS G 3203:1988	SFVA F 5 A	---	---	0.15	0.30-0.60	0.50	0.030	0.030	4.00-6.00	---	0.45-0.65	---
ASTM A 336/A 336M-99	F5	---	K41545	0.15	0.30-0.60	0.50	0.025	0.025	4.0-6.0	0.50	0.45-0.65	---
ISO 9327-2:1999	X12CrMo5-1	---	---	0.08-0.15	0.30-0.60	0.50	0.035	0.030	4.00-6.00	---	0.45-0.65	---
JIS G 3203:1988	SFVA F 5 B	---	---	0.15	0.30-0.60	0.50	0.030	0.030	4.00-6.00	---	0.45-0.65	---
ASTM A 182/A 182M-00	F 5	---	K41545	0.15	0.30-0.60	0.50	0.030	0.030	4.0-6.0	0.50	0.44-0.65	---
ASTM A 336/A 336M-99	F5A	---	K42544	0.25	0.60	0.50	0.025	0.025	4.0-6.0	0.50	0.45-0.65	---
JIS G 3203:1988	SFVA F 5 C	---	---	0.25	0.30-0.60	0.50	0.030	0.030	4.00-6.00	---	0.45-0.65	---
ASTM A 182/A 182M-00	F 5a	---	K42544	0.25	0.60	0.50	0.040	0.030	4.0-6.0	0.50	0.44-0.65	---
JIS G 3203:1988	SFVA F 5 D	---	---	0.25	0.30-0.60	0.50	0.030	0.030	4.00-6.00	---	0.45-0.65	---
EN 10222-2:1999	X16CrMo5-1	1.7366	---	0.18	0.30-0.80	0.40	0.025	0.015	4.00-6.00	---	0.45-0.65	---

6.2.2.7B Mechanical Properties of 5Cr-½Mo Alloy 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		
EN 10222-2:1999	X16CrMo5-1	1.7366	---	A	≤ 300	---	205	---	410-510	---	18 L; 16 T	L: 40 J at RT T: 27 J at RT
JIS G 3203:1988	SFVA F 5 A	---	---	A or NT	---	---	245	---	410-590	---	18	---
ASTM A 336/A 336M-99	F5	---	K41545	A, NT	---	---	250	30	415-585	60-85	20	---
ISO 9327-2:1999	X12CrMo5-1	---	---	A	≤ 150	---	175	---	430-580	---	20 L; 18 T	---
JIS G 3203:1988	SFVA F 5 B	---	---	A or NT	---	---	275	---	480-660	---	18	---
ASTM A 182/A 182M-00	F 5	---	K41545	A, NT	---	---	275	40	485	70	20.0	143-217 HB
ASTM A 336/A 336M-99	F5A	---	K42544	A, NT	---	---	345	50	550-725	80-105	19	---
JIS G 3203:1988	SFVA F 5 C	---	---	A or NT	---	---	345	---	550-730	---	18	---
ASTM A 182/A 182M-00	F 5a	---	K42544	A, NT	---	---	450	65	620	90	22.0	187-248 HB
JIS G 3203:1988	SFVA F 5 D	---	---	A or NT	---	---	450	---	620-780	---	18	---
EN 10222-2:1999	X16CrMo5-1	1.7366	---	NT	≤ 300	---	420	---	640-780	---	16 L; 14 T	L: 40 J at RT T: 27 J at RT

6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

6.2.2.8A Chemical Composition of 9Cr-1Mo Alloy Steel

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 182/A 182M-00	F 9	---	K90941	0.15	0.30-0.60	0.50-1.00	0.030	0.030	8.0-10.0	---	0.90-1.10	---
ASTM A 336/A 336M-99	F9	---	---	0.15	0.30-0.60	0.50-1.00	0.025	0.025	8.0-10.0	---	0.90-1.10	---
JIS G 3203:1988	SFVA F 9	---	---	0.15	0.30-0.60	0.50-1.00	0.030	0.030	8.00-10.00	---	0.90-1.10	---
EN 10222-2:1999	X10CrMoVNb9-1	1.4903	---	0.08-0.12	0.30-0.60	0.50	0.025	0.015	8.00-9.50	0.40	0.85-1.05	Nb 0.06-0.10; V 0.18-0.25; N 0.030-0.070; Al 0.040

6.2.2.8B Mechanical Properties of 9Cr-1Mo Alloy Steel

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 182/A 182M-00	F 9	---	K90941	A, NT	---	---	380	55	585	85	20.0	179-217 HB
ASTM A 336/A 336M-99	F9	---	---	A, NT	---	---	380	55	585-760	85-110	20	---
JIS G 3203:1988	SFVA F 9	---	---	A or NT	---	---	380	---	590-760	---	18	---
EN 10222-2:1999	X10CrMoVNb9-1	1.4903	---	NT	≤ 130	---	450	---	630-730	---	19 L; 17 T	L: 40 J at RT T: 27 J at RT

6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

6.2.2.9A Chemical Composition of 11Cr-½Ni-1Mo Alloy Steel

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10222-2:1999	X20CrMoV11-1	1.4922	---	0.17-0.23	0.30-1.00	0.40	0.025	0.015	10.00-12.50	0.30-0.80	0.80-1.20	V 0.20-0.35
ISO 9327-2:1999	X20CrMoV12-1	---	---	0.17-0.23	0.30-1.00	0.40	0.035	0.030	10.00-12.50	0.30-1.00	0.80-1.20	V 0.20-0.35

6.2.2.9B Mechanical Properties of 11Cr-½Ni-1Mo Alloy Steel

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

6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

6.2.2.10A Chemical Composition of Ni Alloy Steel

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ISO 9327-3:1999	12Ni14G1	---	---	0.15	0.30-0.80	0.35	0.025	0.020	---	3.25-3.75	---	V 0.05
	12Ni14G2	---	---									
EN 10222-3:1999	12Ni14	1.5637	---	0.15	0.30-0.80	0.35	0.020	0.010	---	3.25-3.75	---	V 0.05
ASTM A 350/A 350M-00	LF3	---	K32025	0.20	0.90	0.20-0.35	0.035	0.040	0.30	3.3-3.7	0.12	Cu 0.40; Cb 0.02; V 0.03
JIS G 3205:1988	SFL 3	---	---	0.20	0.90	0.35	0.030	0.030	---	3.25-3.75	---	---
EN 10222-3:1999	X12Ni5	1.5680	---	0.15	0.30-0.80	0.35	0.020	0.010	---	4.75-5.25	---	V 0.05
ISO 9327-3:1999	12Ni19	---	---	0.15	0.30-0.80	0.35	0.025	0.020	---	4.50-5.30	---	V 0.05
EN 10222-3:1999	X8Ni9	1.5662	---	0.10	0.30-0.80	0.35	0.020	0.010	---	8.50-10.00	0.10	V 0.05
ISO 9327-3:1999	X8Ni9	---	---	0.10	0.30-0.80	0.35	0.025	0.020	---	8.00-10.00	0.10	V 0.05

6.2.2.10B Mechanical Properties of Ni Alloy Steel

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ISO 9327-3:1999	12Ni14G1	---	---	N	≤ 30	---	285	---	450-600	---	23	see standard
				NT	30 < t ≤ 50	---	275	---				
				QT								
	12Ni14G2	---	---	N	≤ 30	---	355	---	470-620	---	22	see standard
				NT	30 < t ≤ 50	---	345	---				
				QT								
EN 10222-3:1999	12Ni14	1.5637	---	N	≤ 35	---	355	---	470-640	---	20	---
				NT	35 < t ≤ 50	---	345	---				
				QT	50 < t ≤ 70	---	335	---				
ASTM A 350/A 350M-00	LF3	---	K32025	N, NT or QT	---	---	260	37.5	485-655	70-95	22	20 J at -101.1°C
JIS G 3205:1988	SFL 3	---	---	A, NT or QT	---	---	255	---	490-640	---	19	27 J at -101°C
EN 10222-3:1999	X12Ni5	1.5680	---	N, NT	≤ 35	---	390	---	510-710	---	19	see standard
				QT	35 < t ≤ 50	---	380	---				
ISO 9327-3:1999	12Ni19	---	---	N	≤ 30	---	390	---	510-710	---	19	see standard
				NT, QT	30 < t ≤ 50	---	380	---				
EN 10222-3:1999	X8Ni9	1.5662	---	N, NT	≤ 35	---	490	---	640-840	---	18	see standard
					35 < t ≤ 50	---	480	---				
				QT	50 < t ≤ 70	---	470	---				
ISO 9327-3:1999	X8Ni9	---	---	NNT	≤ 30	---	490	---	640-840	---	18	see standard
				QT	30 < t ≤ 50	---	480	---				

6.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

6.2.2.11A Chemical Composition of Ni-Mn

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

6.2.2.11B Mechanical Properties of Ni-Mn

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

6.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

6.2.2.12A Chemical Composition of $\frac{3}{4}\text{Ni}-\frac{1}{2}\text{Cr}-\text{Mo}$

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 541/A 541M-95 (1999)	2, CI 1, CI 2	---	K12765	0.27	0.50-0.90	0.15-0.35	0.025	0.025	0.25-0.45	0.50-1.00	0.55-0.70	V 0.05
ASTM A 508/A 508M-95 (1999)	2, CI 1, CI 2	---	K12766	0.27	0.50-1.00	0.15-0.40	0.025	0.025	0.25-0.45	0.50-1.00	0.55-0.70	V 0.05
JIS G 3204:1988 (1991)	SFVQ 2A, 2B	---	---	0.27	0.50-1.00	0.40	0.030	0.030	0.25-0.45	0.50-1.00	0.55-0.70	V 0.05

6.2.2.12B Mechanical Properties of $\frac{3}{4}\text{Ni}-\frac{1}{2}\text{Cr}-\text{Mo}$

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

6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

6.2.2.13A Chemical Composition of $\frac{3}{4}\text{Ni}-\frac{1}{2}\text{Mo}$

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 541/A 541M-95 (1999)	3, CI 1, CI 2	---	K12045	0.25	1.20-1.50	0.15-0.35	0.025	0.025	0.25	0.40-1.00	0.45-0.60	V 0.05
ASTM A 508/A 508M-95 (1999)	3, CI 1, CI 2	---	K12042	0.25	1.20-1.50	0.15-0.40	0.025	0.025	0.25	0.40-1.00	0.45-0.60	V 0.05
JIS G 3204:1988	SFVQ 1 A, 2A	---	---	0.25	1.20-1.50	0.40	0.030	0.030	0.25	0.40-1.00	0.45-0.60	V 0.05

6.2.2.13B Mechanical Properties of $\frac{3}{4}\text{Ni}-\frac{1}{2}\text{Mo}$

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 541/A 541M-95 (1999)	3, CI 1	---	K12045	QT	---	---	340	50	550-720	80-405	18	41 J at 4°C
ASTM A 508/A 508M-95 (1999)	3, CI 1	---	K12042	QT	---	---	345	50	550-725	80-105	18	---
JIS G 3204:1988	SFVQ 1 A	---	---	QT	---	---	345	---	550-730	---	16	40 J at 0°C
ASTM A 541/A 541M-95 (1999)	3, CI 2	---	K12045	QT	---	---	450	65	620-790	90-115	16	47 J at 21°C
JIS G 3204:1988	SFVQ 1 B	---	---	QT	---	---	450	---	620-790	---	14	47 J at 20°C
ASTM A 508/A 508M-95 (1999)	3, CI 2	---	K12042	QT	---	---	450	65	620-795	90-115	16	---

6.2.2 Alloy Steel Forgings for Piping, Pressure Vessel and Components

6.2.2.14A Chemical Composition of 3¼Ni-1¼Cr-½Mo

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 541/A 541M-95 (1999)	4N, CI 3	---	---	0.23	0.20-0.40	0.30	0.025	0.025	1.25-2.00	2.8-3.9	0.40-0.60	V 0.03
JIS G 3204:1988	SFVQ 3	---	---	0.23	0.20-0.40	0.40	0.020	0.020	1.50-2.00	2.75-3.90	0.40-0.60	V 0.03
ASTM A 508/A 508M-95 (1999)	4N, CI 3	---	---	0.23	0.20-0.40	0.15-0.40	0.020	0.020	1.50-2.00	2.8-3.9	0.40-0.60	V 0.03

6.2.2.14B Mechanical Properties of 3¼Ni-1¼Cr-½Mo

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

6.3 Stainless Steel Forgings

6.3.1A Chemical Composition of Martensitic Stainless Steel Forgings

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 3214:1991	SUS F 410-A	---	---	0.15	1.00	1.00	0.040	0.030	11.50-13.50	0.50	---	---
ASTM A 182/A 182M-00	F 6a Cl1, Cl 2	---	S41000	0.15	1.00	1.00	0.040	0.030	11.5-13.5	0.50	---	---
JIS G 3214:1991	SUS F 410-B	---	---	0.15	1.00	1.00	0.040	0.030	11.50-13.50	0.50	---	---
EN 10250-4:1999	X12Cr13	1.4006	---	0.08-0.15	1.50	1.00	0.040	0.030	11.50-13.50	0.75	---	---
ASTM A 182/A 182M-00	F 6a Cl 3	---	S41000	0.15	1.00	1.00	0.040	0.030	11.5-13.5	0.50	---	---
JIS G 3214:1991	SUS F 410-C	---	---	0.15	1.00	1.00	0.040	0.030	11.50-13.50	0.50	---	---
ASTM A 182/A 182M-00	F 6a Cl 4	---	S41000	0.15	1.00	1.00	0.040	0.030	11.5-13.5	0.50	---	---
JIS G 3214:1991	SUS F 410-D	---	---	0.15	1.00	1.00	0.040	0.030	11.50-13.50	0.50	---	---
ASTM A 182/A 182M-00	F 6b	---	S41026	0.15	1.00	1.00	0.020	0.020	11.5-13.5	1.00-2.00	0.40-0.60	Cu 0.50
JIS G 3214:1991	SUS F 6B	---	---	0.15	1.00	1.00	0.020	0.020	11.50-13.50	1.00-2.00	0.40-0.60	Cu 0.50
EN 10250-4:1999	X3CrNiMo13-4	1.4313	---	0.05	1.50	0.70	0.040	0.015	12.00-14.00	3.50-4.50	0.30-0.70	N 0.020
EN 10222-5:1999	X3CrNiMo13-4	1.4313	---	0.05	1.50	0.70	0.040	0.015	12.00-14.00	3.50-4.50	0.30-0.70	N 0.020
ASTM A 182/A 182M-00	F 6NM	---	S41500	0.05	0.5-1.0	0.60	0.030	0.030	11.5-14.0	3.5-5.5	0.5-1.0	---
JIS G 3214:1991	SUS F 6NM	---	---	0.05	0.50-1.00	0.60	0.030	0.030	11.50-14.00	3.50-5.50	0.50-1.00	---

6.3 Stainless Steel Forgings

6.3.1B Mechanical Properties of Martensitic Stainless Steel Forgings

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
JIS G 3214:1991	SUS F 410-A	---	---	QT	---	---	275	---	480	---	16	143-187 HBS or HBW
ASTM A 182/A 182M-00	F 6a Cl 1	---	S41000	NT	---	---	275	40	485	70	18	143-207 HB
	F 6a Cl 2	---		NT	---	---	380	55	585	85	18	167-229 HB
JIS G 3214:1991	SUS F 410-B	---	---	QT	---	---	380	---	590	---	16	167-229 HBS or HBW
EN 10250-4:1999	X12Cr13	1.4006	---	QT 650	≤ 160	---	450	---	650-850	---	15	25 J at RT
				A	---	---	---	---	730 max	---	---	220 HB max
ASTM A 182/A 182M-00	F 6a Cl 3	---	S41000	NT	---	---	585	85	760	110	15	235-302 HB
JIS G 3214:1991	SUS F 410-C	---	---	QT	---	---	585	---	760	---	14	217-302 HBS or HBW
ASTM A 182/A 182M-00	F 6a Cl 4	---	S41000	NT	---	---	760	110	895	130	12	263-321 HB
JIS G 3214:1991	SUS F 410-D	---	---	QT	---	---	760	---	900	---	11	262-321 HBS or HBW
ASTM A 182/A 182M-00	F 6b	---	S41026	NT	---	---	620	90	760-930	110-135	16	235-285 HB
JIS G 3214:1991	SUS F 6B	---	---	QT	---	---	620	---	760-930	---	15	217-285 HBS or HBW
EN 10250-4:1999	X3CrNiMo13-4	1.4313	---	QT 650	≤ 450	---	520	---	650-830	---	15	L: 70 J at RT T: 50 J at RT
EN 10222-5:1999	X3CrNiMo13-4	1.4313	---	QT+T	≤ 350	---	550	---	750-900	---	17 L; 16 T	L: 100 J at 20°C
				QT	≤ 250	---	650	---	780-930	---	17 L; 15 T	L: 90 J at 20°C T: 70 J at 20°C
EN 10250-4:1999	X3CrNiMo13-4	1.4313	---	QT 780	≤ 450	---	620	---	780-980	---	15	L: 70 J at RT T: 50 J at RT
ASTM A 182/A 182M-00	F 6NM	---	S41500	NT	---	---	620	90	790	115	15	295 HB max
JIS G 3214:1991	SUS F 6NM	---	---	QT	---	---	620	---	790	---	14	295 max HBS or HBW
EN 10250-4:1999	X3CrNiMo13-4	1.4313	---	QT 900	≤ 450	---	800	---	900-1100	---	12	L: 50 J at RT T: 40 J at RT
				A	---	---	---	---	1100 max	---	---	HB 320 max

6.3 Stainless Steel Forgings

6.3.2A Chemical Composition of Ferritic Stainless Steel Forgings

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10250-4:1999	X6Cr17	1.4016	---	0.08	1.00	1.00	0.040	0.030	16.00-18.00	---	---	---
ASTM A 182/A 182M-00	430	---	S43000	0.12	1.00	0.75	0.040	0.030	16.0-18.0	---	---	---

6.3.2B Mechanical Properties of Ferritic Stainless Steel Forgings

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
EN 10250-4:1999	X6Cr17	1.4016	---	A	≤ 100	---	240	---	400-630	---	---	200 HB max
ASTM A 182/A 182M-00	430	---	S43000	A	---	---	240	35	415	60	20	190 HB max

6.3 Stainless Steel Forgings

6.3.3A Chemical Composition of Austenitic Stainless Steel Forgings

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10222-5:1999	X5CrNi18-10	1.4301	---	0.07	2.00	1.00	0.045	0.015	17.00-19.50	8.00-10.50	---	N 0.11
EN 10250-4:1999	X5CrNi18-10	1.4301	---	0.07	2.00	1.00	0.045	0.030	17.00-19.50	8.00-10.50	---	N 0.11
ISO 9327-5:1999	X5CrNi18-9	---	---	0.07	2.00	1.00	0.045	0.030	17.00-19.00	8.00-11.00	---	---
ASTM A 182/A 182M-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	X2CrNi18-10	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	X2CrNi18-10	---	---	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	X2CrNi18-10	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

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

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10250-4:1999	X5CrNiMo17-12-2	1.4401	---	0.07	2.00	1.00	0.045	0.030	16.50-18.50	10.00-13.00	2.00-2.50	N 0.11
	X3CrNiMo17-13-3	1.4436	---	0.05	2.00	1.00	0.045	0.030	16.50-18.50	10.50-13.00	2.50-3.00	N 0.11
EN 10222-5:1999	X5CrNiMo17-12-2	1.4401	---	0.07	2.00	1.00	0.045	0.015	16.50-18.50	10.00-13.00	2.00-2.50	N 0.11
	X3CrNiMo17-13-3	1.4436	---	0.05	2.00	1.00	0.045	0.015	16.50-18.50	10.50-13.00	2.50-3.00	N 0.11
ISO 9327-5:1999	X5CrNiMo17-12	---	---	0.07	2.00	1.00	0.045	0.030	16.50-18.50	10.50-13.50	2.00-2.50	---
	X5CrNiMo17-13	---	---	0.07	2.00	1.00	0.045	0.030	16.50-18.50	11.00-14.00	2.50-3.00	---
ASTM A 182/A 182M-00	F 316	---	S31600	0.08	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
JIS G 3214:1991	SUS 316	---	---	0.08	2.00	1.00	0.040	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---
JIS G 3214:1991	SUS F 316L	---	---	0.030	2.00	1.00	0.040	0.030	16.00-18.00	12.00-15.00	2.00-3.00	---
ASTM A 182/A 182M-00	F 316L	---	S31603	0.030	2.00	1.00	0.045	0.030	16.0-18.0	10.0-15.0	2.0-3.0	---
EN 10222-5:1999	X2CrNiMo17-12-2	1.4404	---	0.030	2.00	1.00	0.045	0.015	16.50-18.50	10.00-13.00	2.00-2.50	N 0.11
	X2CrNiMo17-12-3	1.4432	---	0.030	2.00	1.00	0.045	0.015	16.50-18.50	10.50-13.00	2.50-3.00	N 0.11
ISO 9327-5:1999	X2CrNiMo17-12	---	---	0.030	2.00	1.00	0.045	0.030	16.50-18.50	11.00-14.00	2.00-2.50	---
	X2CrNiMo17-13	---	---	0.030	2.00	1.00	0.045	0.030	16.50-18.50	11.50-14.50	2.50-3.00	---
EN 10250-4:1999	X2CrNiMo17-12-2	1.4404	---	0.030	2.00	1.00	0.045	0.030	16.50-18.50	10.00-13.00	2.00-2.50	N 0.11
	X2CrNiMo18-14-3	1.4435	---	0.030	2.00	1.00	0.045	0.030	17.00-19.00	12.50-15.00	2.50-3.00	N 0.11
EN 10222-5:1999	X2CrNiMo18-14-3	1.4435	---	0.030	2.00	1.00	0.045	0.015	17.00-19.00	12.50-15.00	2.50-3.00	N 0.11
ASTM A 182/A 182M-00	F 316N	---	S31651	0.08	2.00	1.00	0.045	0.030	16.0-18.0	11.0-14.0	2.00-3.00	N 0.10-0.16
JIS G 3214:1991	SUS F 316N	---	---	0.08	2.00	0.75	0.040	0.030	16.00-18.00	10.00-14.00	2.00-3.00	N 0.10-0.16
ASTM A 182/A 182M-0	F 316LN	---	S31653	0.030	2.00	1.00	0.045	0.030	16.0-18.0	11.0-14.0	2.00-3.00	N 0.10-0.16
JIS G 3214:1991	SUS F 316LN	---	---	0.030	2.00	1.00	0.040	0.030	16.00-18.00	10.00-14.00	2.00-3.00	N 0.10-0.16
EN 10222-5:1999	X2CrNiMoN17-11-2	1.4406	---	0.030	2.00	1.00	0.045	0.015	16.50-18.50	10.00-12.00	2.00-2.50	N 0.12-0.22
	X2CrNiMo17-13-3	1.4429	---	0.030	2.00	1.00	0.045	0.015	16.50-18.50	11.00-14.00	2.50-3.00	N 0.12-0.22
ISO 9327-5:1999	X2CrNiMoN17-12	---	---	0.030	2.00	1.00	0.045	0.030	16.50-18.50	10.50-13.50	2.00-2.50	N 0.12-0.22
	X2CrNiMoN17-13	---	---	0.030	2.00	1.00	0.045	0.030	16.50-18.50	11.50-14.50	2.50-3.00	N 0.12-0.22
EN 10250-4:1999	X2CrNiMoN17-11-2	1.4406	---	0.030	2.00	1.00	0.045	0.030	16.50-18.50	10.00-12.00	2.00-2.50	N 0.12-0.22
	X2CrNiMo17-13-3	1.4429	---	0.030	2.00	1.00	0.045	0.015	16.50-18.50	11.00-14.00	2.50-3.00	N 0.12-0.22
ISO 9327-5:1999	X7CrNiMo17-12	---	---	0.04-0.10	2.00	1.00	0.045	0.030	16.50-18.50	10.50-13.50	2.00-2.50	---
ASTM A 182/A 182M-00	F 316H	---	S31609	0.04-0.10	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
JIS G 3214:1991	SUS 316H	---	---	0.04-0.10	2.00	1.00	0.040	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---

6.3 Stainless Steel Forgings

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

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10250-4:1999	X6CrNiMoTi17-12-2	1.4571	---	0.08	2.00	1.00	0.045	0.030	16.50-18.50	10.50-13.50	2.00-2.50	Ti 5 x C to 0.70
ISO 9327-5:1999	X6CrNiMoTi17-12	---	---	0.08	2.00	1.00	0.045	0.030	16.50-18.50	11.00-14.00	2.00-2.50	Ti 5 x C to 0.80
ASTM A 182/A 182M-00	F 317	---	S31700	0.08	2.00	1.00	0.045	0.030	18.0-20.0	11.0-15.0	3.00-4.00	---
JIS G 3214:1991	SUS 317	---	---	0.08	2.00	1.00	0.040	0.030	18.0-20.0	11.0-15.0	3.00-4.00	---
JIS G 3214:1991	SUS F 317L	---	---	0.030	2.00	1.00	0.040	0.030	18.0-20.0	11.0-15.0	3.00-4.00	---
ASTM A 182/A 182M-00	F 317L	---	S31703	0.030	2.00	1.00	0.045	0.030	18.0-20.0	11.0-15.0	3.00-4.00	---
EN 10250-4:1999	X6CrNiTi18-10	1.4541	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-12.00	---	Ti 5 x C to 0.70
EN 10222-5:1999	X6CrNiTi18-10	1.4541	---	0.08	2.00	1.00	0.045	0.015	17.00-19.00	9.00-12.00	---	Ti 5 x C to 0.70
ISO 9327-5:1999	X6CrNiTi18-10	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-12.00	---	Ti 5 x C to 0.80
ASTM A 182/A 182M-00	F 321	---	S32100	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 5 x C to 0.70
JIS G 3214:1991	SUS F 321	---	---	0.08	2.00	1.00	0.040	0.030	17.00 min	9.00-12.00	---	Ti 5 x C to 0.60
ISO 9327-5:1999	X7CrNiTi18-10	---	---	0.04-0.10	2.00	1.00	0.045	0.030	17.00-19.00	9.00-12.00	---	Ti 5 x C to 0.80
ASTM A 182/A 182M-00	F 321H	---	S32109	0.04-0.10	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 4 x C to 0.70
JIS G 3214:1991	SUS F 321H	---	---	0.04-0.10	2.00	1.00	0.040	0.030	17.0 min	9.00-12.00	---	Ti 4 x C to 0.60
EN 10222-5:1999	X6CrNiNb18-10	1.4550	---	0.08	2.00	1.00	0.045	0.015	17.00-19.00	9.00-12.00	---	Nb 10 x C to 1.00
ISO 9327-5:1999	X6CrNiNb18-10	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-12.00	---	Nb 10 x C to 1.00
ASTM A 182/A 182M-00	F 347	---	S34700	0.08	2.00	1.00	0.045	0.030	17.0-20.0	9.0-13.0	---	Cb 10 x C to 1.10
JIS G 3214:1991	SUS F 347	---	---	0.08	2.00	1.00	0.040	0.030	17.00-20.00	9.00-13.00	---	Nb 10 x C to 1.00
EN 10222-5:1999	X7CrNiNb18-10	1.4912	---	0.04-0.10	2.00	1.00	0.045	0.015	17.00-19.00	9.00-12.00	---	Nb 10 x C to 1.20
ISO 9327-5:1999	X7CrNiNb18-10	---	---	0.04-0.10	2.00	1.00	0.045	0.030	17.00-19.00	9.00-12.00	---	Nb 10 x C to 1.20
ASTM A 182/A 182M-00	F 347H	---	S34709	0.04-0.10	2.00	1.00	0.045	0.030	17.0-20.0	9.0-13.0	---	Cb 8 x C to 1.10
JIS G 3214:1991	SUS F 347H	---	---	0.04-0.10	2.00	1.00	0.040	0.030	17.00-20.00	9.00-13.00	---	Nb 8 x C to 1.00
ISO 9327-5:1999	X2NiCrMoCu25-20-5	---	---	0.025	2.00	1.00	0.030	0.020	19.00-21.00	24.00-27.00	4.00-5.00	Cu 1.00-2.00; N 0.15
EN 10250-4:1999	X1NiCrMoCu25-20-5	1.4539	---	0.020	2.00	0.70	0.030	0.010	19.00-21.00	24.00-26.00	4.00-5.00	Cu 1.20-2.00; N 0.15

6.3 Stainless Steel Forgings

6.3.3B Mechanical Properties of Austenitic Stainless Steel Forgings

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/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

6.3 Stainless Steel Forgings

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 182/A 182M-00	F 304N	---	S30451	ST+Q	---	---	240	35	550	80	30	---
JIS G 3214:1991	SUS F 304N	---	---	S	< 130	---	240	---	550	---	29	217 HB max
					130 ≤ t ≤ 200	---	240	---	550	---	24	217 HB max
ASTM A 182/A 182M-00	F 304LN	---	S30453	ST+Q	---	---	205	30	515	75	30	---
JIS G 3214:1991	SUS F 304LN	---	---	S	< 130	---	205	---	520	---	29	187 HB max
					130 ≤ t ≤ 200	---	205	---	480	---	29	187 HB max
EN 10222-5:1999	X2CrNiN18-10	1.4311	---	AT	≤ 250	---	270	---	550-750	---	45 L; 35 T	L: 100 J at 20°C T: 60 J at 20°C T: 60 J at 196°C
ISO 9327-5:1999	X2CrNiN18-10	---	---	Q	≤ 250	---	270	---	550-750	---	30 L; 30 T	L: 85 J at RT T: 55 J at RT
EN 10250-4:1999	X2CrNiN18-10	1.4311	---	SA	≤ 250	---	270	---	550-760	---	30	L: 100 J at RT T: 60 J at RT
ISO 9327-5:1999	X6CrNi25-21	---	---	Q	≤ 160	---	210	---	500-700	---	30 L; 30 T	L: 85 J at RT T: 55 J at RT
ASTM A 182/A 182M-00	F 310	---	S31000	ST+Q	---	---	205	30	515	75	30	---
	F310H	---	S31009	ST+Q	---	---	205	30	515	75	30	---
JIS G 3214:1991	SUS F 310	---	---	S	< 130	---	205	---	520	---	34	187 HB max
					130 ≤ t ≤ 200	---	205	---	480	---	29	187 HB max
EN 10250-4:1999	X5CrNiMo17-12-2	1.4401	---	SA	≤ 250	---	200	---	500-700	---	30	L: 100 J at RT T: 60 J at RT
	X3CrNiMo17-13-3	1.4436	---	SA	≤ 250	---	200	---	500-700	---	30	L: 100 J at RT T: 60 J at RT
EN 10222-5:1999	X5CrNiMo17-12-2	1.4401	---	AT	≤ 250	---	205	---	510-710	---	45 L; 35 T	L: 100 J at 20°C T: 60 J at 20°C T: 60 J at 196°C
	X3CrNiMo17-13-3	1.4436	---	AT	≤ 250	---	205	---	510-710	---	45 L; 35 T	L: 100 J at 20°C T: 60 J at 20°C T: 60 J at 196°C
ISO 9327-5:1999	X5CrNiMo17-12	---	---	Q	≤ 250	---	205	---	510-710	---	30 L; 30 T	L: 85 J at RT T: 55 J at RT
	X5CrNiMo17-13	---	---	Q	≤ 250	---	205	---	510-710	---	30 L; 30 T	L: 85 J at RT T: 55 J at RT
ASTM A 182/A 182M-00	F 316	---	S31600	ST+Q	---	---	205	30	515	75	30	---
JIS G 3214:1991	SUS 316	---	---	S	< 130	---	205	---	520	---	43	187 HB max
					130 ≤ t ≤ 200	---	205	---	480	---	29	187 HB max

6.3 Stainless Steel Forgings

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
JIS G 3214:1991	SUS F 316L	---	---	S	< 130	---	175	---	480	---	29	187 HB max
					130 ≤ t ≤ 200	---	175	---	450	---	29	187 HB max
ASTM A 182/A 182M-00	F 316L	---	S31603	ST+Q	---	---	170	25	485	70	30	---
EN 10222-5:1999	X2CrNiMo17-12-2	1.4404	---	AT	≤ 250	---	190	---	490-690	---	45 L; 35 T	L: 100 J at 20°C T: 60 J at 20°C T: 60 J at -196°C
	X2CrNiMo17-12-3	1.4432	---	AT	≤ 250	---	190	---	490-690	---	45 L; 35 T	L: 100 J at 20°C T: 60 J at 20°C T: 60 J at -196°C
ISO 9327-5:1999	X2CrNiMo17-12	---	---	Q	≤ 250	---	190	---	490-690	---	30 L; 30 T	L: 85 J at RT T: 55 J at RT
	X2CrNiMo17-13	---	---	Q	≤ 250	---	190	---	490-690	---	30 L; 30 T	L: 85 J at RT T: 55 J at RT
EN 10250-4:1999	X2CrNiMo17-12-2	1.4404	---	SA	≤ 250	---	200	---	500-700	---	30	L: 100 J at RT T: 60 J at RT
	X2CrNiMo18-14-3	1.4435	---	SA	≤ 250	---	200	---	500-700	---	30	L: 100 J at RT T: 60 J at RT
EN 10222-5:1999	X2CrNiMo18-14-3	1.4435	---	AT	≤ 75	---	200	---	520-670	---	45 T	L: 100 J at 20°C T: 60 J at 20°C T: 60 J at -196°C

6.3 Stainless Steel Forgings

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 182/A 182M-00	F 316N	---	S31651	ST+Q	---	---	240	35	550	80	30	---
JIS G 3214:1991	SUS F 316N	---	---	S	< 130	---	240	---	550	---	29	217 HB max
					130 ≤ t ≤ 200	---	240	---	550	---	24	217 HB max
ASTM A 182/A 182M-00	F 316LN	---	S31653	ST+Q	---	---	205	30	515	75	30	---
JIS G 3214:1991	SUS F 316LN	---	---	S	< 130	---	205	---	520	---	29	187 HB max
					130 ≤ t ≤ 200	---	205	---	480	---	29	187 HB max
EN 10222-5:1999	X2CrNiMoN17-11-2	1.4406	---	AT	≤ 160	---	280	---	580-780	---	45 L; 35 T	L: 100 J at 20°C T: 60 J at 20°C T: 60 J at -196°C
	X2CrNiMo17-13-3	1.4429	---	AT	≤ 160	---	280	---	580-780	---	45 L; 35 T	L: 100 J at 20°C T: 60 J at 20°C T: 60 J at -196°C
ISO 9327-5:1999	X2CrNiMoN17-12	---	---	Q	≤ 160	---	280	---	580-780	---	30 L; 30 T	L: 85 J at RT T: 55 J at RT
	X2CrNiMoN17-13	---	---	Q	≤ 160	---	280	---	580-780	---	30 L; 30 T	L: 85 J at RT T: 55 J at RT
EN 10250-4:1999	X2CrNiMoN17-11-2	1.4406	---	SA	≤ 250	---	280	---	580-800	---	30	L: 100 J at RT T: 60 J at RT
	X2CrNiMo17-13-3	1.4429	---	SA	≤ 400	---	280	---	580-800	---	30	L: 100 J at RT T: 60 J at RT
ISO 9327-5:1999	X7CrNiMo17-12	---	---	Q	≤ 250	---	205	---	510-710	---	30 L; 30 T	L: 85 J at RT T: 55 J at RT
ASTM A 182/A 182M-00	F 316H	---	S31609	ST+Q	---	---	205	30	515	75	30	---
JIS G 3214:1991	SUS 316H	---	---	S	< 130	---	205	---	520	---	43	187 HB max
					130 ≤ t ≤ 200	---	205	---	480	---	29	187 HB max
EN 10250-4:1999	X6CrNiMoTi17-12-2	1.4571	---	SA	≤ 450	---	200	---	500-700	---	30	---
ISO 9327-5:1999	X6CrNiMoTi17-12	---	---	Q	≤ 450	---	210	---	510-710	---	30	---
ASTM A 182/A 182M-00	F 317	---	S31700	ST+Q	---	---	205	30	515	75	30	---
JIS G 3214:1991	SUS 317	---	---	S	< 130	---	205	---	520	---	29	187 HB max
					130 ≤ t ≤ 200	---	205	---	480	---	29	187 HB max
JIS G 3214:1991	SUS F 317L	---	---	S	< 130	---	175	---	480	---	29	187 HB max
					130 ≤ t ≤ 200	---	175	---	450	---	29	187 HB max
ASTM A 182/A 182M-00	F 317L	---	S31703	ST+Q	---	---	170	25	485	70	30	---

6.3 Stainless Steel Forgings

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
EN 10250-4:1999	X6CrNiTi18-10	1.4541	---	SA	≤ 450	---	190	---	500-700	---	30	L: 100 J at RT T: 60 J at RT
EN 10222-5:1999	X6CrNiTi18-10	1.4541	---	AT	≤ 450	---	200	---	510-710	---	40 L; 30 T	L: 100 J at 20°C T: 60 J at 20°C T: 60 J at 196°C
ISO 9327-5:1999	X6CrNiTi18-10	---	---	Q	≤ 450	---	200	---	510-710	---	30 L; 30 T	L: 85 J at RT T: 55 J at RT
ASTM A 182/A 182M-00	F 321	---	S32100	ST+Q	---	---	205	30	515	75	30	---
JIS G 3214:1991	SUS F 321	---	---	S	< 130	---	205	---	520	---	43	187 HB max
					130 ≤ t ≤ 200	---	205	---	480	---	29	187 HB max
ISO 9327-5:1999	X7CrNiTi18-10	---	---	Q	≤ 450	---	175	---	490-690	---	30 L; 30 T	L: 85 J at RT T: 55 J at RT
ASTM A 182/A 182M-00	F 321H	---	S32109	ST+Q	---	---	205	30	515	75	30	---
JIS G 3214:1991	SUS F 321H	---	---	S	< 130	---	205	---	520	---	43	187 HB max
					130 ≤ t ≤ 200	---	205	---	480	---	29	187 HB max
EN 10222-5:1999	X6CrNiNb18-10	1.4550	---	AT	≤ 450	---	205	---	510-710	---	40 L; 30 T	L: 100 J at 20°C T: 60 J at 20°C T: 40 J at 196°C
ISO 9327-5:1999	X6CrNiNb18-10	---	---	Q	≤ 450	---	205	---	510-710	---	30 L; 30 T	L: 85 J at RT T: 55 J at RT
ASTM A 182/A 182M-00	F 347	---	S34700	ST+Q	---	---	205	30	515	75	30	---
JIS G 3214:1991	SUS F 347	---	---	S	< 130	---	205	---	520	---	43	187 HB max
					130 ≤ t ≤ 200	---	205	---	480	---	29	187 HB max
EN 10222-5:1999	X7CrNiNb18-10	1.4912	---	AT	≤ 450	---	205	---	510-710	---	40 L; 30 T	L: 100 J at 20°C T: 60 J at 20°C T: 40 J at 196°C
ISO 9327-5:1999	X7CrNiNb18-10	---	---	Q	≤ 450	---	205	---	510-710	---	30 L; 30 T	L: 85 J at RT T: 55 J at RT
ASTM A 182/A 182M-00	F 347H	---	S34709	ST+Q	---	---	205	30	515	75	30	---
JIS G 3214:1991	SUS F 347H	---	---	S	< 130	---	205	---	520	---	43	187 HB max
					130 ≤ t ≤ 200	---	205	---	480	---	29	187 HB max
ISO 9327-5:1999	X2NiCrMoCu25-20-5	---	---	Q	≤ 160	---	220	---	520-720	---	30	see standard
EN 10250-4:1999	X1NiCrMoCu25-20-5	1.4539	---	SA	≤ 250	---	230	---	530-730	---	30	see standard

6.3 Stainless Steel Forgings

6.3.4A Chemical Composition of Precipitation-Hardening Stainless Steel Forgings

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 3214:1991	SUS F 630	---	---	0.07	1.00	1.00	0.040	0.030	15.00-17.50	3.00-5.00	---	Cu 3.00-5.00; Nb 0.15-0.45
EN 10250-4:1999	X5CrNiCuNb16-4	1.4542	---	0.07	1.50	0.70	0.040	0.030	15.00-17.00	3.00-5.00	0.60	Cu 3.00-5.00; Nb 5 x C to 0.45

6.3.4B Mechanical Properties of Precipitation-Hardening Stainless Steel Forgings

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
JIS G 3214:1991	SUS F 630	---	---	H1075	≤ 200	---	860	---	1000	---	12	311 min HBS or HBW see standard
				H1100	≤ 200	---	795	---	970	---	13	302 min HBS or HBW see standard
				H1150	≤ 200	---	725	---	930	---	15	277 min HBS or HBW see standard
EN 10250-4:1999	X5CrNiCuNb16-4	1.4542	---	A	---	---	---	---	1200 max	---	---	360 HB max
				P 930	≤ 250	---	720	---	930	---	15 L; 12 T	L: 40 J at RT T: 30 J at RT
				P1070	≤ 250	---	1000	---	1070	---	12 L; 10 T	L: 20 J at RT T: 15 J at RT
				P 1300	≤ 250	---	1150	---	1300	---	8 L; 6 T	---

6.3 Stainless Steel Forgings

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

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10250-4:1999	X3CrNiMoN27-5-2	1.4460	---	0.05	2.00	1.00	0.035	0.030	25.00-28.00	4.50-6.50	1.30-2.00	N 0.05-0.20
ASTM A 182/A 182M-00	F 50	---	S31200	0.030	2.00	1.00	0.045	0.030	24.0-26.0	5.5-6.5	1.20-2.00	N 0.14-0.20
ISO 9327-5:1999	X2CrNiMoN22-5-3	---	---	0.030	2.00	1.00	0.035	0.020	21.00-23.00	4.50-6.50	2.50-3.50	N 0.08-0.20
ASTM A 182/A 182M-00	F 51	---	S31803	0.030	2.00	1.00	0.030	0.020	21.0-23.0	4.5-6.5	2.5-3.5	N 0.08-0.20
EN 10250-4:1999	X2CrNiMoN22-5-3	1.4462	---	0.030	2.00	1.00	0.035	0.015	21.00-23.00	4.50-6.50	2.50-3.50	N 0.10-0.22
ASTM A 182/A 182M-00	F 60	---	S32205	0.030	2.00	1.00	0.030	0.020	22.0-23.0	4.5-6.5	3.0-3.5	N 0.14-0.20
EN 10222-5:1999	X2CrNiMoN22-5-3	1.4462	---	0.030	2.00	1.00	0.035	0.015	21.00-23.00	4.50-6.50	2.50-3.50	N 0.10-0.22
EN 10250-4:1999	X2CrNiMoN25-7-4	1.4410	---	0.030	2.00	1.00	0.035	0.015	24.0-26.0	6.0-8.0	3.00-4.50	N 0.20-0.35
ASTM A 182/A 182M-00	F 53	---	S32750	0.030	1.20	0.80	0.035	0.020	24.0-26.0	6.0-8.0	3.0-5.0	Cu 0.50; N 0.24-0.32
EN 10222-5:1999	X2CrNiMoN25-7-4	1.4410	---	0.030	2.00	1.00	0.035	0.015	24.0-26.0	6.0-8.0	3.00-4.50	N 0.20-0.35
EN 10250-4:1999	X2CrNiMoCuWN27-7-4	1.4501	---	0.030	1.00	1.00	0.035	0.015	24.00-26.00	6.00-8.00	3.00-4.00	Cu 0.50-1.00; N 0.20-0.30; W 0.50-1.00
ASTM A 182/A 182M-00	F 55	---	S32760	0.030	1.00	1.00	0.030	0.010	24.0-26.0	6.0-8.0	3.0-4.0	Cu 0.50-1.00; N 0.20-0.30; W 0.50-1.00
EN 10250-4:1999	X2CrNiMoCuN25-6-3	1.4507	---	0.030	2.00	0.70	0.035	0.015	24.00-26.00	5.50-7.50	2.70-4.00	Cu 1.00-2.50; N 0.15-0.30
ASTM A 182/A 182M-00	F 59	---	S32520	0.030	1.50	0.80	0.035	0.020	24.0-26.0	5.5-8.0	3.0-5.0	Cu 0.50-3.00; N 0.20-0.35
ISO 9327-5:1999	X2CrNiN23-4	---	---	0.030	2.50	1.00	0.035	0.020	22.00-24.00	3.50-5.00	0.60	Cu 0.60; N 0.05-0.20
EN 10250-4:1999	X2CrNiN23-4	1.4362	---	0.030	2.00	1.00	0.035	0.015	22.00-24.00	3.50-5.50	0.10-0.60	Cu 0.10-0.60; N 0.05-0.20

6.3 Stainless Steel Forgings

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
EN 10250-4:1999	X3CrNiMoN27-5-2	1.4460	---	AT	≤ 160	---	460	---	620-880	---	20 L; 15 T	L: 85 J at RT T: 50 J at RT
ASTM A 182/A 182M-00	F 50	---	S31200	ST+Q	---	---	450	65	690-900	100-130	25	---
ISO 9327-5:1999	X2CrNiMoN22-5-3	---	---	Q	≤ 250	---	450	---	600-860	---	25 L; 20 T	L: 85 J at RT T: 55 J at RT
ASTM A 182/A 182M-00	F 51	---	S31803	ST+Q	---	---	450	65	620	90	25	---
EN 10250-4:1999	X2CrNiMoN22-5-3	1.4462	---	AT	≤ 350	---	450	---	650-880	---	25 L; 20 T	L: 100 J at RT T: 60 J at RT
ASTM A 182/A 182M-00	F 60	---	S32205	ST+Q	---	---	485	70	655	95	25	---
EN 10222-5:1999	X2CrNiMoN22-5-3	1.4462	---	AT	≤ 350	---	450	---	680-880	---	30 L; 25 T	L: 200 J at 20°C T: 100 J at 20°C
EN 10250-4:1999	X2CrNiMoN25-7-4	1.4410	---	AT	≤ 160	---	530	---	730-930	---	25 L; 20 T	L: 100 J at RT T: 60 J at RT
ASTM A 182/A 182M-00	F 53	---	S32750	ST+Q	---	---	550	80	800	116	15	---
EN 10222-5:1999	X2CrNiMoN25-7-4	1.4410	---	AT	≤ 160	---	500	---	800-1000	---	30 L; 25 T	L: 200 J at 20°C T: 100 J at 20°C
EN 10250-4:1999	X2CrNiMoCuWN27-7-4	1.4501	---	AT	≤ 160	---	530	---	730-930	---	25 L; 20 T	L: 100 J at RT T: 60 J at RT
ASTM A 182/A 182M-00	F 55	---	S32760	ST+Q	---	---	550	80	750-895	109-130	25	---
EN 10250-4:1999	X2CrNiMoCuN25-6-3	1.4507	---	AT	≤ 160	---	500	---	700-900	---	25 L; 20 T	L: 100 J at RT T: 60 J at RT
ASTM A 182/A 182M-00	F 59	---	S32520	ST+Q	---	---	550	80	770	112	25	---
ISO 9327-5:1999	X2CrNiN23-4	---	---	Q	≤ 160	---	400	---	600-820	---	25 L; 20 T	L: 85 J at RT T: 55 J at RT
EN 10250-4:1999	X2CrNiN23-4	1.4362	---	AT	≤ 160	---	400	---	600-830	---	25 L; 20 T	L: 100 J at RT T: 60 J at RT

6.4.1 Non-Comparable Carbon Steel Forgings for General Use

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

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

ASTM A 266/A 266M-99 - Carbon Steel Forgings for Pressure Vessel Components												
Grade, Class, Type	3	---	---	---	---	---	---	---	---	---	---	---
UNS Number	K05001	---	---	---	---	---	---	---	---	---	---	---
ISO 9327-4:1999 - Steel Forgings and Rolled or Forged Bars for Pressure Purposes. Technical Delivery Conditions. Part 4 : Weldable Fine Grain Steels with High Proof Strength												
Steel Type	P 46	PH 46	PL 46	PLH 46	---	---	---	---	---	---	---	---

6.4.3 Non-Comparable Alloy Steel Forgings for General Use

ASTM A 668/A 668M-96 - Steel Forgings, Carbon and Alloy, for General Industrial Use												
Grade, Class, Type	G (GH)	H (HH)	J (JH)	K (KH)	L (LH)	M (MH)	N (NH)	---	---	---	---	---
UNS Number	---	---	---	---	---	---	---	---	---	---	---	---
JIS G 3221:1988 - Chromium Molybdenum Steel Forgings for General Use												
Type Symbol	SFCM 590 S	SFCM 640 S	SFCM 830 S	SFCM 880 S	SFCM 930 S	SFCM 980 S	---	---	---	---	---	---
	SFCM 590 R	SFCM 640 R	SFCM 690 R	SFCM 740 R	SFCM 780 R	SFCM 830 R	SFCM 880 R	SFCM 930 R	SFCM 980 R	---	---	---
	SFCM 590 D	SFCM 640 D	SFCM 690 D	SFCM 740 D	SFCM 780 D	SFCM 830 D	SFCM 880 D	SFCM 930 D	SFCM 980 D	---	---	---
EN 10250-2:1999 - Open Die Steel Forgings for General Engineering Purposes - Part 2: Non-Alloy Quality and Special Steels												
Steel Name	28Mn6	20Mn5	---	---	---	---	---	---	---	---	---	---
Steel Number	1.1170	1.1133	---	---	---	---	---	---	---	---	---	---
EN 10250-3:1999 - Open Die Steel Forgings for General Engineering Purposes - Part 3: Alloy Special Steels												
Steel Name	38Cr2	46Cr2	34Cr4	37Cr4	41Cr4	36CrNiMo4	34CrNiMo6	30CrNiMo8	36NiCrMo16	51CrV4	33NiCrMoV14-5	40CrMoV13-9
Steel Number	1.7003	1.7006	1.7033	1.7034	1.7035	1.6511	1.6582	1.6580	1.6773	1.8159	1.6956	1.8523
Steel Name	18CrMo4	20MnMoNi4-5	30CrMoV9	32CrMo12	28NiCrMoV8-5	---	---	---	---	---	---	---
Steel Number	1.7243	1.6311	1.7707	1.7361	1.6932	---	---	---	---	---	---	---

6.4.4 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	---	---	---	---	---	---	---	---	---	---	---

6.4.5 Non-Comparable Stainless Steel Forgings

ASTM A 182/A 182M-00 - Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service												
Grade, Class, Type	F 122	F XM-27Cb	F 429	F 309H	F 310MoLN	F 348	F 348H	F XM-11	F XM-19	F 10	F 20	F 44
UNS Number	K92930	S44627	S42900	S30909	S31050	S34800	S34809	S21904	S20910	S33100	N08020	S31254
Grade, Class, Type	F45	F46	F 47	F 48	F 49	F 52	F 54	F 56	F 57	F 58	F 61	F 62
UNS Number	S30815	S30600	S31725	S31726	S34565	S32950	S39274	S33228	S39277	S31266	S32550	N08367
EN 10222-5:1999 - Steel Forgings for Pressure Purposes - Part 5: Martensitic, Austenitic and Austenitic-Ferritic Stainless Steels												
Steel Name	X6CrNiTiB18-10	X3CrNiMoN17-13-3	X2CrNiCu19-10	X3CrNiMo18-12-3	---	---	---	---	---	---	---	---
Steel Number	1.4941	1.4910	1.4650	1.4449	---	---	---	---	---	---	---	---
EN 10250-4:1999 - Open Die Steel Forgings for General Engineering Purposes - Part 4: Stainless Steels												
Steel Name	X1NiCrMoCu25-20-5	X6CrNiNb18-10	X1NiCrMoCu31-27-4	X1CrNiMoCuN20-18-7	X1NiMoCuN25-20-7	X6CrAl13	X20Cr13	X30Cr13	X17CrNi16-2			
Steel Number	1.4539	1.4550	1.4563	1.4547	1.4529	1.4002	1.4021	1.4028	1.4057			
Steel Name	X4CrNiMo16-5-1	---	---	---	---	---	---	---	---			
Steel Number	1.4418	---	---	---	---	---	---	---	---			
ISO 9327-5:1999 - Steel Forgings and Rolled or Forged Bars for Pressure Purposes. Technical Delivery Conditions. Part 5 : Stainless Steels												
Steel Type	X2NiCrMoCu25-20-5	---	---	---	---	---	---	---	---			

CHAPTER 7

STEEL CASTINGS

AFNOR Standards

AFNOR NF A 32-053:1992	Cast Steels for Low Temperatures Purposes
AFNOR NF A 32-054:1994	Cast Steels for General Purpose in Mechanical Engineering
AFNOR NF A 32-058:1984	Cast Steels and White Cast Iron Resistant to Abrasion
AFNOR NF A 32-057:1981	Steel Grades and Related Alloys -Refractory Moulds

ASTM Standards

ASTM A 27/A 27M-95	Steel Castings, Carbon, for General Application
ASTM A 128/A 128M-93 (1998)	Steel Castings, Austenitic Manganese
ASTM A 148/A 148 M-93 (1998)	Steel Castings, High Strength, for Structural Purposes
ASTM A 216/A 216M-93 (1998)	Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service
ASTM A 217/A 217M-99	Steel Castings, Martensitic Stainless and Alloy, for Pressure- Containing Parts, Suitable for High-Temperature Service
ASTM A 297/A 297M-97 (1998)	Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat Resistant, for General Application
ASTM A 351/A 351M-94 (1999)	Castings, Austenitic, Austenitic-Ferritic (Duplex), for Pressure-Containing Parts
ASTM A 352/A 352M-93 (1998)	Steel Castings, Ferritic and Martensitic, for Pressure-Containing Parts, Suitable for Low-Temperature Service
ASTM A 389/A 389M-93 (1998)	Steel Castings, Alloy, Specially Heat-Treated, for Pressure-Containing Parts, Suitable for High-Temperature Service
ASTM A 447/A 447M-93 (1998)	Steel Castings, Chromium-Nickel-Iron Alloy (25-12 Class), for High-Temperature Service
ASTM A 487/A 487M-93 (1998)	Steel Castings Suitable for Pressure Service
ASTM A 608-91 (1998)	Centrifugally Cast Iron-Chromium-Nickel High-Alloy Tubing for Pressure Application at High Temperatures
ASTM A 743/A 743M-98	Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application
ASTM A 744/A 744M-98	Castings, Iron-Chromium-Nickel, Corrosion Resistant, for Severe Service
ASTM A 757/A 757M-00	Steel Castings, Ferritic and Martensitic, for Pressure-Containing and Other Applications, for Low-Temperature Service
ASTM A 958-00	Steel Castings, Carbon, and Alloy, with Tensile Requirements, Chemical Requirements Similar to Standard Wrought Grades

BSI Standards

BSI BS 3100:1991 Amd. 1:1992	Steel Castings for General Engineering Purposes
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DIN Standards

DIN 1681:1985	Cast Steels for General Engineering Purposes
DIN 17205:1992	Quenched and Tempered Steel Castings for General Applications
DIN 17465:1993	Heat Resisting Steel Castings

CEN Standards

EN 10213-2:1996	Steel Castings for Pressure Purposes Part 2: Steel Grades for Use at Room Temperature and at Elevated Temperature
EN 10213-3:1996	Steel Castings for Pressure Purposes Part 3: Steel Grades for Use at Low Temperatures
EN 10213-4:1996	Steel Castings for Pressure Purposes Part 4: Austenitic and Austenitic-Ferritic Steel Grades
EN 10283:1999	Corrosion Resistant Steel Castings

ISO Standards

ISO 11972:1998	Corrosion-Resistant Cast Steels for General Applications
ISO 11973:1999	Heat-Resistant Cast Steels and Alloys for General Applications
ISO 13521:1999	Austenitic Manganese Steel Castings
ISO 3755:1991	Cast Carbon Steels for General Engineering Purposes
ISO 4991:1994	Steel Castings for Pressure Purposes

JIS Standards

JIS G 5101:1991	Carbon Steel Castings
JIS G 5102:1991	Steel Castings for Welded Structure
JIS G 5111:1991	High Tensile Strength Carbon Steel Castings and Low Alloy Steel Castings for Structural Purposes
JIS G 5121:1991	Stainless Steel Castings
JIS G 5122:1991	Heat Resisting Steel Castings
JIS G 5131:1991	High Manganese Steel Castings
JIS G 5151:1991	Steel Castings for High Temperature and High Pressure Service
JIS G 5152:1991	Steel Castings for Low Temperature and High Pressure Service

Heat Treatment Terms Applicable to this Chapter

Standard	Heat Treatment Terms
AFNOR NF A 32-053:1992	QT: quenched and tempered; Q (HY): hyperquenched
AFNOR NF A 32-054:1994	N: normalized; QT quenched and tempered; Q: quenched
AFNOR NF A 32-057:1981	AS: as cast
AFNOR NF A 32-058:1984	Not specified
ASTM A 27/A 27M-95	AS: as cast; A: annealed; N: normalized; NT: normalized and tempered; QT: quenched and tempered
ASTM A 128/A 128M-93 (1998)	See standard
ASTM A 148/A 148 M-93 (1998)	A: annealed; N: normalized; NT: normalized and tempered; QT: quenched and tempered
ASTM A 216/A 216M-93 (1998)	A: annealed; N: normalized; NT: normalized and tempered
ASTM A 217/A 217M-99	NT: normalized and tempered
ASTM A 297/A 297M-97 (1998)	AS: as cast
ASTM A 351/A 351M-94 (1999)	AS: as cast; S: solution treat and rapid cool
ASTM A 352/A 352M-93 (1998)	NT: normalized and tempered; QT: quenched and tempered
ASTM A 389/A 389M-93 (1998)	NT: normalized and tempered
ASTM A 447/A 447M-93 (1998)	AS: as cast
ASTM A 487/A 487M-93 (1998)	NT: normalized and tempered; QT: quenched and tempered
ASTM A 608-91 (1998)	AS: as cast
ASTM A 743/A 743M-98	A: annealed; N: normalized; S: solution treat and rapid cool
ASTM A 744/A 744M-98	N: normalized; S: solution treat and rapid cool
ASTM A 757/A 757M-00	NT: normalized and tempered; QT: quenched and tempered
ASTM A 958-00	N: normalized; NT: normalized and tempered; QT: quenched and tempered
BSI BS 3100:1991 Amd. 1:1992	A: annealed; N: normalized; OQ: oil quenched; WQ: water quenched; AH: air hardened; T: tempered; ST: solution treated
DIN 1681:1985	---
DIN 17205:1992	NT: air hardened and tempered
DIN 17465:1993	AS: as cast; A: annealed
EN 10213-2:1996	N: normalized; Q: quenched; T: tempered
EN 10213-3:1996	N: normalized; Q: quenched; T: tempered
EN 10213-4:1996	AT + QW: solution annealed + water quenched
EN 10283:1999	Q: quenched; T: tempered; AT: solution annealed
ISO 3755:1991	---
ISO 4991:1994	A: annealed; N: normalized; Q: quenched; T: tempered; N _{ac} : heated, accelerated air cooling; S: solution treated; (): brackets indicate that the treatment is only applied in special cases
ISO 11972:1998	AT: austenitize and temper; ST/Q: solution treat and quench
ISO 11973:1999	AS: as cast; A: annealed
ISO 13521:1999	ST + WQ: solution treated + water quenched
JIS G 5101:1991	A: annealed; N: normalized; NT: normalized and tempered; QT: quenched and tempered
JIS G 5102:1991	A: annealed; N: normalized; NT: normalized and tempered; QT: quenched and tempered
JIS G 5111:1991	NT: normalized and tempered; QT: quenched and tempered
JIS G 5121:1991	T: quenched and tempered; T1 or T2: tempered at specified temperature; S: solution heat treated and rapid cooling; HXXX: solution treated + age hardened.
JIS G 5122:1991	AS: as cast; A: annealed
JIS G 5131:1991	WT: water toughening
JIS G 5151:1991	A: annealed; N: normalized; NT: normalized and tempered; QT: quenched and tempered
JIS G 5152:1991	A: annealed; N: normalized; NT: normalized and tempered; QT: quenched and tempered

7.1 Cast Carbon Steels

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
JIS G 5101:1991	SC 360	---	---	A, N, NT, or QT	---	---	175	---	360	---	23	---
DIN 1681:1985	GS-38	1.0420	---	---	---	---	200	---	380	---	25	---
AFNOR NF A 32-054:1994	GE230	---	---	N	$28 \leq t < 50$	---	230	---	400	---	25	---
		---	---	N	$50 \leq t < 100$	---	210	---	400	---	23	---
ISO 3755:1991	200-400	---	---	---	---	---	200	---	400-550	---	25	---
	200-400W	---	---	---	---	---	200	---	400-550	---	25	---
JIS G 5101:1991	SC 410	---	---	A, N, NT, or QT	---	---	205	---	410	---	21	---
JIS G 5102:1991	SCW 410	---	---	A, N, NT, or QT	---	---	235	---	410	---	21	27 J at 0°C
ASTM A 27/A 27M-95 (2000)	U-60-30	---	J02500	AC	---	---	205	30	415	60	22	---
	60-30	---	J03000	A, N, NT, or QT	---	---	205	30	415	60	24	---
BSI BS 3100:1991 AMD.1:1992	A1	---	---	A, N, NT, OQT or WQT	---	---	230	---	430	---	22	27 J at 20°C
AFNOR NF A 32-054:1994	G16Mn5	---	---	N	$28 \leq t < 50$	---	250	---	430	---	24	---
					$50 \leq t < 100$	---	230	---	430	---	24	---
ASTM A 27/A 27M-95 (2000)	65-35	---	J03001	A, N, NT, or QT	---	---	240	35	450	65	24	---
ASTM A 958-00	SC 1020 Cl. 65/35	---	---	N	---	---	240	35	450	65	24	---
	SC 1025 Cl. 65/35											
	SC 1030 Cl. 65/35											
JIS G 5101:1991	SC 450	---	---	A, N, NT, or QT	---	---	225	---	450	---	19	---
JIS G 5102:1991	SCW 450	---	---	A, N, NT, or QT	---	---	255	---	450	---	20	27 J at 0°C
DIN 1681:1985	GS-45	1.0446	---	---	---	---	230	---	450	---	22	---
ISO 3755:1991	230-450	---	---	---	---	---	230	---	450-600	---	22	---
	230-450W											

7.1 Cast Carbon Steels

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
AFNOR NF A 32-054:1994	GE280	---	---	N	28 ≤ t < 50	---	280	---	480	---	20	---
					50 ≤ t <100	---	260	---	480	---	18	---
JIS G 5101:1991	SC 480	---	---	A, N, NT, or QT	---	---	245	---	480	---	17	---
JIS G 5102:1991	SCW 480	---	---	A, N, NT, or QT	---	---	275	---	480	---	20	27 J at 0°C
ISO 3755:1991	270-480	---	---	---	---	---	270	---	480-630	---	18	---
	270-480W											
ASTM A 27/A 27M-95 (2000)	70-36	---	J03501	A, N, NT, or QT	---	---	250	36	485	70	22	---
	70-40	---	J02501	A, N, NT, or QT	---	---	275	40	485	70	22	---
ASTM A 958-00	SC 1020 Cl. 70/36	---	---	N	---	---	250	36	485	70	22	---
	SC 1025 Cl. 70/36											
	SC 1030 Cl. 70/36	---	---	NT								
	SC 1040 Cl. 70/36											
BSI BS 3100:1991 AMD.1:1992	A2	---	---	A, N, NT, OQT or WQT	---	---	260	---	490	---	18	20 J at 20°C
AFNOR NF A 32-054:1994	G20Mn6	---	---	N	28 ≤ t < 50	---	300	---	500	---	22	---
					50 ≤ t <100	---	280	---	500	---	22	---
					100 ≤ t < 150	---	260	---	480	---	20	---
					150 ≤ t < 250	---	240	---	450	---	---	---
				QT	28 ≤ t < 50	---	360	---	500	---	24	---
					50 ≤ t <100	---	300	---	500	---	24	---
					100 ≤ t < 150	---	280	---	500	---	22	---
AFNOR NF A 32-053:1992	20 M5-M	---	---	QT	≤ 30	---	300	---	500	---	24	27 J at -30°C
DIN 1681:1985	GS-52	1.0552	---	---	---	---	260	---	520	---	18	---
DIN 17205:1992	GS-30 Mn 5	1.1165	---	QT	≤ 400	---	260	---	520-670	---	18	---
JIS G 5111:1991	SCC 3A	---	---	NT	---	---	265	---	520	---	13	143 HB
BSI BS 3100:1991 AMD.1:1992	A3	---	---	A, N, NT, OQT or WQT	---	---	295	---	540	---	14	18 J at 20°C
JIS G 5111:1991	SCMn 1A	---	---	NT	---	---	275	---	540	---	17	143 HB
BSI BS 3100:1991 AMD.1:1992	A4	---	---	N, NT, OQT or WQT	---	---	320	---	540-690	---	16	30 J at 20°C

7.1 Cast Carbon Steels

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 148/A 148M-93 (1998)	80-40	---	---	A, N, NT, or QT	---	---	275	40	550	80	18	---
	80-50	---	---	A, N, NT, or QT	---	---	345	50	550	80	22	---
ASTM A 958-00	SC 1030 Cl. 80/40	---	---	QT	---	---	275	40	550	80	18	---
	SC 1040 Cl. 80/40	---	---	NT								
	SC 1045 Cl. 80/40	---	---	NT								
	SC 1030 Cl. 80/50	---	---	QT	---	---	345	50	550	80	22	---
	SC 1040 Cl. 80/50	---	---	NT								
	SC 1045 Cl. 80/50	---	---	NT								
JIS G 5102:1991	SCW 550	---	---	A, N, NT, or QT	---	---	355	---	550	---	18	27 J at 0°C
ISO 3755:1991	340-550	---	---	---	---	---	340	---	550-700	---	15	---
	340-550W											
AFNOR NF A 32-054:1994	GE320	---	---	N	28 ≤ t < 50	---	320	---	560	---	16	---
					50 ≤ t < 100	---	300	---	560	---	14	---
	G30Mn6	---	---	N	28 ≤ t < 50	---	350	---	580	---	16	---
					50 ≤ t < 100	---	300	---	550	---	16	---
					100 ≤ t < 150	---	280	---	550	---	14	---
					150 ≤ t < 250	---	250	---	520	---	14	---
JIS G 5111:1991	SCSiMn 2A	---	---	NT	---	---	295	---	590	---	13	163 HB
	SCMn 1B	---	---	QT	---	---	390	---	590	---	17	170 HB
	SCMn 2A	---	---	NT	---	---	345	---	590	---	16	163 HB

7.1 Cast Carbon Steels

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
DIN 1681:1985	GS-60	1.0558	---	---	---	---	300	---	600	---	15	---
AFNOR NF A 32-054:1994	G30Mn6	---	---	QT2 (TR2)	28 ≤ t < 50	---	450	---	600	---	16	27 J at -10°C
					50 ≤ t < 100	---	450	---	600	---	16	---
					100 ≤ t < 150	---	400	---	550	---	14	---
					150 ≤ t < 250	---	250	---	520	---	14	---
JIS G 5111:1991	SCC 5A	---	---	NT	---	---	295	---	620	---	9	163 HB
	SCC 3B	---	---	QT	---	---	370	---	620	---	13	183 HB
BSI BS 3100:1991 AMD.1:1992	A5	---	---	N, NT, OQT or WQT	---	---	370	---	620-770	---	13	25 J at 20°C
ASTM A 148/A 148M-93 (1998)	90-60	---	---	A, N, NT, or QT	---	---	415	60	620	90	20	---
ASTM A 958-00	SC 1040 Cl. 90/60	---	---	NT	---	---	415	60	620	90	18	---
	SC 1045 Cl. 90/60	---	---	NT	---	---	415	60	620	90	18	---
JIS G 5102:1991	SCW 620	---	---	A, N, NT, or QT	---	---	430	---	620	---	17	27 J at 0°C
JIS G 5111:1991	SCMn 3A	---	---	NT	---	---	370	---	640	---	13	170 HB
	SCMn 2B	---	---	QT	---	---	440	---	640	---	16	183 HB
	SCSiMn 2B	---	---	QT	---	---	440	---	640	---	17	183 hb
AFNOR NF A 32-054:1994	GE370	---	---	N	28 ≤ t < 50	---	370	---	650	---	12	---
					50 ≤ t < 100	---	320	---	650	---	10	---
JIS G 5111:1991	SCMn 5A	---	---	NT	---	---	390	---	690	---	9	183 HB
	SCC 5B	---	---	QT	---	---	440	---	690	---	9	201 HB
	SCMn 3B	---	---	QT	---	---	490	---	690	---	13	197 HB
BSI BS 3100:1991 AMD.1:1992	A6	---	---	OQT or WQT	---	---	495	---	690-850	---	13	25 J at 20°C
AFNOR NF A 32-054:1994	G30Mn6	---	---	QT1 (TR1)	28 ≤ t < 50	---	550	---	700	---	10	---
					50 ≤ t < 100	---	550	---	700	---	10	---
ASTM A 148/A 148M-93 (1998)	105-85	---	J31575	A, N, NT, or QT	---	---	585	85	725	105	17	---
ASTM A 958-00	SC 1045 Cl. 105/85	---	---	NT	---	---	585	85	725	105	17	---
JIS G 5111:1991	SCMn 5B	---	---	QT	---	---	540	---	740	---	9	212 HB

7.1 Cast Carbon Steels

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

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 5101:1991	SC 360	---	---	0.20	---	---	0.040	0.040	---	---	---	---
DIN 1681:1985	GS-38	1.0420	---	---	---	---	---	---	---	---	---	---
AFNOR NF A 32-054:1994	GE 230	---	---	0.20	1.20	0.60	0.035	0.030	---	---	---	---
ISO 3755:1991	200-400	---	---	---	---	---	0.035	0.035	---	---	---	---
	200-400W	---	---	0.25	1.00	0.60	0.035	0.035	0.35	0.40	0.15	Cu 0.40; V 0.05; Ni+Cr+Mo+V 1.00
JIS G 5101:1991	SC 410	---	---	0.30	---	---	0.040	0.040	---	---	---	---
JIS G 5102:1991	SCW 410	---	---	0.22	1.50	0.80	0.040	0.040	---	---	---	---
ASTM A 27/A 27M-95 (2000)	U-60-30	---	J02500	0.25	0.75	0.80	0.05	0.06	---	---	---	---
	60-30	---	J03000	0.30	0.60	0.80	0.05	0.06	---	---	---	---
BSI BS 3100:1991 AMD.1:1992	A1	---	---	0.25	0.90	0.60	0.050	0.050	0.30	0.40	0.15	Cu 0.30; Cu+Ni+Cr+Mo 0.80
AFNOR NF A 32-054:1994	G16Mn5	---	---	0.13-0.20	1.60	0.60	0.030	0.025	---	---	---	---
ASTM A 27/A 27M-95 (2000)	65-35	---	J03001	0.30	0.70	0.80	0.05	0.06	---	---	---	---
ASTM A 958-00	SC 1020 Cl. 65/35	---	---	0.18-0.23	0.40-0.80	0.30-0.60	0.040	0.040	---	---	---	---
	SC 1025 Cl. 65/35	---	---	0.22-0.28	0.40-0.80	0.30-0.60	0.040	0.040	---	---	---	---
	SC 1030 Cl. 65/35	---	---	0.28-0.34	0.50-0.90	0.30-0.60	0.040	0.040	---	---	---	---
JIS G 5101:1991	SC 450	---	---	0.35	---	---	0.040	0.040	---	---	---	---
JIS G 5102:1991	SCW 450	---	---	0.22	1.50	0.80	0.040	0.040	---	---	---	---
DIN 1681:1985	GS-45	---	---	---	---	---	---	---	---	---	---	---
ISO 3755:1991	230-450	---	---	---	---	---	0.035	0.035	---	---	---	---
	230-450W	---	---	0.25	1.20	0.60	0.035	0.035	0.35	0.40	0.15	Cu 0.40; V 0.05; Ni+Cr+Mo+V 1.00

7.1 Cast Carbon Steels

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

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
AFNOR NF A 32-054:1994	GE 280	---	---	0.25	1.20	0.60	0.035	0.030	---	---	---	---
JIS G 5101:1991	SC 480	---	---	0.40	---	---	0.040	0.040	---	---	---	---
JIS G 5102:1991	SCW 480	---	---	0.22	1.50	0.80	0.040	0.040	0.50	0.50	---	---
ISO 3755:1991	270-480	---	---	---	---	---	0.035	0.035	---	---	---	---
	270-480W	---	---	0.25	1.20	0.60	0.035	0.035	0.35	0.40	0.15	Cu 0.40; V 0.05; Ni+Cr+Mo+V 1.00
ASTM A 27/A 27M-95 (2000)	70-36	---	J03501	0.35	0.70	0.80	0.05	0.06	---	---	---	---
	70-40	---	J02501	0.25	1.20	0.70	0.05	0.06	---	---	---	---
ASTM A 958-00	SC 1020 Cl. 70/36	---	---	0.18-0.23	0.40-0.80	0.30-0.60	0.040	0.040	---	---	---	---
	SC 1025 Cl. 70/36	---	---	0.22-0.28	0.40-0.80	0.30-0.60	0.040	0.040	---	---	---	---
	SC 1030 Cl. 70/36	---	---	0.20-0.34	0.50-0.90	0.30-0.60	0.040	0.040	---	---	---	---
	SC 1040 Cl. 70/36	---	---	0.37-0.44	0.50-0.90	0.30-0.60	0.040	0.040	---	---	---	---
BSI BS 3100:1991 AMD.1:1992	A2	---	---	0.35	1.00	0.60	0.050	0.050	---	---	---	---
AFNOR NF A 32-054:1994	G20Mn6	---	---	0.17-0.23	1.80	0.60	0.030	0.025	---	---	---	---
AFNOR NF A 32-053:1992	20 M5-M	---	---	0.17-0.23	1.10-1.50	0.60	0.025	0.020	---	---	---	---
DIN 1681:1985	GS-52	1.0552	---	---	---	---	---	---	---	---	---	---
DIN 17205:1992	GS-30 Mn 5	1.1165	---	0.27-0.34	1.20-1.50	0.60	0.020	0.015	---	---	---	---
JIS G 5111:1991	SCC 3	---	---	0.30-0.40	0.50-0.80	0.30-0.60	0.040	0.040	---	---	---	---
BSI BS 3100:1991 AMD.1:1992	A3	---	---	0.40	1.0	0.60	0.050	0.050	---	---	---	---
JIS G 5111:1991	SCMn 1	---	---	0.20-0.30	1.00-1.60	0.30-0.60	0.040	0.040	---	---	---	---
BSI BS 3100:1991 AMD.1:1992	A4	---	---	0.18-0.25	1.2-1.6	0.60	0.050	0.050	---	---	---	---

7.1 Cast Carbon Steels

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

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 148/A 148M-93 (1998)	80-40	---	---	---	---	---	0.05	0.06	---	---	---	---
ASTM A 958-00	SC 1030 Cl. 80/40	---	---	0.20-0.34	0.40-0.80	0.30-0.60	0.040	0.040	---	---	---	---
	SC 1030 Cl. 80/50	---	---	0.37-0.44	0.50-0.90	0.30-0.60	0.040	0.040	---	---	---	---
	SC 1040 Cl. 80/40	---	---	0.37-0.44	0.50-0.90	0.30-0.60	0.040	0.040	---	---	---	---
	SC 1040 Cl. 80/50	---	---	0.37-0.44	0.50-0.90	0.30-0.60	0.040	0.040	---	---	---	---
JIS G 5102:1991	SCW 550	---	---	0.22	1.50	0.80	0.040	0.040	0.50	2.50	0.30	V 0.20
	340-550	---	---	---	---	---	0.035	0.035	---	---	---	---
ISO 3755:1991	340-550W	---	---	0.25	1.50	0.60	0.035	0.035	0.35	0.40	0.15	V 0.05; Cu+Ni+Cr+Mo+V 1.00
	GE320	---	---	0.32	1.20	0.60	0.035	0.030	---	---	---	---
AFNOR NF A 32-054:1994	G30Mn6	---	---	0.25-0.32	1.80	0.60	0.030	0.025	---	---	---	---
	SCSiMn 2	---	---	0.25-0.35	0.90-1.20	0.50-0.80	0.040	0.040	---	---	---	---
JIS G 5111:1991	SCMn 1	---	---	0.20-0.30	1.00-1.60	0.30-0.60	0.040	0.040	---	---	---	---
JIS G 5111:1991	SCMn 2	---	---	0.25-0.35	1.00-1.60	0.30-0.60	0.040	0.040	---	---	---	---
DIN 1681:1985	GS-80	1.0558	---	---	---	---	---	---	---	---	---	---
AFNOR NF A 32-054:1994	G30Mn6	---	---	0.25-0.32	1.80	0.60	0.030	0.025	---	---	---	---
	SCC 5	---	---	0.40-0.50	0.50-0.80	0.30-0.60	0.040	0.040	---	---	---	---
JIS G 5111:1991	SCC 3	---	---	0.30-0.40	0.50-0.80	0.30-0.60	0.040	0.040	---	---	---	---
	SCC 3	---	---	0.30-0.40	0.50-0.80	0.30-0.60	0.040	0.040	---	---	---	---
BSI BS 3100:1991 AMD.1:1992	A5	---	---	0.25-0.33	1.2-1.6	0.60	0.05	0.05	---	---	---	---
ASTM A 148/A 148M-93 (1998)	90-60	---	---	---	---	---	0.05	0.06	---	---	---	---
ASTM A 958-00	SC 1040 Cl. 90/60	---	---	0.37-0.44	0.50-0.90	0.30-0.60	0.040	0.040	---	---	---	---
	SC 1045 Cl. 90/60	---	---	0.43-0.50	0.50-0.90	0.30-0.60	0.040	0.040	---	---	---	---
JIS G 5102:1991	SCW 620	---	---	0.22	1.50	0.80	0.040	0.040	0.50	2.50	0.30	V 0.20
JIS G 5111:1991	SCMn 3	---	---	0.30-0.40	1.00-1.60	0.30-0.60	0.040	0.040	---	---	---	---
	SCMn 2	---	---	0.25-0.35	1.00-1.60	0.30-0.60	0.040	0.040	---	---	---	---
	SCSiMn 2	---	---	0.25-0.35	0.90-1.20	0.50-0.80	0.040	0.040	---	---	---	---

7.1 Cast Carbon Steels

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

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
AFNOR NF A 32-054:1994	GE370	---	---	0.45	1.20	0.60	0.035	0.030	---	---	---	---
JIS G 5111:1991	SCMn 5	---	---	0.40-0.50	1.00-1.60	0.30-0.60	0.040	0.040	---	---	---	---
	SCC 5	---	---	0.40-0.50	0.50-0.80	0.30-0.60	0.040	0.040	---	---	---	---
	SCMn 3	---	---	0.30-0.40	1.00-1.60	0.30-0.60	0.040	0.040	---	---	---	---
BSI BS 3100:1991 AMD.1:1992	A6	---	---	0.25-0.32	1.2-1.6	0.60	0.050	0.050	---	---	---	---
ASTM A 148/A 148M-93 (1998)	105-85	---	J31575	---	---	---	0.05	0.06	---	---	---	---
ASTM A 958-00	SC 1045 Cl. 105/85	---	---	0.43-0.50	0.50-0.90	0.30-0.60	0.040	0.040	---	---	---	---
JIS G 5111:1991	SCMn 5	---	---	0.40-0.50	1.00-1.60	0.30-0.60	0.040	0.040	---	---	---	---

7.1 Cast Carbon Steels

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
JIS G 5151:1991	SCPH 1	---	---	A, N, NT, or QT	---	---	205	---	410	---	---	---
ASTM A 216/A 216M-93 (1998)	WCA	---	J02502	A, N, or NT	---	---	205	---	415-585	---	---	---
EN 10213-2:1996	GP240GR	1.0621	---	N	---	---	240	---	420-600	---	22	---
	GP240GH	1.0619	---	N or QT	---	---	240	---	420-600	---	22	---
ISO 4991:1994	C23-45A	---	---	A, N(T), or (QT)	---	---	240	---	450-600	---	22	---
	C23-45AH	---	---	N(T) or QT								
	C23-45B	---	---	A, N(T), or (QT)								
	C23-45BH	---	---	N(T) or QT								
JIS G 5151:1991	SCPH 2	---	---	A, N, NT, or QT	---	---	245	---	480	---	---	---
EN 10213-2:1996	GP280GH	1.0625	---	N or QT	---	---	280	---	480-640	---	22	---
ASTM A 216/A 216M-93 (1998)	WCB	---	J03002	A, N, or NT	---	---	250	---	485-655	---	---	---
	WCC	---	J02503	A, N, or NT	---	---	275	---	485-655	---	---	---
ISO 4991:1994	C26-52	---	---	A, N(T), or (QT)	---	---	280	---	520-670	---	18	---
	C26-52H	---	---	NT or QT								

7.1 Cast Carbon Steels

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

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 5151:1991	SCPH 1	---	---	0.25	0.70	0.60	0.040	0.040	0.25	0.50	0.25	Cu+Ni+Cr+Mo 1.00
ASTM A 216/A 216M-93 (1998)	WCA	---	J02502	0.25	0.70	0.60	0.04	0.045	0.50	0.50	0.20	Cu 0.30; V 0.03; Cu+Ni+Cr+Mo+V 1.00
EN 10213-2:1996	GP240GP	1.0621	---	0.18-0.25	1.20	0.60	0.030	0.020	---	---	---	---
	GP240GH	1.0619	---	0.18-0.23	0.50-1.20	0.60	0.030	0.020	---	---	---	---
ISO 4991:1995	C23-45A	---	---	0.025	1.20	0.60	0.035	0.035	---	---	---	---
	C23-45H											
	C23-45B	---	---	0.20	1.00-1.60	0.60	0.030	0.030	---	---	---	---
	C23-45BH											
JIS G 5151:1991	SCPH 2	---	---	0.30	1.00	0.60	0.040	0.040	0.25	0.50	0.25	Cu+Ni+Cr+Mo 1.00
EN 10213-2:1996	GP280GH	1.0625	---	0.18-0.25	0.80-1.20	0.60	0.030	0.020	---	---	---	---
ASTM A 216/A 216M-93 (1998)	WCB	---	J03002	0.30	1.00	0.60	0.04	0.045	0.50	0.50	0.20	Cu 0.30; V 0.03; Cu+Ni+Cr+Mo+V 1.00
	WCC	---	J02503	0.25	1.20	0.60	0.04	0.045	0.50	0.50	0.20	Cu 0.30; V 0.03; Cu+Ni+Cr+Mo+V 1.00
ISO 4991:1995	C26-52	---	---	0.25	1.20	0.60	0.030	0.030	---	---	---	---
	C26-52H											

7.1 Cast Carbon Steels

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 352/A 352M-93 (1998)	LCA	---	J02504	NT or QT	---	---	205	30.0	415-585	60-85	24	18 J at -46°C
ASTM A 757/A 757M-00	A1Q	---	J03002	QT	---	---	240	35	450	65	24	17 J at -46°C
JIS G 5152:1991	SCPL 1	---	---	A, N, NT, or QT	---	---	245	---	450	---	21	18 J at -46°C
ISO 4991:1994	C23-45BL	---	---	(NT) or QT	---	---	240	---	450-600	---	22	27 J at -40°C
EN 10213-3:1996	G17Mn5	1.1131	---	QT	≤ 50	---	240	---	450-600	---	24	27 J at -40°C
ASTM A 352/A 352M-93 (1998)	LCB	---	J03003	NT or QT	---	---	240	35	450-620	65.0-90.0	24	18 J at -46°C
EN 10213-3:1996	G20Mn5	1.6220	---	N	≤ 30	---	300	---	480-620	---	20	27 J at -30°C
ASTM A 757/A 757M-00	A2Q	---	J02503	QT	---	---	275	40	485	70	22	20 J at -46°C
ASTM A 352/A 352M-93 (1998)	LCC	---	J02505	NT or QT	---	---	275	40.0	485-655	70.0-95.0	22	20 J at -46°C
EN 10213-3:1996	G20Mn5	1.6220	---	QT	≤ 100	---	300	---	500-650	---	22	27 J at -40°C
ISO 4991:1994	C26-52L	---	---	(NT) or QT	---	---	280	---	520-670	---	18	27 J at -35°C

7.1 Cast Carbon Steels

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

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 352/A 352M-93 (1998)	LCA	---	J02504	0.25	0.70	0.60	0.04	0.045	0.50	0.50	0.20	Cu 0.30; V 0.03; Ni+Cr+Mo+Cu+V 1.00
ASTM A 757/A 757M-00	A1Q	---	J03002	0.30	1.00	0.60	0.025	0.025	0.40	0.50	0.25	Cu 0.50; V 0.03; Ni+Cr+Mo+Cu+V 1.00
JIS G 5152:1991	SCPL 1	---	---	0.30	1.00	0.60	0.040	0.040	0.25	0.50	---	Cu 0.50; Cu+Ni+Cr 1.00
ISO 4991:1994	C23-45BL	---	---	0.20	1.00-1.60	0.60	0.030	0.030	---	---	---	---
EN 10213-3:1996	G17Mn5	1.1131	---	0.15-0.20	1.00-1.60	0.60	0.020	0.020	---	---	---	---
ASTM A 352/A 352M-93 (1998)	LCB	---	J03003	0.30	1.00	0.60	0.04	0.045	0.50	0.50	0.20	Cu 0.30; V 0.03; Ni+Cr+Mo+Cu+V 1.00
EN 10213-3:1996	G20Mn5	1.6220	---	0.17-0.23	1.00-1.60	0.60	0.020	0.020	---	0.80	---	---
ASTM A 757/A 757M-00	A2Q	---	J02503	0.25	1.20	0.60	0.025	0.025	0.40	0.50	0.25	Cu 0.50; V 0.03; Ni+Cr+Mo+Cu+V 1.00
ASTM A 352/A 352M-93 (1998)	LCC	---	J02505	0.25	1.20	0.60	0.04	0.045	0.50	0.50	0.20	V 0.03; Ni+Cr+Mo+Cu+V 1.00
ISO 4991:1994	C26-52L	---	---	0.25	1.20	0.60	0.030	0.030	---	---	---	---

7.2 Cast Manganese Steels

7.2A Chemical Composition of Cast Manganese Steels

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 5131:1991	SCMnH 1	---	---	0.90-1.30	11.00-14.00	---	0.100	0.050	---	---	---	---
	SCMnH 2	---	---	0.90-1.20	11.00-14.00	0.80	0.070	0.040	---	---	---	---
	SCMnH 3	---	---	0.90-1.20	11.00-14.00	0.30-0.80	0.050	0.035	---	---	---	---
ASTM A 128/A 128M-93 (1998)	A	---	J91109	1.05-1.35	11.0	1.00	0.07	---	---	---	---	---
	B-1	---	J91119	0.9-1.05	11.5-14.0	1.00	0.07	---	---	---	---	---
	B-2	---	J91129	1.05-1.2	11.5-14.0	1.00	0.07	---	---	---	---	---
	B-3	---	J91139	1.12-1.28	11.5-14.0	1.00	0.07	---	---	---	---	---
	B-4	---	J91149	1.2-1.35	11.5-14.0	1.00	0.07	---	---	---	---	---
BSI BS 3100:1991 AMD.1:1992	BW 10	---	---	1.00-1.35	11.0	1.0	0.050	0.050	---	---	---	---
AFNOR NF A 32-058:1984	Z120M12-M	---	---	1.1-1.4	11-14	1	0.08	0.030	---	---	---	---
ISO 13521:1999	GX100Mn13	---	---	0.90-1.05	11-14	0.3-0.9	0.060	0.045	---	---	---	---
	GX120Mn13	---	---	1.05-1.35	11-14	0.3-0.9	0.060	0.045	---	---	---	---
JIS G 5131:1991	SCMnH 11	---	---	0.90-1.30	11.00-14.00	0.80	0.070	0.040	1.50-2.50	---	---	---
ASTM A 128/A 128M-93 (1998)	C	---	J91309	1.05-1.35	11.5-14.0	1.00	0.07	---	1.5-2.5	---	---	---
AFNOR NF A 32-058:1984	Z120MC12-M	---	---	1.1-1.4	11-14	1	0.08	0.030	1-2.5	---	---	---
ISO 13521:1999	GX120MnCr13-2	---	---	1.05-1.35	11-14	0.3-0.9	0.060	0.045	1.5-2.5	---	---	---
ASTM A 128/A 128M-93 (1998)	D	---	J91459	0.7-1.3	11.5-14.0	1.00	0.07	---	---	3.0-4.0	---	---
AFNOR NF A 32-058:1984	Z100MN13 4-M	---	---	0.7-1.3	12-15	1	0.08	0.030	---	2-5	---	---
ISO 13521:1999	GX120MnNi13-3	---	---	1.05-1.35	11-14	0.3-0.9	0.060	0.045	---	3-4	---	---
ASTM A 128/A 128M-93 (1998)	E-1	---	J91249	0.7-1.3	11.5-14.0	1.00	0.07	---	---	---	0.9-1.2	---
AFNOR NF A 32-058:1984	Z110MD12 1-M	---	---	0.8-1.3	11-14	1	0.08	0.030	---	---	0.8-1.2	---
ISO 13521:1999	GX110MnMo13-1	---	---	0.75-1.35	11-14	0.3-0.9	0.060	0.045	---	---	0.9-1.2	---

7.2 Cast Manganese Steels

7.2A Chemical Composition of Cast Manganese Steels (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 128/A 128M-93 (1998)	E-2	---	J91339	1.05-1.45	11.5-14.0	1.00	0.07	---	---	---	1.8-2.1	---
ISO 13521:1999	GX90MnMo14	---	---	0.70-1.00	13-15	0.3-0.6	0.070	0.045	---	---	1.0-1.8	---
ASTM A 128/A 128M-93 (1998)	F	---	J91340	1.05-1.35	6.0-8.0	1.00	0.07	---	---	---	0.9-1.2	---
AFNOR NF A 32-058:1984	Z100MD8 1-M	---	---	0.8-1.2	5-7	1	0.08	0.030	---	---	0.8-1.2	---
ISO 13521:1999	GX120MnMo7-1	---	---	1.05-1.35	6-8	0.3-0.9	0.060	0.045	---	---	0.9-1.2	---
AFNOR NF A 32-058:1984	Z120MC17 2-M	---	---	1.1-1.4	16-18	1	0.08	0.030	1.8-2.3	---	---	---
ISO 13521:1999	GX120MnCr7-2	---	---	1.05-1.35	16-19	0.3-0.9	0.060	0.045	1.5-2.5	---	---	---

7.2 Cast Manganese Steels

7.2B Mechanical Properties of Cast Manganese Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
JIS G 5131:1991	SCMnH 1	---	---	WT	---	---	---	---	---	---	---	---
	SCMnH 2	---	---	WT	---	---	---	---	740	---	---	---
	SCMnH 3	---	---	WT	---	---	---	---	740	---	---	---
ASTM A 128/A 128M-93 (1998)	A	---	J91109	see standard	---	---	---	---	---	---	---	---
	B-1	---	J91119	see standard	---	---	---	---	---	---	---	---
	B-2	---	J91129	see standard	---	---	---	---	---	---	---	---
	B-3	---	J91139	see standard	---	---	---	---	---	---	---	---
	B-4	---	J91149	see standard	---	---	---	---	---	---	---	---
BSI BS 3100:1991 AMD.1:1992	BW 10	---	---	ST	---	---	---	---	---	---	---	---
AFNOR NF A 32-058:1984	Z120M12-M	---	---	---	---	---	---	---	---	---	---	---
ISO 13521:1999	GX100Mn13	---	---	ST + WQ	---	---	---	---	---	---	---	---
	GX120Mn13	---	---	ST + WQ	---	---	---	---	---	---	---	---
JIS G 5131:1991	SCMnH 11	---	---	WT	---	---	390	---	740	---	---	---
ASTM A 128/A 128M-93 (1998)	C	---	J91309	see standard	---	---	---	---	---	---	---	---
AFNOR NF A 32-058:1984	Z120MC12-M	---	---	---	---	---	---	---	---	---	---	---
ISO 13521:1999	GX120MnCr13-2	---	---	ST + WQ	---	---	---	---	---	---	---	---
ASTM A 128/A 128M-93 (1998)	D	---	J91459	see standard	---	---	---	---	---	---	---	---
AFNOR NF A 32-058:1984	Z100MN13 4-M	---	---	---	---	---	---	---	---	---	---	---
ISO 13521:1999	GX120MnNi13-3	---	---	ST + WQ	---	---	---	---	---	---	---	---
ASTM A 128/A 128M-93 (1998)	E-1	---	J91249	see standard	---	---	---	---	---	---	---	---
AFNOR NF A 32-058:1984	Z110MD12 1M	---	---	---	---	---	---	---	---	---	---	---
ISO 13521:1999	GX110MnMo13-1	---	---	ST + WQ	---	---	---	---	---	---	---	---

7.2 Cast Manganese Steels

7.2B Mechanical Properties of Cast Manganese Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 128/A 128M-93 (1998)	E-2	---	J91339	see standard	---	---	---	---	---	---	---	---
ISO 13521:1999	GX90MnMo14	---	---	AC	< 45 mm and C < 0.8	---	---	---	---	---	---	---
				ST + WQ	≥ 45 mm	---						
ASTM A 128/A 128M-93 (1998)	F	---	J91340	see standard	---	---	---	---	---	---	---	---
AFNOR NF A 32-058:1984	Z100MD8 1-M	---	---	---	---	---	---	---	---	---	---	---
ISO 13521:1999	GX120MnMo7-1	---	---	ST + WQ	---	---	---	---	---	---	---	---
AFNOR NF A 32-058:1984	Z120MC17 2-M	---	---	---	---	---	---	---	---	---	---	---
ISO 13521:1999	GX120MnCr7-2	---	---	ST + WQ	---	---	---	---	---	---	---	---

7.3 Cast Alloy Steels

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

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
AFNOR NF A 32-053:1992	20 D5-M	---	---	0.23	1.20	0.60	0.025	0.020	---	---	0.45-0.65	---
BSI BS 3100:1991 AMD.1:1992	B1	---	---	0.20	0.40-1.00	0.20-0.60	0.040	0.040	0.30	0.40	0.45-0.65	Cu 0.30; Cr+Ni+Cu+V 0.80
AFNOR NF A 32-054:1994	G 25 CrMo 4	---	---	0.22-0.28	1.00	0.60	0.030	0.020	0.80-1.20	---	0.15-0.35	---
JIS G 5111:1991	SCCrM 1	---	---	0.20-0.30	0.50-0.80	0.30-0.60	0.040	0.040	0.80-1.20	---	0.15-0.35	---
DIN 17205:1992	GS-25 CrMo 4	1.7218	---	0.22-0.29	0.50-0.80	0.60	0.020	0.015	0.80-1.20	---	0.20-0.30	---
ASTM A 958-00	SC 4130	---	---	0.28-0.33	0.40-0.80	0.30-0.60	0.035	0.040	0.80-1.10	---	0.15-0.25	---
DIN 17205:1992	GS-34 CrMo 4	1.7220	---	0.30-0.37	0.50-0.80	0.60	0.020	0.015	0.80-1.20	---	0.20-0.30	---
JIS G 5111:1991	SCCrM 3	---	---	0.30-0.40	0.50-0.80	0.30-0.60	0.040	0.040	0.80-1.20	---	0.15-0.35	---
AFNOR NF A 32-054:1994	G 35 CrMo 4	---	---	0.30-0.38	1.00	0.60	0.030	0.020	0.80-1.20	---	0.15-0.35	---
ASTM A 958-00	SC 4140	---	---	0.38-0.43	0.70-1.10	0.30-0.60	0.035	0.040	0.80-1.10	---	0.15-0.25	---
DIN 17205:1992	GS-42 CrMo 4	1.7225	---	0.38-0.45	0.60-1.00	0.60	0.020	0.015	0.80-1.20	---	0.20-0.30	---
AFNOR NF A 32-054:1994	G 42 CrMo 4	---	---	0.39-0.45	1.00	0.60	0.030	0.020	0.80-1.20	---	0.15-0.35	---
ASTM A 958-00	SC 4330	---	---	0.28-0.33	0.60-0.90	0.30-0.60	0.035	0.040	0.70-0.90	1.65-2.00	0.20-0.30	---
JIS G 5111:1991	SCNCrM 2	---	---	0.25-0.35	0.90-1.50	0.30-0.60	0.040	0.040	0.30-0.90	1.60-2.00	0.15-0.35	---
DIN 17205:1992	GS-33 CrNiMo 7 4 4	1.6740	---	0.30-0.36	0.50-0.80	0.60	0.015	0.007	0.90-1.20	1.50-1.80	0.35-0.60	---
AFNOR NF A 32-054:1994	G 30 NiCrMo 8	---	---	0.33	1.00	0.60	0.030	0.020	0.80-1.20	1.70-2.30	0.30-0.60	---

7.3 Cast Alloy Steels

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

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

7.3 Cast Alloy Steels

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

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

7.3 Cast Alloy Steels

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 958-00	SC 4140 Cl. 65/35	---	---	NT	---	---	240	35	450	65	24	---
	SC 4140 Cl. 70/36	---	---	NT	---	---	250	36	485	70	22	---
	SC 4140 Cl. 80/40	---	---	NT	---	---	275	40	550	80	18	---
	SC 4140 Cl. 80/50	---	---	NT	---	---	345	50	550	80	22	---
	SC 4140 Cl. 90/60	---	---	NT	---	---	415	60	620	90	18	---
	SC 4140 Cl. 105/85	---	---	NT or QT	---	---	585	85	725	105	17	---
	SC 4140 Cl. 115/95	---	---	QT	---	---	655	95	795	115	14	---
	SC 4140 Cl. 130/115	---	---	QT	---	---	795	115	895	130	11	---
	SC 4140 Cl. 135/125	---	---	QT	---	---	860	125	930	135	9	---
	SC 4140 Cl. 150/135	---	---	QT	---	---	930	135	1035	150	7	---
DIN 17205:1992	GS-42 CrMo 4	1.7225	---	NT	≤ 150	---	400	---	700-850	---	10	see standard
					150 < t ≤ 250	---	350	---	650-800	---	10	
					250 < t ≤ 400	---	320	---	650-800	---	10	
	GS-42 CrMo 4, Cl. I	1.7225	---	QT	≤ 50	---	650	---	780-930	---		
	GS-42 CrMo 4, Cl. II	1.7225	---	QT	≤ 50	---	800	---	900-1100	---		
	GS-42 CrMo 4, Cl. I	1.7225	---	QT	50 < t ≤ 100	---	600	---	800-950	---		
	GS-42 CrMo 4, Cl. II	1.7225	---	QT	50 < t ≤ 100	---	700	---	850-1000	---		
	GS-42 CrMo 4, Cl. I	1.7225	---	QT	100 < t ≤ 150	---	550	---	700-850	---		
AFNOR NF A 32-054:1994	G42CrMo4	---	---	N	28 ≤ t < 50	---	580	---	780	---	10	12 J at RT
					50 ≤ t < 100	---	460	---	740	---	10	12 J at RT
					100 ≤ t < 150	---	400	---	700	---	10	10 J at RT
					150 ≤ t < 250	---	350	---	650	---	10	10 J at RT
				QT2 (TR2)	28 ≤ t < 50	---	650	---	800	---	14	27 J at RT
					50 ≤ t < 100	---	600	---	780	---	12	27 J at RT
					100 ≤ t < 150	---	550	---	700	---	10	20 J at RT

7.3 Cast Alloy Steels

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 958-00	SC 4330 Cl. 65/35	---	---	NT	---	---	240	35	450	65	24	---
	SC 4330 Cl. 70/36	---	---	NT	---	---	250	36	485	70	22	---
	SC 4330 Cl. 80/40	---	---	NT	---	---	275	40	550	80	18	---
	SC 4330 Cl. 80/50	---	---	NT	---	---	345	50	550	80	22	---
	SC 4330 Cl. 90/60	---	---	NT or QT	---	---	415	60	620	90	18	---
	SC 4330 Cl. 105/85	---	---	QT	---	---	585	85	725	105	17	---
	SC 4330 Cl. 115/95	---	---	QT	---	---	655	95	795	115	14	---
	SC 4330 Cl. 130/115	---	---	QT	---	---	795	115	895	130	11	---
	SC 4330 Cl. 135/125	---	---	QT	---	---	860	125	930	135	9	---
	SC 4330 Cl. 150/135	---	---	QT	---	---	930	135	1035	150	7	---
	SC 4330 Cl. 160/145	---	---	QT	---	---	1000	145	1105	160	6	---
	SC 4330 Cl. 165/150	---	---	QT	---	---	1035	150	1140	165	5	---
	SC 4330 Cl. 210/180	---	---	QT	---	---	1240	180	1450	210	4	---
JIS G 5111:1991	SCNCrM 2A	---	---	NT	---	---	590	---	780	---	9	223 HB min
	SCNCrM 2B	---	---	QT	---	---	685	---	880	---	9	269 HB min
DIN 17205:1992	GS-33 CrNiMo 7 4 4	1.6740	---	NT	≤ 150	---	600	---	800-950	---	12	see standard
					150 < t ≤ 400	---	550	---	750-900	---	12	
	GS-33 CrNiMo 7 4 4, Cl. I	1.6740	---	QT	≤ 100	---	700	---	850-1000	---	16	
	GS-33 CrNiMo 7 4 4, Cl. II	1.6740	---	QT	≤ 100	---	950	---	1050-1250	---	10	
	GS-33 CrNiMo 7 4 4, Cl. I	1.6740	---	QT	100 < t ≤ 250	---	700	---	850-1000	---	14	
	GS-33 CrNiMo 7 4 4, Cl. I	1.6740	---	QT	250 < t ≤ 400	---	650	---	800-950	---	10	
AFNOR NF A 32-054:1994	G 30 NiCrMo 8	---	---	N	28 ≤ t < 50	---	550	---	750	---	15	32 J at RT
					50 ≤ t < 100	---	550	---	750	---	12	32 J at RT
					100 ≤ t < 150	---	550	---	750	---	12	32 J at RT
					150 ≤ t < 250	---	500	---	700	---	12	32 J at RT
				QT2 (TR2)	28 ≤ t < 50	---	700	---	850	---	15	50 J at RT
					50 ≤ t < 100	---	700	---	850	---	14	50 J at RT
					100 ≤ t < 150	---	650	---	850	---	12	35 J at RT
					150 ≤ t < 250	---	650	---	820	---	10	27 J at RT

7.3 Cast Alloy Steels

7.3.2.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	2.00-2.50	---	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	2.00-2.50	---	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 J at 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	---

7.3 Cast Alloy Steels

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
JIS G 5151:1991	SCPH 61	---	---	A, N, NT, or QT	---	---	410	---	620	---	17	---
ASTM A 217/A 217M-99	C5	---	J42045	NT	---	---	415	60	620-795	90-115	18	---
EN 10213-2:1996	GX15CrMo5	1.7365	---	QT	≤ 150	---	420	---	630-760	---	16	27 J at RT
ISO 4991:1994	C37H	---	---	NT	---	---	420	---	630-780	---	16	25 J at RT
ASTM A 217/A 217M-99	C12	---	J82090	NT	---	---	415	60	620-795	90-115	18	---
ISO 4991:1994	C38H	---	---	NT	---	---	420	---	630-780	---	16	20 J at RT

7.3 Cast Alloy Steels

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

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10213-3:1996	G18Mo5	1.5422	---	0.15-0.20	0.80-1.20	0.60	0.020	0.020	---	---	0.45-0.65	---
JIS G 5152:1991	SCPL 11	---	---	0.25	0.50-0.80	0.60	0.040	0.040	0.35	---	0.45-0.65	Cu 0.50
ASTM A 352/A 352M-93 (1998)	LC1	---	J12522	0.25	0.50-0.80	0.60	0.04	0.045	---	---	0.45-0.65	---
JIS G 5152:1991	SCPL 21	---	---	0.25	0.50-0.80	0.60	0.040	0.040	0.35	2.00-3.00	---	Cu 0.50
EN 10213-3:1996	G9Ni10	1.5636	---	0.06-0.12	0.50-0.80	0.60	0.020	0.015	---	2.00-3.00	---	---
ASTM A 757/A 757M-00	B2N, B2Q	---	J22501	0.25	0.50-0.80	0.60	0.025	0.025	0.40	2.0-3.0	0.25	Cu 0.50; V 0.03; Cu+V+Cr+Mo 1.00
ASTM A 352/A 352M-93 (1998)	LC2	---	J22500	0.25	0.50-0.80	0.60	0.04	0.045	---	2.00-3.00	---	---
ISO 4991:1994	C43L	---	---	0.14	0.50-0.80	0.30-0.60	0.030	0.030	---	3.00-4.00	---	---
JIS G 5152:1991	SCPL 31	---	---	0.15	0.50-0.80	0.60	0.040	0.040	0.35	3.00-4.00	---	Cu 0.50
ASTM A 757/A 757M-00	B3N, B3Q	---	J31500	0.15	0.50-0.80	0.60	0.025	0.025	0.40	3.0-4.0	0.25	Cu 0.50; V 0.03; Cu+V+Cr+Mo 1.00
ASTM A 352/A 352M-93 (1998)	LC3	---	J31550	0.15	0.50-0.80	0.60	0.04	0.045	---	3.00-4.00	---	---
EN 10213-3:1996	G9Ni14	1.5638	---	0.06-0.12	0.50-0.80	0.60	0.020	0.015	---	3.00-4.00	---	---
ISO 4991:1994	C43E2aL	---	---	0.22	0.40-0.80	0.30-0.60	0.030	0.030	1.35-2.00	2.50-3.50	0.35-0.60	---
ASTM A 352/A 352M-93 (1998)	LC2-1	---	J42215	0.22	0.55-0.75	0.50	0.04	0.045	1.351.85	2.50-3.50	0.30-0.60	---
EN 10213-3:1996	G17NiCrMo13-6	1.6781	---	0.15-0.19	0.50-0.80	0.50	0.015	0.015	1.30-1.80	3.00-3.50	0.45-0.60	---
ASTM A 757/A 757M-00	E3N	---	J42065	0.20	0.40-0.70	0.60	0.020	0.020	1.50-2.0	2.75-3.90	0.40-0.60	Cu 0.50; W 0.10; Cu+W 0.50
ISO 4991:1994	C43E2bL	---	---	0.22	0.40-0.80	0.30-0.60	0.030	0.030	1.50-2.00	2.75-3.90	0.35-0.60	---

7.3 Cast Alloy Steels

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
EN 10213-3:1996	G18Mo5	1.5422	---	QT	≤ 100	---	240	---	440-790	---	23	27 J at -45°C
JIS G 5152:1991	SCPL 11	---	---	A, N, NT, or QT	---	---	245	---	450	---	21	18 J at -60°C
ASTM A 352/A 352M-93 (1998)	LC1	---	J12522	NT or QT	---	---	240	35.0	450-620	65.0-90.0	24	18 J at -59°C
JIS G 5152:1991	SCPL 21	---	---	A, N, NT, or QT	---	---	275	---	480	---	21	21 J at -75°C
EN 10213-3:1996	G9Ni10	1.5636	---	QT	≤ 35	---	280	---	480-630	---	24	27 J at -70°C
ASTM A 757/A 757M-00	B2N, B2Q	---	J22501	NT or QT	≤ 125	5	275	40	485	70	24	20 J at -73°C
ASTM A 352/A 352M-93 (1998)	LC 2	---	J22500	NT or QT	---	---	275	40.0	485-655	70.0-95.0	24	20 J at -73°C
ISO 4991:1994	C43L	---	---	QT	---	---	300	---	460-610	---	20	27 at -70°C
JIS G 5152:1991	SCPL 31	---	---	A, N, NT, or QT	---	---	275	---	480	---	21	21 J at -100°C
ASTM A 757/A 757M-00	B3N, B3Q	---	J31500	NT or QT	≤ 32	1¼	275	40	485	70	24	20 J at -101°C
ASTM A 352/A 352M-93 (1998)	LC3	---	J31550	NT or QT	---	---	275	40.0	485-655	70.0-95.0	24	20 J at -101°C
EN 10213-3:1996	G9Ni14	1.5638	---	QT	≤ 35	---	360	---	500-650	---	20	27 J -90°C
ISO 4991:1994	C43E2aL	---	---	(NT), N _{ac} T or QT	---	---	450	---	620-800	---	16	27 J at -80°C
ASTM A 352/A 352M-93 (1998)	LC2-1	---	J42215	NT or QT	---	---	550	80.0	725-895	105.0-130.0	18	41 J at -73°C
EN 10213-3:1996	G17NiCrMo13-6	1.6781	---	QT	≤ 200	---	600	---	750-900	---	15	27 J at -80°C
ASTM A 757/A 757M-00	E3N	---	J42065	NT	≤ 32	1¼	550	80	760	110	15	27 J at -73°C
ISO 4991:1994	C43E2bL	---	---	(NT), N _{ac} T or QT	---	---	655	---	800-950	---	13	27 J at -60°C

7.4 Cast Stainless Steels

7.4.1 Cast Stainless Steels for General and Corrosion Resistant Applications

7.4.1.1A Chemical Composition of Martensitic and Ferritic Stainless Steels

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 1	---	---	0.15	1.00	1.50	0.040	0.040	11.50-14.00	1.00	0.50	---
BSI BS 3100:1991 Amd. 1:1992	410C21	---	---	0.15	1.0	1.0	0.040	0.040	11.5-13.5	1.0	---	Cu 0.30
ASTM A 743/A 743M-98	CA-15	---	J91150	0.15	1.00	1.50	0.04	0.04	11.5-14.0	1.00	0.50	---
BSI BS 3100:1991 Amd. 1:1992	420C28	---	---	0.20	1.0	1.0	0.040	0.040	11.5-13.5	1.0	---	Cu 0.30
EN 10283:1999	GX12Cr12	1.4011	---	0.15	1.00	1.00	0.035	0.025	11.50-13.50	1.0	0.50	---
ISO 11972:1998	GX 12 Cr 12	---	---	0.15	0.8	0.8	0.035	0.025	11.5-13.5	1.0	0.5	---
BSI BS 3100:1991 Amd. 1:1992	420C29	---	---	0.20	1.0	1.0	0.040	0.040	11.5-13.5	1.0	---	Cu 0.30
JIS G 5121:1991	SCS 3	---	---	0.15	1.00	1.00	0.040	0.040	11.50-14.00	0.50-1.50	0.15-1.00	---
EN 10283:1999	GX7CrNiMo12-1	1.4008	---	0.10	1.00	1.00	0.035	0.025	12.00-13.50	1.00-2.00	0.20-0.50	---
ISO 11972:1998	GX 8 CrNiMo 12 1	---	---	0.10	0.8	0.8	0.035	0.025	11.5-13.0	0.8-1.8	0.2-0.5	---
ASTM A 743/A 743M-98	CA-15M	---	J91151	0.15	1.00	0.65	0.040	0.040	11.5-14.0	1.00	0.15-1.0	---
JIS G 5121:1991	SCS 2	---	---	0.16-0.24	1.00	1.50	0.040	0.040	11.50-14.00	1.00	0.50	---
	SCS 2A	---	---	0.25-0.40	1.00	1.50	0.040	0.040	11.50-14.00	1.00	0.50	---
ASTM A 743/A 743M-98	CA-40	---	J91153	0.20-0.40	1.00	1.50	0.04	0.04	11.5-14.0	1.0	0.5	---
AFNOR NF A 32-053:1992	Z 3CN13.4-M	---	---	0.05	1.00	1.00	0.035	0.015	12.0-13.5	3.5-5.0	0.70	---
AFNOR NF A 32-054:1994	GX4CrNi13-4	---	---	0.06	1.00	0.80	0.035	0.020	12.00-13.50	3.50-4.50	---	---
EN 10283:1999	GX4CrNi13-4	1.4317	---	0.06	1.00	1.00	0.035	0.025	12.00-13.50	3.50-5.00	0.70	---
JIS G 5121:1991	SCS 5	---	---	0.06	1.00	1.00	0.040	0.040	11.50-14.00	3.50-4.50	---	---
ISO 11972:1998	GX 4CrNi 12 4	---	---	0.06	1.5	1.0	0.035	0.025	11.5-13.0	3.5-5.0	1.0	---
BSI BS 3100:1991 Amd. 1:1992	425C11	---	---	0.10	1.0	1.0	0.040	0.030	11.5-13.5	3.4-4.2	0.60	---
JIS G 5121:1991	SCS 6	---	---	0.06	1.00	1.00	0.040	0.030	11.50-14.00	3.50-4.50	0.40-1.00	---
BSI BS 3100:1991 Amd. 1:1992	425C12	---	---	0.06	1.0	1.0	0.040	0.030	11.5-14.0	3.5-4.5	0.40-1.0	---
ASTM A 743/A 743M-98	CA-6NM	---	J91540	0.06	1.00	1.00	0.04	0.03	11.5-14.0	3.5-4.5	0.4-1.0	---
EN 10283:1999	GX4CrNiMo16-5-1	1.4405	---	0.06	1.00	0.80	0.035	0.025	15.00-17.00	4.00-6.00	0.70-1.50	---
ISO 11972:1998	GX 4 CrNiMo 16 5 1	---	---	0.06	0.8	0.8	0.035	0.025	15.0-17.0	4.0-6.0	0.7-1.5	---
AFNOR NF A 32-054:1994	GX4CrNi16-4	---	---	0.06	1.00	0.80	0.020	0.035	15.50-17.00	4.00-5.50	---	---

7.4 Cast Stainless Steels

7.4.1 Cast Stainless Steels for General and Corrosion Resistant Applications

7.4.1.1B Mechanical Properties of Martensitic and Ferritic Stainless Steels

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 1	---	---	T1	---	---	345	---	540	---	18	163-229 HB
BSI BS 3100:1991 Amd. 1:1992	410C21	---	---	AHT or OQT	---	---	370	---	540	---	15	---
ASTM A 743/A 743M-98	CA-15	---	J91150	A or NT	---	---	450	65	620	90	18	---
JIS G 5121:1991	SCS 1	---	---	T2	---	---	450	---	620	---	16	179-241 HB
BSI BS 3100:1991 Amd. 1:1992	420C28	---	---	AHT or OQT	---	---	450	---	620	---	13	---
EN 10283:1999	GX12Cr12	1.4011	---	QT	≤ 150	---	450	---	620	---	15	20 J at RT
ISO 11972:1998	GX 12 Cr 12	---	---	NT	≤ 150	---	450	---	620	---	14	20 J at RT
BSI BS 3100:1991 Amd. 1:1992	420C29	---	---	AHT or OQT	---	---	465	---	690	---	11	---
JIS G 5121:1991	SCS 3	---	---	T	---	---	440	---	590	---	16	170-235 HB
EN 10283:1999	GX7CrNiMo12-1	1.4008	---	QT	≤ 300	---	440	---	590	---	15	27 J at RT
ISO 11972:1998	GX 8 CrNiMo 12 1	---	---	NT	≤ 300	---	440	---	590	---	15	27 J at RT
ASTM A 743/A 743M-98	CA-15M	---	J91151	A or NT	---	---	450	65	620	90	18	---
JIS G 5121:1991	SCS 2	---	---	T	---	---	390	---	590	---	16	170-235 HB
	SCS 2A	---	---	T	---	---	485	---	690	---	15	269 HB max
ASTM A 743/A 743M-98	CA-40	---	J91153	A or NT	---	---	485	70	690	100	15	---
AFNOR NF A 32-053:1992	Z 3CN13.4-M	---	---	Q+T1+T2	≤ 300	---	500	---	700	---	20	27 J at -120°C
AFNOR NF A 32-054:1994	GX4CrNi13-4	---	---	QT3	28 ≤ t < 100	---	500	---	700	---	18	60 J at RT
					100 ≤ t < 200	---	500	---	700	---	16	60 J at RT
EN 10283:1999	GX4CrNi13-4	1.4317	---	QT3	≤ 300	---	500	---	700	---	16	50 J at RT
JIS G 5121:1991	SCS 5	---	---	QT	---	---	540	---	740	---	13	217-277 HB
AFNOR NF A 32-054:1994	GX4CrNi13-4	---	---	QT2	28 ≤ t < 200	---	550	---	750	---	15	50 J at RT
ISO 11972:1998	GX 4CrNi 12 4	---	---	QT1	≤ 300	---	550	---	750	---	15	45 J at RT
EN 10283:1999	GX4CrNi13-4	1.4317	---	QT1	≤ 300	---	550	---	760	---	15	50 J at RT
BSI BS 3100:1991 Amd. 1:1992	425C11	---	---	AHT or OQT	---	---	620	---	770	---	12	30 J at 20°C
AFNOR NF A 32-054:1994	GX4CrNi13-4	---	---	QT1	28 ≤ t < 200	---	800	---	900	---	12	35 J at RT
EN 10283:1999	GX4CrNi13-4	1.4317	---	QT2	≤ 300	---	830	---	900	---	12	35 J at RT
ISO 11972:1998	GX 4CrNi 12 4	---	---	QT2	≤ 300	---	830	---	900	---	12	35 J at RT

7.4 Cast Stainless Steels

7.4.1 Cast Stainless Steels for General and Corrosion Resistant Applications

7.4.1.1B Mechanical Properties of Martensitic and Ferritic Stainless Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
JIS G 5121:1991	SCS 6	---	---	T	---	---	550	---	750	---	15	285 HB max
BSI BS 3100:1991 Amd. 1:1992	425C12	---	---	AHT or OQT	---	---	550	---	755	---	15	---
ASTM A 743/A 743M-98	CA-6NM	---	J91540	NT	---	---	550	80	755	110	15	---
EN 10283:1999	GX4CrNiMo16-5-1	1.4405	---	QT	≤ 300	---	540	---	760	---	15	60 J at RT
ISO 11972:1998	GX 4 CrNiMo 16 5 1	---	---	NT	≤ 300	---	540	---	760	---	15	60 J at RT
AFNOR NF A 32-054:1994	GX4CrNi16-4	---	---	QT2 (TR2)	28 ≤ t < 250	---	540	---	780	---	15	60 J at RT
				QT1 (TR1)	28 ≤ t < 250	---	830	---	1000	---	10	30 J at RT

7.4 Cast Stainless Steels

7.4.1 Cast Stainless Steels for General and Corrosion Resistant Applications

7.4.1.2A Chemical Composition of Austenitic Stainless Steels

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	304C15	---	---	0.08	2.0	1.5	0.040	0.040	18.0-21.0	8.0-11.0	---	---
AMD.1:1992	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

7.4.1.2A Chemical Composition of Austenitic Stainless Steels (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10283:1999	GX5CrNiMo19-11-2	1.4408	---	0.07	1.50	1.50	0.040	0.030	18.00-20.00	9.00-12.00	2.00-2.50	---
ISO 11972:1998	GX 5 CrNiMo 19 11 2	---	---	0.07	1.5	1.5	0.040	0.030	17.0-20.0	9.0-12.0	2.0-2.5	---
	GX 5 CrNiMo 19 11 3	---	---	0.07	1.5	1.5	0.040	0.030	17.0-20.0	9.0-12.0	3.0-3.5	---
JIS G 5121:1991	SCS 14	---	---	0.08	2.00	2.00	0.040	0.040	17.00-20.00	10.00-14.00	2.00-3.00	---
	SCS 14A	---	---	0.08	1.50	1.50	0.040	0.040	18.00-21.00	9.00-12.00	2.00-3.00	---
BSI BS 3100:1991 AMD.1:1992	316C16	---	---	0.08	2.0	1.5	0.040	0.040	17.0-21.0	9.0 min	2.0-3.0	---
	316C16LT196	---	---	0.08	2.0	1.5	0.040	0.040	17.0-21.0	9.0 min	2.0-3.0	---
ASTM A 743/A 743M-98	CF-8M	---	J92900	0.08	1.50	2.00	0.04	0.04	18.0-21.0	9.0-12.0	2.0-3.0	---
ASTM A 744/A 744M-00	CF8M	---	J92900	0.08	1.50	2.0	0.04	0.04	18.0-21.0	9.0-12.0	2.0-3.0	---
JIS G 5121:1991	SCS 22	---	---	0.08	2.00	2.00	0.040	0.040	17.00-20.00	10.00-14.00	2.00-3.00	Nb 10 x C to 1.35
EN 10283:1999	GX5CrNiMoNb19-11-2	1.4581	---	0.07	1.50	1.50	0.040	0.030	18.00-20.00	9.00-12.00	2.00-2.50	Nb 8 x C to 1.00
ISO 11972:1998	GX 6 CrNiMoNb 19 11 2	---	---	0.08	1.5	1.5	0.040	0.030	17.0-20.0	9.0-12.0	2.0-2.5	Nb 8 x C to 1.00
BSI BS 3100:1991 AMD.1:1992	318C17	---	---	0.08	2.0	1.5	0.040	0.040	17.0-21.0	9.0 min	2.0-3.0	Nb 8 x C to 1.0
BSI BS 3100:1991 AMD.1:1992	316C12	---	---	0.03	2.0	1.5	0.040	0.040	17.0-21.0	9.0 min	2.0-3.0	---
EN 10283	GX2CrNiMo19-11-2	1.4409	---	0.030	2.00	1.50	0.035	0.025	18.00-20.00	9.00-12.00	2.00-2.50	N 0.20
ISO 11972:1998	GX 2 CrNiMo 19 11 2	---	---	0.03	1.5	1.5	0.040	0.030	17.0-20.0	9.0-12.0	2.0-2.5	---
JIS G 5121:1991	SCS 16 A	---	---	0.03	1.50	1.50	0.040	0.040	17.00-21.00	9.00-13.00	2.00-3.00	---
ASTM A 743/A 743M-98	CF-3M	---	---	0.03	1.50	1.50	0.04	0.04	17.0-21.0	9.0-13.0	2.0-3.0	---
ASTM A 744/A 744M-00	CF3M	---	J92800	0.03	1.50	1.50	0.04	0.04	17.0-21.0	9.0-13.0	2.0-3.0	---
EN 10283:1999	GX2CrNiMoN17-13-4	1.4446	---	0.030	1.50	1.00	0.040	0.030	16.50-18.50	12.50-14.50	4.00-4.50	N 0.12-0.22
ISO 11972:1998	GX 2 CrNiMoN 19 11 2	---	---	0.03	1.5	1.5	0.040	0.030	17.0-20.0	9.0-12.0	2.0-2.5	N 0.10-0.20
	GX 2 CrNiMoN 19 11 3	---	---	0.03	1.5	1.5	0.040	0.030	17.0-20.0	9.0-12.0	3.0-3.5	N 0.10-0.20
ASTM A 743/A 743M-98	CF3-MN	---	---	0.03	1.50	1.50	0.040	0.040	17.0-22.0	9.0-13.0	2.0-3.0	N 0.10-0.20
EN 10283:1999	GX5CrNiMo19-11-3	1.4412	---	0.07	1.50	1.50	0.040	0.030	18.00-20.00	10.00-13.00	3.00-3.50	---
BSI BS 3100:1991 AMD.1:1992	317C16	---	---	0.08	2.0	1.5	0.040	0.040	17.0-21.0	9.0 min	3.0-4.0	---
ASTM A 743/A 743M-98	CG-8M	---	J93000	0.08	1.50	1.50	0.04	0.04	18.0-21.0	9.0-13.0	3.0-4.0	---
ASTM A 744/A 744M-00	CG8M	---	J93000	0.08	1.50	1.50	0.04	0.04	18.0-21.0	9.0-13.0	3.0-4.0	---

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 (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ISO 11972:1998	GX 2 CrNiMo 19 11 3	---	---	0.03	1.5	1.5	0.040	0.030	17.0-20.0	9.0-12.0	3.0-3.5	---
ASTM A 743/A 743M-98	CG-3M	---	J92999	0.03	1.50	1.50	0.04	0.04	18.0-21.0	9.0-13.0	3.0-4.0	---
ASTM A 744/A 744M-00	CG3M	---	J92999	0.03	1.50	1.50	0.04	0.04	18.0-21.0	9.0-13.0	3.0-4.0	---
JIS G 5121:1991	SCS 17	---	---	0.20	2.00	2.00	0.040	0.040	22.00-26.00	12.00-15.00	---	---
ASTM A 743/A 743M-98	CH-20	---	J93402	0.20	1.50	2.00	0.04	0.04	22.0-26.0	12.0-15.0	---	---
JIS G 5121:1991	SCS 23	---	---	0.07	2.00	2.00	0.040	0.040	19.00-22.00	27.50-30.00	2.00-3.00	Cu 3.00-4.00
ASTM A 743/A 743M-98	CN-7M	---	---	0.07	1.50	1.50	0.04	0.04	19.0-22.0	27.5-30.5	2.0-3.0	Cu 3.0-4.0
ASTM A 744/A 744M-00	CN7M	---	N08007	0.07	1.50	1.50	0.04	0.04	19.0-22.0	27.5-30.5	2.0-3.0	Cu 3.0-4.0
BSI BS 3100:1991 AMD.1:1992	332C11	---	---	0.07	1.5	1.5	0.040	0.040	19.0-22.0	27.5-30.5	2.0-3.0	Cu 3.0-4.0
EN 10283:1999	GX2NiCrMo28-20-2	1.4458	---	0.030	2.00	1.00	0.035	0.025	19.00-22.00	26.00-30.00	2.00-2.50	Cu 2.00; N 0.20
	GX4NiCrCuMo30-20-4	1.4527	---	0.06	1.50	1.50	0.040	0.030	19.00-22.00	27.50-30.50	2.00-3.00	Cu 3.00-4.00
EN 10283:1999	GX2NiCrMoN25-20-5	1.4416	---	0.030	1.00	1.00	0.035	0.020	19.00-21.00	24.00-26.00	4.50-5.50	N 0.12-0.20
ASTM A 743/A 743M-98	CN-3M	---	J94652	0.03	1.0	2.0	0.03	0.03	20.0-22.0	23.00-27.00	4.5-5.5	---
EN 10283:1999	GX2NiCrMoCuN25-20-6	1.4588	---	0.025	2.00	1.00	0.035	0.020	19.00-21.00	24.00-26.00	6.00-7.00	Cu 0.50-1.50; N 0.10-0.25
ASTM A 743/A 743M-98	CN-3MN	---	---	0.03	2.00	1.00	0.040	0.010	20.0-22.0	23.50-25.50	6.00-7.00	Cu 0.75; N 0.18-0.26
ASTM A 744/A 744M-00	CN3MN	---	J94651	0.03	2.00	1.00	0.040	0.010	20.0-22.0	23.5-25.5	6.00-7.00	Cu 0.75; N 0.18-0.26
EN 10283:1999	GX2CrNiMoCuN20-18-6	1.4593	---	0.025	1.20	1.00	0.030	0.010	19.50-20.50	17.50-19.50	6.00-7.00	Cu 0.50-1.00; N 0.18-0.24
ASTM A 743/A 743M-98	CK-3MCuN	---	---	0.025	1.20	1.00	0.045	0.010	19.5-20.5	17.5-19.5	6.0-7.0	Cu 0.50-1.00; N 0.180-0.240
ASTM A 744/A 744M-00	CK3MCuN	---	J93254	0.025	1.20	1.00	0.045	0.010	19.5-20.5	17.5-19.5	6.0-7.0	Cu 0.50-1.00; N 0.180-0.240
ISO 11972:1998	GX 2 CrNiCuMoN 26 5 3	---	---	0.03	1.5	1.0	0.035	0.025	25.0-27.0	4.5-6.5	2.5-3.5	Cu 2.5-3.5; N 0.12-0.25
BSI BS 3100:1991 AMD.1:1992	332C13	---	---	0.04	1.0	1.0	0.040	0.040	24.5-26.5	4.75-6.0	1.75-2.25	Cu 2.75-3.25
BSI BS 3100:1991 AMD.1:1992	332C15	---	---	0.08	1.5	1.5	0.040	0.040	21.0-27.0	4.0-7.0	1.75-3.0	N 0.10-0.25
ISO 11972:1998	GX 2 CrNiMoN 26 5 3	---	---	0.03	1.5	1.0	0.035	0.025	25.0-27.0	4.5-6.5	2.5-3.5	N 0.12-0.25

7.4 Cast Stainless Steels

7.4.1 Cast Stainless Steels for General and Corrosion Resistant Applications

7.4.1.2B Mechanical Properties of Austenitic Stainless Steels

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	---

7.4 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 (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
EN 10283:1999	GX5CrNiMo19-11-2	1.4408	---	AT	≤ 150	---	185	---	440	---	30	60 J ar RT
ISO 11972:1998	GX 5 CrNiMo 19 11 2	---	---	ST/Q	≤ 150	---	180	---	440	---	30	60 J at RT
	GX 5 CrNiMo 19 11 3	---	---	ST/Q	≤ 150	---	180	---	440	---	30	60 J at RT
JIS G 5121:1991	SCS 14	---	---	S	---	---	185	---	440	---	28	183 HB max
	SCS 14A	---	---	S	---	---	205	---	480	---	33	183 HB max
BSI BS 3100:1991 AMD.1:1992	316C16	---	---	ST	---	---	240	---	480	---	26	---
	316C16LT196	---	---	ST	---	---	240	---	480	---	26	41 J at -196°C
ASTM A 743/A 743M-98	CF-8M	---	J92900	S	---	---	205	30	485	70	30	---
ASTM A 744/A 744M-00	CF8M	---	J92900	S	---	---	205	30	485	70	30	---
JIS G 5121:1991	SCS 22	---	---	S	---	---	205	---	440	---	28	183 HB max
EN 10283:1999	GX5CrNiMoNb19-11-2	1.4581	---	AT	≤ 150	---	185	---	440	---	25	40 J ar RT
ISO 11972:1998	GX 6 CrNiMoNb 19 11 2	---	---	ST/Q	≤ 150	---	180	---	440	---	25	40 J at RT
BSI BS 3100:1991 AMD.1:1992	318C17	---	---	ST	---	---	240	---	480	---	18	---
BSI BS 3100:1991 AMD.1:1992	316C12	---	---	ST	---	---	215	---	430	---	26	---
EN 10283	GX2CrNiMo19-11-2	1.4409	---	AT	≤ 150	---	195	---	440	---	30	80 J at RT
ISO 11972:1998	GX 2 CrNiMo 19 11 2	---	---	ST/Q	≤ 150	---	180	---	440	---	30	80 J at RT
JIS G 5121:1991	SCS 16 A	---	---	S	---	---	205	---	480	---	33	183 HB max
ASTM A 743/A 743M-98	CF-3M	---	---	S	---	---	205	30	485	70	30	---
ASTM A 744/A 744M-00	CF3M	---	J92800	S	---	---	205	30	485	70	30	---
EN 10283:1999	GX2CrNiMoN17-13-4	1.4446	---	AT	≤ 150	---	210	---	440	---	20	50 J at RT
ISO 11972:1998	GX 2 CrNiMoN 19 11 2	---	---	ST/Q	≤ 150	---	230	---	510	---	30	80 J at RT
	GX 2 CrNiMoN 19 11 3	---	---	ST/Q	≤ 150	---	230	---	510	---	30	80 J at RT
ASTM A 743/A 743M-98	CF3-MN	---	---	S	---	---	255	37	515	75	35	---
EN 10283:1999	GX5CrNiMo19-11-3	1.4412	---	AT	≤ 150	---	205	---	440	---	30	60 J at RT
BSI BS 3100:1991 AMD.1:1992	317C16	---	---	ST	---	---	240	---	480	---	22	---
ASTM A 743/A 743M-98	CG-8M	---	J93000	S	---	---	240	35	520	75	25	---
ASTM A 744/A 744M-00	CG8M	---	J93000	S	---	---	240	35	520	75	25	---

7.4 Cast Stainless Steels

7.4.1 Cast Stainless Steels for General and Corrosion Resistant Applications

7.4.1.2B Mechanical Properties of Austenitic Stainless Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ISO 11972:1998	GX 2 CrNiMo 19 11 3	---	---	ST/Q	≤ 150	---	180	---	440	---	30	80 J at RT
ASTM A 743/A 743M-98	CG-3M	---	J92999	S	---	---	240	35	515	75	25	---
ASTM A 744/A 744M-00	CG3M	---	J92999	S	---	---	240	35	515	75	25	---
JIS G 5121:1991	SCS 17	---	---	S	---	---	205	---	480	---	28	183 HB max
ASTM A 743/A 743M-98	CH-20	---	J93402	S	---	---	205	30	485	70	30	---
JIS G 5121:1991	SCS 23	---	---	S	---	---	165	---	390	---	30	183 HB max
ASTM A 743/A 743M-98	CN-7M	---	---	S	---	---	170	25	425	62	35	---
ASTM A 744/A 744M-00	CN7M	---	N08007	S	---	---	170	25	425	62	35	---
BSI BS 3100:1991 AMD.1:1992	332C11	---	---	ST	---	---	170	---	425	---	34	---
EN 10283:1999	GX2NiCrMo28-20-2	1.4458	---	AT	≤ 150	---	165	---	430	---	30	60 J at RT
	GX4NiCrCuMo30-20-4	1.4527	---	---	---	---	---	---	---	---	---	---
EN 10283:1999	GX2NiCrMoN25-20-5	1.4416	---	AT	≤ 150	---	185	---	450	---	30	60 J at RT
ASTM A 743/A 743M-98	CN-3M	---	J94652	S	---	---	260	38	550	80	35	---
EN 10283:1999	GX2NiCrMoCuN25-20-6	1.4588	---	AT	≤ 50	---	210	---	480	---	30	60 J at RT
ASTM A 743/A 743M-98	CN-3MN	---	---	S	---	---	260	38	550	80	35	---
ASTM A 744/A 744M-00	CN3MN	---	J94651	S	---	---	260	38	550	80	35	---
EN 10283:1999	GX2CrNiMoCuN20-18-6	1.4593	---	AT	≤ 50	---	260	---	500	---	35	50 J at RT
ASTM A 743/A 743M-98	CK-3MCuN	---	---	S	---	---	260	38	550	80	35	---
ASTM A 744/A 744M-00	CK3MCuN	---	J93254	S	---	---	260	38	550	80	35	---
ISO 11972:1998	GX 2 CrNiCuMoN 26 5 3 3	---	---	ST/Q	≤ 150	---	450	---	650	---	18	50 J at RT
BSI BS 3100:1991 AMD.1:1992	332C13	---	---	ST	---	---	485	---	690	---	16	25 J at 20°C
BSI BS 3100:1991 AMD.1:1992	332C15	---	---	ST	---	---	430	---	640	---	30	25 J at 20°C
ISO 11972:1998	GX 2 CrNiMoN 26 5 3	---	---	ST/Q	≤ 150	---	450	---	650	---	18	50 J at RT

7.4 Cast Stainless Steels

7.4.2 Cast Stainless Steels for Pressure Purposes

7.4.2.1A Chemical Composition of Martensitic and Ferritic Stainless Steels

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 487/A 487M-93 (1998)	CA15	---	J91171	0.15	1.00	1.50	0.040	0.040	11.5-14.0	1.00	0.50	Cu 0.50; W 0.10; V 0.05 Cu+W+V 0.50
ISO 4991:1994	C39CH	---	---	0.10-0.17	1.00	0.8	0.035	0.035	11.5-13.5	1.0	0.5	---
ASTM A 217/A 217M-99	CA15	---	J91150	0.15	1.00	1.50	0.040	0.040	11.5-14.0	1.00	0.50	---
EN 10213-2:1996	GX8CrNi12	1.4107	---	0.10	0.50-0.80	0.40	0.030	0.020	11.50-12.50	0.80-1.50	0.50	---
ISO 4991:1994	C39CNiH	---	---	0.05-0.10	0.40-0.80	0.80	0.035	0.035	11.5-13.0	0.80-1.80	0.20-0.50	---
EN 10213-3:1996	GX3CrNi13-4	1.6982	---	0.05	1.00	1.00	0.035	0.015	12.00-13.50	3.50-5.00	0.70	---
ISO 4991:1994	C39NiH	---	---	0.08	1.50	1.00	0.035	0.035	11.5-13.5	3.50-5.00	1.00	---
	C39NiL	---	---	0.08	1.50	1.00	0.030	0.030	11.5-13.5	3.50-5.00	1.00	---
EN 10213-2:1996	GX4CrNi13-4	1.4317	---	0.06	1.00	1.00	0.035	0.025	12.00-13.50	3.50-5.00	0.70	---
ASTM A 487/A 487M-93 (1998)	CA6NM	---	J91540	0.06	1.00	1.00	0.04	0.03	11.5-14.0	3.5-4.5	0.4-1.0	Cu 0.50; W 0.10; V 0.05; Cu+W+V 0.50
ASTM A 757/A 757M-00	E3N	---	J91550	0.06	1.00	1.00	0.030	0.030	11.5-14.0	3.5-4.5	0.4-1.0	Cu 0.50; W 0.10; Cu+W 0.50
ASTM A 352/A 352M-93 (1998)	CA6NM	---	J91540	0.06	1.00	1.00	0.04	0.03	11.5-14.0	3.5-4.5	0.4-1.0	---
EN 10213-2:1996	GX23CrMoV12-1	1.4931	---	0.20-0.26	0.50-0.80	0.40	0.030	0.020	11.30-12.20	1.00	1.00-1.20	V 0.25-0.35; W 0.50
ISO 4991:1994	C40H	---	---	0.20-0.26	0.50-0.70	0.20-0.40	0.035	0.035	11.3-12.3	0.70-1.00	1.00-1.20	V 0.25-0.35

7.4 Cast Stainless Steels

7.4.2 Cast Stainless Steels for Pressure Purposes

7.4.2.1B Mechanical Properties of Martensitic and Ferritic Stainless Steels

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 487/A 487M-93 (1998)	CA15 Cl. C	---	J91171	NT or QT	---	---	415	60	620	90	18	22 HRCmax 235 HB max
ISO 4991:1994	C39CH	---	---	NT	---	---	450	---	620-770	---	14	20 J at RT
ASTM A 487/A 487M-93 (1998)	CA15 Cl. B	---	J91171	NT or QT	---	---	450	65	620-795	90-115	18	---
ASTM A 217/A 217M-99	CA15	---	J91150	NT	---	---	450	65	620-795	90-115	18	---
ASTM A 487/A 487M-93 (1998)	CA15 Cl. D	---	J91171	NT or QT	---	---	515	75	690	100	17	22 HRC max 235 HB max
ASTM A 487/A 487M-93 (1998)	CA15 Cl. A	---	J91171	NT or QT	---	---	760-895	110-130	965-1170	140-170	10	---
EN 10213-2:1996	GX8CrNi12	1.4107	---	QT1	≤ 300	---	355	---	540-690	---	18	45 J at RT
ISO 4991:1994	C39CNIH	---	---	NT	---	---	360	---	540-690	---	18	35 J at RT
EN 10213-2:1996	GX8CrNi12	1.4107	---	QT2	≤ 300	---	500	---	600-800	---	16	40 J at RT
EN 10213-3:1996	GX3CrNi13-4	1.6982	---	QT	≤ 300	---	500	---	700-900	---	15	27 J at -120°C
ISO 4991:1994	C39NiH	---	---	NT	---	---	550	---	750-900	---	15	45 J at RT
	C39NiL	---	---	N _{ac} T or (NT)	---	---	550	---	750-900	---	15	27 J at -80°C
EN 10213-2:1996	GX4CrNi13-4	1.4317	---	QT	≤ 300	---	550	---	760-960	---	15	50 J at RT
ASTM A 487/A 487M-93 (1998)	CA6NM Cl. B	---	J91540	NT or QT	---	---	515	75	690	100	17	23 HRC max 255 HB max
ASTM A 757/A 757M-00	E3N	---	J91550	NT	≤ 32	1¼	550	80	760	110	15	27 J at -73°C
ASTM A 352/A 352M-93 (1998)	CA6NM	---	J91540	NT	---	---	550	80	760-930	110.0-135.0	15	27 J at -73°C
ASTM A 487/A 487M-93 (1998)	CA6NM Cl. A	---	J91540	NT or QT	---	---	550	80	760-930	110-135	15	---
EN 10213-2:1996	GX23CrMoV12-1	1.4931	---	QT	≤ 150	---	540	---	740-880	---	15	27 J at RT
ISO 4991:1994	C40H	---	---	NT	---	---	540	---	740-880	---	15	21 J at RT

7.4 Cast Stainless Steels

7.4.2 Cast Stainless Steels for Pressure Purposes

7.4.2.2A Chemical Composition of Austenitic Stainless Steels

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
EN 10213-4:1996	GX5CrNi19-10	1.4308	---	0.07	1.50	1.50	0.040	0.030	18.00-20.00	8.00-11.00	---	---
ISO 4991:1994	C47	---	---	0.07	2.00	2.00	0.045	0.035	18.0-21.0	8.0-11.0	---	---
	C47L	---	---	0.07	2.00	2.00	0.045	0.035	17.0-20.0	9.0-12.0	---	---
ASTM A 351/A 351M-00	CF-8, CF-8A	---	J92600	0.08	1.50	2.00	0.040	0.040	18.0-21.0	8.0-11.0	0.50	---
EN 10213-4:1996	GX2CrNi19-11	1.4309	---	0.03	2.00	1.50	0.035	0.025	18.00-20.00	9.00-12.00	---	N 0.20
ISO 4991:1994	C46	---	---	0.03	2.00	2.00	0.045	0.035	17.0-19.0	9.0-12.0	---	---
ASTM A 351/A 351M-00	CF-3, CF-3A	---	J92800	0.03	1.50	2.00	0.040	0.040	17.0-21.0	8.0-12.0	0.50	---
EN 10213-4:1996	GX5CrNiNb19-11	1.4552	---	0.07	1.50	1.50	0.040	0.030	18.00-20.00	9.00-12.00	---	Nb 8 x C to 1.0
ISO 4991:1994	C50	---	---	0.08	2.00	2.00	0.045	0.035	18.0-21.0	9.0-12.0	---	Nb 8 x C to 1.0
ASTM A 351/A 351M-00	CF-8C	---	J92710	0.08	1.50	2.00	0.040	0.040	18.0-21.0	9.0-12.0	0.50	Cb 8 x C to 1.00
EN 10213-4:1996	GX5CrNiMo19-11-2	1.4408	---	0.07	1.50	1.50	0.040	0.030	18.00-20.00	9.00-12.00	2.00-2.50	---
ISO 4991:1994	C60	---	---	0.07	2.00	2.00	0.045	0.035	17.0-21.0	9.0-13.0	2.0-2.5	---
	C61	---	---	0.07	2.00	2.00	0.045	0.035	17.0-21.0	9.0-13.0	2.5-3.0	---
ASTM A 351/A 351M-00	CF-8M	---	J92900	0.08	1.50	1.50	0.040	0.040	18.0-21.0	9.0-12.0	2.0-3.0	---
EN 10213-4:1996	GX5CrNiMoNb19-11-2	1.4581	---	0.07	1.50	1.50	0.040	0.030	18.00-20.00	9.00-12.00	2.00-2.50	Nb 8 x C to 1.0
ISO 4991:1994	C60Nb	---	---	0.08	2.00	2.00	0.045	0.035	17.0-21.0	9.0-13.0	2.0-2.5	Nb 8 x C to 1.0
ISO 4991:1994	C57	---	---	0.03	2.00	2.00	0.045	0.035	17.0-21.0	9.0-13.0	2.0-2.5	---
	C61LC	---	---	0.03	2.00	2.00	0.045	0.035	17.0-21.0	9.0-13.0	2.5-3.0	---
EN 10213-4:1996	GX2CrNiMo19-11-2	1.4409	---	0.030	2.00	1.50	0.035	0.025	18.00-20.00	9.00-12.00	2.00-2.50	N 0.20
ASTM A 351/A 351M-00	CF-3M, CF-3MA	---	J92800	0.03	1.50	1.50	0.040	0.040	17.0-21.0	9.0-13.0	2.0-3.0	---
ASTM A 351/A 351M-00	CN-7M	---	N08007	0.07	1.50	1.50	0.04	0.04	19.0-22.0	27.5-30.5	2.0-3.0	Cu 3.0-4.0
EN 10213-4:1996	GX2NiCrMo28-20-2	1.4458	---	0.030	2.00	1.00	0.035	0.025	19.00-22.00	26.00-30.00	2.00-2.50	Cu 2.00; N 0.20
EN 10213-4:1996	GX2CrNiCuMoN25-6-3-3	1.4517	---	0.030	1.50	1.00	0.035	0.025	24.50-26.50	5.00-7.00	2.50-3.50	Cu 2.75-3.50; N 0.12-0.22
ASTM A 351/A 351M-00	CD-4MCu	---	J93370	0.04	1.00	1.00	0.04	0.04	24.5-26.5	4.75-6.00	1.75-2.25	Cu 2.75-3.25

7.4 Cast Stainless Steels

7.4.2 Cast Stainless Steels for Pressure Purposes

7.4.2.2B Mechanical Properties of Austenitic 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		
EN 10213-4:1996	GX5CrNi19-10	1.4308	---	AT + QW	≤ 150	---	200	---	440-640	---	30	60 J at RT
ISO 4991:1994	C47	---	---	S	---	---	210	---	440-640	---	30	---
	C47L	---	---	S	---	---	210	---	440-640	---	30	45 J at -195°C
ASTM A 351/A 351M-00	CF-8	---	J92600	S	---	---	205	30	485	70	35.0	---
	CF-8A	---	J92600	S	---	---	240	35	530	77	35.0	---
EN 10213-4:1996	GX2CrNi19-11	1.4309	---	AT + QW	≤ 150	---	210	---	440-640	---	30	80 J at RT
ISO 4991:1994	C46	---	---	S	---	---	210	---	440-640	---	30	---
	CF-3	---	J92800	S	---	---	205	30	485	70	35.0	---
ASTM A 351/A 351M-00	CF-3A	---	J92800	S	---	---	240	35	530	77	35.0	---
EN 10213-4:1996	GX5CrNiNb19-11	1.4552	---	AT + QW	≤ 150	---	200	---	440-640	---	25	40 J at RT
ISO 4991:1994	C50	---	---	S	---	---	210	---	440-640	---	25	---
	CF-8C	---	J92710	S	---	---	205	30	485	70	30.0	---
EN 10213-4:1996	GX5CrNiMo19-11-2	1.4408	---	AT + QW	≤ 150	---	210	---	440-640	---	30	60 J at RT
ISO 4991:1994	C60	---	---	S	---	---	210	---	440-640	---	30	---
	C61	---	---	S	---	---	210	---	440-640	---	30	---
ASTM A 351/A 351M-00	CF-8M	---	J92900	S	---	---	205	30	485	70	30.0	---
EN 10213-4:1996	GX5CrNiMoNb19-11-2	1.4581	---	AT + QW	≤ 150	---	210	---	440-640	---	25	40 J at RT
ISO 4991:1994	C60Nb	---	---	S	---	---	210	---	440-640	---	25	---
	C57	---	---	S	---	---	210	---	440-620	---	30	---
	C61LC	---	---	S	---	---	210	---	440-640	---	30	---
EN 10213-4:1996	GX2CrNiMo19-11-2	1.4409	---	AT + QW	≤ 150	---	220	---	440-640	---	30	80 J at RT
ASTM A 351/A 351M-00	CF-3M	---	J92800	S	---	---	205	30	485	70	30.0	---
	CF-3MA	---	J92800	S	---	---	255	37	550	80	30.0	---
ASTM A 351/A 351M-00	CN-7M	---	N08007	S	---	---	170	25	425	62	35.0	---
EN 10213-4:1996	GX2NiCrMo28-20-2	1.4458	---	AT + QW	≤ 150	---	190	---	430-630	---	30	60 J at RT
EN 10213-4:1996	GX2CrNiCuMoN25-6-3-3	1.4517	---	AT + QW	≤ 150	---	480	---	650-850	---	22	50 J at RT
ASTM A 351/A 351M-00	CD-4MCu	---	J93370	S	---	---	485	70	690	100	16.0	---

7.5 Cast Heat Resistant Steels

7.5A Chemical Composition of Cast Heat Resistant Steels

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								Others
				C	Mn	Si	P	S	Cr	Ni	Mo	
DIN 17465:1993	GX30CrSi5	1.4710	---	0.20-0.35	0.5-1.0	1.0-2.5	0.035	0.030	6.0-8.0	---	---	---
ISO 11973:1999	GX30CrSi7	---	---	0.20-0.35	0.5-1.0	1.0-2.5	0.04	0.04	6-8	0.5	0.5	---
JIS G 5122:1991	SCH 1	---	---	0.20-0.40	1.00	1.50-3.00	0.040	0.040	12.00-15.00	1.00	0.50	---
	SCH 3	---	---	0.40	1.00	2.00	0.040	0.040	12.00-15.00	1.00	0.50	---
BSI BS 3100:1991 AMD.1: 1992	420C24	---	---	0.25	1.0	2.0	0.050	0.050	12.0-16.0	---	---	---
DIN 17465:1993	GX40CrSi13	1.4729	---	0.30-0.45	0.5-1.0	1.0-2.5	0.035	0.030	12.0-14.0	---	---	---
AFNOR NF A 32-057:1981	Z 25C13-M	---	---	0.20-0.35	2.0	2.0	0.04	0.03	12-14	---	---	---
ISO 11973:1999	GX40CrSi13	---	---	0.3-0.5	0.5-1.0	1.0-2.5	0.04	0.03	12-14	1	0.5	---
DIN 17465:1993	GX40CrSi17	1.4740	---	0.30-0.45	0.5-1.0	1.0-2.5	0.035	0.030	16.0-18.0	---	---	---
ISO 11973:1999	GX40CrSi17	---	---	0.3-0.5	0.5-1.0	1.0-2.5	0.04	0.03	16-19	1	0.5	---
DIN 17465:1993	GX40CrSi23	1.4745	---	0.30-0.45	0.5-1.0	1.0-2.5	0.035	0.030	22.0-24.0	---	---	---
ISO 11973:1999	GX40CrSi24	---	---	0.3-0.5	0.5-1.0	1.0-2.5	0.04	0.03	23-26	1	0.5	---
DIN 17465:1993	GX40CrSi29	1.4776	---	0.30-0.45	0.5-1.0	1.0-2.5	0.035	0.030	27.0-30.0	---	---	---
ISO 11973:1999	GX40CrSi28	---	---	0.3-0.5	0.5-1.0	1.0-2.5	0.04	0.03	27-30	1	0.5	---
DIN 17465:1993	GX130CrSi29	1.4777	---	1.20-1.40	0.5-1.0	1.0-2.5	0.035	0.030	27.0-30.0	---	---	---
ISO 11973:1999	GX130CrSi29	---	---	1.2-1.4	0.5-1.0	1.0-2.5	0.04	0.03	27-30	1	0.5	---
JIS G 5122:1991	SCH 2	---	---	0.40	1.00	2.00	0.040	0.040	25.00-28.00	1.00	0.50	---
ASTM A 297/A 297M-97 (1998)	HC	---	J92605	0.50	1.00	2.00	0.04	0.04	26.0-30.0	4.00	0.50	---
AFNOR NF A 32-057:1981	Z 40C28-M	---	---	0.30-0.50	2.0	2.0	0.04	0.03	25-30	3	---	---
ASTM A 608-91 (1998)	HC30	---	J92613	0.25-0.35	0.5-1.0	0.50-2.00	0.04	0.04	26-30	4.0	0.50	---
BSI BS 3100:1991 AMD.1: 1992	452C11	---	---	1.0	1.0	2.0	0.050	0.050	25.0-30.0	4.0	1.5	---
	452C12	---	---	1.0-2.0	1.0	2.0	0.050	0.050	25.0-30.0	4.0	1.5	---
ISO 11973:1999	GX40CrNiSi27-4	---	---	0.3-0.5	1.5	1.0-2.5	0.04	0.03	25-28	3-6	0.5	---
ASTM A 297/A 297M-97 (1998)	HD	---	J93005	0.50	1.50	2.00	0.04	0.04	26.0-30.0	4.0-7.0	0.50	---
AFNOR NF A 32-057:1981	Z 30CN26.05-M	---	---	0.20-0.50	2.0	2.0	0.04	0.03	25-30	3-6	---	---
JIS G 5122:1991	SCH 11	---	---	0.40	1.00	2.00	0.040	0.040	24.00-28.00	4.00-6.00	0.50	---
ASTM A 608-91 (1998)	HD50	---	J93015	0.45-0.55	1.50	0.50-2.00	0.04	0.04	26-30	4-7	0.50	---
DIN 17465:1993	GX40CrNiSi27-4	1.4823	---	0.30-0.50	1.5	1.0-2.5	0.035	0.030	25.0-28.0	3.5-5.5	---	---

7.5 Cast Heat Resistant Steels

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

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 5122:1991	SCH 17	---	---	0.20-0.50	2.00	2.00	0.040	0.040	26.00-30.00	8.00-11.00	0.50	---
ASTM A 297/A 297M-97 (1998)	HE	---	J93403	0.20-0.50	2.00	2.00	0.04	0.04	26.0-30.0	8.0-11.0	0.50	---
ASTM A 608-91 (1998)	HE35	---	J93413	0.30-0.40	1.50	0.50-2.00	0.04	0.04	26-30	8-11	0.50	---
BSI BS 3100:1991 AMD.1: 1992	309C40	---	---	0.5	2.0	2.0	0.050	0.050	25.0-30.0	8.0-12.0	1.5	---
DIN 17465:1993	GX25CrNiSi18-9	1.4825	---	0.15-0.30	1.5	1.0-2.5	0.035	0.030	17.0-19.0	8.0-10.0	---	---
	GX40CrNiSi22-9	1.4826	---	0.30-0.50	1.5	1.0-2.5	0.035	0.030	21.0-23.0	9.0-11.0	---	---
AFNOR NF A 32-057:1981	Z 25CN20.10-M	---	---	0.20-0.40	2.0	2.0	0.04	0.03	19-23	9-12	---	---
ISO 11973:1999	GX25CrNiSi18-9	---	---	0.15-0.35	2	1.0-2.5	0.04	0.03	17-19	8-10	0.5	---
	GX40CrNiSi22-10	---	---	0.3-0.5	2	1.0-2.5	0.04	0.03	21-23	9-11	0.5	---
ASTM A 297/A 297M-97 (1998)	HF	---	J93603	0.20-0.40	2.00	2.00	0.04	0.04	18.0-23.0	8.0-12.0	0.50	---
JIS G 5122:1991	SCH 12	---	---	0.20-0.40	2.00	2.00	0.040	0.040	18.00-23.00	8.00-12.00	0.50	---
ASTM A 608-91 (1998)	HF 30	---	J92803	0.25-0.35	1.50	0.50-2.00	0.04	0.04	19-23	9-12	0.50	---
BSI BS 3100:1991 AMD.1: 1992	302C35	---	---	0.2-0.4	2.0	2.0	0.050	0.050	17.0-22.0	6.0-10.0	---	---
DIN 17465:1993	GX25CrNiSi20-14	1.4832	---	0.15-0.30	1.5	1.0-2.5	0.035	0.030	19.0-21.0	13.0-15.0	---	---
ISO 11973:1999	GX25CrNiSi20-14	---	---	0.15-0.35	2	1.0-2.5	0.04	0.03	19-21	13-15	0.5	---

7.5 Cast Heat Resistant Steels

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

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
DIN 17465:1993	GX40CrNiSi25-12	1.4837	---	0.30-0.50	1.5	1.0-2.5	0.035	0.030	24.0-26.0	11.0-14.0	---	---
ISO 11973:1999	GX40CrNiSi25-12	---	---	0.3-0.5	2	1.0-2.5	0.04	0.03	24-27	11-14	0.5	---
JIS G 5122:1991	SCH 13	---	---	0.20-0.50	2.00	2.00	0.040	0.040	24.00-28.00	11.00-14.00	0.50	---
	SCH 13A	---	---	0.25-0.50	2.50	1.75	0.040	0.040	23.00-26.00	12.00-14.00	0.50	---
AFNOR NF A 32-057:1981	Z 40CN25.12-M	---	---	0.30-0.50	2.0	2.0	0.04	0.03	23-26	12-14	---	---
BSI BS 3100:1991 AMD.1: 1992	309C35	---	---	0.20-0.50	2.0	1.5	0.040	0.040	24.0-28.0	11.0-14.0	1.5	---
ASTM A 297/A 297M-97 (1998)	HH	---	J93503	0.20-0.50	2.00	2.00	0.04	0.04	24.0-28.0	11.0-14.0	0.50	---
ASTM A 447/A 447M-93 (1998)	Type I	---	J93303	0.20-0.45	2.50	1.75	0.05	0.05	23.00-28.00	10.00-14.00	---	N 0.20
	Type II	---	J93303	0.20-0.45	2.50	1.75	0.05	0.05	23.00-28.00	10.00-14.00	---	N 0.20
BSI BS 3100:1991 AMD.1: 1992	309C32	---	---	0.20-0.45	2.5	1.5	0.040	0.040	24.0-28.0	11.0-14.0	1.5	N 0.2
ASTM A 608-91 (1998)	HH30	---	J93513	0.25-0.35	1.50	0.50-2.00	0.04	0.04	24-28	11-14	0.50	---
	HH33	---	J93633	0.28-0.38	1.50	0.50-2.00	0.04	0.04	24-26	12-14	0.50	---
BSI BS 3100:1991 AMD.1: 1992	309C30	---	---	0.5	2.0	2.5	0.050	0.050	22.0-27.0	10.0-14.0	1.5	---
ASTM A 297/A 297M-97 (1998)	HI	---	J94003	0.20-0.50	2.00	2.00	0.04	0.04	26.0-30.0	14.0-18.0	0.50	---
ASTM A 608-91 (1998)	HI35	---	J94013	0.30-0.40	1.50	0.50-2.00	0.04	0.04	26-30	14-18	0.50	---
JIS G 5122:1991	SCH 18	---	---	0.20-0.50	2.00	2.00	0.040	0.040	26.00-30.00	14.00-18.00	0.50	---
JIS G 5122:1991	SCH 21	---	---	0.25-0.35	1.50	1.75	0.040	0.040	23.00-27.00	19.00-22.00	0.50	---
ASTM A 297/A 297M-97 (1998)	HK	---	J94224	0.20-0.60	2.00	2.00	0.04	0.04	24.0-28.0	18.0-22.0	0.50	---
ASTM A 351/A 351M-00	HK30	---	J94203	0.25-0.35	1.50	1.75	0.040	0.040	23.0-27.0	19.0-22.0	0.50	---
ASTM A 608-91 (1998)	HK30	---	J94203	0.25-0.35	1.50	0.50-2.00	0.04	0.04	23-27	19-22	0.50	---

7.5 Cast Heat Resistant Steels

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

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
AFNOR NF A 32-057:1981	Z 40CN25.20-M	---	---	0.30-0.50	2.0	2.0	0.04	0.03	23-27	18-22	---	---
ASTM A 351/A 351M-00	HK40	---	J94204	0.35-0.45	1.50	1.75	0.040	0.040	23.0-27.0	19.0-22.0	0.50	---
DIN 17465:1993	GX40CrNiSi25-20	1.4848	---	0.30-0.50	1.5	1.0-2.5	0.035	0.030	24.0-26.0	19.0-21.0	---	---
JIS G 5122:1991	SCH 22	---	---	0.35-0.45	1.50	1.75	0.040	0.040	23.00-27.00	19.00-22.00	0.50	---
BSI BS 3100:1991 AMD.1: 1992	310C40	---	---	0.30-0.5	2.0	1.5	0.040	0.040	24.0-27.0	19.0-22.0	1.5	---
ISO 11973:1999	GX40CrNiSi25-20	---	---	0.3-0.5	2	1.0-2.5	0.04	0.03	24-27	19-22	0.5	---
ASTM A 608-91 (1998)	HK40	---	J94204	0.35-0.45	1.50	0.50-2.00	0.04	0.04	23-27	19-22	0.50	---
BSI BS 3100:1991 AMD.1: 1992	310C45	---	---	0.5	2.0	3.0	0.050	0.050	22.0-27.0	17.0-22.0	1.5	---
ASTM A 297/A 297M-97 (1998)	HL	---	N08604	0.20-0.60	2.00	2.00	0.04	0.04	28.0-32.0	18.0-22.0	0.50	---
ASTM A 608-91 (1998)	HL30	---	N08613	0.25-0.35	1.50	0.50-2.00	0.04	0.04	28-32	18-22	0.50	---
	HL40	---	N08614	0.35-0.45	1.50	0.50-2.00	0.04	0.04	28-32	18-22	0.50	---
JIS G 5122:1991	SCH 23	---	---	0.20-0.60	2.00	2.00	0.040	0.040	28.00-32.00	18.00-22.00	0.50	---
AFNOR NF A 32-057:1981	Z 40CN30.20-M	---	---	0.30-0.60	2.0	2.0	0.04	0.03	28-32	18-22	---	---
JIS G 5122:1991	SCH 19	---	---	0.20-0.50	2.00	2.00	0.040	0.040	19.00-23.00	23.00-27.00	0.50	---
ASTM A 297/A 297M-97 (1998)	HN	---	J94213	0.20-0.50	2.00	2.00	0.04	0.04	19.0-23.0	23.0-27.0	0.50	---
ASTM A 608-91 (1998)	HN40	---	J94214	0.35-0.45	1.50	0.50-2.00	0.04	0.04	19-23	23-27	0.50	---
BSI BS 3100:1991 AMD.1: 1992	311C11	---	---	0.5	2.0	3.0	0.050	0.050	17.0-23.0	23.0-28.0	1.5	---
DIN 17465:1993	GX30CrNiSiNb24-24	1.4855	---	0.25-0.40	1.5	0.5-2.0	0.035	0.030	23.0-25.0	23.0-25.0	---	Nb 1.2-1.8
ISO 11973:1999	GX40CrNiSiNb24-24	---	---	0.25-0.50	2	1.0-2.5	0.04	0.03	23-25	23-25	0.5	Nb 1.2-1.8
DIN 17465:1993	GX40NiCrSiNb35-25	1.4852	---	0.35-0.45	1.5	1.0-2.5	0.035	0.030	24.0-26.0	33.0-35.0	---	Nb 0.8-1.8
ASTM A 297/A 297M-97 (1998)	HP	---	N08705	0.35-0.75	2.00	2.50	0.04	0.04	24-28	33-37	0.50	---
JIS G 5122:1991	SCH 24	---	---	0.35-0.75	2.00	2.00	0.040	0.040	24.00-28.00	33.00-37.00	0.50	---
DIN 17465:1993	GX40NiCrSi35-25	1.4857	---	0.30-0.50	1.5	1.0-2.5	0.035	0.030	24.0-26.0	34.0-36.0	---	---
ISO 11973:1999	GX40NiCrSi35-26	---	---	0.3-0.5	2	1.0-2.5	0.04	0.03	24-27	33-36	0.5	---
	GX40NiCrSiNb35-26	---	---	0.3-0.5	2	1.0-2.5	0.04	0.03	24-27	33-36	0.5	Nb 0.8-1.8

7.5 Cast Heat Resistant Steels

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

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
AFNOR NF A 32-057:1981	Z 40NC35.15-M	---	---	0.35-0.65	2.0	2.5	0.04	0.03	14-20	33-40	---	---
ISO 11973:1999	GX40NiCrSi35-17	---	---	0.3-0.5	2	1.0-2.5	0.04	0.03	16-18	34-36	0.5	---
JIS G 5122:1991	SCH 15	---	---	0.35-0.70	2.00	2.50	0.040	0.040	15.00-19.00	33.00-37.00	0.50	---
ASTM A 297/A 297M-97 (1998)	HT	---	N08605	0.35-0.75	2.00	2.50	0.04	0.04	15.0-19.0	33.0-37.0	0.50	---
ASTM A 608-91 (1998)	HT50	---	N08050	0.40-0.60	1.50	0.50-2.00	0.04	0.04	15-19	33-37	0.50	---
BSI BS 3100:1991 AMD.1: 1992	330C12	---	---	0.75	2.0	3.0	0.050	0.050	13.0-20.0	30.0-40.0	1.5	---
JIS G 5122:1991	SCH 16	---	---	0.20-0.35	2.00	2.50	0.040	0.040	13.00-17.00	33.00-37.00	0.50	---
BSI BS 3100:1991 AMD.1: 1992	330C11	---	---	0.35-0.55	2.0	1.5	0.040	0.040	13.0-17.0	33.0-37.0	1.5	---
ASTM A 351/A 351M-00	HT30	---	N08603	0.25-0.35	2.00	2.50	0.040	0.040	13.0-17.0	33.0-37.0	0.50	---
JIS G 5122:1991	SCH 20	---	---	0.35-0.75	2.00	2.50	0.040	0.040	17.00-21.00	37.00-41.00	0.50	---
DIN 17465:1993	GX40NiCrSi38-18	1.4865	---	0.30-0.50	1.5	1.0-2.5	0.035	0.030	17.0-19.0	36.0-39.0	---	---
	GX40NiCrSiNb38-18	1.4849	---	0.30-0.50	1.5	1.0-2.5	0.035	0.030	17.0-19.0	36.0-39.0	---	Nb 1.2-1.8
ISO 11973:1999	GX40NiCrSi38-19	---	---	0.3-0.5	2	1.0-2.5	0.04	0.03	18-21	36	0.5	---
	GX40NiCrSiNb38-19	---	---	0.3-0.5	2	1.0-2.5	0.04	0.03	18-21	36	0.5	Nb 1.2-1.8
ASTM A 297/A 297M-97 (1998)	HU	---	N08004	0.35-0.75	2.00	2.50	0.04	0.04	17.0-21.0	37.0-41.0	0.50	---
BSI BS 3100:1991 AMD.1: 1992	331C40	---	---	0.35-0.55	2.0	1.5	0.040	0.040	17.0-21.0	33.0-37.0	1.5	---
ASTM A 608-91 (1998)	HU50	---	N08005	0.40-0.60	1.50	0.50-2.00	0.04	0.04	17-21	37-41	0.50	---
BSI BS 3100:1991 AMD.1: 1992	331C60	---	---	0.75	2.0	3.0	0.050	0.050	15.0-25.0	36.0-46.0	1.5	---
AFNOR NF A 32-057:1981	NC 50-M	---	---	0.10	0.30	1.0	0.02	0.02	48-52	balance	---	---
ISO 11973:1999	GX10NiCrNb50-50	---	---	0.1	0.5	0.5	0.02	0.02	47-52	balance	0.5	N 0.16; Nb 1.4-1.7; N+C 0.2

7.5 Cast Heat Resistant Steels

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

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
AFNOR NF A 32-057:1981	Z 50NC60.15-M	---	---	0.35-0.65	2.0	2.5	0.04	0.03	12-18	58-66	---	---
ISO 11973:1999	GX50NiCr65-15	---	---	0.35-0.65	1.3	2	0.04	0.03	13-19	64-69	---	---
ASTM A 297/A 297M-97 (1998)	HX	---	N06006	0.35-0.75	2.00	2.50	0.04	0.04	15.0-19.0	64.0-68.0	0.50	---
ASTM A 608-91 (1998)	HX50	---	N08006	0.40-0.60	1.50	0.50-2.00	0.04	0.04	15.0-19.0	64-68	0.50	---
BSI BS 3100:1991 AMD.1: 1992	334C11	---	---	0.75	2.0	3.0	0.050	0.050	10.0-20.0	55.0-65.0	1.5	---
DIN 17465:1993	G-CoCr 28	2.4778	---	0.10-0.20	1.5	0.5-1.5	0.035	0.030	27.0-30.0	---	---	Co 48.0-52.0
AFNOR NF A 32-057:1981	KC 30 Fe 20-M	---	---	0.30-0.60	1.0	1.0	0.024	0.02	25-30	3	---	Co 48-52; Nb 2; Fe 20
ISO 11973:1999	GX30CoCr50-28	---	---	0.5	1	1	0.04	0.03	25-30	1	0.5	Co 48-52; Fe 20
DIN 17465:1993	G-NiCr 26 W	2.4879	---	0.35-0.50	1.5	0.5-1.5	0.035	0.030	27.0-30.0	47.0-50.0	---	W 4.0-5.5
AFNOR NF A 32-057:1981	Z 45NCW45.25-M	---	---	0.35-0.55	2.0	2.5	0.04	0.03	23-27	42-48	---	W 5-6
ISO 11973:1999	GX45NiCrWSi48-28-5	---	---	0.35-0.55	1.5	1.0-2.5	0.04	0.03	27-30	47-50	---	W 4-6
AFNOR NF A 32-057:1981	Z 40CNK20.20.20-M	---	---	0.35-0.60	2.0	1.0	0.04	0.03	19-22	18-22	2.5-3	Co 18-22; W 2-3; Nb 0.75-1.25; Fe balance
ISO 11973:1999	GX40NiCrCo20-20-20	---	---	0.35-0.60	2	1	0.04	0.03	19-22	18-22	2.5-3.0	Co 18-22; W 2-3

7.5 Cast Heat Resistant Steels

7.5B Mechanical Properties of Cast Heat Resistant Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
DIN 17465:1993	GX30CrSi5	1.4710	---	A	---	---	---	---	---	---	---	300 HB max
ISO 11973:1999	GX30CrSi7	---	---	AC or A	---	---	---	---	---	---	---	---
JIS G 5122:1991	SCH 1	---	---	A	---	---	---	---	490	---	---	---
	SCH 3	---	---	A	---	---	---	---	490	---	---	---
BSI BS 3100:1991 AMD.1: 1992	420C24	---	---	AC	---	---	---	---	---	---	---	---
DIN 17465:1993	GX40CrSi13	1.4729	---	A	---	---	---	---	---	---	---	300 HB max
AFNOR NF A 32-057:1981	Z 25C13-M	---	---	AC	---	---	380	---	500	---	12	---
ISO 11973:1999	GX40CrSi13	---	---	A	---	---	---	---	---	---	---	300 HB max
DIN 17465:1993	GX40CrSi17	1.4740	---	A	---	---	---	---	---	---	---	300 HB max
ISO 11973:1999	GX40CrSi17	---	---	A	---	---	---	---	---	---	---	300 HB max
DIN 17465:1993	GX40CrSi23	1.4745	---	AC	---	---	---	---	---	---	---	---
ISO 11973:1999	GX40CrSi24	---	---	A	---	---	---	---	---	---	---	300 HB max
DIN 17465:1993	GX40CrSi29	1.4776	---	AC	---	---	---	---	---	---	---	---
ISO 11973:1999	GX40CrSi28	---	---	A	---	---	---	---	---	---	---	320 HB max
DIN 17465:1993	GX130CrSi29	1.4777	---	AC	---	---	---	---	---	---	---	---
ISO 11973:1999	GX130CrSi29	---	---	A	---	---	---	---	---	---	---	400 HB max
JIS G 5122:1991	SCH 2	---	---	A	---	---	---	---	340	---	---	---
ASTM A 297/A 297M-97 (1998)	HC	---	J92605	AC	---	---	---	---	380	55	---	---
AFNOR NF A 32-057:1981	Z 40C28-M	---	---	AC	---	---	---	---	400	---	---	---
ASTM A 608-91 (1998)	HC30	---	J92613	AC	---	---	---	---	---	---	---	---
BSI BS 3100:1991 AMD.1: 1992	452C11	---	---	AC	---	---	---	---	---	---	---	---
	452C12	---	---	AC	---	---	---	---	---	---	---	---
ISO 11973:1999	GX40CrNiSi27-4	---	---	AC	---	---	250	---	400	---	3	400 HB max
ASTM A 297/A 297M-97 (1998)	HD	---	J93005	AC	---	---	240	35	515	75	8	---
AFNOR NF A 32-057:1981	Z 30CN26.05-M	---	---	AC	---	---	250	---	550	---	8	---
JIS G 5122:1991	SCH 11	---	---	AC	---	---	---	---	590	---	---	---
ASTM A 608-91 (1998)	HD50	---	J93015	AC	---	---	---	---	---	---	---	---
DIN 17465:1993	GX40CrNiSi27-4	1.4823	---	AC	---	---	---	---	---	---	---	---

7.5 Cast Heat Resistant Steels

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
JIS G 5122:1991	SCH 17	---	---	AC	---	---	275	---	540	---	5	---
ASTM A 297/A 297M-97 (1998)	HE	---	J93403	AC	---	---	275	40	585	85	9	---
ASTM A 608-91 (1998)	HE35	---	J93413	AC	---	---	---	---	---	---	---	---
BSI BS 3100:1991 AMD.1: 1992	309C40	---	---	AC	---	---	---	---	---	---	---	---
DIN 17465:1993	GX25CrNiSi18-9	1.4825	---	AC	---	---	230	---	440	---	15	---
	GX40CrNiSi22-9	1.4826	---	AC	---	---	230	---	440	---	8	---
AFNOR NF A 32-057:1981	Z 25CN20.10-M	---	---	AC	---	---	240	---	450	---	15	---
ISO 11973:1999	GX25CrNiSi18-9	---	---	AC	---	---	230	---	450	---	15	---
	GX40CrNiSi22-10	---	---	AC	---	---	230	---	450	---	8	---
ASTM A 297/A 297M-97 (1998)	HF	---	J93603	AC	---	---	240	35	485	70	25	---
JIS G 5122:1991	SCH 12	---	---	AC	---	---	235	---	490	---	23	---
ASTM A 608-91 (1998)	HF 30	---	J92803	AC	---	---	---	---	---	---	---	---
BSI BS 3100:1991 AMD.1: 1992	302C35	---	---	AC	---	---	---	---	---	---	---	---
DIN 17465:1993	GX25CrNiSi20-14	1.4832	---	AC	---	---	230	---	440	---	10	---
ISO 11973:1999	GX25CrNiSi20-14	---	---	AC	---	---	230	---	450	---	10	---

7.5 Cast Heat Resistant Steels

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
DIN 17465:1993	GX40CrNiSi25-12	1.4837	---	AC	---	---	230	---	440	---	7	---
ISO 11973:1999	GX40CrNiSi25-12	---	---	AC	---	---	220	---	450	---	6	---
JIS G 5122:1991	SCH 13	---	---	AC	---	---	235	---	490	---	8	---
	SCH 13A	---	---	AC	---	---	235	---	490	---	8	---
AFNOR NF A 32-057:1981	Z 40CN25.12-M	---	---	AC	---	---	240	---	500	---	8	---
BSI BS 3100:1991 AMD.1: 1992	309C35	---	---	AC	---	---	---	---	510	---	7	---
ASTM A 297/A 297M-97 (1998)	HH	---	J93503	AC	---	---	240	35	515	75	10	---
ASTM A 447/A 447M-93 (1998)	Type I	---	J93303	AC	---	---	---	---	550	80	9	---
	Type II	---	J93303	AC	---	---	---	---	550	80	4	---
BSI BS 3100:1991 AMD.1: 1992	309C32	---	---	HTC	---	---	---	---	550	---	3	---
ASTM A 608-91 (1998)	HH30	---	J93513	AC	---	---	---	---	---	---	---	---
	HH33	---	J93633	AC	---	---	---	---	---	---	---	---
BSI BS 3100:1991 AMD.1: 1992	309C30	---	---	AC	---	---	---	---	---	---	---	---
ASTM A 297/A 297M-97 (1998)	HI	---	J94003	AC	---	---	240	35	485	70	10	---
ASTM A 608-91 (1998)	HI35	---	J94013	AC	---	---	---	---	---	---	---	---
JIS G 5122:1991	SCH 18	---	---	AC	---	---	235	---	490	---	8	---
JIS G 5122:1991	SCH 21	---	---	AC	---	---	235	---	440	---	8	---
ASTM A 297/A 297M-97 (1998)	HK	---	J94224	AC	---	---	240	35	450	65	10	---
ASTM A 351/A 351M-00	HK30	---	J94203	AC	---	---	240	35	450	65	10.0	---
ASTM A 608-91 (1998)	HK30	---	J94203	AC	---	---	---	---	---	---	---	---

7.5 Cast Heat Resistant Steels

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
AFNOR NF A 32-057:1981	Z 40CN25.20-M	---	---	AC	---	---	200	---	400	---	8	---
ASTM A 351/A 351M-00	HK40	---	J94204	AC	---	---	240	35	425	62	10.0	---
DIN 17465:1993	GX40CrNiSi25-20	1.4848	---	AC	---	---	230	---	440	---	6	---
JIS G 5122:1991	SCH 22	---	---	AC	---	---	235	---	440	---	8	---
BSI BS 3100:1991 AMD.1: 1992	310C40	---	---	AC	---	---	---	---	450	---	7	---
ISO 11973:1999	GX40CrNiSi25-20	---	---	AC	---	---	220	---	450	---	6	---
ASTM A 608-91 (1998)	HK40	---	J94204	AC	---	---	---	---	---	---	---	---
BSI BS 3100:1991 AMD.1: 1992	310C45	---	---	AC	---	---	---	---	---	---	---	---
ASTM A 297/A 297M-97 (1998)	HL	---	N08604	AC	---	---	240	35	450	65	10	---
ASTM	HL30	---	N08613	AC	---	---	---	---	---	---	---	---
A 608-91 (1998)	HL40	---	N08614	AC	---	---	---	---	---	---	---	---
JIS G 5122:1991	SCH 23	---	---	AC	---	---	245	---	450	---	8	---
AFNOR NF A 32-057:1981	Z 40CN30.20-M	---	---	AC	---	---	---	---	---	---	---	---
JIS G 5122:1991	SCH 19	---	---	AC	---	---	---	---	390	---	5	---
ASTM A 297/A 297M-97 (1998)	HN	---	J94213	AC	---	---	---	---	435	63	8	---
ASTM A 608-91 (1998)	HN40	---	J94214	AC	---	---	---	---	---	---	---	---
BSI BS 3100:1991 AMD.1: 1992	311C11	---	---	AC	---	---	---	---	---	---	---	---
DIN 17465:1993	GX30CrNiSiNb24-24	1.4855	---	AC	---	---	230	---	440	---	5	---
ISO 11973:1999	GX40CrNiSiNb24-24	---	---	AC	---	---	220	---	400	---	4	---
DIN 17465:1993	GX40NiCrSiNb35-25	1.4852	---	AC	---	---	220	---	400	---	5	---
ASTM A 297/A 297M-97 (1998)	HP	---	N08705	AC	---	---	235	34	430	62.5	4.5	---
JIS G 5122:1991	SCH 24	---	---	AC	---	---	235	---	440	---	5	---
DIN 17465:1993	GX40NiCrSi35-25	1.4857	---	AC	---	---	230	---	440	---	5	---
ISO 11973:1999	GX40NiCrSi35-26	---	---	AC	---	---	220	---	440	---	6	---
	GX40NiCrSiNb35-26	---	---	AC	---	---	220	---	440	---	4	---

7.5 Cast Heat Resistant Steels

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
AFNOR NF A 32-057:1981	Z 40NC35.15-M	---	---	AC	---	---	200	---	400	---	4	---
ISO 11973:1999	GX40NiCrSi35-17	---	---	AC	---	---	220	---	420	---	6	---
JIS G 5122:1991	SCH 15	---	---	AC	---	---	---	---	440	---	4	---
ASTM A 297/A 297M-97 (1998)	HT	---	N08605	AC	---	---	---	---	450	65	4	---
ASTM A 608-91 (1998)	HT50	---	N08050	AC	---	---	---	---	---	---	---	---
BSI BS 3100:1991 AMD.1: 1992	330C12	---	---	AC	---	---	---	---	---	---	---	---
JIS G 5122:1991	SCH 16	---	---	AC	---	---	195	---	440	---	13	---
BSI BS 3100:1991 AMD.1: 1992	330C11	---	---	AC	---	---	---	---	450	---	3	---
ASTM A 351/A 351M-00	HT30	---	N08603	AC	---	---	195	28	450	65	15.0	---
JIS G 5122:1991	SCH 20	---	---	AC	---	---	---	---	390	---	4	---
DIN 17465:1993	GX40NiCrSi38-18	1.4865	---	AC	---	---	230	---	400	---	5	---
	GX40NiCrSiNb38-18	1.4849	---	AC	---	---	220	---	400	---	5	---
ISO 11973:1999	GX40NiCrSi38-19	---	---	AC	---	---	220	---	420	---	6	---
	GX40NiCrSiNb38-19	---	---	AC	---	---	220	---	420	---	4	---
ASTM A 297/A 297M-97 (1998)	HU	---	N08004	AC	---	---	---	---	450	65	4	---
BSI BS 3100:1991 AMD.1: 1992	331C40	---	---	AC	---	---	---	---	450	---	3	---
ASTM A 608-91 (1998)	HU50	---	N08005	AC	---	---	---	---	---	---	---	---
BSI BS 3100:1991 AMD.1: 1992	331C60	---	---	AC	---	---	---	---	---	---	---	---
AFNOR NF A 32-057:1981	NC 50-M	---	---	AC	---	---	300	---	500	---	4	---
ISO 11973:1999	GX10NiCrNb50-50	---	---	AC	---	---	230	---	540	---	8	---

7.5 Cast Heat Resistant Steels

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Other
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
AFNOR NF A 32-057:1981	Z 50NC60.15-M	---	---	AC	---	---	---	---	400	---	---	---
ISO 11973:1999	GX50NiCr65-15	---	---	AC	---	---	200	---	400	---	3	---
ASTM A 297/A 297M-97 (1998)	HX	---	N06006	AC	---	---	---	---	415	60	---	---
ASTM A 608-91 (1998)	HX50	---	N08006	AC	---	---	---	---	---	---	---	---
BSI BS 3100:1991 AMD.1: 1992	334C11	---	---	AC	---	---	---	---	---	---	---	---
DIN 17465:1993	G-CoCr 28	2.4778	---	AC	---	---	---	---	---	---	---	---
AFNOR NF A 32-057:1981	KC 30 Fe 20-M	---	---	AC	---	---	350	---	540	---	3	---
ISO 11973:1999	GX30CoCr50-28	---	---	AC	---	---	---	---	---	---	---	---
DIN 17465:1993	G-NiCr 26 W	2.4879	---	AC	---	---	---	---	---	---	---	---
AFNOR NF A 32-057:1981	Z 45NCW45.25-M	---	---	AC	---	---	200	---	400	---	4	---
ISO 11973:1999	GX45NiCrWSi48-28-5	---	---	AC	---	---	220	---	400	---	3	---
AFNOR NF A 32-057:1981	Z 40CNK20.20.20-M	---	---	AC	---	---	320	---	400	---	6	---
ISO 11973:1999	GX40NiCrCo20-20-20	---	---	AC	---	---	320	---	400	---	6	---

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		---	

7.6 Non-Comparable Steel Castings

ISO 4991:1994 - Steel Castings for Pressure Purposes												
Steel Type	C31L	C33H	C34BL	C43CL1	C47H	C60H	---	---	---	---	---	---
ISO 11972:1998 - Corrosion-Resistant Cast Steels for General Applications												
Steel Type	GX 2 CrNiN 18 10		---	---	---	---	---	---	---	---	---	---
ISO 11973:1999 - Heat-Resistant Cast Steels and Alloys for General Applications												
Steel Type	GX10NiCrNb31-20		GX50NiCr52-19		GX45NiCrCoW35-25-15-5		---	---	---	---	---	---
ISO 13521:1999 - Austenitic Manganese Steel Castings												
Steel Type	GX120Mn17	---	---	---	---	---	---	---	---	---	---	---

CHAPTER

8

WROUGHT STAINLESS STEELS

Plate, Sheet, Strip**ASTM Standards**

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

JIS Standards

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

CEN Standards

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

Bars**ASTM Standards**

ASTM A 276-00	Stainless Steel Bars and Shapes
ASTM A 564/A 564M-99	Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes
ASTM A 582/A 582M-95	Free-Machining Stainless Steel Bars
ASTM B 649-95	Ni-Fe-Cr-Mo-Cu Low-Carbon Alloy (UNS N08904), Ni-Fe-Cr-Mo-Cu-N Low-Carbon Alloys (UNS N08925, UNS N08031, and UNS N08926), and Cr-Ni-Fe-N Low-Carbon Alloy (UNS R20033) Bar and Wire
ASTM B 691-95	Iron-Nickel-Chromium-Molybdenum Alloys (UNS N08366 and UNS N08367) Rod, Bar, and Wire

JIS Standards

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

CEN Standards

EN 10088-3:1995	Stainless Steels – Part 3: Technical Delivery Conditions for Semi-Finished Products, Bars, Rod and Sections for General Purposes
EN 10095:1991	Heat Resisting Steels and Nickel Alloys

ISO Standard

ISO 4955:1994	Heat-Resisting Steels and Alloys
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Heat Treatment Terms Applicable to this Chapter

Standard	Heat Treatment Terms
ASTM A 167-99	---
ASTM A 176-99	---
ASTM A 276-00	HF or CF: hot-finished or cold-finished A: annealed; H: hardened and tempered at a relatively low temp.; T: hardened and tempered at a relatively high temperature; S: strain hardened – relatively light cold work; B: relatively severe cold work; as hot-rolled
ASTM A 564/A 564M-99	HR & CF: hot-rolled and cold-finished A: solution treated; HXXX: age hardening at specified temperature
ASTM A 582/A 582M-95	HF or CF: hot-finished or cold-finished A: annealed; T: intermediate temper; H: hard temper
ASTM A 666-00	A: annealed; CW: cold-worked, $\frac{1}{16}$ hard, $\frac{1}{8}$ hard, $\frac{1}{4}$ hard, $\frac{1}{2}$ hard, $\frac{3}{4}$ hard, full hard
ASTM B 625-99	HR or CR: hot rolled or cold-rolled. A: annealed
ASTM B 649-95	CF & HF: cold finished and hot finished S: solution-treated; A: annealed
ASTM B 688-96	HR or CR: hot-rolled or cold-rolled
ASTM B 691-95	HF & CF: hot-finished and cold-finished A: annealed
EN 10088-2:1995	HR or CR: hot rolled or cold rolled C: cold rolled strip; H: hot rolled strip; P: hot rolled plate and sheet A: annealed; QT: quenched and tempered; AT: solution annealed; P: precipitation hardened (with specified temperature); SR: strength relieved
EN 10088-3:1995	HF or CF: hot- or cold-formed A: annealed; QT: quenched and tempered; AT: solution annealed; PXXX: precipitation hardened at specified temperature
EN 10095:1999	Pl, Sh, St/HR or CR: hot rolled or cold rolled; Bars/HF or CF: hot formed or cold formed A: annealed; AT: solution annealed
ISO 4955:1994	TA: annealed; TQ: quenched
JIS G 4303:1998	HF: hot-finished S: solution-treated; A: annealed; Q: quenched and tempered; HXXX: precipitation hardened at specified temperature
JIS G 4304:1999	HR: hot rolled; S: solution treated; A: annealed; QT: quenched and tempered; HXXX: precipitation hardening treatment at specified temperature
JIS G 4305:1999	CR: cold rolled as JIS G 4304, except SUS 301 and SUS 301L (TRR: thermal refining rolled)/ $\frac{1}{4}$ H, $\frac{1}{2}$ H, $\frac{3}{4}$ H, H
JIS G 4311:1991	SUS" as G 4303 and G 4308 H: aging treatment after solution treatment
JIS G 4312:1991	"SUS" types, as 4304 and 4305, HR or CR: hot rolled or cold rolled; "SUH", H: aging treatment after solution treatment
JIS G 4318:1998	CF: cold finished

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.1A Chemical Composition of Martensitic Stainless Steels

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

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.1B Mechanical Properties of Martensitic Stainless Steels

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

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.2A Chemical Composition of Ferritic Stainless Steels

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
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

8.1.3A Chemical Composition of Austenitic Stainless Steels (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 666-00	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
JIS G 4304:1999	SUS304N1	---	---	0.08	2.50	1.00	0.045	0.030	18.00-20.00	7.00-10.50	---	N 0.15-0.25
JIS G 4305:1999	SUS304N1	---	---	0.08	2.50	1.00	0.045	0.030	18.00-20.00	7.00-10.50	---	N 0.15-0.25
ASTM A 666-00	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
JIS G 4304:1999	SUS304LN	---	---	0.030	2.00	1.00	0.045	0.030	17.00-19.00	8.50-11.50	---	N 0.12-0.22
JIS G 4305:1999	SUS304LN	---	---	0.030	2.00	1.00	0.045	0.030	17.00-19.00	8.50-11.50	---	N 0.12-0.22
EN 10088-2:1995	X2CrNi18-10	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 167-99	309	---	S30900	0.20	2.00	0.75	0.045	0.030	22.0-24.0	12.0-15.0	---	---
JIS G 4312:1991	SUH309	---	---	0.20	2.00	1.00	0.040	0.030	22.00-24.00	12.00-15.00	---	---
JIS G 4304:1999	SUS309S	---	---	0.08	2.00	1.00	0.045	0.030	22.00-24.00	12.00-15.00	---	---
JIS G 4305:1999	SUS309S	---	---	0.08	2.00	1.00	0.045	0.030	22.00-24.00	12.00-15.00	---	---
JIS G 4312:1991	SUS309S	---	---	0.08	2.00	1.00	0.045	0.030	22.00-24.00	12.00-15.00	---	---
EN 10095:1999	X12CrNi23-13	1.4833	---	0.15	2.00	1.00	0.045	0.015	22.00-24.00	12.00-15.00	---	N 0.11
ISO 4955:1994	X6CrNi23-14	---	---	0.08	2.0	1.0	0.045	0.030	22.0-24.0	12.0-15.0	---	---
ASTM A 167-99	310	---	S31000	0.25	2.00	1.50	0.045	0.030	24.0-26.0	19.0-22.0	---	---
JIS G 4312:1991	SUH310	---	---	0.25	2.00	1.50	0.040	0.030	24.00-26.00	19.00-22.00	---	---
JIS G 4304:1999	SUS310S	---	---	0.08	2.00	1.50	0.045	0.030	24.00-26.00	19.00-22.00	---	---
JIS G 4305:1999	SUS310S	---	---	0.08	2.00	1.50	0.045	0.030	24.00-26.00	19.00-22.00	---	---
JIS G 4312:1991	SUS310S	---	---	0.08	2.00	1.50	0.045	0.030	24.00-26.00	19.00-22.00	---	---
ISO 4955:1994	X15CrNiSi25-21	---	---	0.20	2.0	1.5-2.5	0.045	0.030	24.0-26.0	19.0-22.0	---	---
ASTM A 666-00	316	---	S31600	0.08	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
JIS G 4304:1999	SUS316	---	---	0.08	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---
JIS G 4305:1999	SUS316	---	---	0.08	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---
JIS G 4312:1991	SUS316	---	---	0.08	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---
EN 10088-2:1995	X5CrNiMo17-12-2	1.4401	---	0.07	2.00	1.00	0.045	0.015	16.50-18.50	10.00-13.00	2.00-2.50	N 0.11
	X3CrNiMo17-13-3	1.4436	---	0.05	2.00	1.00	0.045	0.015	16.50-18.50	10.50-13.00	2.50-3.00	N 0.11
ASTM A 666-00	316L	---	S31603	0.030	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
JIS G 4304:1999	SUS316L	---	---	0.030	2.00	1.00	0.045	0.030	16.00-18.00	12.00-15.00	2.00-3.00	---
JIS G 4305:1999	SUS316L	---	---	0.030	2.00	1.00	0.045	0.030	16.00-18.00	12.00-15.00	2.00-3.00	---
EN 10088-2:1995	X2CrNiMo17-12-2	1.4404	---	0.030	2.00	1.00	0.045	0.015	16.50-18.50	10.00-13.00	2.00-2.50	N 0.11
	X2CrNiMo17-12-3	1.4432	---	0.030	2.00	1.00	0.045	0.015	16.50-18.50	10.50-13.00	2.50-3.00	N 0.11
	X2CrNiMo18-14-3	1.4435	---	0.030	2.00	1.00	0.045	0.015	17.00-19.00	12.00-15.00	2.50-3.00	N 0.11

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3A Chemical Composition of Austenitic Stainless Steels (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 666-00	316N	---	S31651	0.08	2.00	0.75	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	N 0.10-0.16
JIS G 4304:1999	SUS316N	---	---	0.08	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	N 0.10-0.22
JIS G 4305:1999	SUS316N	---	---	0.08	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	N 0.10-0.22
JIS G 4304:1999	SUS316LN	---	---	0.030	2.00	1.00	0.045	0.030	16.50-18.50	10.50-14.50	2.00-3.00	N 0.12-0.22
JIS G 4305:1999	SUS316LN	---	---	0.030	2.00	1.00	0.045	0.030	16.50-18.50	10.50-14.50	2.00-3.00	N 0.12-0.22
EN 10088-2:1995	X2CrNiMoN17-11-2	1.4406	---	0.030	2.00	1.00	0.045	0.015	16.50-18.50	10.00-12.00	2.00-2.50	N 0.12-0.22
	X2CrNiMoN17-13-3	1.4429	---	0.030	2.00	1.00	0.045	0.015	16.50-18.50	11.00-14.00	2.50-3.00	N 0.12-0.22
JIS G 4304:1999	SUS316Ti	---	---	0.08	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	Ti \geq 5 x C
JIS G 4305:1999	SUS316Ti	---	---	0.08	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	Ti \geq 5 x C
JIS G 4312:1991	SUS316Ti	---	---	0.08	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	Ti \geq 5 x C
EN 10088-2:1995	X6CrNiMoTi17-12-2	1.4571	---	0.08	2.00	1.00	0.045	0.015	16.50-18.50	10.50-13.50	2.0-2.50	Ti 5 x C to 0.70
JIS G 4304:1999	SUS317L	---	---	0.030	2.00	1.00	0.045	0.030	18.00-20.00	11.00-15.00	3.00-4.00	---
JIS G 4305:1999	SUS317L	---	---	0.030	2.00	1.00	0.045	0.030	18.00-20.00	11.00-15.00	3.00-4.00	---
EN 10088-2:1995	X2NiCrMo18-15-4	1.4438	---	0.030	2.00	1.00	0.045	0.015	17.50-19.50	13.00-16.00	3.00-4.00	N 0.11
JIS G 4304:1999	SUS317LN	---	---	0.03	2.00	1.00	0.045	0.030	18.00-20.00	11.00-15.00	3.00-4.00	N 0.10-0.22
JIS G 4305:1999	SUS317LN	---	---	0.03	2.00	1.00	0.045	0.030	18.00-20.00	11.00-15.00	3.00-4.00	N 0.10-0.22
EN 10088-2:1995	X2CrNiMoN18-12-4	1.4434	---	0.030	2.00	1.00	0.045	0.015	16.50-19.50	10.50-14.00	3.00-4.00	N 0.10-0.20
JIS G 4304:1999	SUS317J1	---	---	0.040	2.50	1.00	0.045	0.030	16.00-19.00	15.00-17.00	4.00-6.00	---
JIS G 4305:1999	SUS317J1	---	---	0.040	2.50	1.00	0.045	0.030	16.00-19.00	15.00-17.00	4.00-6.00	---
EN 10088-2:1995	X2CrNiMoN17-13-5	1.4439	---	0.030	2.00	1.00	0.045	0.015	16.50-18.50	12.50-14.50	4.00-5.00	N 0.12-0.22
ASTM B 688-96	---	---	N08366	0.035	2.00	1.00	0.040	0.030	20.00-22.00	23.50-25.50	6.00-7.00	---
	---	---	N08367	0.030	2.00	1.00	0.040	0.030	20.00-22.00	23.50-25.50	6.00-7.00	N 0.18-0.25; Cu 0.75
JIS G 4304:1999	SUS836L	---	---	0.030	2.00	1.00	0.045	0.030	19.00-24.00	24.00-26.00	5.00-7.00	N 0.25
JIS G 4305:1999	SUS836L	---	---	0.030	2.00	1.00	0.045	0.030	19.00-24.00	24.00-26.00	5.00-7.00	N 0.25
EN 10088-2:1995	1XNiCrMoCuN25-20-7	1.4529	---	0.020	1.00	0.50	0.030	0.010	19.00-21.00	24.00-26.00	6.00-7.00	N 0.15-0.25; Cu 0.50-1.50
ASTM B 625-99	---	---	N08904	0.020	2.00	1.00	0.045	0.035	19.00-23.00	23.00-28.00	4.0-5.0	Cu 1.0-2.0; Fe balance
JIS G 4304:1999	SUS890L	---	---	0.020	2.00	1.00	0.045	0.030	19.00-23.00	23.00-28.00	4.00-5.00	Cu 1.00-2.00
JIS G 4305:1999	SUS890L	---	---	0.020	2.00	1.00	0.045	0.030	19.00-23.00	23.00-28.00	4.00-5.00	Cu 1.00-2.00
EN 10088-2:1995	X1NiCrMoCu25-20-5	1.4539	---	0.020	2.00	0.70	0.030	0.010	19.00-21.00	24.00-26.00	4.00-5.00	N 0.15; Cu 1.20-2.00
JIS G 4304:1999	SUS321	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Ti \geq 5 x C
JIS G 4305:1999	SUS321	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Ti \geq 5 x C
JIS G 4312:1991	SUS321	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Ti \geq 5 x C
EN 10088-2:1995	X6CrNiTi18-10	1.4541	---	0.08	2.00	1.00	0.045	0.015	17.00-19.00	9.00-12.00	---	Ti 5 x C to 0.70
ISO 4955:1994	X7CrNiTi18-10	---	---	0.040-0.10	2.0	1.0	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 5 x C to 0.80

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3A Chemical Composition of Austenitic Stainless Steels (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 4304:1999	SUS 347	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Nb \geq 10 x C
JIS G 4305:1999	SUS 347	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Nb \geq 10 x C
JIS G 4312:1991	SUS 347	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Nb \geq 10 x C
EN 10088-3:1995	X6CrNiNb18-10	1.4550	---	0.08	2.00	1.00	0.045	0.015	17.00-19.00	9.00-12.00	---	Nb 10 x C to 1.00
ISO 4955:1994	X7CrNiNb18-10	---	---	0.040-0.10	2.0	1.0	0.045	0.030	17.0-19.0	9.0-12.0	---	Nb 10 x C to 1.2

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/mm ² or MPa	ksi	N/mm ² 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	---/---/---
				Pl, Sh, St/CW, 3/4 Hard	---	≥ 0.015					18	
				Pl, Sh, St/CW, 1/2 Hard	---	< 0.015	930	135	1205	175	10	---/---/---
				Pl, Sh, St/CW, 3/4 Hard	---	≥ 0.015					12	
				Pl, Sh, St/CW, Full Hard	---	< 0.015	965	140	1275	185	8	---/---/---
				Pl, Sh, St/CW, Full Hard	---	≥ 0.015					9	
EN 10088-2:1995	X12CrMnNiN17-7-5	1.4372	---	Pl, Sh, St/A	---	---	310	45	655	95	40	241/100/---
				St/CR, AT	≤ 6	---	350	---	750-950	---	45	---/---/---
				St/HR, AT	≤ 12	---	330	---			40	
				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	
				Pl, Sh, St/CW, 1/2 Hard	---	> 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	
				Pl, Sh, St/CW, 1/2 Hard	---	> 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	---			35	
				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	---/---/---
				Pl, Sh, St/CW, ⅛ Hard	---	---	310	45	620	90	40	
				Pl, Sh, St/CW, ⅙ 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
					< 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	---/---/---

8.1 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	301L	---	S30103	Pl, Sh, St/A	---	---	220	32	550	80	45	---/---/---
				Pl, Sh, St/CW, 1/16 Hard	---	---	345	50	690	100	40	
				Pl, Sh, St/CW, 1/8 Hard	---	---	415	60	760	110	35	
				Pl, Sh, St/CW, 1/4 Hard	---	---	515	75	825	120	25	
				Pl, Sh, St/CW, 1/2 Hard	---	---	690	100	930	135	20	
	301LN	---	S30153	Pl, Sh, St/A	---	---	240	35	550	80	45	---/---/---
				Pl, Sh, St/CW, 1/16 Hard	---	---	345	50	690	100	40	
				Pl, Sh, St/CW, 1/8 Hard	---	---	415	60	760	110	35	
				Pl, Sh, St/CW, 1/4 Hard	---	---	515	75	825	120	25	
				Pl, Sh, St/CW, 1/2 Hard	---	---	690	100	930	135	20	
JIS G 4304:1999	SUS301L	---	---	Pl, Sh, St/HR, S	---	---	215	---	550	---	45	187/90/200
	SUS301J1	---	---	Pl, Sh, St/HR, S	---	---	205	---	570	---	45	187/90/200
JIS G 4305:1999	SUS301L	---	---	Pl, Sh, St/CR, S	---	---	215	---	550	---	45	187/90/200
				Pl, Sh, St/TRR, 1/4 H	---	---	345	---	690	---	40	---/---/---
				Pl, Sh, St/TRR, 1/2 H	---	---	410	---	760	---	35	---/---/---
				Pl, Sh, St/TRR, 3/4 H	---	---	480	---	820	---	25	---/---/---
				Pl, Sh, St/TRR, H	---	---	685	---	930	---	20	---/---/---
	SUS301J1	---	---	Pl, Sh, St/CR, S	---	---	205	---	570	---	45	187/90/200
EN 10088-2:1995	X2CrNiN18-7	1.4318	---	St/CR, AT	≤ 6	---	350	---	650-850	---	35	---/---/---
				St/HR, AT	≤ 12	---	330	---				
				Pl/HR, AT	≤ 75	---	330	---	630-830	---	45	

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	302	---	S30200	PI, Sh, St/A	---	---	205	30	515	75	40	201/92/---
				PI, Sh, St/CW, 1/16 Hard	---	---	310	45	585	85	40	---/---/---
				PI, Sh, St/CW, 1/8 Hard	---	---	380	55	690	100	35	
				PI, Sh, St/CW, 1/4 Hard	---	≤ 0.030	515	75	860	125	10	
				PI, Sh, St/CW, 1/2 Hard	---	> 0.030					12	
				PI, Sh, St/CW, 3/4 Hard	---	< 0.015	760	110	1035	150	9	
				PI, Sh, St/CW, Full Hard	---	≥ 0.015					10	
				PI, Sh, St/CW, Full Hard	---	< 0.015	930	135	1205	175	5	
				PI, Sh, St/CW, Full Hard	---	≥ 0.015					6	
JIS G 4304:1999	SUS302	---	---	PI, Sh, St/HR, S	---	---	205	---	520	---	40	187/90/200
JIS G 4305:1999	SUS302	---	---	PI, Sh, St/CR, S	---	---	205	---	520	---	40	187/90/200
ASTM A 167-00	302B	---	S30215	PI, Sh, St/---	---	---	205	30	515	75	40	217/95/---
JIS G 4304:1999	SUS302B	---	---	PI, Sh, St/HR, S	---	---	205	---	520	---	40	207/95/218
JIS G 4305:1999	SUS302B	---	---	PI, Sh, St/CR, S	---	---	205	---	520	---	40	207/95/218
JIS G 4312:1991	SUS302B	---	---	PI, Sh/HR or CR, S	---	---	205	---	520	---	40	207/95/218

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	304	---	S30400	Pl, Sh, St/A	---	---	205	30	515	75	40	---/---/---
				Pl, Sh, St/CW, 1/16 Hard	---	---	310	45	550	80	35	
				Pl, Sh, St/CW, 1/8 Hard	---	---	380	55	690	100	35	
				Pl, Sh, St/CW, 1/4 Hard	---	≤ 0.030	515	75	860	125	10	
				---	> 0.030	12						
				Pl, Sh, St/CW, 1/2 Hard	---	< 0.015	760	110	1035	150	6	
				---	≥ 0.015	7						
JIS G 4304:1999	SUS304	---	---	Pl, Sh, St/HR, S	---	---	205	---	520	---	40	187/90/200
JIS G 4305:1999	SUS304	---	---	Pl, Sh, St/CR, S	---	---	205	---	520	---	40	187/90/200
JIS G 4312:1991	SUS304	---	---	Pl, Sh/HR or CR, S	---	---	205	---	520	---	40	187/90/200
EN 10088-2:1995	X5CrNi18-10	1.4301	---	St/CR, AT	≤ 6	---	230	---	540-750	---	45	---/---/---
				St/HR, AT	≤ 12	---	210	---	520-720			
				Pl/HR, AT	≤ 75	---	210	---				
ISO 4955:1994	X7CrNi18-9	---	---	Pl, Sh, St/TQ	0.5 ≤ a ≤ 75	---	195	---	500-700	---	see standard	192/---/---
ASTM A 666-00	304L	---	S30403	Pl, Sh, St/A	---	---	170	25	485	70	40	---/---/---
				Pl, Sh, St/CW, 1/16 Hard	---	---	310	45	550	80	40	
				Pl, Sh, St/CW, 1/8 Hard	---	---	380	55	690	100	30	
				Pl, Sh, St/CW, 1/4 Hard	---	≤ 0.030	515	75	860	125	8	
				---	> 0.030	10						
				Pl, Sh, St/CW, 1/2 Hard	---	< 0.015	760	110	1035	150	5	
				---	≥ 0.015	6						
JIS G 4304:1999	SUS304L	---	---	Pl, Sh, St/HR, S	---	---	175	---	480	---	40	187/90/200
JIS G 4305:1999	SUS304L	---	---	Pl, Sh, St/CR, S	---	---	175	---	480	---	40	187/90/200
EN 10088-2:1995	X2CrNi18-9	1.4307	---	St/CR, AT	≤ 6	---	220	---	520-670	---	45	---/---/---
				St/HR, AT	≤ 12	---	200	---				
				Pl/HR, AT	≤ 75	---	200	---	500-650	---		

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRB/HV
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 666-00	304N	---	S30451	Pl, Sh, St/A	---	---	240	35	550	80	30	217/95/---
				Pl, Sh, St/CW, 1/16 Hard	---	---	310	45	620	90	40	---/---/---
				Pl, Sh, St/CW, 1/8 Hard	---	---	380	55	690	100	37	
				Pl, Sh, St/CW, 1/4 Hard	---	---	515	75	860	125	12	
				Pl, Sh, St/CW, 1/2 Hard	---	< 0.015	760	110	1035	150	6	
				Pl, Sh, St/CW, 1/2 Hard	---	≥ 0.015					8	
JIS G 4304:1999	SUS304N1	---	---	Pl, Sh, St/HR, S	---	---	275	---	550	---	35	217/95/220
JIS G 4305:1999	SUS304N1	---	---	Pl, Sh, St/CR, S	---	---	275	---	550	---	35	217/95/220
ASTM A 666-00	304LN	---	S30453	Pl, Sh, St/A	---	---	205	30	515	75	40	217/95/---
				Pl, Sh, St/CW, 1/16 Hard	---	---	310	45	620	90	40	---/---/---
				Pl, Sh, St/CW, 1/8 Hard	---	---	380	55	690	100	33	
				Pl, Sh, St/CW, 1/4 Hard	---	≤ 0.030	515	75	860	125	10	
				Pl, Sh, St/CW, 1/4 Hard	---	> 0.030					12	
				Pl, Sh, St/CW, 1/2 Hard	---	< 0.015	760	110	1035	150	6	
				Pl, Sh, St/CW, 1/2 Hard	---	≥ 0.015					7	
JIS G 4304:1999	SUS304LN	---	---	Pl, Sh, St/HR, S	---	---	245	---	550	---	40	217/95/220
JIS G 4305:1999	SUS304LN	---	---	Pl, Sh, St/CR, S	---	---	245	---	550	---	40	217/95/220
EN 10088-2:1995	X2CrNiN18-10	1.4311	---	St/CR, AT	≤ 6	---	290	---	550-750	---	40	---/---/---
				St/HR, AT	≤ 12	---	270	---				
				Pl/HR, AT	≤ 75	---	270	---				
ASTM A 167-99	309	---	S30900	Pl, Sh, St/---	---	---	205	30	515	75	40	217/95/---
JIS G 4312:1991	SUH309	---	---	Pl, Sh/HR or CR, S	---	---	205	---	560	---	40	201/95/210
JIS G 4304:1999	SUS309S	---	---	Pl, Sh, St/HR, S	---	---	205	---	520	---	40	187/90/200
JIS G 4305:1999	SUS309S	---	---	Pl, Sh, St/CR, S	---	---	205	---	520	---	40	187/90/200
JIS G 4312:1991	SUS309S	---	---	Pl, Sh/HR or CR, A	---	---	205	---	520	---	40	187/90/200
EN 10095:1999	X12CrNi23-13	1.4833	---	Pl, Sh, St/AT	≤ 75	---	210	---	500-700	---	see standard	192/---/---
ISO 4955:1994	X6CrNi23-14	---	---	Pl, Sh, St/TQ	---	---	210	---	500-700	---	see standard	192/---/---

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 167-99	310	---	S31000	Pl, Sh, St/---	---	---	205	30	515	75	40	217/95/---
JIS G 4312:1991	SUH310	---	---	Pl, Sh/HR or CR, S	---	---	205	---	590	---	35	201/95/210
JIS G 4304:1999	SUS310S	---	---	Pl, Sh, St/HR, S	---	---	205	---	520	---	40	187/90/200
JIS G 4305:1999	SUS310S	---	---	Pl, Sh, St/CR, S	---	---	205	---	520	---	40	187/90/200
JIS G 4312:1991	SUS310S	---	---	Pl, Sh/HR or CR, A	---	---	205	---	520	---	40	187/90/200
ISO 4955:1994	X15CrNiSi25-21	---	---	Pl, Sh, St/TQ	---	---	230	---	550-750	---	see standard	223/---/---
ASTM A 666-00	316	---	S31600	Pl, Sh, St/A	---	---	205	30	515	75	40	---/---/---
				Pl, Sh, St/CW, 1/16 Hard	---	---	310	45	585	85	35	
				Pl, Sh, St/CW, 1/8 Hard	---	---	380	55	690	100	30	
				Pl, Sh, St/CW, 1/4 Hard	---	---	515	75	860	125	10	
				Pl, Sh, St/CW, 1/2 Hard	---	< 0.015	760	110	1035	150	6	
				---	≥ 0.015	7						
				JIS G 4304:1999	SUS316	---	---	Pl, Sh, St/HR, S	---	---	205	
JIS G 4305:1999	SUS316	---	---	Pl, Sh, St/CR, S	---	---	205	---	520	---	40	187/90/200
JIS G 4312:1991	SUS316	---	---	Pl, Sh/HR or CR, A	---	---	205	---	520	---	40	187/90/200
EN 10088-2:1995	X5CrNiMo17-12-2	1.4401	---	St/CR, AT	≤ 6	---	240	---	530-680	---	40	---/---/---
				St/HR, AT	≤ 12	---	220	---				
				Pl/HR, AT	≤ 75	---	220	---	520-670	---	45	
	X3CrNiMo17-13-3	1.4436	---	St/CR, AT	≤ 6	---	240	---	550-700	---	40	
				St/HR, AT	≤ 12	---	220	---				
				Pl/HR, AT	≤ 75	---	220	---	530-730	---		

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	316L	---	S31603	Pl, Sh, St/A	---	---	170	25	485	70	40	217/95/---
				Pl, Sh, St/CW, 1/16 Hard	---	---	310	45	585	85	35	---/---/---
				Flat Bar/CW, 1/16 Hard	---	>0.030	310	45	620	90	40	---/---/---
				Pl, Sh, St/CW, 1/8 Hard	---	---	380	55	690	100	25	---/---/---
				Pl, Sh, St/CW, 1/4 Hard	---	---	515	75	860	125	8	---/---/---
				Pl, Sh, St/CW, 1/2 Hard	---	< 0.015	760	110	1035	150	5	---/---/---
					---	≥ 0.015					6	
JIS G 4304:1999	SUS316L	---	---	Pl, Sh, St/HR, S	--	---	175	---	480	---	40	187/90/200
JIS G 4305:1999	SUS316L	---	---	Pl, Sh, St/CR, S	---	---	175	---	480	---	40	187/90/200
EN 10088-2:1995	X2CrNiMo17-12-2	1.4404	---	St/CR, AT	≤ 6	---	240	---	530-680	---	40	---/---/---
				St/HR, AT	≤ 12	---	220	---		---	45	
				Pl/HR, AT	≤ 75	---	220	---	520-670	---	45	
	X2CrNiMo17-12-3	1.4432	---	St/CR, AT	≤ 6	---	240	---	550-700	---	40	---/---/---
				St/HR, AT	≤ 12	---	220	---		---	45	
				Pl/HR, AT	≤ 75	---	220	---	520-670	---	45	
	X2CrNiMo18-14-3	1.4435	---	St/CR, AT	≤ 6	---	240	---	550-700	---	40	---/---/---
				St/HR, AT	≤ 12	---	220	---		---	45	
				Pl/HR, AT	≤ 75	---	220	---	520-670	---	45	
ASTM A 666-00	316N	---	S31651	Pl, Sh, St/A	---	---	240	35	550	80	35	---/---/---
				Pl, Sh, St/CW, 1/16 Hard	---	---	310	45	620	90	35	
				Pl, Sh, St/CW, 1/8 Hard	---	---	380	55	690	100	32	
				Pl, Sh, St/CW, 1/4 Hard	---	---	515	75	860	125	12	
				Pl, Sh, St/CW, 1/2 Hard	---	< 0.015	760	110	1035	150	6	
					---	≥ 0.015					8	
JIS G 4304:1999	SUS316N	---	---	Pl, Sh, St/HR, S	---	---	275	---	550	---	35	217/95/220
JIS G 4305:1999	SUS316N	---	---	Pl, Sh, St/CR, S	---	---	275	---	550	---	35	217/95/220

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		
JIS G 4304:1999	SUS316LN	---	---	Pl, Sh, St/HR, S	---	---	245	---	550	---	40	217/95/220
JIS G 4305:1999	SUS316LN	---	---	Pl, Sh, St/CR, S	---	---	245	---	550	---	40	217/95/220
EN 10088-2:1995	X2CrNiMoN17-11-2	1.4406	---	St/CR, AT	≤ 6	---	300	---	580-780	---	40	---/---/---
				St/HR, AT	≤ 12	---	280	---				
				Pl/HR, AT	≤ 75	---	280	---				
	X2CrNiMoN17-13-3	1.4429	---	St/CR, AT	≤ 6	---	300	---	580-780	---	35	---/---/---
				St/HR, AT	≤ 12	---	280	---				
				Pl/HR, AT	≤ 75	---	280	---			40	
JIS G 4304:1999	SUS316Ti	---	---	Pl, Sh, St/HR, S	---	---	205	---	520	---	40	187/90//200
JIS G 4305:1999	SUS316Ti	---	---	Pl, Sh, St/CR, S	---	---	205	---	520	---	40	187/90/200
JIS G 4312:1991	SUS316Ti	---	---	Pl, Sh/HR or CR, A	---	---	205	---	520	---	40	187/90//200
EN 10088-2:1995	X6CrNiMoTi17-12-2	1.4571	---	St/CR, AT	≤ 6	---	240	---	540-690	---	40	---/---/---
				St/HR, AT	≤ 12	---	220	---				
				Pl/HR, AT	≤ 75	---	220	---	520-670	---		
JIS G 4304:1999	SUS317L	---	---	Pl, Sh, St/HR, S	---	---	175	---	480	---	40	187/90/200
JIS G 4305:1999	SUS317L	---	---	Pl, Sh, St/CR, S	---	---	175	---	480	---	40	187/90/200
EN 10088-2:1995	X2NiCrMo18-15-4	1.4438	---	St/CR, AT	≤ 6	---	240	---	550-700	---	35	---/---/---
				St/HR, AT	≤ 12	---	220	---				
				Pl/HR, AT	≤ 75	---	220	---	520-720	---	40	
JIS G 4304:1999	SUS317LN	---	---	Pl, Sh, St/HR, S	---	---	245	---	550	---	40	217/95/220
JIS G 4305:1999	SUS317LN	---	---	Pl, Sh, St/CR, S	---	---	245	---	550	---	40	217/95/220
EN 10088-2:1995	X2CrNiMoN18-12-4	1.4434	---	St/CR, AT	≤ 6	---	290	---	570-770	---	35	---/---/---
				St/HR, AT	≤ 12	---	270	---				
				Pl/HR, AT	≤ 75	---	270	---	540-740	---	40	
JIS G 4304:1999	SUS317J1	---	---	Pl, Sh, St/HR, S	---	---	175	---	480	---	40	187/90/200
JIS G 4305:1999	SUS317J1	---	---	Pl, Sh, St/CR, S	---	---	175	---	480	---	40	187/90/200
EN 10088-2:1995	X2CrNiMoN17-13-5	1.4439	---	St/CR, AT	≤ 6	---	290	---	580-780	---	35	---/---/---
				St/HR, AT	≤ 12	---	270	---				
				Pl/HR, AT	≤ 75	---	270	---			40	

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 B 688-96	---	---	N08366	Pl, Sh, St/HR or CR	≤ 4.8	≤ 3/16	240	35	515	75	30	---/95/---
					> 4.8	> 3/16						212/---/---
	---	---	N08367	Pl, Sh, St/HR or CR	≤ 4.8	≤ 3/16	310	45	690	100	30	---/100/---
					> 4.8	> 3/16			655	95	30	240/---/---
JIS G 4304:1999	SUS836L	---	---	Pl, Sh, St/HR, S	---	---	275	---	640	---	40	217/96/230
JIS G 4305:1999	SUS836L	---	---	Pl, Sh, St/CR, S	---	---	275	---	640	---	40	217/96/230
EN 10088-2:1995	1XNiCrMoCuN25-20-7	1.4529	---	Pl/HR, AT	≤ 75	---	300	---	650-850	---	40	---/---/---
ASTM B 625-99	---	---	N08904	Pl, Sh, St/HR or CR, A	---	---	215	31	480	71	35	---/70-90/---
JIS G 4304:1999	SUS890L	---	---	Pl, Sh, St/HR, S	---	---	215	---	490	---	35	187/90/200
JIS G 4305:1999	SUS890L	---	---	Pl, Sh, St/CR, S	---	---	215	---	490	---	35	187/90/200
EN 10088-2:1995	X1NiCrMoCu25-20-5	1.4539	---	St/CR, AT	≤ 6	---	240	---	530-730	---	35	---/---/---
				St/HR, AT	≤ 12	---	220	---				
				Pl/HR, AT	≤ 75	---	220	---	520-720	---		
JIS G 4304:1999	SUS321	---	---	Pl, Sh, St/HR, S	---	---	205	---	520	---	40	187/90/200
JIS G 4305:1999	SUS321	---	---	Pl, Sh, St/CR, S	---	---	205	---	520	---	40	187/90/200
JIS G 4312:1991	SUS321	---	---	Pl, Sh/HR or CR, A	---	---	205	---	520	---	40	187/90/200
EN 10088-2:1995	X6CrNiTi18-10	1.4541	---	St/CR, AT	≤ 6	---	220	---	520-720	---	40	---/---/---
				St/HR, AT	≤ 12	---	200	---				
				Pl/HR, AT	≤ 75	---	200	---	500-700	---		
ISO 4955:1994	X7CrNiTi18-10	---	---	Pl, Sh, St/TQ	---	---	200	---	510-710	---	see standard	192/---/---

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		
JIS G 4304:1999	SUS 347	---	---	Pl, Sh, St/HR, S	---	---	205	---	520	---	40	187/90/200
JIS G 4305:1999	SUS 347	---	---	Pl, Sh, St/CR, S	---	---	205	---	520	---	40	187/90/200
JIS G 4312:1991	SUS 347	---	---	Pl, Sh/HR or CR, A	---	---	205	---	520	---	40	187/90/200
EN 10088-2:1995	X6CrNiNb18-10	1.4550	---	St/CR, AT	≤ 6	---	220	---	520-720	---	40	---/---/---
				St/HR, AT	≤ 12	---	200	---				
				Pl/HR, AT	≤ 75	---	200	---	500-700	---		
ISO 4955:1994	X7CrNiNb18-10	---	---	Pl, Sh, St/TQ	---	---	205	---	510-710	---	see standard	192/---/---

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.4A Chemical Composition of Precipitation-Hardening Stainless Steels

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 4304:1999	SUS630	---	---	0.07	1.00	1.00	0.040	0.030	15.50-17.50	3.00-5.00	---	Cu 3.00-5.00; Nb 0.15-0.45
JIS G 4305:1999	SUS630	---	---	0.07	1.00	1.00	0.040	0.030	15.50-17.50	3.00-5.00	---	Cu 3.00-5.00; Nb 0.15-0.45
JIS G 4312:1991	SUS630	---	---	0.07	1.00	1.00	0.040	0.030	15.50-17.50	3.00-5.00	---	Cu 3.00-5.00; Nb 0.15-0.45
EN 10088-2:1995	X5CrNiCuNb16-4	1.4542	---	0.07	1.50	0.70	0.040	0.015	15.00-17.00	3.00-5.00	0.60	Cu 3.00-5.00; Nb 5 x C to 0.45
JIS G 4304:1999	SUS 631	---	---	0.09	1.00	1.00	0.040	0.030	16.00-18.00	6.50-7.75	---	Al 0.75-1.50
JIS G 4305:1999	SUS 631	---	---	0.09	1.00	1.00	0.040	0.030	16.00-18.00	6.50-7.75	---	Al 0.75-1.50
JIS G 4312:1991	SUS 631	---	---	0.09	1.00	1.00	0.040	0.030	16.00-18.00	6.50-7.75	---	Al 0.75-1.50
EN 10088-2:1995	X7CrNiAl17-7	1.4568	---	0.09	1.00	0.70	0.040	0.015	16.00-18.00	6.50-7.80	---	Al 0.70-1.50

8.1.4B Mechanical Properties of Precipitation-Hardening Stainless Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRC/HV
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
JIS G 4304:1999	SUS630	---	---	Pl, Sh, St/HR, S	---	---	---	---	---	---	---	---/38/---
				Pl, Sh, St/HR, H900	≤ 5	---	1175	---	1310	---	5	---/40 min/---
					5 < t ≤ 15	---					8	
					> 15	---					10	
				Pl, Sh, St/HR, H1025	≤ 5	---	1000	---	1070	---	5	---/35 min/---
					5 < t ≤ 15	---					8	
					> 15	---					12	
				Pl, Sh, St/HR, H1075	≤ 5	---	860	---	1000	---	5	---/31 min/---
					5 < t ≤ 15	---					9	
					> 15	---					13	
				Pl, Sh, St/HR, H1150	≤ 5	---	725	---	930	---	8	---/28 min/---
					5 < t ≤ 15	---					10	
					> 15	---					16	
JIS G 4305:1999	SUS630	---	---	Pl, Sh, St/CR, S	---	---	---	---	---	---	---	363/38/---
				Pl, Sh, St/CR, H900	≤ 5	---	1175	---	1310	---	5	375 min/40 min/---
					5 < t ≤ 15	---					8	
				Pl, Sh, St/CR, H1025	≤ 5	---	1000	---	1070	---	5	331 min/35 min/---
					5 < t ≤ 15	---					8	
				Pl, Sh, St/CR, H1075	≤ 5	---	860	---	1000	---	5	302 min/31 min/---
					5 < t ≤ 15	---					9	
				Pl, Sh, St/CR, H1150	≤ 5	---	725	---	930	---	8	277 min/28 min/---
					5 < t ≤ 15	---					10	

8.1 Stainless Steels: Plate, Sheet and Strip

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRC/HV	
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi			
JIS G 4312:1991	SUS630	---	---	Pl, Sh/HR or CR, S	---	---	---	---	---	---	---	363/38/---	
				Pl, Sh/HR or CR, H900	≤ 5	---	1175	---	1310	---	5	375 min/40 min/---	
					5 < t ≤ 15	---					8		
				Pl, Sh/HR or CR, H1025	≤ 5	---	1000	---	1070	---	5	331 min/35 min/---	
					5 < t ≤ 15	---					8		
				Pl, Sh/HR or CR, H1075	≤ 5	---	860	---	1000	---	5	302 min/31 min/---	
5 < t ≤ 15	---	9											
EN 10088-2:1995	X5CrNiCuNb16-4	1.4542	---	Pl, Sh/HR or CR, H1150	≤ 5	---	725	---	930	---	8	277 min/28 min/---	
				5 < t ≤ 15	---	10							
				St/CR, AT	≤ 6	---	---	---	≤ 1275	---	5	---/---/---	
				St/CR, P1300			1150	---	≥ 1300	---	3		
				St/CR, P900			700	---	≥ 900	---	6		
				JIS G 4304:1999	SUS 631	---	---	Pl/HR, P1070	≤ 50	---	1000	---	1070-1270
Pl/HR, P950	800	---	950-1150					---			10		
Pl/HR, P850	600	---	850-1050					---			12		
Pl/HR, SR630	---	---	≤ 1050					---			---		
Pl, Sh, St/HR, S	380	---	1030					---			20	---/92/200	
Pl, Sh, St/HR, TH1050	≤ 3	---	960					---			1140	---	3
	> 3	---		5									
JIS G 4305:1999	SUS 631	---	---	Pl, Sh, St/HR, RH950	≤ 3	---	1030	---	1230	---	---	---/40 min HRC/392 min	
				> 3	---	4							
				Pl, Sh, St/CR, S	---	---	380 max	---	1030 max	---	20	192/92/200	
				Pl, Sh, St/CR, TH1050	≤ 3	---	960	---	1140	---	3	---/35 min HRC/345 min	
					> 3	---					5		
				Pl, Sh, St/CR, RH950	≤ 3	---	1030	---	1230	---	---	---/40 min HRC/392 min	
> 3	---	4											
JIS G 4312:1991	SUS 631	---	---	Pl, Sh/HR or CR, S	---	---	380 max	---	1030 max	---	20	192/92/200	
				Pl, Sh/HR or CR, TH1050	≤ 3	---	960	---	1140	---	3	---/35 min HRC/345 min	
					> 3	---					5		
				Pl, Sh/HR or CR, RH950	≤ 3	---	1030	---	1230	---	---	---/40 min HRC/392 min	
> 3	---	4											
EN 10088-2:1995	X7CrNiAl17-7	1.4568	---	St/CR, AT	≤ 6	---	---	---	≤ 1030	---	19	---/---/---	
				St/CR, P1450			1310	---	≥ 1450	---	2		

8.1 Stainless Steels: Plate, Sheet and Strip

8.1.5A Chemical Composition of Austenitic-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	SUS329J3L	---	---	0.030	2.00	1.00	0.040	0.030	21.00-24.00	4.50-6.50	2.50-3.50	N 0.08-0.20
JIS G 4305:1999	SUS329J3L	---	---	0.030	2.00	1.00	0.040	0.030	21.00-24.00	4.50-6.50	2.50-3.50	N 0.08-0.20
EN 10088-2:1995	X2CrNiMoN22-5-3	1.4462	---	0.030	2.00	1.00	0.035	0.015	21.00-23.00	4.50-6.50	2.50-3.50	N 0.10-0.22

8.1.5B Mechanical Properties of Austenitic-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	SUS329J3L	---	---	Pl, Sh, St/HR, S	---	---	450	---	620	---	18	302/32/320
JIS G 4305:1999	SUS329J3L	---	---	Pl, Sh, St/CR, S	---	---	450	---	620	---	18	302/32 HRC/320
EN 10088-2:1995	X2CrNiMoN22-5-3	1.4462	---	St/CR, AT	≤ 6	---	480	---	660-950	---	20	---/---/---
				St/HR, AT	≤ 12	---	460	---		---		
				Pl/HR, AT	≤ 75	---	460	---	640-840	---	25	

8.2 Stainless Steels: Bar

8.2.1A Chemical Composition of Martensitic Stainless Steels

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 276-00	403	---	S40300	0.15	1.00	0.50	0.040	0.030	11.50-13.0	---	---	---
JIS G 4303:1998	SUS403	---	---	0.15	1.00	0.50	0.040	0.030	11.50-13.00	---	---	---
JIS G 4311:1991	SUS403	---	---	0.15	1.00	0.50	0.040	0.030	11.50-13.00	---	---	---
JIS G 4318:1998	SUS403	---	---	0.15	1.00	0.50	0.040	0.030	11.50-13.00	---	---	---
ASTM A 276-00	410	---	S41000	0.15	1.00	1.00	0.040	0.030	11.5-13.5	---	---	---
JIS G 4303:1998	SUS410	---	---	0.15	1.00	1.00	0.040	0.030	11.50-13.50	---	---	---
JIS G 4311:1991	SUS410	---	---	0.15	1.00	1.00	0.040	0.030	11.50-13.50	---	---	---
JIS G 4318:1998	SUS410	---	---	0.15	1.00	1.00	0.040	0.030	11.50-13.50	---	---	---
EN 10088-3:1995	X12Cr13	1.4006	---	0.08-0.15	1.50	1.00	0.040	0.030	11.50-13.50	0.75	---	---
ASTM A 582/A 582M-95	416	---	S41600	0.15	1.25	1.00	0.06	0.15 min	12.00-14.00	---	0.60	---
JIS G 4303:1998	SUS416	---	---	0.15	1.25	1.00	0.060	0.15 min	12.00-14.00	---	0.60	---
JIS G 4318:1998	SUS416	---	---	0.15	1.25	1.00	0.060	0.15 min	12.00-14.00	---	0.60	---
EN 10088-3:1995	X12CrS13	1.4005	---	0.08-0.15	1.50	1.0	0.040	0.15-0.35	12.00-14.00	---	0.60	---
JIS G 4303:1998	SUS420J1	---	---	0.16-0.25	1.00	1.00	0.040	0.030	12.00-14.00	---	---	---
JIS G 4318:1998	SUS420J1	---	---	0.16-0.25	1.00	1.00	0.040	0.030	12.00-14.00	---	---	---
EN 10088-3:1995	X20Cr13	1.4021	---	0.16-0.25	1.50	1.00	0.040	0.030	12.00-14.00	---	---	---
JIS G 4303:1998	SUS420J2	---	---	0.26-0.40	1.00	1.00	0.040	0.030	12.00-14.00	---	---	---
JIS G 4318:1998	SUS420J2	---	---	0.26-0.40	1.00	1.00	0.040	0.030	12.00-14.00	---	---	---
EN 10088-3:1995	X30Cr13	1.4028	---	0.26-0.35	1.50	1.00	0.040	0.030	12.00-14.00	---	---	---
ASTM A 582/A 582M-95	420F	---	S42020	0.30-0.40	1.25	1.00	0.06	0.15 min	12.00-14.00	0.50	---	---
JIS G 4303:1998	SUS420F	---	---	0.26-0.40	1.25	1.00	0.060	0.15 min	12.00-14.00	---	0.60	---
JIS G 4318:1998	SUS420F	---	---	0.26-0.40	1.25	1.00	0.060	0.15 min	12.00-14.00	---	0.60	---
EN 10088-3:1995	X29CrS13	1.4029	---	0.25-0.32	1.50	1.00	0.040	0.15-0.25	12.00-13.50	---	0.60	---
ASTM A 276-00	431	---	S43100	0.20	1.00	1.00	0.040	0.030	15.0-17.0	1.25-2.5	---	---
JIS G 4303:1998	SUS431	---	---	0.20	1.00	1.00	0.040	0.030	15.00-17.00	1.25-2.50	---	---
JIS G 4311:1991	SUS431	---	---	0.20	1.00	1.00	0.040	0.030	15.00-17.00	1.25-2.50	---	---
EN 10088-3:1995	X17CrNi16-2	1.4057	---	0.12-0.22	1.50	1.00	0.040	0.030	15.00-17.00	1.50-2.50	---	---
ASTM A 276-00	440A	---	S44002	0.60-0.75	1.00	1.00	0.040	0.030	16.0-18.0	---	0.75	---
JIS G 4303:1998	SUS440A	---	---	0.60-0.75	1.00	1.00	0.040	0.040	16.00-18.00	---	0.75	---
EN 10088-3:1995	X70CrMo15	1.4109	---	0.65-0.75	1.00	0.70	0.040	0.030	14.00-16.00	---	0.40-0.80	---
ASTM A 276-00	440B	---	S44003	0.75-0.95	1.00	1.00	0.040	0.030	16.0-18.0	---	0.75	---
JIS G 4303:1998	SUS440B	---	---	0.75-0.95	1.00	1.00	0.040	0.030	16.00-18.00	---	0.75	---

8.2 Stainless Steels: Bar

8.2.1A Chemical Composition of Martensitic Stainless Steels (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 276-00	440C	---	S44004	0.95-1.20	1.00	1.00	0.040	0.030	16.0-18.0	---	0.75	---
JIS G 4303:1998	SUS440C	---	---	0.95-1.20	1.00	1.00	0.040	0.030	16.00-18.00	---	0.75	---
JIS G 4318:1998	SUS440C	---	---	0.95-1.20	1.00	1.00	0.040	0.030	16.00-18.00	---	0.75	---
EN 10088-3:1995	X105CrMo17	1.4125	---	0.95-1.20	1.00	1.00	0.040	0.030	16.00-18.00	---	0.40-0.80	---

8.2 Stainless Steels: Bar

8.2.1B Mechanical Properties of Martensitic Stainless Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRC/HV
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 276-00	403	---	S40300	Bar, Shape/HF, A	all	all	275	40	480	70	20	---/---/---
				Bar, Shape/CF, A			275	40	480	70	16	---/---/---
				Bar, Shape/HF, T			550	80	690	100	15	---/---/---
				Bar, Shape/CF, T			550	80	690	100	12	---/---/---
JIS G 4303:1998	SUS403	---	---	Bar/HF, Q	≤ 75	---	390	---	590	---	25	170 min/---/---
JIS G 4311:1991	SUS403	---	---	Bar/HF, Q	≤ 75	---	390	---	590	---	25	170 min/---/---
JIS G 4318:1998	SUS403	---	---	Bar/CF	mechanical properties of bars shall be agreed upon between the parties concerned with delivery							
ASTM A 276-00	410	---	S41000	Bar, Shape/HF, A	all	all	275	40	480	70	20	---/---/---
				Bar, Shape/CF, A			275	40	480	70	16	---/---/---
				Bar, Shape/HF, T			550	80	690	100	15	---/---/---
				Bar, Shape/CF, T			550	80	690	100	12	---/---/---
JIS G 4303:1998	SUS410	---	---	Bar/HF, Q	≤ 75	---	345	---	540	---	25	159 min/---/---
JIS G 4311:1991	SUS410	---	---	Bar/Q, HF	≤ 75	---	345	---	540	---	25	159 min/---/---
JIS G 4318:1998	SUS410	---	---	Bar/CF	mechanical properties of bars shall be agreed upon between the parties concerned with delivery							
EN 10088-3:1995	X12Cr13	1.4006	---	Bar/HF or CF, A	---	---	---	---	730 max	---	---	220/---/---
				Bar/HF or CF, QT650	≤ 160	---	450	---	650-850	---	15	---/---/---
ASTM A 582/A 582M-95	416	---	S41600	Bar/HF or CF, A	---	---	---	---	---	---	---	262/---/---
				Bar/HF or CF, T	---	---	---	---	---	---	---	248-302/---/---
				Bar/HF or CF, H	---	---	---	---	---	---	---	293-352/---/---
JIS G 4303:1998	SUS416	---	---	Bar/HF, Q	≤ 75	---	345	---	540	---	17	15 min/---/---
JIS G 4318:1998	SUS416	---	---	Bar/CF	mechanical properties of bars shall be agreed upon between the parties concerned with delivery							
EN 10088-3:1995	X12CrS13	1.4005	---	Bar/HF or CF, A	---	---	---	---	730 max	---	---	220/---/---
				Bar/HF or CF, QT650	≤ 160	---	450	---	650-850	---	12	---/---/---

8.2 Stainless Steels: Bar

8.2.1B Mechanical Properties of Martensitic Stainless Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRC/HV
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
JIS G 4303:1998	SUS420J1	---	---	Bar/HF, Q	≤ 75	---	440	---	640	---	20	192 min/---/---
JIS G 4318:1998	SUS420J1	---	---	Bar/CF	mechanical properties of bars shall be agreed upon between the parties concerned with delivery							
EN 10088-3:1995	X20Cr13	1.4021	---	Bar/HF or CF, A	---	---	---	---	760 max	---	---	230/---/---
				Bar/HF or CF, QT700	≤ 160	---	500	---	700-850	---	13	---/---/---
				Bar/HF or CF, QT800	≤ 160	---	600	---	800-950	---	12	---/---/---
JIS G 4303:1998	SUS420J2	---	---	Bar/HF, Q	≤ 75	---	540	---	740	---	12	217 min/---/---
JIS G 4318:1998	SUS420J2	---	---	Bar/CF	mechanical properties of bars shall be agreed upon between the parties concerned with delivery							
EN 10088-3:1995	X30Cr13	1.4028	---	Bar/HF or CF, A	---	---	---	---	800 max	---	---	245/---/---
				Bar/HF or CF, QT850	≤ 160	---	650	---	850-1000	---	10	---/---/---
ASTM A 582/A 582M-95	420F	---	S42020	Bar/HF or CF, A	---	---	---	---	---	---	---	262/---/---
JIS G 4303:1998	SUS420F	---	---	Bar/HF, Q	≤ 75	---	540	---	740	---	8	217 min/---/---
JIS G 4318:1998	SUS420F	---	---	Bar/CF	mechanical properties of bars shall be agreed upon between the parties concerned with delivery							
EN 10088-3:1995	X29CrS13	1.4029	---	Bar/HF or CF, A	---	---	---	---	800 max	---	---	245/---/---
				Bar/HF or CF, QT850	≤ 160	---	650	---	850-1000	---	9	---/---/---
ASTM A 276-00	431	---	S43100	Bar, Shape/HF or CF, A	all	all	---	---	---	---	---	285/---/---
JIS G 4303:1998	SUS431	---	---	Bar/HF, Q	≤ 75	---	590	---	780	---	15	229 min/---/---
JIS G 4311:1991	SUS431	---	---	Bar/HF, Q	≤ 75	---	590	---	780	---	15	229 min/---/---
EN 10088-3:1995	X17CrNi16-2	1.4057	---	Bar/HF or CF, A	---	---	---	---	950 max	---	---	295/---/---
				Bar/HF or CF, QT800	≤ 60	---	600	---	800-950	---	14	---/---/---
					60 < d ≤ 160	---					12	
				Bar/HF or CF, QT900	≤ 60	---	700	---	900-1050	---	12	---/---/---
					60 < d ≤ 160	---					10	
ASTM A 276-00	440A	---	S44002	Bar, Shape/HF, A	all	all	---	---	---	---	---	269/---/---
				Bar, Shape/CF, A	all	all	---	---	---	---	---	285/---/---
JIS G 4303:1998	SUS440A	---	---	Bar/HF, Q	≤ 75	---	---	---	---	---	---	---/54 min/---
EN 10088-3:1995	X70CrMo15	1.4109	---	Bar/HF or CF, A	≤ 100	---	---	---	900 max	---	---	280/---/---

8.2 Stainless Steels: Bar

8.2.1B Mechanical Properties of Martensitic Stainless Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRC/HV
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 276-00	440B	---	S44003	Bar, Shape/HF, A	all	all	---	---	---	---	---	269/---/---
				Bar, Shape/CF, A	all	all	---	---	---	---	---	285/---/---
JIS G 4303:1998	SUS440B	---	---	Bar/HF, Q	≤ 75	---	---	---	---	---	---	---/56 min/---
ASTM A 276-00	440C	---	S44004	Bar, Shape/HF, A	all	all	---	---	---	---	---	269/---/---
				Bar, Shape/CF, A	all	all	---	---	---	---	---	285/---/---
JIS G 4303:1998	SUS440C	---	---	Bar/HF, Q	≤ 75	---	---	---	---	---	---	---/58 min/---
JIS G 4318:1998	SUS440C	---	---	Bar/CF	mechanical properties of bars shall be agreed upon between the parties concerned with delivery							
EN 10088-3:1995	X105CrMo17	1.4125	---	Bar/HF or CF, A	≤ 100	---	---	---	---	---	---	285/---/---

8.2 Stainless Steels: Bar

8.2.2A Chemical Composition of Ferritic Stainless Steels

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 276-00	405	---	S40500	0.08	1.00	1.00	0.040	0.030	11.5-14.5	0.50	---	Al 0.10-0.30
JIS G 4303:1998	SUS405	---	---	0.08	1.00	1.00	0.040	0.030	11.50-14.50	---	---	Al 0.10-0.30
JIS G 4311:1991	SUS405	---	---	0.08	1.00	1.00	0.040	0.030	11.50-14.50	---	---	Al 0.10-0.30
EN 10088-3:1995	X6Cr13	1.4000	---	0.08	1.00	1.00	0.040	0.030	12.00-14.00	---	---	---
ISO 4955:1994	X6Cr13	---	---	0.08	1.0	1.0	0.040	0.030	12.0-14.0	1.0	---	---
ASTM A 276-00	430	---	S43000	0.12	1.00	1.00	0.040	0.030	16.0-18.0	---	---	---
JIS G 4303:1998	SUS430	---	---	0.12	1.00	0.75	0.040	0.030	16.00-18.00	---	---	---
JIS G 4311:1991	SUS430	---	---	0.12	1.00	0.75	0.040	0.030	16.00-18.00	---	---	---
JIS G 4318:1998	SUS430	---	---	0.12	1.00	0.75	0.040	0.030	16.00-18.00	---	---	---
EN 10088-3:1995	X6Cr17	1.4016	---	0.08	1.00	1.00	0.040	0.030	16.00-18.00	---	---	---
ASTM A 582/A 582M-95	430F	---	S43020	0.12	1.25	1.00	0.060	0.15 min	16.00-18.00	---	---	---
JIS G 4303:1998	SUS430F	---	---	0.12	1.25	1.00	0.060	0.15 min	16.00-18.00	---	0.60	---
JIS G 4318:1998	SUS430F	---	---	0.12	1.25	1.00	0.060	0.15 min	16.00-18.00	---	0.60	---
EN 10088-3:1995	X6CrMoS17	1.4105	---	0.08	1.50	1.50	0.040	0.15-0.35	16.00-18.00	---	0.20-0.60	---
ASTM A 582/A 582M-95	---	---	S18235	0.025	0.50	1.00	0.030	0.15-0.35	17.05-18.50	1.00	2.00-2.50	N 0.025; Ti 0.30-1.00; C+N 0.035
EN 10088-3:1995	X2CrMoTiS18-2	1.4523	---	0.030	0.50	1.00	0.040	0.15-0.35	17.50-19.00	---	2.00-2.50	C+N 0.040
JIS G 4303:1998	SUS434	---	---	0.12	1.00	1.00	0.040	0.030	16.00-18.00	---	0.75-1.25	---
EN 10088-3:1995	X6CrMo17-1	1.4113	---	0.08	1.00	1.00	0.040	0.030	16.00-18.00	---	0.90-1.40	---
ASTM A 276-00	447	---	S44700	0.010	0.30	0.20	0.025	0.020	28.0-30.0	0.15	3.5-4.2	N 0.020; Cu 0.15; C+N 0.025
JIS G 4303:1998	SUS447J1	---	---	0.010	0.40	0.40	0.030	0.020	28.50-32.00	0.50	1.50-2.50	N 0.015; Cu 0.20; Ni+Cu 0.50
ASTM A 276-00	XM-27	---	S44627	0.010	0.40	0.40	0.020	0.020	25.0-27.5	0.50	0.75-1.50	N 0.015; Cu 0.20; Cb 0.05-0.20
JIS G 4303:1998	SUSXM27	---	---	0.010	0.40	0.40	0.030	0.020	25.00-27.50	0.50	0.75-1.50	N 0.015; Cu 0.20; Ni+Cu 0.50
ASTM A 276-00	446	---	S44600	0.20	1.50	1.00	0.040	0.030	23.0-27.0	0.15	---	N 0.25
JIS G 4311:1991	SUH446	---	---	0.20	1.50	1.00	0.040	0.030	23.00-27.00	---	---	N 0.25
ISO 4955:1994	X15CrN26	---	---	0.20	1.0	1.0	0.040	0.030	24.0-28.0	1.0	---	N 0.15-0.25

8.2 Stainless Steels: Bar

8.2.2B Mechanical Properties of Ferritic Stainless Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRB/HV
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 276-00	405	---	S40500	Bar, Shape/HF, A	all	all	---	---	---	---	---	207/---/---
				Bar, Shape/CF, A	all	all	---	---	---	---	---	217/---/---
JIS G 4303:1998	SUS405	---	---	Bar/HF, A	≤ 75	---	175	---	410	---	20	183/---/---
JIS G 4311:1991	SUS405	---	---	Bar/HF, A	≤ 75	---	175	---	410	---	20	183/---/---
EN 10088-3:1995	X6Cr13	1.4000	---	Bar/HF or CF, A	≤ 25	---	230	---	400-630	---	20	200/---/---
ISO 4955:1994	X6Cr13	---	---	Bar/TA	---	---	230	---	400-630	---	see standard	197/---/---
ASTM A 276-00	430	---	S43000	Bar, Shape/HF or CF, A	all	all	207	30	415	60	20	---/---/---
JIS G 4303:1998	SUS430	---	---	Bar/HF, A	≤ 75	---	205	---	450	---	22	183/---/---
JIS G 4311:1991	SUS430	---	---	Bar/HF, A	≤ 75	---	205	---	450	---	22	183/---/---
JIS G 4318:1998	SUS430	---	---	Bar/CF	mechanical properties of bars shall be agreed upon between the parties concerned with delivery							
EN 10088-3:1995	X6Cr17	1.4016	---	Bar/HF or CF, A	≤ 100	---	240	---	400-630	---	20	200/---/---
ASTM A 582/A 582M-95	430F	---	S43020	Bar/HF or CF, A	---	---	---	---	---	---	---	262/---/---
JIS G 4303:1998	SUS430F	---	---	Bar/HF, A	≤ 75	---	205	---	450	---	22	183/---/---
JIS G 4318:1998	SUS430F	---	---	Bar/CF	mechanical properties of bars shall be agreed upon between the parties concerned with delivery							
EN 10088-3:1995	X6CrMoS17	1.4105	---	Bar/HF or CF, A	≤ 100	---	250	---	430-630	---	20	200/---/---
ASTM A 582/A 582M-95	---	---	S18235	Bar/HF or CF, A	---	---	---	---	---	---	---	207/---/---
EN 10088-3:1995	X2CrMoTiS18-2	1.4523	---	Bar/HF or CF, A	≤ 100	---	280	---	430-600	---	15	200/---/---
JIS G 4303:1998	SUS434	---	---	Bar/HF, A	≤ 75	---	205	---	450	---	22	183/---/---
EN 10088-3:1995	X6CrMo17-1	1.4113	---	Bar/HF or CF, A	≤ 100	---	280	---	440-660	---	18	200/---/---
ASTM A 276-00	447	---	S44700	Bar, Shape/HF, A	all	all	380	55	480	70	20	---/---/---
				Bar, Shape/CF, A	all	all	415	60	520	75	15	---/---/---
JIS G 4303:1998	SUS447J1	---	---	Bar/HF, A	≤ 75	---	295	---	450	---	20	228/---/---
ASTM A 276-00	XM-27	---	S44627	Bar, Shape/HF, A	all	all	275	40	450	65	20	219/---/---
				Bar, Shape/CF, A	all	all	275	40	450	65	16	219/---/---
JIS G 4303:1998	SUSXM27	---	---	Bar/HF, A	≤ 75	---	245	---	410	---	20	219/---/---

8.2 Stainless Steels: Bar

8.2.2B Mechanical Properties of Ferritic Stainless Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRB/HV
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 276-00	446	---	S44600	Bar, Shape/HF, A	all	all	275	40	450	65	20	219/---/---
				Bar, Shape/CF, A	all	all	275	40	450	65	16	219/---/---
JIS G 4311:1991	SUH446	---	---	Bar/HF, A	---	---	275	---	510	---	20	201/---/---
ISO 4955:1994	X15CrN26	---	---	Bar/TA	---	---	280	---	500-700	---	see standard	212/---/---

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	X8CrNi18-9	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

8.2.3A Chemical Composition of Austenitic Stainless Steels (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 276-00	305	---	S30500	0.12	2.00	1.00	0.045	0.030	17.0-19.0	11.0-13.0	---	---
JIS G 4303:1998	SUS305	---	---	0.12	2.00	1.00	0.045	0.030	17.00-19.00	10.50-13.00	---	---
JIS G 4318:1998	SUS305	---	---	0.12	2.00	1.00	0.045	0.030	17.00-19.00	10.50-13.00	---	---
EN 10088-3:1995	X4CrNi18-12	1.4303	---	0.06	2.00	1.00	0.045	0.030	17.00-19.00	11.00-13.00	---	N 0.11
ASTM A 276-00	309S	---	S30908	0.08	2.00	1.00	0.045	0.030	22.0-24.0	12.0-15.0	---	---
JIS G 4303:1998	SUS309S	---	---	0.08	2.00	1.00	0.045	0.030	22.00-24.00	12.00-15.00	---	---
JIS G 4311:1991	SUS309S	---	---	0.08	2.00	1.00	0.045	0.030	22.00-24.00	12.00-15.00	---	---
JIS G 4318:1998	SUS309S	---	---	0.08	2.00	1.00	0.045	0.030	22.00-24.00	12.00-15.00	---	---
ISO 4955:1994	X6CrNi23-14	---	---	0.08	2.0	1.0	0.045	0.030	22.0-24.0	12.0-15.0	---	---
ASTM A 276-00	310S	---	S31008	0.08	2.00	1.50	0.045	0.30	24.0-26.0	19.0-22.0	---	---
JIS G 4303:1998	SUS310S	---	---	0.08	2.00	1.50	0.045	0.030	24.00-26.00	19.00-22.00	---	---
JIS G 4311:1991	SUS310S	---	---	0.08	2.00	1.50	0.045	0.030	24.00-26.00	19.00-22.00	---	---
JIS G 4318:1998	SUS310S	---	---	0.08	2.00	1.50	0.045	0.030	24.00-26.00	19.00-22.00	---	---
ASTM A 276-00	316	---	S31600	0.08	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	---
JIS G 4303:1998	SUS316	---	---	0.08	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---
JIS G 4311:1991	SUS316	---	---	0.08	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---
JIS G 4318:1998	SUS316	---	---	0.08	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	---
EN 10088-3:1995	X5CrNiMo17-12-2	1.4401	---	0.07	2.00	1.00	0.045	0.030	16.50-18.50	10.00-13.00	2.00-2.50	N 0.11
	X3CrNiMo17-13-3	1.4436	---	0.05	2.00	1.00	0.045	0.015	16.50-18.50	10.50-13.00	2.50-3.00	N 0.11
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
ASTM A 276-00	316N	---	S31651	0.08	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	N 0.10-0.16
JIS G 4303:1998	SUS316N	---	---	0.08	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	N 0.10-0.22
ASTM A 276-00	316LN	---	S31653	0.030	2.00	1.00	0.045	0.030	16.0-18.0	10.0-13.0	2.00-3.00	N 0.10-0.16
JIS G 4303:1998	SUS316LN	---	---	0.030	2.00	1.00	0.045	0.030	16.50-18.50	10.50-14.50	2.00-3.00	N 0.12-0.22
EN 10088-3:1995	X2CrNiMoN17-11-2	1.4406	---	0.030	2.00	1.00	0.045	0.030	16.50-18.50	10.00-12.00	2.00-2.50	N 0.12-0.22
	X2CrNiMoN17-13-3	1.4429	---	0.030	2.00	1.00	0.045	0.015	16.50-18.50	11.00-14.00	2.50-3.00	N 0.12-0.22
ASTM A 276-00	316Ti	---	S31635	0.08	2.00	1.00	0.045	0.030	16.0-18.0	10.0-14.0	2.00-3.00	N 0.10; Ti 5 x (C+N) to 0.70
JIS G 4303:1998	SUS316Ti	---	---	0.08	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	Ti 5 x C min
JIS G 4311:1991	SUS316Ti	---	---	0.08	2.00	1.00	0.045	0.030	16.00-18.00	10.00-14.00	2.00-3.00	Ti 5 x C min
EN 10088-3:1995	X6CrNiMoTi17-12-2	1.4571	---	0.08	2.00	1.00	0.045	0.030	16.50-18.50	10.50-13.50	2.0-2.50	Ti 5 x C to 0.70

8.2 Stainless Steels: Bar

8.2.3A Chemical Composition of Austenitic Stainless Steels (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 276-00	317	---	S31700	0.08	2.00	1.00	0.045	0.030	18.0-20.0	11.0-15.0	3.0-4.0	N 0.10
JIS G 4303:1998	SUS317	---	---	0.08	2.00	1.00	0.045	0.030	18.00-20.00	11.00-15.00	3.00-4.00	---
JIS G 4311:1991	SUS317	---	---	0.08	2.00	1.00	0.045	0.030	18.00-20.00	11.00-15.00	3.00-4.00	---
JIS G 4303:1998	SUS317L	---	---	0.030	2.00	1.00	0.045	0.030	18.00-20.00	11.00-15.00	3.00-4.00	---
EN 10088-3:1995	X2CrNiMo18-15-4	1.4438	---	0.030	2.00	1.00	0.045	0.030	17.50-19.50	13.00-16.00	3.00-4.00	N 0.11
JIS G 4303:1998	SUS 317J1	---	---	0.040	2.50	1.00	0.045	0.030	16.00-19.00	15.00-17.00	4.00-6.00	---
EN 10088-3:1995	X2CrNiMoN17-13-5	1.4439	---	0.030	2.00	1.00	0.045	0.015	16.50-18.50	12.50-14.50	4.00-5.00	N 0.12-0.22
ASTM B 691-95	---	---	N08367	0.030	2.00	1.00	0.040	0.030	20.00-22.00	23.50-25.50	6.00-7.00	N 0.18-0.25; Cu 0.75
JIS G 4303:1998	SUS836L	---	---	0.030	2.00	1.00	0.045	0.030	19.00-24.00	24.00-26.00	5.00-7.00	N 0.25
ASTM B 649-95	---	---	N08904	0.020	2.00	1.00	0.045	0.035	19.00-23.00	23.00-28.00	4.00-5.00	Cu 1.0-2.0
JIS G 4303:1998	SUS890L	---	---	0.020	2.00	1.00	0.045	0.030	19.00-23.00	23.00-28.00	4.00-5.00	Cu 1.00-2.00
EN 10088-3:1995	X1NiCrMoCu25-20-5	1.4539	---	0.020	2.00	0.70	0.030	0.010	19.00-21.00	24.00-26.00	4.00-5.00	N 0.15; Cu 1.20-2.00
ASTM A 276-00	321	---	S32100	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 5 x (C+N) to 0.70
JIS G 4303:1998	SUS321	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Ti 5 x C min
JIS G 4318:1998	SUS321	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Ti 5 x C min
JIS G 4311:1991	SUS321	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Ti 5 x C min
EN 10088-3:1995	X6CrNiTi18-10	1.4541	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-12.00	---	Ti 5 x C to 0.70
ISO 4955:1994	X7CrNiTi18-10	---	---	0.040-0.10	2.0	1.0	0.045	0.030	17.0-19.0	9.0-12.0	---	Ti 5 x C to 0.80
ASTM A 276-00	347	---	S34700	0.08	2.00	1.00	0.045	0.030	17.0-19.0	9.0-12.0	---	Cb 10 x C to 1.10
JIS G 4303:1998	SUS347	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Nb 10 x C min
JIS G 4311:1991	SUS347	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Nb 10 x C min
JIS G 4318:1998	SUS347	---	---	0.08	2.00	1.00	0.045	0.030	17.00-19.00	9.00-13.00	---	Nb 10 x C min
EN 10088-3:1995	X6CrNiNb18-10	1.4550	---	0.08	2.00	1.00	0.045	0.015	17.00-19.00	9.00-12.00	---	Nb 10 x C to 1.00
ISO 4955:1994	X7CrNiNb18-10	---	---	0.040-0.10	2.0	1.0	0.045	0.030	17.0-19.0	9.0-12.0	---	Nb 10 x C to 1.2
ASTM A 276-00	309	---	S30900	0.20	2.00	1.00	0.045	0.030	22.0-24.0	12.0-15.0	---	---
JIS G 4311:1991	SUH309	---	---	0.20	2.00	1.00	0.040	0.030	22.00-24.00	12.00-15.00	---	---
EN 10095:1999	X12CrNi23-13	1.4833	---	0.15	2.00	1.00	0.045	0.015	22.00-24.00	12.00-14.00	---	N 0.11
ASTM A 276-00	310	---	S31000	0.25	2.00	1.50	0.045	0.030	24.0-26.0	19.0-22.0	---	---
JIS G 4311:1991	SUH310	---	---	0.25	2.00	1.50	0.040	0.030	24.00-26.00	19.00-22.00	---	---
EN 10095:1999	X15CrNiSi25-21	1.4841	---	0.20	2.00	1.50-2.50	0.045	0.015	24.00-26.00	19.00-22.00	---	N 0.11
ISO 4955:1994	X15CrNiSi25-21	---	---	0.20	2.0	1.5-2.5	0.045	0.030	24.0-26.0	19.0-22.0	---	---

8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRB/HV
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² 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/---/---

8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRB/HV
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 582/A 582M-95	303Se	---	S30323	Bar/ HF or CF, A	---	---	---	---	---	---	---	262/---/---
JIS G 4303:1998	SUS303Se	---	---	Bar/HF, S	≤ 180	---	205	---	520	---	40	187/90/200
JIS G 4318:1998	SUS303Se	---	---	Bar/CF	mechanical properties of bars shall be agreed upon between the parties concerned with delivery							
ASTM A 276-00	304	---	S30400	Bar, Shape/ HF, A	all	all	205	30	515	75	40	---/---/---
				Bar, Shape/ CF, A	≤ 12.70	≤ ½	310	45	620	90	30	---/---/---
					> 12.70	> ½	205	30	515	75	30	---/---/---
				Bar, Shape/ CF, B	≤ 19.05	≤ ¾	690	100	860	125	12	---/---/---
					19.05 < t ≤ 25.40	¾ < t ≤ 1	550	80	795	115	15	---/---/---
					25.40 < t ≤ 31.75	1 < t ≤ 1¼	450	65	725	105	20	---/---/---
					31.75 < t ≤ 38.10	1¼ < t ≤ 1½	345	50	690	100	24	---/---/---
					38.10 < t ≤ 44.45	1½ < t ≤ 1¾	310	45	655	95	28	---/---/---
				Bar, Shape/ CF, S	≤ 50.8	≤ 2	515	75	650	95	25	---/---/---
					50.8 < t ≤ 63.5	2 < t ≤ 2½	450	65	620	90	30	---/---/---
					63.5 < t ≤ 76.2	2½ < t ≤ 3	380	55	550	80	30	---/---/---
JIS G 4303:1998	SUS304	---	---	Bar/HF, S	≤ 180	---	205	---	520	---	40	187/90/200
JIS G 4311:1991	SUS304	---	---	Bar/HF, H	≤ 180	---	205	---	520	---	40	187/90/200
JIS G 4318:1998	SUS304	---	---	Bar/CF	mechanical properties of bars shall be agreed upon between the parties concerned with delivery							
EN 10088-3:1995	X5CrNi18-10	1.4301	---	Bar/ HF or CF, AT	≤ 160	---	190	---	500-700	---	L: 45	215/---/---
					160 < t ≤ 250	---					T: 35	
ASTM A 276-00	304L	---	S30403	Bar, Shape/ HF, A	all	all	170	25	485	70	40	---/---/---
				Bar, Shape/ CF, A	≤ 12.70	≤ ½	310	45	620	90	30	---/---/---
JIS G 4303:1998	SUS304L	---	---	Bar/HF, S	> 12.70	> ½	170	25	485	70	30	---/---/---
JIS G 4318:1998	SUS304L	---	---	Bar/CF	≤ 180	---	175	---	480	---	40	187/90/200
EN 10088-3:1995	X2CrNi18-9	1.4307	---	Bar/ HF or CF, AT	≤ 160	---	175	---	450-680	---	L: 45	215/---/---
					160 < t ≤ 250	---					T: 35	

8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRB/HV
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 276-00	304N	---	S30451	Bar, Shape/HF or CF, A	all	all	240	35	550	80	30	---/---/---
				Bar, Shape/CF, B	≤ 19.05	≤ ¾	690	100	860	125	12	---/---/---
					19.05 < t ≤ 25.40	¾ < t ≤ 1	550	80	795	115	15	---/---/---
					25.40 < t ≤ 31.75	1 < t ≤ 1¼	450	65	725	105	20	---/---/---
					31.75 < t ≤ 38.10	1¼ < t ≤ 1½	345	50	690	100	24	---/---/---
					38.10 < t ≤ 44.45	1½ < t ≤ 1¾	310	45	655	95	28	---/---/---
				Bar, Shape/CF, S	≤ 50.8	≤ 2	515	75	650	95	25	---/---/---
					50.8 < t ≤ 63.5	2 < t ≤ 2½	450	65	620	90	30	---/---/---
					63.5 < t ≤ 76.2	2½ < t ≤ 3	380	55	550	80	30	---/---/---
JIS G 4303:1998	SUS304N1	---	---	Bar/HF, S	≤ 180	---	275	---	550	---	35	217/95/220
ASTM A 276-00	304LN	---	S30453	Bar, Shape/HF, A	all	all	205	30	515	75	40	---/---/---
				Bar, Shape/CF, A	≤ 12.70	≤ ½	310	45	620	90	30	---/---/---
					> 12.70	> ½	205	30	515	75	30	---/---/---
JIS G 4303:1998	SUS304LN	---	---	Bar/HF, S	≤ 180	---	245	---	550	---	40	217/95/220
EN 10088-3:1995	X2CrNi18-10	1.4311	---	Bar/HF or CF, AT	≤ 160	---	270	---	550-760	---	L: 40	230/---/---
					160 < t ≤ 250	---					T: 30	
ASTM A 276-00	XM-21	---	S30452	Bar, Shape/HF or CF, A	all	all	345	50	620	90	30	---/---/---
JIS G 4303:1998	SUS304N2	---	---	Bar/HF, S	≤ 180	---	345	---	690	---	35	250/100/260
ASTM A 276-00	305	---	S30500	Bar, Shape/HF, A	all	all	205	30	515	75	40	---/---/---
				Bar, Shape/CF, A	≤ 12.70	≤ ½	310	45	620	90	30	---/---/---
					> 12.70	> ½	205	30	515	75	30	---/---/---
JIS G 4303:1998	SUS305	---	---	Bar/HF, S	≤ 180	---	175	---	480	---	40	187/90/200
JIS G 4318:1998	SUS305	---	---	Bar/CF	mechanical properties of bars shall be agreed upon between the parties concerned with delivery							
EN 10088-3:1995	X4CrNi18-12	1.4303	---	Bar/HF or CF, AT	≤ 160	---	190	---	500-700	---	L: 45	215/---/---
					160 < t ≤ 250	---					T: 35	

8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRB/HV
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 276-00	309S	---	S30908	Bar, Shape/HF, A	all	all	205	30	515	75	40	---/---/---
				Bar, Shape/CF, A	≤ 12.70	≤ ½	310	45	620	90	30	---/---/---
					> 12.70	> ½	205	30	515	75	30	---/---/---
JIS G 4303:1998	SUS309S	---	---	Bar/HF, S	≤ 180	---	205	---	520	---	40	187/90/200
JIS G 4311:1991	SUS309S	---	---	Bar/HF, H	≤ 180	---	205	---	520	---	40	187/90/200
JIS G 4318:1998	SUS309S	---	---	Bar/CF	mechanical properties of bars shall be agreed upon between the parties concerned with delivery							
ISO 4955:1994	X6CrNi23-14	---	---	Bar/TQ	---	---	210	---	500-700	---	see standard	192/---/---
ASTM A 276-00	310S	---	S31008	Bar, Shape/HF, A	all	all	205	30	515	75	40	---/---/---
				Bar, Shape/CF, A	≤ 12.70	≤ ½	310	45	620	90	30	---/---/---
					> 12.70	> ½	205	30	515	75	30	---/---/---
JIS G 4303:1998	SUS310S	---	---	Bar/HF, S	≤ 180	---	205	---	520	---	40	187/90/200
JIS G 4311:1991	SUS310S	---	---	Bar/HF, H	≤ 180	---	205	---	520	---	40	187/90/200
JIS G 4318:1998	SUS310S	---	---	Bar/CF	mechanical properties of bars shall be agreed upon between the parties concerned with delivery							
ASTM A 276-00	316	---	S31600	Bar, Shape/HF, A	all	all	205	30	515	75	40	---/---/---
				Bar, Shape/CF, A	≤ 12.70	≤ ½	310	45	620	90	30	---/---/---
					> 12.70	> ½	205	30	515	75	30	---/---/---
				Bar, Shape/CF, B	≤ 19.05	≤ ¾	690	100	860	125	12	---/---/---
					19.05 < t ≤ 25.40	¾ < t ≤ 1	550	80	795	115	15	---/---/---
					25.40 < t ≤ 31.75	1 < t ≤ 1¼	450	65	725	105	20	---/---/---
					31.75 < t ≤ 38.10	1¼ < t ≤ 1½	345	50	690	100	24	---/---/---
					38.10 < t ≤ 44.45	1½ < t ≤ 1¾	310	45	655	95	28	---/---/---
				Bar, Shape/CF, S	≤ 50.8	≤ 2	515	75	650	95	25	---/---/---
					50.8 < t ≤ 63.5	2 < t ≤ 2½	450	65	620	90	30	---/---/---
					63.5 < t ≤ 76.2	2½ < t ≤ 3	380	55	550	80	30	---/---/---
JIS G 4303:1998	SUS316	---	---	Bar/HF, S	≤ 180	---	205	---	520	---	40	187/90/200
JIS G 4311:1991	SUS316	---	---	Bar/HF, H	≤ 180	---	205	---	520	---	40	187/90/200
JIS G 4318:1998	SUS316	---	---	Bar/CF	mechanical properties of bars shall be agreed upon between the parties concerned with delivery							
EN 10088-3:1995	X5CrNiMo17-12-2	1.4401	---	Bar/HF or CF, AT	≤ 160	---	200	---	500-700	---	L: 40	215/---/---
					160 < t ≤ 250	---					T: 30	
	X3CrNiMo17-13-3	1.4436	---	Bar/HF or CF, AT	≤ 160	---	200	---	500-700	---	L: 40	
					160 < t ≤ 250	---					T: 30	

8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRB/HV
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 276-00	316L	---	S31603	Bar, Shape/HF, A	all	all	170	25	485	70	40	---/---/---
				Bar, Shape/CF, A	≤ 12.70	≤ ½	310	45	620	90	30	---/---/---
					> 12.70	> ½	170	25	485	70	30	---/---/---
JIS G 4303:1998	SUS316L	---	---	Bar/HF, S	≤ 180	---	175	---	480	---	40	187/90/200
JIS G 4318:1998	SUS316L	---	---	Bar/CF	mechanical properties of bars shall be agreed upon between the parties concerned with delivery							
EN 10088-3:1995	X2CrNiMo17-12-2	1.4404	---	Bar/HF or CF, AT	≤ 160	---	200	---	500-700	---	L: 40	215/---/---
					160 < t ≤ 250	---					T: 30	
	X2CrNiMo17-12-3	1.4432	---	Bar/HF or CF, AT	≤ 160	---	200	---	500-700	---	L: 40	215/---/---
					160 < t ≤ 250	---					T: 30	
	X2CrNiMo18-14-3	1.4435	---	Bar/HF or CF, AT	≤ 160	---	200	---	500-700	---	L: 40	215/---/---
					160 < t ≤ 250	---					T: 30	
ASTM A 276-00	316N	---	S31651	Bar, Shape/HF or CF, A	all	all	240	35	550	80	30	---/---/---
				Bar, Shape/CF, B	≤ 19.05	≤ ¾	690	100	860	125	12	---/---/---
					19.05 < t ≤ 25.40	¾ < t ≤ 1	550	80	795	115	15	---/---/---
					25.40 < t ≤ 31.75	1 < t ≤ 1½	450	65	725	105	20	---/---/---
					31.75 < t ≤ 38.10	1½ < t ≤ 1¾	345	50	690	100	24	---/---/---
					38.10 < t ≤ 44.45	1¾ < t ≤ 1¾	310	45	655	95	28	---/---/---
				Bar, Shape/CF, S	≤ 50.8	≤ 2	515	75	650	95	25	---/---/---
					50.8 < t ≤ 63.5	2 < t ≤ 2½	450	65	620	90	30	---/---/---
					63.5 < t ≤ 76.2	2½ < t ≤ 3	380	55	550	80	30	---/---/---
					≤ 180	---	275	---	550	---	35	217/95/220
JIS G 4303:1998	SUS316N	---	---	Bar/HF, S	≤ 180	---	275	---	550	---	35	217/95/220
ASTM A 276-00	316LN	---	S31653	Bar, Shape/HF, A	all	all	205	30	515	75	40	---/---/---
				Bar, Shape/CF, A	≤ 12.70	≤ ½	310	45	620	90	30	---/---/---
					> 12.70	> ½	205	30	515	75	30	---/---/---
JIS G 4303:1998	SUS316LN	---	---	Bar/HF, S	≤ 180	---	245	---	550	---	40	217/95/220
EN 10088-3:1995	X2CrNiMoN17-11-2	1.4406	---	Bar/HF or CF, AT	≤ 160	---	280	---	580-800	---	L: 40	250/---/---
					160 < t ≤ 250	---					T: 30	
	X2CrNiMoN17-13-3	1.4429	---	Bar/HF or CF, AT	≤ 160	---	280	---	580-800	---	L: 40	250/---/---
					160 < t ≤ 250	---					T: 30	

8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRB/HV
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 276-00	316Ti	---	S31635	Bar, Shape/HF, A	all	all	205	30	515	75	40	---/---/---
				Bar, Shape/CF, A	≤ 12.70	≤ ½	310	45	620	90	30	---/---/---
					> 12.70	> ½	205	30	515	75	30	---/---/---
JIS G 4303:1998	SUS316Ti	---	---	Bar/HF, S	≤ 180	---	205	---	520	---	40	187/90/200
JIS G 4311:1991	SUS316Ti	---	---	Bar/HF, H	≤ 180	---	205	---	520	---	40	187/90/200
EN 10088-3:1995	X6CrNiMoTi17-12-2	1.4571	---	Bar/HF or CF, AT	≤ 160	---	200	---	500-700	---	L: 40	215/---/---
					160 < t ≤ 250	---					T: 30	
ASTM A 276-00	317	---	S31700	Bar, Shape/HF, A	all	all	205	30	515	75	40	---/---/---
				Bar, Shape/CF, A	≤ 12.70	≤ ½	310	45	620	90	30	---/---/---
					> 12.70	> ½	205	30	515	75	30	---/---/---
JIS G 4303:1998	SUS317	---	---	Bar/HF, S	≤ 180	---	205	---	520	---	40	187/90/200
JIS G 4311:1991	SUS317	---	---	Bar/HF, H	≤ 180	---	205	---	520	---	40	187/90/200
JIS G 4303:1998	SUS317L	---	---	Bar/HF, S	≤ 180	---	175	---	480	---	40	187/90/200
EN 10088-3:1995	X2CrNiMo18-15-4	1.4438	---	Bar/HF or CF, AT	≤ 160	---	200	---	500-700	---	L: 40	215/---/---
					160 < t ≤ 250	---					T: 30	
JIS G 4303:1998	SUS 317J1	---	---	Bar/HF, S	≤ 180	---	175	---	480	---	40	187/90/200
EN 10088-3:1995	X2CrNiMoN17-13-5	1.4439	---	Bar/HF or CF, AT	≤ 160	---	280	---	580-800	---	L: 35	250/---/---
					160 < t ≤ 250	---					T: 30	
ASTM B 691-95	---	---	N08367	Bar/HF or CF, A	all	all	310	45	655	95	30	---/---/---
JIS G 4303:1998	SUS836L	---	---	Bar/HF, S	≤ 180	---	205	---	520	---	35	217/96/230
ASTM B 649-95	---	---	N08904	Bar/HF or CF, ST	all	all	220	31	490	71	35	---/---/---
JIS G 4303:1998	SUS890L	---	---	Bar/HF, S	≤ 180	---	215	---	490	---	35	187/90/200
EN 10088-3:1995	X1NiCrMoCu25-20-5	1.4539	---	Bar/HF or CF, AT	≤ 160	---	230	---	530-730	---	L: 35	230/---/---
					160 < t ≤ 250	---					T: 30	
ASTM A 276-00	321	---	S32100	Bar, Shape/HF, A	all	all	205	30	515	75	40	---/---/---
				Bar, Shape/CF, A	≤ 12.70	≤ ½	310	45	620	90	30	---/---/---
					> 12.70	> ½	205	30	515	75	30	---/---/---
JIS G 4303:1998	SUS321	---	---	Bar/HF, S	≤ 180	---	205	---	520	---	40	187/90/200
JIS G 4318:1998	SUS321	---	---	Bar/CF	mechanical properties of bars shall be agreed upon between the parties concerned with delivery							
JIS G 4311:1991	SUS321	---	---	Bar/HF, H	≤ 180	---	205	---	520	---	40	187/90/200
EN 10088-3:1995	X6CrNiTi18-10	1.4541	---	Bar/HF or CF, AT	≤ 160	---	190	---	500-700	---	L: 40	215/---/---
					160 < t ≤ 250	---					T: 30	
ISO 4955:1994	X7CrNiTi18-10	---	---	Bar/TQ	---	---	200	---	510-710	---	see standard	192/---/---

8.2 Stainless Steels: Bar

8.2.3B Mechanical Properties of Austenitic Stainless Steels (Continued)

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRB/HV
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 276-00	347	---	S34700	Bar, Shape/HF, A	all	all	205	30	515	75	40	---/---/---
				Bar, Shape/CF, A	≤ 12.70	≤ ½	310	45	620	90	30	---/---/---
					> 12.70	> ½	205	30	515	75	30	---/---/---
JIS G 4303:1998	SUS347	---	---	Bar/HF, S	≤ 180	---	205	---	520	---	40	187/90/200
JIS G 4311:1991	SUS347	---	---	Bar/HF, H	≤ 180	---	205	---	520	---	40	187/90/200
JIS G 4318:1998	SUS347	---	---	Bar/CF	mechanical properties of bars shall be agreed upon between the parties concerned with delivery							
EN 10088-3:1995	X6CrNiNb18-10	1.4550	---	Bar/HF or CF, AT	≤ 160 160 < t ≤ 250	---	205	---	510-740	---	L: 40 T: 30	230/---/---
ISO 4955:1994	X7CrNiNb18-10	---	---	Bar/TQ	---	---	205	---	510-710	---	see standard	192/---/---
ASTM A 276-00	309	---	S30900	Bar, Shape/HF, A	all	all	205	30	515	75	40	---/---/---
				Bar, Shape/CF, A	≤ 12.70	≤ ½	310	45	620	90	30	---/---/---
					> 12.70	> ½	205	30	515	75	30	---/---/---
JIS G 4311:1991	SUH309	---	---	Bar/HF, S	≤ 180	---	205	---	560	---	45	201/---/---
EN 10095:1999	X12CrNi23-13	1.4833	---	Bar/HF or CF, AT	---	---	210	---	500-700	---	see standard	192/---/---
ASTM A 276-00	310	---	S31000	Bar, Shape/HF, A	all	all	205	30	515	75	40	---/---/---
				Bar, Shape/CF, A	≤ 12.70	≤ ½	310	45	620	90	30	---/---/---
					> 12.70	> ½	205	30	515	75	30	---/---/---
JIS G 4311:1991	SUH310	---	---	Bar/HF, S	≤ 180	---	205	---	590	---	40	201/---/---
EN 10095:1999	X15CrNiSi25-21	1.4841	---	Bar/HF or CF, AT	---	---	230	---	550-750	---	see standard	223/---/---
ISO 4955:1994	X15CrNiSi25-21	---	---	Bar/TQ	---	---	230	---	550-750	---	see standard	223/---/---

8.2 Stainless Steels: Bar

8.2.4A Chemical Composition of Precipitation-Hardening Stainless Steels

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 564/A 564M-99	630	---	S17400	0.07	1.00	1.00	0.040	0.030	15.00-17.50	3.00-5.00	---	Cu 3.00-5.00; Cb+Ta 0.15-0.45
JIS G 4303:1998	SUS630	---	---	0.07	1.00	1.00	0.040	0.030	15.50-17.50	3.00-5.00	---	Cu 3.00-5.00; Nb 0.15-0.45
JIS G 4311:1991	SUS630	---	---	0.07	1.00	1.00	0.040	0.030	15.50-17.50	3.00-5.00	---	Cu 3.00-5.00; Nb 0.15-0.45
EN 10088-3:1995	X5CrNiCuNb16-4	1.4542	---	0.07	1.50	0.70	0.040	0.030	15.00-17.00	3.00-5.00	0.60	Cu 3.00-5.00; Nb 5 x C to 0.45
ASTM A 564/A 564M-99	631	---	S17700	0.09	1.00	1.00	0.040	0.030	16.00-18.00	6.50-7.75	---	Al 0.75-1.50
JIS G 4303:1998	SUS631	---	---	0.09	1.00	1.00	0.040	0.030	16.00-18.00	6.5-7.75	---	Al 0.75-1.50
JIS G 4311:1991	SUS631	---	---	0.09	1.00	1.00	0.040	0.030	16.00-18.00	6.5-7.75	---	Al 0.75-1.50
EN 10088-3:1995	X7CrNiAl17-7	1.4568	---	0.09	1.00	0.70	0.040	0.015	16.00-18.00	6.50-7.80	---	Al 0.70-1.50

8.2 Stainless Steels: Bar

8.2.4B Mechanical Properties of Precipitation-Hardening Stainless Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRC/HV
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 564/A 564M-99	630	---	S17400	Bar, Shape/HR & CF, A	---	---	---	---	---	---	---	363/38/---
				Bar, Shape/HR & CF, H900	≤ 75	≤ 3	1170	170	1310	190	10	388/40/---
					75 < t ≤ 200	3 < t ≤ 8						
				Bar, Shape/HR & CF, H925	≤ 75	≤ 3	1070	155	1170	170	10	375/38/---
					75 < t ≤ 200	3 < t ≤ 8						
				Bar, Shape/HR & CF, H1025	≤ 200	≤ 8	1000	145	1070	155	12	331/35/---
				Bar, Shape/HR & CF, H1075	≤ 200	≤ 8	860	125	1000	145	13	311/21/---
				Bar, Shape/HR & CF, H1100	≤ 200	≤ 8	795	115	965	140	14	302/31/---
				Bar, Shape/HR & CF, H1150	≤ 200	≤ 8	725	105	930	135	16	277/28/---
JIS G 4303:1998	SUS630	---	---	Bar, Shape/HR & CF, H1150M	≤ 200	≤ 8	520	75	795	115	18	255/24/---
				Bar, Shape/HR & CF, H1150D	≤ 200	≤ 8	725	105	860	125	16	255/24/---
				Bar/ HF, S	≤ 75	---	---	---	---	---	---	---/38/---
				Bar/ HF, H900			1175	---	1310	---	10	---/40 min/---
				Bar/ HF, H1025			1000	---	1070	---	12	---/35 min/---
				Bar/ HF, H1075			860	---	1000	---	13	---/31 min/---
				Bar/ HF, H1150			725	---	930	---	16	---/28 min/---

8.2 Stainless Steels: Bar

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

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRC/HV
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
JIS G 4311:1991	SUS630	---	---	Bar/HF, S	≤ 75	---	---	---	---	---	---	---/38/---
				Bar/HF, H900			1175	---	1310	---	10	---/40 min/---
				Bar/HF, H1025			1000	---	1070	---	12	---/35 min/---
				Bar/HF, H1075			860	---	1000	---	13	---/31 min/---
				Bar/HF, H1150			725	---	930	---	16	---/28 min/---
EN 10088-3:1995	X5CrNiCuNb16-4	1.4542	---	Bar/HF or CF, AT	≤ 100	---	---	---	1200 max	---	---	360/---/---
				Bar/HF or CF, P800			520	---	800-950	---	18	---/---/---
				Bar/HF or CF, P930			720	---	930-1100	---	16	---/---/---
				Bar/HF or CF, P960			790	---	960-1160	---	12	---/---/---
				Bar/HF or CF, P1070			1000	---	1070-1270	---	10	---/---/---
ASTM A 564/A 564M-99	631	---	S17700	Bar, Shape/HR & CF, A	---	---	---	---	---	---	---	229/HRB98/---
				Bar, Shape/HR & CF, RH950	≤ 100	≤ 4	1030	150	1280	185	6	388/41/---
				Bar, Shape/HR & CF, TH1050	≤ 150	≤ 6	965	140	1170	170	6	352/38/---
JIS G 4303:1998	SUS631	---	---	Bar/HF, S	≤ 75	---	380	---	1030	---	20	---/---/---
				Bar/HF, RH950	≤ 75	---	1030	---	1230	---	4	---/---/---
				Bar/HF, TH1050	≤ 75	---	960	---	1140	---	5	---/---/---
JIS G 4311:1991	SUS631	---	---	Bar/HF, S	≤ 75	---	380	---	1030	---	20	---/---/---
				Bar/HF, RH950	≤ 75	---	1030	---	1230	---	4	---/---/---
				Bar/HF, TH1050	≤ 75	---	960	---	1140	---	5	---/---/---
EN 10088-3:1995	X7CrNiAl17-7	1.4568	---	Bar/HF or CF, AT	≤ 30	---	---	---	850 max	---	---	255/---/---

8.2 Stainless Steels: Bar

8.2.5A Chemical Composition of Duplex Stainless Steels

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 276-00	---	---	S31803	0.030	2.00	1.00	0.030	0.020	21.0-23.0	4.5-6.5	2.5-3.5	N 0.08-0.20
	---	---	S32205	0.030	2.00	1.00	0.030	0.020	22.0-23.0	4.5-6.5	3.0-3.5	N 0.14-0.20
JIS G 4303:1998	SUS 329J3L	---	---	0.030	2.00	1.00	0.040	0.030	21.00-24.00	4.50-6.50	2.50-3.50	N 0.08-0.20
EN 10088-3:1995	X2CrNiMoN22-5-3	1.4462	---	0.030	2.00	1.00	0.035	0.015	21.00-23.00	4.50-6.50	2.50-3.50	N 0.10-0.22

8.2.5B Mechanical Properties of Duplex Stainless Steels

Standard Designation	Grade, Class, Type, Symbol or Name	Steel Number	UNS Number	Product Form/Heat Treatment	Thickness		Yield Strength, min		Tensile Strength, min		Elongation, min, %	Hardness, max HB/HRC/HV
					t, mm	t, in.	N/mm ² or MPa	ksi	N/mm ² or MPa	ksi		
ASTM A 276-00	---	---	S31803	Bar, Shape/HF or CF, A	all	all	448	65	620	90	25	290/---/---
	---	---	S32205	Bar, Shape/HF or CF, A	all	all	450	65	620	90	25	290/---/---
JIS G 4303:1998	SUS 329J3L	---	---	Bar/HF, S	≤ 75	---	450	---	620	---	18	302/32/320
EN 10088-3:1995	X2CrNiMoN22-5-3	1.4462	---	Bar/HF or CF, AT	≤ 160	---	450	---	650-880	---	25	270/---/---

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

ASTM A 167-99 - Stainless 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		X8CrNiMoAl15-7-2	
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	

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

EN 10095: 1999 - Heat Resisting Steels and Nickel Alloys											
Steel Name	X10CrAlSi7	X10CrAlSi13	X10CrAlSi18	X10CrAlSi25	X3CrAlTi18-2	X8CrNiTi18-10	X15CrNiSi20-12	X12NiCrSi35-16	X15CrNiSi25-4	NiCr15Fe	NiCr20Ti
Steel Number	1.4713	1.4724	1.4742	1.4742	1.4736	1.4878	1.4828	1.4864	1.4821	2.4816	2.4951
Steel Name	NiCr22Mo9Nb		X6CrNiSiNce19-10		X6NiCrSiNce35-25		X10NiCrSiNb35-22		X9CrNiSiNce21-11-1		X10NiCrAlTi32-21
Steel Number	2.4856		1.4818		1.4854		1.4887		1.4835		1.4876
Steel Name	X6NiCrNbCe32-27		X25CrMnNiN25-9-7		NiCr23Fe		NiCr28FeSiCe		X10NiCrSi35-19		X8CrNi25-21
Steel Number	1.4877		1.4872		2.4851		2.4889		1.4886		1.4845

8.4 Non-Comparable Stainless Steel Standards: Bar

ASTM A 276-00 - Stainless Steel Bars and Shapes												
Grade, Class, Type	---	---	205	XM-19	---	XM-10	XM-11	XM-29	XM-28	302B	---	308
UNS Number	N08367	S20160	S20500	S20910	S21800	S21900	S21904	S24000	S24100	S30215	S30454	S30800
Grade, Class, Type	---	309Cb	310Cb	---	314	316Cb	---	---	---	---	-	348
UNS Number	S30815	S30940	S31040	S31254	S31400	S31640	S31654	S31725	S31726	S32654	S34565	S34800
Grade, Class, Type	XM-26	---	---	---	---	429	444	---	XM-30	414	---	---
UNS Number	S31100	S32304	S32550	32760	S40976	S42900	S44400	S44800	S41040	S41400	S41425	S41500
Grade, Class, Type	---	---	---	---	---	---	---	---	---	---	---	---
UNS Number	S42010	---	---	---	---	---	---	---	---	---	---	---
ASTM A 564/A 564M-99 - Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes												
Grade, Class, Type	632	634	635	XM-12	XM-13	XM-16	---	XM-25	---	---	---	---
UNS Number	S15700	S35500	S17600	S15500	S13800	S45500	S45503	S45000	---	---	---	---
ASTM 582/A 582M-95 - Free-Machining Stainless Steel Bars												
Grade, Class, Type	XM-1	XM-5	XM-2	XM-6	416Se	420FSe	XM-34	---	430FSe	---	---	---
UNS Number	S20300	S30310	S30345	S41610	S41623	S42023	S18200	S41603	S43023	---	---	---
ASTM B 649-95 - Ni-Fe-Cr-Mo-Cu Low-Carbon Alloy (UNS N08904), Ni-Fe-Cr-Mo-Cu-N Low-Carbon Alloys (UNS N08925, UNS N08031, and UNS N08926), and Cr-Ni-Fe-N Low-Carbon Alloy (UNS R20033) Bar and Wire												
Grade, Class, Type	---	---	---	---	---	---	---	---	---	---	---	---
UNS Number	N08925	N08031	N08926	R20033	---	---	---	---	---	---	---	---
ASTM B 691-95 - Iron-Nickel-Chromium-Molybdenum Alloys (UNS N08366 and UNS N08367) Rod, Bar, and Wire												
Grade, Class, Type	---	---	---	---	---	---	---	---	---	---	---	---
UNS Number	N08366	---	---	---	---	---	---	---	---	---	---	---
JIS G 4303:1998 - Stainless Steel Bars												
Symbol of Grade	SUS303Cu	SUS304J3	SUS316J1	SUS316J1L	SUS316F	SUS317LN	SUSXM15J1	SUS329J1	SUS329J4L	SUS410L	SUS410J1	SUS410F2
	SUS420F2	SUS440F	SUSXM7	---	---	---	---	---	---	---	---	---
JIS G 4311:1991 - Heat-Resisting Steel Bars												
Symbol of Grade	SUSXM15J1	SUS410J1	SUH31	SUH35	SUH36	SUH37	SUH38	SUH330	SUH660	SUH661	SUH446	SUH1
	SUH3	SUH4	SUH11	SUH600	SUH616	---	---	---	---	---	---	---
JIS G 4318:1998 - Cold Finished Stainless Steel Bars												
Symbol of Grade	SUS303Cu	SUS304J3	SUS305J1	SUS316F	SUS410F2	SUS420J2	SUS420F2	---	---	---	---	---

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

EN 10088-3:1995 - Stainless Steels – Part 3: Technical Delivery Conditions for Semi-Finished Products, Bars, Rod and Sections for General Purposes												
Steel Name	X2CrNi12	X39Cr13	X46Cr13	X50CrMoV15	X14CrMoS17	X39CrMo17-1	X3CrNiMo13-4	X90CrMoV18	X2CrNi19-11	---	---	---
Steel Number	1.4003	1.4031	1.4034	1.4116	1.4104	1.4122	1.4313	1.4112	1.4306	---	---	---
Steel Name	X3CrNiCu18-9-4		X1NiCrMoCu25-20-5		X5CrNiMoCuNb14-5		X6CrNiMoNb17-12-2		X2CrNiMo18-14-3		X3CrNiCu19-9-2	
Steel Number	1.4567		1.4539		1.4594		1.4580		1.4435		1.4460	
Steel Name	X6NiCrCuS18-9-2		X3CrNiCuMo17-11-3-2		X1NiCrMoCu31-27-4		X1CrNiMoCuN25-25-5		X1CrNiMoCuN20-18-7		X1NiCrMoCuN25-20-7	
Steel Number	1.4570		1.4578		1.4563		1.4537		1.4547		1.4529	
Steel Name	X3CrNiMoN27-5-2		X2CrNiN23-4		X2CrNiMoCuN25-6-3		X2CrNiMoN25-7-4		X2CrNiMoCuWN25-7-4		X4CrNiMo16-5-1	
Steel Number	1.4460		1.4362		1.4507		1.4410		1.4501		1.4418	
Steel Name	X6CrNiNb18-10		X1CrNiSi18-15-4		----		----		----		----	
Steel Number	1.4550		1.4361		----		----		----		----	
EN 10095:1999 - Heat Resisting Steels and Nickel Alloys												
Steel Name	X10CrAlSi7	X10CrAlSi13	X10CrAlSi18	X10CrAlSi25	X3CrAlTi18-2	X8CrNiTi18-10	X15CrNiSi20-12		X12NiCrSi35-16	X15CrNiSi25-4	NiCr15Fe	NiCr20Ti
Steel Number	1.4713	1.4724	1.4742	1.4742	1.4736	1.4878	1.4828		1.4864	1.4821	2.4816	2.4951
Steel Name	NiCr22Mo9Nb		X6CrNiSiNce19-10		X6NiCrSiNce35-25		X10NiCrSiNb35-22		X9CrNiSiNce21-11-1		X10NiCrAlTi32-21	
Steel Number	2.4856		1.4818		1.4854		1.4887		1.4835		1.4876	
Steel Name	X6NiCrNbCe32-27		X25CrMnNiN25-9-7		NiCr23Fe		NiCr28FeSiCe		X10NiCrSi35-19		X8CrNi25-21	
Steel Number	1.4877		1.4872		2.4851		2.4889		1.4886		1.4845	
ISO 4955:1994 - Heat-Resisting Steels and Alloys												
Steel Type	X6CrTi12	X10CrAlSi13	X10CrAlSi18	X10CrAlSi25	X6NiCrSi36-19	X15CrNiSi201-2	X12NiCrSi35-16	X8NiCrAlTi32-21	X7CrNiSiNce21-11	NiCr15Fe8		
	NiCr20Ti	NiCr22Mo9Nb	---	---	---	---	---	---	---	---		

CHAPTER

9

STEELS FOR SPECIAL USE

Free-Machining Steels

ASTM Standards

ASTM A 29/A 29M-99	General Requirements for Steel Bars, Carbon and Alloy, Hot-Wrought and Cold-Finished
ASTM A 576-90 (2000)	Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality
ASTM A 895-89(2000)	Free-Machining Stainless Steel Plate, Sheet, and Strip

SAE Standard

SAE J403-2000	Chemical Compositions of SAE Carbon Steels
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JIS Standard

JIS G 4804:1999	Free Cutting Carbon Steels
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CEN Standards

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

ISO Standard

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

ASTM Standards

ASTM A 682/A 682M-00	General Requirements For Steel, Strip, High-Carbon, Cold-Rolled
ASTM A 689-97	Carbon and Alloy Steel Bars for Springs

JIS Standards

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

BSI Standards

BSI BS 970-2:1988	Wrought Steels for Mechanical and Allied Engineering Purposes Part 2: Requirements for Steels for the Manufacture of Hot Formed Springs
AMD 2:1992	
BSI BS 5770-4:1981	Steel Strip Intended for the Manufacture of Springs Part 4: Martensitic and Austenitic Stainless Steel

DIN Standards

DIN 17221-1988	Hot Rolled Steels for Springs Suitable for Quenching and Tempering; Technical Delivery Conditions
DIN 17224:1982	Stainless Steel Wire and Strip for Springs; Technical Delivery Conditions

AFNOR Standard

AFNOR NF A35-571:1996	Special Structural Steels Suitable for the Manufacture of Suspension Components
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CEN Standard

EN 10132-4: 2000	Cold Rolled Narrow Steel Strip for Heat Treatment - Technical Delivery Conditions - Part 4: Spring Steels and Other Applications
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ISO Standard

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

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

SAE Standard

SAE J438 May 1970	Tool and Die Steels
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JIS Standards

JIS G 4401:1983	Carbon Tool Steels
JIS G 4403:1983	High Speed Tool Steels
JIS G 4404:1983	Alloy Tool Steels

CEN Standard

EN ISO 4957:2000	Tool Steels
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Bearing Steels**ASTM Standards**

ASTM A 295-98	High-Carbon Anti-Friction Bearing Steel
ASTM A 485-00	High Hardenability Antifriction Bearing Steel

JIS Standard

JIS G 4805:1999	High Carbon Chromium Bearing Steels
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CEN/ISO Standard

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

9.1.1 Chemical Composition of Free-Machining Steels - Resulturized

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	1109	---	G11090	0.08-0.13	0.60-0.90	---	0.040	0.08-0.13	---	---	---	---
ASTM A 576-90 (2000)	1109	---	G11090	0.08-0.13	0.60-0.90	---	0.040	0.08-0.13	---	---	---	---
JIS G 4804:1999	SUM 12	---	---	0.08-0.13	0.60-0.90	---	0.040	0.08-0.13	---	---	---	---
EN 10087:1998	10S20	1.0721	---	0.07-0.13	0.70-1.10	0.40	0.06	0.15-0.25	---	---	---	---
EN 10277:1999	10S20	1.0721	---	0.07-0.13	0.70-1.10	0.40	0.06	0.15-0.25	---	---	---	---
ISO 683-9:1988	10 S 20	---	---	0.07-0.13	0.70-1.10	0.15-0.40	0.06	0.15-0.25	---	---	---	---
ASTM A 29/A 29M-99	11 L 09	---	G11094	0.08-0.13	0.60-0.90	---	0.040	0.08-0.13	---	---	---	Pb 0.15-0.35
ASTM A 576-90 (2000)	11 L 09	---	G11094	0.08-0.13	0.60-0.90	---	0.040	0.08-0.13	---	---	---	Pb 0.15-0.35
EN 10087:1998	10SPb20	1.0722	---	0.07-0.13	0.70-1.10	0.40	0.06	0.15-0.25	---	---	---	Pb 0.20-0.35
EN 10277:1999	10SPb20	1.0722	---	0.07-0.13	0.70-1.10	0.40	0.06	0.15-0.25	---	---	---	Pb 0.20-0.35
ISO 683-9:1988	10 SPb 20	---	---	0.07-0.13	0.70-1.10	0.15-0.40	0.06	0.15-0.25	---	---	---	Pb 0.15-0.35
ASTM A 29/A 29M-99	1110	---	G11100	0.08-0.13	0.30-0.60	---	0.040	0.08-0.13	---	---	---	---
ASTM A 576-90 (2000)	1110	---	G11100	0.08-0.13	0.30-0.60	---	0.040	0.08-0.13	---	---	---	---
JIS G 4804:1999	SUM 11	---	---	0.08-0.13	0.30-0.60	---	0.040	0.08-0.13	---	---	---	---
ASTM A 29/A 29M-99	1117	---	G11700	0.14-0.20	1.00-1.30	---	0.040	0.08-0.13	---	---	---	---
ASTM A 576-90 (2000)	1117	---	G11700	0.14-0.20	1.00-1.30	---	0.040	0.08-0.13	---	---	---	---
SAE J403-2000	1117	---	G11700	0.14-0.20	1.00-1.30	---	0.030	0.08-0.13	---	---	---	---
JIS G 4804:1999	SUM 31	---	---	0.14-0.20	1.00-1.30	---	0.040	0.08-0.13	---	---	---	---
EN 10087:1998	15SMn13	1.0725	---	0.12-0.18	0.90-1.30	0.40	0.06	0.08-0.18	---	---	---	---
EN 10277:1999	15SMn13	1.0725	---	0.12-0.18	0.90-1.30	0.40	0.06	0.08-0.18	---	---	---	---
ISO 983-9:1988	10 SMn 20	---	---	0.14-0.20	1.20-1.60	0.15-0.40	0.06	0.15-0.25	---	---	---	---
ASTM A 29/A 29M-99	11 L 17	---	G11174	0.14-0.20	1.00-1.30	---	0.040	0.08-0.13	---	---	---	Pb 0.15-0.35
ASTM A 576-90 (2000)	11 L 17	---	G11174	0.14-0.20	1.00-1.30	---	0.040	0.08-0.13	---	---	---	Pb 0.15-0.35
SAE J403-2000	11L17	---	G11174	0.14-0.20	1.00-1.30	---	0.030	0.08-0.13	---	---	---	Pb 0.15-0.35
JIS G 4804:1999	SUM 31 L	---	---	0.14-0.20	1.00-1.30	---	0.040	0.08-0.13	---	---	---	Pb 0.10-0.35

9.1 Free-Machining Steels

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

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 29/A 29M-99	1137	---	G11370	0.32-0.39	1.35-1.65	---	0.040	0.08-0.13	---	---	---	---
ASTM A 576-90 (2000)	1137	---	G11370	0.32-0.39	1.35-1.65	---	0.040	0.08-0.13	---	---	---	---
SAE J403-2000	1137	---	G11370	0.32-0.39	1.35-1.65	---	0.030	0.08-0.13	---	---	---	---
JIS G 4804:1999	SUM 41	---	---	0.32-0.39	1.35-1.65	---	0.040	0.08-0.13	---	---	---	---
EN 10087:1998	36SMn14	1.0764	---	0.32-0.39	1.30-1.70	0.40	0.06	0.10-0.18	---	---	---	---
EN 10277:1999	36SMn14	1.0764	---	0.32-0.39	1.30-1.70	0.40	0.06	0.10-0.18	---	---	---	---
ISO 983-9:1988	35 SMn 20	---	---	0.32-0.39	0.90-1.40	0.15-0.40	0.06	0.15-0.25	---	---	---	---
ASTM A 29/A 29M-99	11 L 37	---	G11374	0.32-0.39	1.35-1.65	---	0.040	0.08-0.13	---	---	---	Pb 0.15-0.35
ASTM A 576-90 (2000)	11 L 37	---	G11374	0.32-0.39	1.35-1.65	---	0.040	0.08-0.13	---	---	---	Pb 0.15-0.35
SAE J403-2000	11L37	---	G11374	0.32-0.39	1.35-1.65	---	0.030	0.08-0.13	---	---	---	Pb 0.15-0.35
EN 10087:1998	35SMnPb14	1.0765	---	0.32-0.39	1.30-1.70	0.40	0.06	0.10-0.18	---	---	---	Pb 0.15-0.35
EN 10277:1999	35SMnPb14	1.0765	---	0.32-0.39	1.30-1.70	0.40	0.06	0.10-0.18	---	---	---	Pb 0.15-0.35
ASTM A 29/A 29M-99	1141	---	G11410	0.37-0.45	1.35-1.65	---	0.040	0.08-0.13	---	---	---	---
ASTM A 576-90 (2000)	1141	---	G11410	0.37-0.45	1.35-1.65	---	0.040	0.08-0.13	---	---	---	---
SAE J403-2000	1141	---	G11410	0.37-0.45	1.35-1.65	---	0.030	0.08-0.13	---	---	---	---
JIS G 4804:1999	SUM 42	---	---	0.37-0.45	1.35-1.65	---	0.040	0.08-0.13	---	---	---	---
EN 10087:1998	38SMn28	1.0760	---	0.35-0.40	1.20-1.50	0.40	0.06	0.24-0.33	---	---	---	---
EN 10277:1999	38SMn28	1.0760	---	0.35-0.40	1.20-1.50	0.40	0.06	0.24-0.33	---	---	---	---
ASTM A 29/A 29M-99	11 L 41	---	G11414	0.37-0.45	1.35-1.65	---	0.040	0.08-0.13	---	---	---	Pb 0.15-0.35
ASTM A 576-90 (2000)	11L41	---	G11414	0.37-0.45	1.35-1.65	---	0.040	0.08-0.13	---	---	---	Pb 0.15-0.35
SAE J403-2000	11 L 41	---	G11414	0.37-0.45	1.35-1.65	---	0.030	0.08-0.13	---	---	---	Pb 0.15-0.35
EN 10087:1998	38SMnPb28	1.0761	---	0.35-0.40	1.20-1.50	0.40	0.06	0.24-0.33	---	---	---	Pb 0.15-0.35
EN 10277:1999	38SMnPb28	1.0761	---	0.35-0.40	1.20-1.50	0.40	0.06	0.24-0.33	---	---	---	Pb 0.15-0.35

9.1 Free-Machining Steels

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

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 29/A 29M-99	1144	---	G11440	0.40-0.48	1.35-1.65	---	0.040	0.24-0.33	---	---	---	---
ASTM A 576-90 (2000)	1144	---	G11440	0.40-0.48	1.35-1.65	---	0.040	0.24-0.33	---	---	---	---
SAE J403-2000	1144	---	G11440	0.40-0.48	1.35-1.65	---	0.030	0.24-0.33	---	---	---	---
JIS G 4804:1999	SUM 43	---	---	0.40-0.48	1.35-1.65	---	0.040	0.24-0.33	---	---	---	---
EN 10087:1998	44SMn28	1.0762	---	0.40-0.48	1.20-1.50	0.40	0.06	0.24-0.33	---	---	---	---
EN 10277:1999	44SMn28	1.0762	---	0.40-0.48	1.30-1.70	0.40	0.06	0.24-0.33	---	---	---	---
ISO 683-9:1988	44 SMn 28	---	---	0.40-0.48	1.30-1.70	0.15-0.40	0.06	0.24-0.33	---	---	---	---
ASTM A 29/A 29M-99	11 L 44	---	G11444	0.40-0.48	1.35-1.65	---	0.040	0.24-0.33	---	---	---	Pb 0.15-0.35
ASTM A 576-90 (2000)	11 L 44	---	G11444	0.40-0.48	1.35-1.65	---	0.040	0.24-0.33	---	---	---	Pb 0.15-0.35
SAE J403-2000	11L44	---	G11444	0.40-0.48	1.35-1.65	---	0.030	0.24-0.33	---	---	---	Pb 0.15-0.35
EN 10087:1998	44SMnPb28	1.0763	---	0.40-0.48	1.20-1.50	0.40	0.06	0.24-0.33	---	---	---	Pb 0.15-0.35
EN 10277:1999	44SMnPb28	1.0763	---	0.40-0.48	1.30-1.70	0.40	0.06	0.24-0.33	---	---	---	Pb 0.15-0.35
ASTM A 29/A 29M-99	1146	---	G11460	0.42-0.49	0.70-1.00	---	0.040	0.08-0.13	---	---	---	---
ASTM A 576-90 (2000)	1146	---	G11460	0.42-0.49	0.70-1.00	---	0.040	0.08-0.13	---	---	---	---
SAE J403-2000	1146	---	G11460	0.42-0.49	0.70-1.00	---	0.030	0.08-0.13	---	---	---	---
EN 10087:1998	46S20	1.0727	---	0.42-0.50	0.70-1.10	0.40	0.06	0.15-0.25	---	---	---	---
EN 10277:1999	46S20	1.0727	---	0.42-0.50	0.70-1.10	0.40	0.06	0.15-0.25	---	---	---	---
ISO 683-9:1988	46 S 20	---	---	0.42-0.50	0.70-1.10	0.15-0.40	0.06	0.15-0.25	---	---	---	---
ASTM A 29/A 29M-99	11 L 46	---	G11464	0.42-0.49	0.70-1.00	---	0.040	0.08-0.13	---	---	---	Pb 0.15-0.35
ASTM A 576-90 (2000)	11 L 46	---	G11464	0.42-0.49	0.70-1.00	---	0.040	0.08-0.13	---	---	---	Pb 0.15-0.35
SAE J403-2000	11L46	---	G11464	0.42-0.49	0.70-1.00	---	0.030	0.08-0.13	---	---	---	Pb 0.15-0.35
EN 10087:1998	46SPb20	1.0757	---	0.42-0.50	0.70-1.10	0.40	0.06	0.15-0.25	---	---	---	Pb 0.15-0.35
EN 10277:1999	46SPb20	1.0757	---	0.42-0.50	0.70-1.10	0.40	0.06	0.15-0.25	---	---	---	Pb 0.15-0.35
ASTM A 895-89 (2000)	416	---	S41600	0.15	1.25	1.00	0.06	0.15 min	12.00-14.00	---	---	---
EN 10088-3:1995	X12CrS13	1.4005	---	0.08-0.15	1.50	1.00	0.040	0.15-0.35	12.00-14.00	---	0.60	---
ASTM A 895-89 (2000)	303	---	S30300	0.15	2.00	1.00	0.20	0.15 min	17.00-19.00	8.00-10.00	---	---
EN 10088-3:1995	X8CrNiS18-9	1.4305	---	0.10	2.00	1.00	0.045	0.15-0.35	17.00-19.00	8.00-10.00	---	N 0.11; Cu 1.00

9.1 Free-Machining Steels

9.1.2 Chemical Composition of Free-Machining Steels - Rephosphorized and Resulfurized

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	1212	---	G12120	0.13	0.70-1.00	---	0.07-0.12	0.16-0.23	---	---	---	---
ASTM A 576-90 (2000)	1212	---	G12120	0.13	0.70-1.00	---	0.07-0.12	0.16-0.23	---	---	---	---
SAE J403-2000	1212	---	G12120	0.13	0.70-1.00	---	0.07-0.12	0.16-0.23	---	---	---	---
JIS G 4804:1999	SUM 21	---	---	0.13	0.70-1.00	---	0.07-0.12	0.16-0.23	---	---	---	---
ISO 683-9:1988	9 S 20	---	---	0.13	0.60-1.20	0.05	0.11	0.15-0.25	---	---	---	---
ASTM A 29/A 29M-99	1213	---	G12130	0.13	0.70-1.00	---	0.07-0.12	0.24-0.33	---	---	---	---
ASTM A 576-90 (2000)	1213	---	G12130	0.13	0.70-1.00	---	0.07-0.12	0.24-0.33	---	---	---	---
SAE J403-2000	1213	---	G12130	0.13	0.70-1.00	---	0.07-0.12	0.24-0.33	---	---	---	---
JIS G 4804:1999	SUM 22	---	---	0.13	0.70-1.00	---	0.07-0.12	0.24-0.33	---	---	---	---
EN 10087:1998	11SMn30	1.0715	---	0.14	0.90-1.30	0.05	0.11	0.27-0.33	---	---	---	---
EN 10277:1999	11SMn30	1.0715	---	0.14	0.90-1.30	0.05	0.11	0.27-0.33	---	---	---	---
ISO 683-9:1988	11 SMn 28	---	---	0.14	0.90-1.30	0.05	0.11	0.24-0.33	---	---	---	---
ASTM A 29/A 29M-99	12 L 13	---	G12134	0.13	0.70-1.00	---	0.07-0.12	0.24-0.33	---	---	---	Pb 0.15-0.35
ASTM A 576-90 (2000)	12 L 13	---	G12134	0.13	0.70-1.00	---	0.07-0.12	0.24-0.33	---	---	---	Pb 0.15-0.35
SAE J403-2000	12L13	---	G12134	0.13	0.70-1.00	---	0.07-0.12	0.24-0.33	---	---	---	Pb 0.15-0.35
JIS G 4804:1999	SUM 22 L	---	---	0.13	0.70-1.00	---	0.07-0.12	0.24-0.33	---	---	---	Pb 0.10-0.35
EN 10087:1998	11SMnPb30	1.0718	---	0.14	0.90-1.30	0.05	0.11	0.27-0.33	---	---	---	Pb 0.20-0.35
EN 10277:1999	11SMnPb30	1.0718	---	0.14	0.90-1.30	0.05	0.11	0.27-0.33	---	---	---	Pb 0.20-0.35
ISO 683-9:1988	11 SMnPb 28	---	---	0.14	0.90-1.30	0.05	0.11	0.24-0.33	---	---	---	Pb 0.15-0.35
ASTM A 29/A 29M-99	12 L 14	---	G12144	0.15	0.85-1.15	---	0.04-0.09	0.26-0.35	---	---	---	Pb 0.15-0.35
ASTM A 576-90 (2000)	12 L 14	---	G12144	0.15	0.85-1.15	---	0.04-0.09	0.26-0.35	---	---	---	Pb 0.15-0.35
SAE J403-2000	12L14	---	G12144	0.15	0.85-1.15	---	0.04-0.09	0.26-0.35	---	---	---	Pb 0.15-0.35
JIS G 4804:1999	SUM 24 L	---	---	0.15	0.85-1.15	---	0.04-0.09	0.26-0.35	---	---	---	Pb 0.10-0.35
ASTM A 29/A 29M-99	1215	---	G12150	0.09	0.75-1.05	---	0.04-0.09	0.26-0.35	---	---	---	---
ASTM A 576-90 (2000)	1215	---	G12150	0.09	0.75-1.05	---	0.04-0.09	0.26-0.35	---	---	---	---
SAE J403-2000	1215	---	G12150	0.09	0.75-1.05	---	0.04-0.09	0.26-0.35	---	---	---	---
JIS G 4804:1999	SUM 23	---	---	0.09	0.75-1.05	---	0.04-0.09	0.26-0.35	---	---	---	---

9.1 Free-Machining Steels

9.1.2 Chemical Composition of Free-Machining Steels - Rephosphorized and Resulfurized (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 29/A 29M-99	12 L 15	---	G12154	0.09	0.75-1.05	---	0.04-0.09	0.26-0.35	---	---	---	Pb 0.15-0.35
ASTM A 576-90 (2000)	12 L 15	---	G12154	0.09	0.75-1.05	---	0.04-0.09	0.26-0.35	---	---	---	Pb 0.15-0.35
SAE J403-2000	12L15	---	G12154	0.09	0.75-1.05	---	0.04-0.09	0.26-0.35	---	---	---	Pb 0.15-0.35
JIS G 4804:1999	SUM 23 L	---	---	0.09	0.75-1.05	---	0.04-0.09	0.26-0.35	---	---	---	Pb 0.10-0.35
JIS G 4804:1999	SUM 25	---	---	0.15	0.90-1.40	---	0.07-0.12	0.30-0.40	---	---	---	---
EN 10087:1998	11SMn37	1.0736	---	0.14	1.00-1.50	0.05	0.11	0.34-0.40	---	---	---	---
EN 10277:1999	11SMn37	1.0736	---	0.14	1.00-1.50	0.05	0.11	0.34-0.40	---	---	---	---
ISO 683-9:1988	12 SMn 35	---	---	0.15	1.00-1.50	0.05	0.11	0.30-0.40	---	---	---	---
EN 10087:1998	11SMnPb37	1.0737	---	0.14	1.00-1.50	0.05	0.11	0.34-0.40	---	---	---	0.20-0.35
EN 10277:1999	11SMnPb37	1.0737	---	0.14	1.00-1.50	0.05	0.11	0.34-0.40	---	---	---	0.20-0.35
ISO 683-9:1988	12 SMnPb 35	---	---	0.15	1.00-1.50	0.05	0.11	0.30-0.40	---	---	---	0.15-0.35

9.2 Spring Steels

9.2.1 Chemical Composition of Carbon Spring Steels - Cold Rolled

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 682/A 682M-00	1050	---	G10500	0.47-0.55	0.60-0.90	0.15-0.30	0.035	0.040	---	---	---	---
JIS G 4802:1999	S50C-CSP	---	---	0.47-0.53	0.60-0.90	0.15-0.35	0.030	0.035	0.20	0.20	---	Cu 0.30; Ni+Cr 0.35
ASTM A 682/A 682M-00	1055	---	G10550	0.52-0.60	0.60-0.90	0.15-0.30	0.035	0.040	---	---	---	---
JIS G 4802:1999	S55C-CSP	---	---	0.52-0.58	0.60-0.90	0.15-0.35	0.030	0.035	0.20	0.20	---	Cu 0.30; Ni+Cr 0.35
EN 10132-4:2000	C55S	1.1204	---	0.52-0.60	0.60-0.90	0.15-0.35	0.025	0.025	0.40	0.40	0.10	---
ASTM A 682/A 682M-00	1060	---	G10600	0.55-0.66	0.60-0.90	0.15-0.30	0.035	0.040	---	---	---	---
JIS G 4802:1999	S55C-CSP	---	---	0.55-0.65	0.60-0.90	0.15-0.35	0.030	0.035	0.20	0.20	---	Cu 0.30; Ni+Cr 0.35
EN 10132-4:2000	C60S	1.1211	---	0.57-0.65	0.60-0.90	0.15-0.35	0.025	0.025	0.40	0.40	0.10	---
ASTM A 682/A 682M-00	1064	---	G10640	0.59-0.70	0.50-0.80	0.15-0.30	0.035	0.040	---	---	---	---
ASTM A 682/A 682M-00	1065	---	G10650	0.59-0.70	0.60-0.90	0.15-0.30	0.035	0.040	---	---	---	---
JIS G 4802:1999	S65C-CSP	---	---	0.60-0.70	0.60-0.90	0.15-0.35	0.030	0.035	0.20	0.20	---	Cu 0.30; Ni+Cr 0.35
ASTM A 682/A 682M-00	1070	---	G10700	0.65-0.76	0.60-0.90	0.15-0.30	0.035	0.040	---	---	---	---
JIS G 4802:1999	S70C-CSP	---	---	0.65-0.75	0.60-0.90	0.15-0.35	0.030	0.035	0.20	0.20	---	Cu 0.30; Ni+Cr 0.35
EN 10132-4:2000	C67S	1.1231	---	0.65-0.73	0.60-0.90	0.15-0.35	0.025	0.025	0.40	0.40	0.10	---
ASTM A 682/A 682M-00	1074	---	G10740	0.69-0.80	0.50-0.80	0.15-0.30	0.035	0.040	---	---	---	---
EN 10132-4:2000	C75S	1.1248	---	0.70-0.80	0.60-0.90	0.15-0.35	0.025	0.025	0.40	0.40	0.10	---
ASTM A 689-97	1078	---	G10780	0.72-0.90	0.30-0.60	---	0.040	0.050	---	---	---	---
JIS G 4801:1984	SUP 3	---	---	0.75-0.90	0.30-0.60	0.15-0.35	0.035	0.035	---	---	---	Cu 0.30
ASTM A 682/A 682M-00	1085	---	G10850	0.80-0.94	0.70-1.00	0.15-0.30	0.035	0.040	---	---	---	---
JIS G 4802:1999	SK5-CSP	---	---	0.80-0.90	0.50	0.35	0.030	0.030	0.30	0.25	---	Cu 0.25
EN 10132-4:2000	C85S	1.1269	---	0.80-0.90	0.40-0.70	0.15-0.35	0.025	0.025	0.40	0.40	0.10	---
ASTM A 682/A 682M-00	1086	---	G10860	0.80-0.94	0.30-0.50	0.15-0.30	0.035	0.040	---	---	---	---
EN 10132-4:2000	C90S	1.1217	---	0.85-0.95	0.40-0.70	0.15-0.35	0.025	0.025	0.40	0.40	0.10	---
ASTM A 682/A 682M-00	1095	---	G10950	0.90-1.04	0.30-0.50	0.15-0.30	0.035	0.040	---	---	---	---
JIS G 4802:1999	SK4-CSP	---	---	0.90-1.00	0.50	0.35	0.030	0.030	0.30	0.25	---	Cu 0.25
EN 10132-4:2000	C100S	1.1274	---	0.95-1.05	0.30-0.60	0.15-0.35	0.025	0.025	0.40	0.40	0.10	---

9.2 Spring Steels

9.2.2 Chemical Composition of Alloy Spring Steels - Hot Rolled

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 4801:1984	SUP 6	---	---	0.56-0.64	0.70-1.00	1.50-1.80	0.035	0.035	---	---	---	Cu 0.30
AFNOR NF A 35-571:1996	RH 388	---	---	0.55-0.65	0.7-1.0	1.5-2.0	0.050	0.050	---	---	---	---
ISO 683-14:1992	59 Si 7	---	---	0.55-0.63	0.60-1.00	1.60-2.00	0.030	0.030	---	---	---	---
ASTM A 689-97	9260	---	G92600	0.56-0.64	0.75-1.00	1.80-2.20	0.035	0.040	---	---	---	---
JIS G 4801:1984	SUP 7	---	---	0.56-0.64	0.70-1.00	1.80-2.20	0.035	0.035	---	---	---	Cu 0.30
ISO 683-14:1992	59 Si 7	---	---	0.55-0.63	0.60-1.00	1.60-2.00	0.030	0.030	---	---	---	---
ASTM A 689-97	5155	---	G51550	0.51-0.59	0.70-0.90	0.15-0.35	0.035	0.040	0.70-0.90	---	---	---
JIS G 4801:1984	SUP 9	---	---	0.52-0.60	0.65-0.95	0.15-0.35	0.035	0.035	0.65-0.95	---	---	Cu 0.30
DIN 17221:1988	55 Cr 3	---	---	0.52-0.59	0.70-1.10	0.25-0.50	0.030	0.030	0.70-1.00	---	---	---
AFNOR NF A 35-571:1996	55 Cr 3	---	---	0.52-0.59	0.70-1.00	0.10-0.40	0.035	0.035	0.60-0.90	---	---	---
ISO 683-14:1992	55 Cr 3	---	---	0.52-0.59	0.70-1.00	0.15-0.40	0.030	0.030	0.70-1.00	---	---	---
ASTM A 689-97	5160	---	G51600	0.56-0.64	0.75-1.00	0.15-0.35	0.035	0.040	0.70-0.90	---	---	---
JIS G 4801:1984	SUP 9 A	---	---	0.56-0.64	0.70-1.00	0.15-0.35	0.035	0.035	0.70-1.00	---	---	Cu 0.30
ASTM A 689-97	6150	---	G61500	0.48-0.53	0.70-0.90	0.15-0.30	0.035	0.040	0.80-1.10	---	---	V 0.15
JIS G 4801:1984	SUP 10	---	---	0.47-0.55	0.65-0.95	0.15-0.35	0.035	0.035	0.80-1.10	---	---	V 0.15-0.25; Cu 0.30
BSI BS 970-2:1988 AMD 2:1992	735A51	---	---	0.48-0.54	0.70-1.0	0.20-0.35	0.035	0.035	0.90-1.20	---	---	V 0.10-0.20
BSI BS 970-2:1988 AMD 2:1992	735H51	---	---	0.47-0.55	0.70-1.10	0.15-0.40	0.035	0.035	0.90-1.20	---	---	V 0.10-0.25
DIN 17221:1988	50 CrV 4	---	---	0.47-0.55	0.70-1.10	0.15-0.40	0.030	0.030	0.90-1.20	---	---	V 0.10-0.20
AFNOR NF A 35-571:1996	50 CV 4	---	---	0.47-0.55	0.70-1.0	0.10-0.40	0.035	0.035	0.85-1.15	---	---	V 0.10-0.20
ISO 683-14:1992	51 CrV 4	---	---	0.47-0.55	0.60-1.00	0.10-0.40	0.030	0.030	0.80-1.10	---	---	V 0.10-0.25
ASTM A 689-97	51 B 60	---	G51601	0.56-0.64	0.75-1.00	0.15-0.35	0.035	0.040	0.70-0.90	---	---	B 0.0005-0.003
JIS G 4801:1984	SUP 11 A	---	---	0.56-0.64	0.70-1.00	0.15-0.35	0.035	0.035	0.70-1.00	---	---	B 0.0005; Cu 0.30
ISO 683-14:1992	60 CrB 3	---	---	0.56-0.64	0.70-1.00	0.15-0.40	0.030	0.030	0.60-0.90	---	---	B 0.0008

9.2 Spring Steels

9.2.2 Chemical Composition of Alloy Spring Steels - Hot Rolled (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 4801:1984 BSI BS 970-2:1988 AMD 2:1992	SUP 12	---	---	0.51-0.59	0.60-0.90	1.20-1.60	0.035	0.035	0.60-0.90	---	---	---
BSI BS 970-2:1988 AMD 2:1992	685A57	---	---	0.55-0.60	0.70-0.90	1.20-1.60	0.035	0.035	0.60-0.85	---	---	---
BSI BS 970-2:1988 AMD 2:1992	685H57	---	---	0.54-0.62	0.50-0.80	1.20-1.60	0.035	0.035	0.50-0.80	---	---	---
DIN 17221:1988	54 SiCr 6	---	---	0.51-0.59	0.50-0.80	1.20-1.60	0.030	0.030	0.50-0.80	---	---	---
ISO 683-14:1992	55 SiCr 63	---	---	0.51-0.59	0.50-0.80	1.20-1.60	0.030	0.030	0.55-0.85	---	---	---
ASTM A 689-97	4161	---	G41610	0.56-0.64	0.75-1.00	0.15-0.35	0.035	0.040	0.70-0.90	---	0.25-0.35	---
JIS G 4801:1984 BSI BS 970-2:1988 AMD 2:1992	SUP 13	---	---	0.56-0.64	0.70-1.00	0.15-0.35	0.035	0.035	0.70-0.90	---	0.25-0.35	---
BSI BS 970-2:1988 AMD 2:1992	705A60	---	---	0.57-0.62	0.85-1.0	0.20-0.35	0.035	0.035	0.85-1.00	---	0.25-0.35	---
BSI BS 970-2:1988 AMD 2:1992	705H60	---	---	0.55-0.64	0.65-1.10	0.15-0.40	0.035	0.035	0.60-1.00	---	0.25-0.35	---
ISO 683-14:1992	60 CrMo 33	---	---	0.56-0.64	0.70-1.00	0.15-0.40	0.030	0.030	0.70-1.00	---	0.25-0.35	---

9.2 Spring Steels

9.2.3 Chemical Composition of Stainless Spring Steels

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
BSI BS 5770-4:1981	420S45	---	---	0.28-0.36	1.00	1.00	0.040	0.030	12.0-14.0	1.00	---	---
JIS G 4313:1996	SUS 420 J 2-CSP	---	---	0.26-0.40	1.00	1.00	0.040	0.030	12.00-14.00	---	---	---
BSI BS 5770-4:1981	301S21	---	---	0.15	2.00	1.00	0.045	0.030	16.00-18.00	6.00-8.00	---	---
DIN 17224:1982	X 12 CrNi 17 7	1.4310	---	0.12	2.00	1.5	0.045	0.030	16.00-18.00	6.00-9.00	0.8	---
JIS G 4313:1996	SUS 301-CSP	---	---	0.15	0.50-2.00	0.20-1.00	0.045	0.030	16.00-18.00	6.00-8.00	---	---
DIN 17224:1982	X 7 CrNiAl 17 7	1.4568	---	0.09	1.0	1.0	0.045	0.030	16.0-18.0	6.50-7.75	---	Al 0.75-1.50
JIS G 4313:1996	SUS 631-CSP	---	---	0.09	1.00	1.00	0.040	0.030	16.00-18.00	6.5-7.75	---	Al 0.75-1.50

9.3 Tool Steels

9.3.1 Chemical Composition of Carbon Tool Steels

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 4401:1983	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

9.3 Tool Steels

9.3.2.1 Chemical Composition of High Speed Tool Steels - Tungsten Type

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 600-92 (1999)	T1	---	T12001	0.65-0.80	0.10-0.40	0.20-0.40	0.03	0.03	3.75-4.50	---	---	V 0.90-1.30; W 17.25-18.75; Ni+Cu 0.75
SAE J438-1970	T1	---	T12001	0.65-0.75	0.20-0.40	0.20-0.40	---	---	3.75-4.50	---	---	V 0.90-1.30; W 17.25-18.75
JIS G 4403:1983	SKH 2	---	---	0.73-0.83	0.40	0.40	0.030	0.030	3.80-4.50	0.25	---	V 0.80-1.20; W 17.00-19.00; Cu 0.25
EN ISO 4957:1999	HS 18-0-1	---	---	0.73-0.83	0.40	0.70	0.030	0.030	3.50-4.50	---	---	V 1.00-1.20; W 17.20-18.70
ASTM A 600-92 (1999)	T4	---	T12004	0.70-0.80	0.10-0.40	0.20-0.40	0.03	0.03	3.75-4.50	---	0.40-1.00	V 0.80-1.20; W 17.50-19.00; Co 4.25-5.75; Ni+Cu 0.75
SAE J438-1970	T4	---	T12004	0.70-0.80	0.20-0.40	0.20-0.40	---	---	3.75-4.50	---	0.70-1.00	V 0.80-1.20; W 17.25-18.75; Co 4.25-5.75
JIS G 4403:1983	SKH 3	---	---	0.73-0.83	0.40	0.40	0.030	0.030	3.80-4.50	0.25	---	V 0.80-1.20; W 17.00-19.00; Co 4.50-5.50; Cu 0.25
ASTM A 600-92 (1999)	T5	---	T12005	0.75-0.85	0.20-0.40	0.20-0.40	0.03	0.03	3.75-5.00	---	0.50-1.25	V 1.80-2.40; W 17.50-19.00; Co 7.00-9.50; Ni+Cu 0.75
SAE J438-1970	T5	---	T12005	0.75-0.85	0.20-0.40	0.20-0.40	---	---	3.75-4.50	---	0.70-1.00	V 1.80-2.40; W 17.50-19.00; Co 7.00-9.00
JIS G 4403:1983	SKH 4	---	---	0.73-0.83	0.40	0.40	0.030	0.030	3.80-4.50	0.25	---	V 1.00-1.50; W 17.00-19.00; Co 9.00-11.00; Cu 0.25
ASTM A 600-92 (1999)	T15	---	T12015	1.50-1.60	0.15-0.40	0.15-0.40	0.03	0.03	3.75-5.00	---	1.00	V 4.50-5.25; W 11.75-13.00; Co 4.75-5.25; Ni+Cu 0.75
JIS G 4403:1983	SKH 10	---	---	1.45-1.60	0.40	0.40	0.030	0.030	3.80-4.50	0.25	---	V 4.20-5.20; W 11.50-13.50; Co 4.20-5.20; Cu 0.25

9.3 Tool Steels

9.3.2.2 Chemical Composition of High Speed Tool Steels - Molybdenum Type

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 600-92 (1999)	M2	---	T11301	0.78-0.88	0.15-0.40	0.20-0.45	0.03	0.03	3.75-4.50	---	4.50-5.50	V 1.75-2.20; W 5.50-6.75; Ni+Cu 0.75
SAE J438-1970	M2	---	T11301	0.78-0.88	0.20-0.40	0.20-0.40	---	---	3.75-4.50	---	4.50-5.50	V 1.60-2.20; W 5.50-6.75
JIS G 4403:1983	SKH 51	---	---	0.80-0.90	0.40	0.40	0.030	0.030	3.80-4.50	0.25	4.50-5.50	V 1.60-2.20; W 5.50-6.70; Cu 0.25
EN ISO 4957:1999	HS6-5-2	---	---	0.80-0.88	0.40	0.45	0.030	0.030	3.80-4.50	---	4.70-5.20	V 1.70-2.10; W 5.90-6.70
ASTM A 600-92 (1999)	M3 CI 1	---	T11313	1.00-1.10	0.15-0.40	0.20-0.45	0.03	0.03	3.75-4.50	---	4.75-6.50	V 2.25-2.75; W 5.50-6.75; Ni+Cu 0.75
SAE J438-1970	M3	---	T11313	1.00-1.25	0.20-0.40	0.20-0.40	---	---	3.75-4.50	---	4.75-6.25	V 2.25-3.25; W 5.50-6.75
JIS G 4403:1983	SKH 52	---	---	1.00-1.10	0.40	0.40	0.030	0.030	3.80-4.50	0.25	4.80-6.20	V 2.30-2.80; W 5.50-6.70; Cu 0.25
EN ISO 4957:1999	HS6-6-2	---	---	1.00-1.10	0.40	0.45	0.030	0.030	3.80-4.50	---	5.50-6.50	V 2.30-2.60; W 5.90-6.70
ASTM A 600-92 (1999)	M3 CI 2	---	T11323	1.15-1.25	0.15-0.40	0.20-0.45	0.03	0.03	3.75-4.50	---	4.75-6.50	V 2.75-3.25; W 5.00-6.75; Ni+Cu 0.75
JIS G 4403:1983	SKH 53	---	---	1.10-1.25	0.40	0.40	0.030	0.030	3.80-4.50	0.25	4.60-5.30	V 2.80-3.30; W 5.70-6.70; Cu 0.25
EN ISO 4957:1999	HS6-5-3	---	---	1.15-1.25	0.40	0.45	0.030	0.030	3.80-4.50	---	4.70-5.20	V 2.70-3.20; W 5.90-6.70
ASTM A 600-92 (1999)	M4	---	T11304	1.25-1.40	0.15-0.40	0.20-0.45	0.03	0.03	3.75-4.75	---	4.25-5.50	V 3.75-4.50; W 5.25-6.50; Ni+Cu 0.75
SAE J438-1970	M4	---	T11304	1.25-1.40	0.20-0.40	0.20-0.40	---	---	4.00-4.75	---	4.50-5.50	V 3.90-4.50; W 5.25-6.50
JIS G 4403:1983	SKH 54	---	---	1.25-1.40	0.40	0.40	0.030	0.030	3.80-4.50	0.25	4.50-5.50	V 3.90-4.50; W 5.30-6.50; Cu 0.25
EN ISO 4957:1999	HS6-5-4	---	---	1.25-1.40	0.40	0.45	0.030	0.030	3.80-4.50	---	4.20-5.00	V 3.70-4.20; W 5.20-6.00
ASTM A 600-92 (1999)	M7	---	T11307	0.97-1.05	0.15-0.40	0.20-0.55	0.03	0.03	3.50-4.00	---	8.20-9.20	V 1.75-2.25; W 1.40-2.10; Ni+Cu 0.75
JIS G 4403:1983	SKH 58	---	---	0.95-1.05	0.40	0.50	0.030	0.030	3.50-4.50	0.25	8.20-9.20	V1.70-2.20; W 1.50-2.10; Cu 0.25
EN ISO 4957:1999	HS2-9-2	---	---	0.95-1.05	0.40	0.45	0.030	0.030	3.50-4.50	---	8.20-9.20	V 1.70-2.20; W 1.50-2.10
ASTM A 600-92 (1999)	M36	---	T11336	0.80-0.90	0.15-0.40	0.20-0.45	0.03	0.03	3.75-4.50	---	4.50-5.50	V 1.75-2.25; W 5.50-6.50; Co 7.75-8.75; Ni+Cu 0.75
JIS G 4403:1983	SKH 56	---	---	0.85-0.95	0.40	0.40	0.030	0.030	3.80-4.50	0.25	4.60-5.30	V 1.70-2.20; W 5.70-6.70; Co 7.00-9.00; Cu 0.25
ASTM A 600-92 (1999)	M42	---	T11342	1.05-1.15	0.15-0.40	0.15-0.65	0.03	0.03	3.50-4.25	---	9.00-10.00	V 0.95-1.35; W 1.15-1.85; Co 7.75-8.75; Ni+Cu 0.75
JIS G 4403:1983	SKH 59	---	---	1.00-1.15	0.40	0.25	0.030	0.030	3.50-4.50	---	9.00-10.00	V 0.90-1.40; W 1.20-1.90; Cu 0.25
EN ISO 4957:1999	HS2-9-1-8	---	---	1.05-1.15	0.40	0.45	0.030	0.030	3.50-4.50	---	9.00-10.0	V 0.90-1.30; W 1.20-1.90; Co 7.50-8.50

9.3 Tool Steels

9.3.2.2 Chemical Composition of High Speed Tool Steels - Molybdenum Type (Continued)

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
JIS G 4403:1983	SKH 55	---	---	0.85-0.95	0.40	0.40	0.030	0.030	3.80-4.50	0.25	4.60-5.30	V 1.70-2.20; W 5.70-6.70; Co 4.50-5.50; Cu 0.25
EN ISO 4957:1999	HS6-5-2-5	---	---	0.87-0.95	0.40	0.45	0.030	0.030	3.80-4.50	---	4.70-5.20	V 1.70-2.10; W 5.90-6.70; Co 4.50-5.00
JIS G 4403:1983	SKH 57	---	---	1.20-1.35	0.40	0.40	0.030	0.030	3.80-4.50	0.25	3.00-4.00	V 3.00-3.70; W 9.00-11.00; Co 9.00-11.00; Cu 0.25
EN ISO 4957:1999	HS10-4-3-10	---	---	1.20-1.35	0.40	0.45	0.030	0.030	3.80-4.50	---	3.20-3.90	V 3.00-3.50; W 9.00-10.0; Co 9.50-10.50

9.3 Tool Steels

9.3.3 Chemical Composition of Cold Work Tool Steels

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 681-94 (1999)	A2	---	T30102	0.95-1.05	0.40-1.00	0.10-0.50	0.030	0.030	4.75-5.50	---	0.90-1.40	V 0.15-0.50; Ni+Cu 0.75
SAE J438-1970	A2	---	T30102	0.95-1.05	0.45-0.75	0.20-0.40	---	---	4.75-5.50	---	0.90-1.40	V 0.40
JIS G 4404:1983	SKD 12	---	---	0.95-1.05	0.60-0.90	0.40	0.030	0.030	4.50-5.50	0.50	0.80-1.20	V 0.20-0.50; Cu 0.25
EN ISO 4957:1999	X100CrMoV5	---	---	0.95-1.05	0.40-0.80	0.10-0.40	0.030	0.030	4.80-5.50	---	0.90-1.20	V 0.15-0.35
ASTM A 681-94 (1999)	D2	---	T30402	1.40-1.60	0.10-0.60	0.10-0.60	0.030	0.030	11.00-13.00	---	0.70-1.20	V 0.50-1.10; Ni+Cu 0.75
SAE J438-1970	D2	---	T30402	1.40-1.60	0.30-0.50	0.10-0.60	---	---	11.00-13.00	---	0.70-1.20	V 0.80; Co 0.60
JIS G 4404:1983	SKD 11	---	---	1.40-1.60	0.60	0.40	0.030	0.030	11.00-13.00	0.50	0.80-1.20	V 0.20-0.50; Cu 0.25
ASTM A 681-94 (1999)	D3	---	T30403	2.00-2.35	0.10-0.60	0.10-0.60	0.030	0.030	11.00-13.50	---	---	V 1.00; W 1.00; Ni+Cu 0.75
SAE J438-1970	D3	---	T30403	2.00-2.35	0.24-0.45	0.25-0.45	---	---	11.00-13.00	---	0.80	V 0.80; W 0.75
JIS G 4404:1983	SKD 1	---	---	1.80-2.40	0.60	0.40	0.030	0.030	12.00-15.00	---	---	Cu 0.25
EN ISO 4957:1999	X210Cr12	---	---	1.90-2.20	0.20-0.60	0.10-0.60	0.030	0.030	11.00-13.00	---	---	---
JIS G 4404:1983	SKS 43	---	---	1.00-1.10	0.30	0.25	0.030	0.030	---	---	---	V 0.10-0.25
EN ISO 4957:1999	105V	---	---	1.00-1.10	0.10-0.40	0.10-0.30	0.030	0.030	---	---	---	V 0.10-0.20

9.3 Tool Steels

9.3.4 Chemical Composition of Hot Work Tool Steels

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 681-94 (1999)	H10	---	T20810	0.35-0.45	0.20-0.70	0.80-1.25	0.030	0.030	3.00-3.75	---	2.00-3.00	V 0.25-0.75; Ni+Cu 0.75
JIS G 4404:1983	SKD 7	---	---	0.28-0.38	0.60	0.50	0.030	0.030	2.50-3.50	0.25	2.50-3.00	V 0.40-0.70; Cu 0.25
EN ISO 4957:1999	32CrMoV12-28	---	---	0.28-0.35	0.15-0.45	0.10-0.40	0.030	0.020	2.70-3.20	---	2.50-3.00	V 0.40-0.70
ASTM A 681-94 (1999)	H11	---	T20811	0.33-0.43	0.20-0.60	0.80-1.25	0.030	0.030	4.75-5.50	---	1.10-1.60	V 0.30-0.60; Ni+Cu 0.75
SAE J438-1970	H11	---	T20811	0.30-0.40	0.20-0.40	0.80-1.20	---	---	4.75-5.50	---	1.25-1.75	V 0.30-0.50
JIS G 4404:1983	SKD 6	---	---	0.32-0.42	0.50	0.80-1.20	0.030	0.030	4.50-5.50	0.25	1.00-1.50	V 0.30-0.50; Cu 0.25
EN ISO 4957:1999	X37CrMoV5-1	---	---	0.33-0.41	0.25-0.50	0.80-1.20	0.030	0.020	4.80-5.50	---	1.10-1.50	V 0.30-0.50
ASTM A 681-94 (1999)	H12	---	T20812	0.30-0.40	0.20-0.60	0.80-1.25	0.030	0.030	4.75-5.50	---	1.25-1.75	V 0.20-0.50; W 1.00-1.70; Ni+Cu 0.75
SAE J438-1970	H12	---	T20812	0.30-0.40	0.20-0.40	0.80-1.20	---	---	4.75-5.50	---	1.25-1.75	V 0.10-0.50; W 1.00-1.70
JIS G 4404:1983	SKD 62	---	---	0.32-0.42	0.50	0.80-1.20	0.030	0.030	4.50-5.50	0.25	1.00-1.50	V 0.20-0.60; W 1.00-1.50; Cu 0.25
EN ISO 4957:1999	X35CrWMoV5	---	---	0.32-0.40	0.20-0.50	0.80-1.20	0.030	0.020	4.75-5.50	---	1.25-1.60	V 0.20-0.50; W 1.10-1.60
ASTM A 681-94 (1999)	H13	---	T20813	0.32-0.45	0.20-0.60	0.80-1.25	0.030	0.030	4.75-5.50	---	1.10-1.75	V 0.80-1.20; Ni+Cu 0.75
SAE J438-1970	H13	---	T20813	0.30-0.40	0.20-0.40	0.80-1.20	---	---	4.75-5.50	---	1.25-1.75	V 0.80-1.20
JIS G 4404:1983	SKD 61	---	---	0.32-0.42	0.50	0.80-1.20	0.030	0.030	4.50-5.50	0.25	1.00-1.50	V 0.80-1.20; Cu 0.25
EN ISO 4957:1999	X40CrMoV5-1	---	---	0.35-0.42	0.25-0.50	0.80-1.20	0.030	0.020	4.80-5.50	---	1.20-1.50	V 0.85-1.15
ASTM A 681-94 (1999)	H19	---	T20819	0.32-0.45	0.20-0.50	0.15-0.50	0.030	0.030	4.00-4.75	---	0.30-0.55	V 1.75-2.20; W 3.75-4.50; Co 4.00-4.50; Ni+Cu 0.75
JIS G 4404:1983	SKD 8	---	---	0.35-0.45	0.60	0.50	0.030	0.030	4.00-4.70	0.25	0.30-0.50	V 1.70-2.20; W 3.80-4.50; Co 3.80-4.50; Cu 0.25
EN ISO 4957:1999	38CrCoWV18-17-17	---	---	0.35-0.45	0.25-0.50	0.15-0.50	0.030	0.020	4.00-4.70	---	0.30-0.50	V 1.70-2.10; W 3.80-4.50; Co 4.00-4.50
ASTM A 681-94 (1999)	H21	---	T20821	0.26-0.36	0.15-0.40	0.15-0.50	0.030	0.030	3.00-3.75	---	---	V 0.30-0.60; W 8.50-10.00; Ni+Cu 0.75
SAE J438-1970	H21	---	T20821	0.30-0.40	0.20-0.40	0.15-0.30	---	---	3.00-3.75	---	---	V 0.30-0.50; W 8.75-10.00
JIS G 4404:1983	SKD 5	---	---	0.25-0.35	0.60	0.40	0.030	0.030	2.00-3.00	0.25	---	V 0.30-0.50; W 9.00-10.00; Cu 0.25
EN ISO 4957:1999	X30WCrV9-3	---	---	0.25-0.35	0.15-0.45	0.10-0.40	0.030	0.020	2.50-3.20	---	---	V 0.30-0.50; W 8.50-9.50
JIS G 4404:1983	SKT 4	---	---	0.50-0.60	0.60-1.00	0.35	0.030	0.030	0.70-1.00	1.30-2.00	0.20-0.50	V 0.20; Cu 0.25
EN ISO 4957:1999	55NiCrMoV7	---	---	0.50-0.60	0.60-0.90	0.10-0.40	0.030	0.030	0.80-1.20	1.50-1.80	0.35-0.55	V 0.05-0.15

9.3 Tool Steels

9.3.5 Chemical Composition of Special Purpose Tool Steels

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 681-94 (1999)	L6	---	T61206	0.65-0.75	0.25-0.80	0.10-0.50	0.030	0.030	0.60-1.20	1.25-2.00	0.50	---
SAE J438-1970	L6	---	T61206	0.65-0.75	0.55-0.85	0.20-0.40	---	---	0.65-0.85	1.25-1.75	0.25	---
JIS G 4404:1983	SKS 51	---	---	0.75-0.85	0.50	0.35	0.030	0.030	0.20-0.50	1.30-2.00	---	Cu 0.25
ASTM A 681-94 (1999)	F2	---	T60602	1.20-1.40	0.10-0.50	0.10-0.50	0.030	0.030	0.20-0.40	---	---	W 3.00-4.50; Ni+Cu 0.75
JIS G 4404:1983	SKS 11	---	---	1.20-1.30	0.50	0.35	0.030	0.030	0.20-0.50	0.25	---	W 3.00-4.00; V 0.10-0.30; Cu 0.25

9.4 Bearing Steels

9.4.1 Chemical Composition of Bearing Steels

Standard Designation	Grade, Class, Type Symbol or Name	Steel Number	UNS Number	Weight, %, max, Unless Otherwise Specified								
				C	Mn	Si	P	S	Cr	Ni	Mo	Others
ASTM A 295-98	52100	---	---	0.93-1.05	0.25-0.45	0.15-0.35	0.025	0.015	1.35-1.60	0.25	0.10	Cu 0.30; Al 0.050; O 0.0015
JIS G 4805:1999	SUJ 2	---	---	0.95-1.10	0.50	0.15-0.35	0.025	0.025	1.30-1.60	0.25	0.08	Cu 0.25
EN ISO 683-17:1999	B1 100Cr6	---	---	0.93-1.05	0.25-0.45	0.15-0.35	0.025	0.015	1.35-1.60	---	0.10	Cu 0.30; Al 0.050; O 0.0015
ASTM A 485-00	1	---	K19667	0.90-1.05	0.90-1.20	0.45-0.75	0.025	0.015	0.90-1.20	0.25	0.10	Cu 0.35; Al 0.050; O 0.0015; Ti 0.0050
	B2, 100CrMnSi4-4	---	---	0.93-1.05	0.90-1.20	0.45-0.75	0.025	0.015	0.90-1.20	---	0.10	Cu 0.30; Al 0.050; O 0.0015
JIS G 4805:1999	SUJ 3	---	---	0.95-1.10	0.90-1.15	0.40-0.70	0.025	0.025	0.90-1.20	0.25	0.08	Cu 0.25
EN ISO 683-17:1999	B2, 100CrMnSi4-4	---	---	0.93-1.05	0.90-1.20	0.45-0.75	0.025	0.015	0.90-1.20	---	0.10	Cu 0.30; Al 0.050; O 0.0015
ASTM A 485-00	B3, 100CrMnSi6-4	---	---	0.93-1.05	1.00-1.20	0.45-0.75	0.025	0.015	1.40-1.65	---	0.10	Cu 0.30; Al 0.050; O 0.0015
EN ISO 683-17:1999	B3, 100CrMnSi6-4	---	---	0.93-1.05	1.00-1.20	0.45-0.75	0.025	0.015	1.40-1.65	---	0.10	Cu 0.30; Al 0.050; O 0.0015
ASTM A 485-00	B4, 100CrMnSi6-6	---	---	0.93-1.05	1.40-1.70	0.45-0.75	0.025	0.015	1.40-1.65	---	0.10	Cu 0.30; Al 0.050; O 0.0015
EN ISO 683-17:1999	B4, 100CrMnSi6-6	---	---	0.93-1.05	1.40-1.70	0.45-0.75	0.025	0.015	1.40-1.65	---	0.10	Cu 0.30; Al 0.050; O 0.0015
ASTM A 485-00	B5, 100CrMo7	---	---	0.93-1.05	0.25-0.45	0.15-0.35	0.025	0.015	1.65-1.95	---	0.15-0.30	Cu 0.30; Al 0.050; O 0.0015
EN ISO 683-17:1999	B5, 100CrMo7	---	---	0.93-1.05	0.25-0.45	0.15-0.35	0.025	0.015	1.65-1.95	---	0.15-0.30	Cu 0.30; Al 0.050; O 0.0015
ASTM A 485-00	B6, 100CrMo7-3	---	---	0.93-1.05	0.60-0.80	0.15-0.35	0.025	0.015	1.65-1.95	---	0.20-0.35	Cu 0.30; Al 0.050; O 0.0015
EN ISO 683-17:1999	B6, 100CrMo7-3	---	---	0.93-1.05	0.60-0.80	0.15-0.35	0.025	0.015	1.65-1.95	---	0.20-0.35	Cu 0.30; Al 0.050; O 0.0015
ASTM A 485-00	B7, 100CrMo7-4	---	---	0.93-1.05	0.60-0.80	0.15-0.35	0.025	0.015	1.65-1.95	---	0.40-0.50	Cu 0.30; Al 0.050; O 0.0015
EN ISO 683-17:1999	B7, 100CrMo7-4	---	---	0.93-1.05	0.60-0.80	0.15-0.35	0.025	0.015	1.65-1.95	---	0.40-0.50	Cu 0.30; Al 0.050; O 0.0015
ASTM A 485-00	B8, 100CrMnMoSi8-4-6	---	---	0.93-1.05	0.80-1.10	0.40-0.60	0.025	0.015	1.80-2.05	---	0.50-0.60	Cu 0.30; Al 0.050; O 0.0015
EN ISO 683-17:1999	B8, 100CrMnMoSi8-4-6	---	---	0.93-1.05	0.80-1.10	0.40-0.60	0.025	0.015	1.80-2.05	---	0.50-0.60	Cu 0.30; Al 0.050; O 0.0015

9.5 Non-Comparable Free-Machining Steels

ASTM A 29/A 29M-99 - General Requirements for Steel Bars, Carbon and Alloy, Hot-Wrought and Cold-Finished												
Grade	1108	1116	1118	1119	1132	1139	1140	1145	1211	---	---	---
UNS Number	G11080	G11160	G11180	G11190	G11320	G11390	G11400	G11450	G12110	---	---	---
ASTM A 576-90 (2000) - Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality												
Grade	1116	1118	1119	1132	1139	1140	1145	1151	1211	---	---	---
UNS Number	G11160	G11180	G11190	G11320	G11390	G11400	G11450	G11510	G12110	---	---	---
ASTM A 895-89(2000) - Free-Machining Stainless Steel Plate, Sheet, and Strip												
Grade	---	---	---	---	---	---	---	---	---	---	---	---
UNS Number	S30323	S41623	S42020	S42023	S43020	S43023	---	---	---	---	---	---
SAE J403-2000 - Chemical Compositions of SAE Carbon Steels												
SAE Number	1118	1126	1132	1138	1140	1151	---	---	---	---	---	---
UNS Number	G11180	G11260	G11320	G11380	G11400	G11510	---	---	---	---	---	---
JIS G 4804:1999 - Free Cutting Carbon Steels												
Symbol of Grade	SUM 32	---	---	---	---	---	---	---	---	---	---	---
EN 10087:1999 - Free Cutting Steels - Technical Delivery Conditions for Semi-Finished Products, Hot-Rolled Bars and Rods												
Steel Name	35S20	35SPb20	---	---	---	---	---	---	---	---	---	---
Steel Number	1.0726	1.0756	---	---	---	---	---	---	---	---	---	---
EN 10277-3:1999 - Bright Steel Products - Technical Delivery Conditions - Part 3: Free-Cutting Steels												
Steel Name	35S20	35SPb20	---	---	---	---	---	---	---	---	---	---
Steel Number	1.0726	1.0756	---	---	---	---	---	---	---	---	---	---
ISO 683-9:1988 - Heat-Treatable Steels, Alloy Steels and Free-Cutting Steels - Part 9: Wrought Free-Cutting Steels												
Steel Type	17 SMn 20	35 S 20	35 SMn 20	---	---	---	---	---	---	---	---	---

9.6 Non-Comparable Spring Steels

ASTM A 682/A 682M-00 - General Requirements For Steel, Strip, High-Carbon, Cold-Rolled												
Grade	1030	1035	1040	1045	1080	---	---	---	---	---	---	---
UNS Number	G10300	G10350	G10400	G10450	G1080	---	---	---	---	---	---	---
JIS G 4802:1999 - Cold-Rolled Steel Strip for Springs												
Grade Designation	SUP10 CSP	---	---	---	---	---	---	---	---	---	---	---
JIS G 4313:1996 - Cold Rolled Stainless Steel Strip for Springs												
Grade Designation	SUS 304-CSP	SUS 632J1-CSP	---	---	---	---	---	---	---	---	---	---
BSI BS 970-2:1988 AMD 2:1992 - Wrought Steels for Mechanical and Allied Engineering Purposes Part 2: Requirements for Steels for the Manufacture of Hot Formed Springs												
Grade Designation	251A58	251A60	525A58	525A60	525A61	704A60	735A54	925A60	251H60	525H60	704H60	805H60
BSI BS 5770-4:1981 - Steel Strip Intended for the Manufacture of Springs Part 4: Martensitic and Austenitic Stainless Steel												
Grade Designation	302S25	316S16	420S29	---	---	---	---	---	---	---	---	---
DIN 17221-1988 - Hot Rolled Steels for Springs Suitable for Quenching and Tempering; Technical Delivery Conditions												
Material Designation	38 Si 7	60 SiCr 7	51 CrMo 4	---	---	---	---	---	---	---	---	---
Material Number	1.5023	1.7108	1.7701	---	---	---	---	---	---	---	---	---
DIN 17224:1982 - Stainless Steel Wire and Strip for Springs; Technical Delivery Conditions												
Material Designation	X 5 CrNiMo 18 10	---	---	---	---	---	---	---	---	---	---	---
Material Number	1.4401	---	---	---	---	---	---	---	---	---	---	---
EN 10132-4: 2000 - Cold Rolled Narrow Steel Strip for Heat Treatment - Technical Delivery Conditions - Part 4: Spring Steels and Other Applications												
Material Designation	C125S	48Si7	56Si7	51CrV4	80CrV2	75Ni8	125Cr2	102Cr6	---	---	---	---
Material Number	1.1224	1.5021	1.5026	1.8159	1.2235	1.5634	1.2002	1.2067	---	---	---	---

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	---	---	---	---	---	---	---	---	---	---	---

9.8 Non-Comparable Bearing Steels

ASTM A 295-98 - High-Carbon Anti-Friction Bearing Steel												
Grade	5195	1070M	5160	---	---	---	---	---	---	---	---	---
UNS Number	G51950	---	G51600	K19526	---	---	---	---	---	---	---	---
ASTM A 485-00 - High Hardenability Antifriction Bearing Steel												
Number	2	3	4	---	---	---	---	---	---	---	---	---
Name	Grade 2	Grade 3	Grade 4	---	---	---	---	---	---	---	---	---
UNS Number	K19195	K19965	K19990	---	---	---	---	---	---	---	---	---
JIS G 4805:1999 - High Carbon Chromium Bearing Steels												
Grade	SUJ 1	SUJ 4	SUJ 5	---	---	---	---	---	---	---	---	---
EN ISO 683-17:1999 - Heat-Treated Steels, Alloy Steels and Free-Cutting Steels - Part 17: Ball and Roller Bearing Steels												
Number	B20	B21	B22	B23	B24	B25	B26	B27	B28	B29	B30	B31
Name	20Cr3	20Cr4	20MnCr4-2	17MnCr5	19MnCr5	15CrMo4	20CrMo4	20MnCrMo4-2	20NiCrMo2	20NiCrMo7	18CrNiMo7-6	18NiCrMo14-6
Number	B32	B40	B41	B42	B43	B50	B51	B52	B53		B60	
Name	16NiCrMo16-5	C56E2	56Mn4	70Mn4	43CrMo4	X47Cr14	X65Cr14	X106CrMo17	X89CrMoV18-1		80MoCrV42-16	
Number	B61		B62		B63		---	---	---	---	---	---
Name	13MoCrNi42-16-14		X82WMoCrV6-5-4		X75WCrV18-4-1		---	---	---	---	---	---

Appendix

1

ASTM FERROUS METAL STANDARDS

Designation	Title
ASTM A 1-00	Standard Specification for Carbon Steel Tee Rails
ASTM A 2-90 (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 Ferrovandium
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

Designation	Title
ASTM A 185-97	Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 192/A 192M-91 (1996)e1	Standard Specification for Seamless Carbon Steel Boiler Tubes for High-Pressure Service
ASTM A 193/A 193M-00b	Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 194/A 194M-00b	Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both
ASTM A 197/A 197M-00	Standard Specification for Cupola Malleable Iron
ASTM A 202/A 202M-93 (1999)	Standard Specification for Pressure Vessel Plates, Alloy Steel, Chromium-Manganese-Silicon
ASTM A 203/A 203M-97	Standard Specification for Pressure Vessel Plates, Alloy Steel, Nickel
ASTM A 204/A 204M-93 (1999)	Standard Specification for Pressure Vessel Plates, Alloy Steel, Molybdenum
ASTM A 209/A 209M-98	Standard Specification for Seamless Carbon-Molybdenum Alloy-Steel Boiler and Superheater Tubes
ASTM A 210/A 210M-96	Standard Specification for Seamless Medium-Carbon Steel Boiler and Superheater Tubes
ASTM A 213/A 213M-99ae1	Standard Specification for Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater, and Heat-Exchanger Tubes
ASTM A 214/A 214M-96	Standard Specification for Electric-Resistance-Welded Carbon Steel Heat-Exchanger and Condenser Tubes
ASTM A 216/A 216M-93 (1998)	Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service
ASTM A 217/A 217M-99	Standard Specification for Steel Castings, Martensitic Stainless and Alloy, for Pressure-Containing Parts, Suitable for High-Temperature Service
ASTM A 220/A 220M-99	Standard Specification for Pearlitic Malleable Iron
ASTM A 225/A 225M-93 (1999)	Standard Specification for Pressure Vessel Plates, Alloy Steel, Manganese-Vanadium-Nickel
ASTM A 227/A 227M-99	Standard Specification for Steel Wire, Cold-Drawn for Mechanical Springs
ASTM A 228/A 228M-00	Standard Specification for Steel Wire, Music Spring Quality
ASTM A 229/A 229M-99	Standard Specification for Steel Wire, Oil-Tempered for Mechanical Springs
ASTM A 230/A 230M-99	Standard Specification for Steel Wire, Oil-Tempered Carbon Valve Spring Quality
ASTM A 231/A 231M-96	Standard Specification for Chromium-Vanadium Alloy Steel Spring Wire
ASTM A 232/A 232M-99	Standard Specification for Chromium-Vanadium Alloy Steel Valve Spring Quality Wire
ASTM A 234/A 234M-00a	Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
ASTM A 239-95 (1999)	Standard Practice for Locating the Thinnest Spot in a Zinc (Galvanized) Coating on Iron or Steel Articles
ASTM A 240/A 240M-01	Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels
ASTM A 242/A 242M-00a	Standard Specification for High-Strength Low-Alloy Structural Steel
ASTM A 247-67 (1998)	Standard Test Method for Evaluating the Microstructure of Graphite in Iron Castings
ASTM A 249/A 249M-98e1	Standard Specification for Welded Austenitic Steel Boiler, Superheater, Heat-Exchanger, and Condenser Tubes
ASTM A 250/A 250M-95	Standard Specification for Electric-Resistance-Welded Ferritic Alloy-Steel Boiler and Superheater Tubes
ASTM A 252-98e1	Standard Specification for Welded and Seamless Steel Pipe Piles
ASTM A 254-97	Standard Specification for Copper-Brazed Steel Tubing
ASTM A 255-99	Standard Test Method for Determining Hardenability of Steel
ASTM A 262-98	Standard Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels
ASTM A 263-94a (1999)	Standard Specification for Corrosion-Resisting Chromium Steel-Clad Plate, Sheet, and Strip
ASTM A 264-94a (1999)	Standard Specification for Stainless Chromium-Nickel Steel-Clad Plate, Sheet, and Strip
ASTM A 265-94a (1999)	Standard Specification for Nickel and Nickel-Base Alloy-Clad Steel Plate
ASTM A 266/A 266M-99	Standard Specification for Carbon Steel Forgings for Pressure Vessel Components
ASTM A 268/A 268M-00a	Standard Specification for Seamless and Welded Ferritic and Martensitic Stainless Steel Tubing for General Service
ASTM A 269-00	Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
ASTM A 270-98ae3	Standard Specification for Seamless and Welded Austenitic Stainless Steel Sanitary Tubing
ASTM A 275/A 275M-98	Standard Test Method for Magnetic Particle Examination of Steel Forgings
ASTM A 276-00a	Standard Specification for Stainless Steel Bars and Shapes
ASTM A 278M-93e1	Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 350°C
ASTM A 278-93	Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 650°F
ASTM A 283/A 283M-00	Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A 285/A 285M-90 (2001)	Standard Specification for Pressure Vessel Plates, Carbon Steel, Low- and Intermediate-Tensile Strength
ASTM A 288-91 (1998)	Standard Specification for Carbon and Alloy Steel Forgings for Magnetic Retaining Rings for Turbine Generators

Designation	Title
ASTM A 289/A 289M-97	Standard Specification for Alloy Steel Forgings for Nonmagnetic Retaining Rings for Generators
ASTM A 290-95 (1999)	Standard Specification for Carbon and Alloy Steel Forgings for Rings for Reduction Gears
ASTM A 291-95 (1999)	Standard Specification for Steel Forgings, Carbon and Alloy, for Pinions, Gears and Shafts for Reduction Gears
ASTM A 295-98	Standard Specification for High-Carbon Anti-Friction Bearing Steel
ASTM A 297/A 297M-97 (1998)	Standard Specification for Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat Resistant, for General Application
ASTM A 299/A 299M-97e1	Standard Specification for Pressure Vessel Plates, Carbon Steel, Manganese-Silicon
ASTM A 302/A 302M-97e1	Standard Specification for Pressure Vessel Plates, Alloy Steel, Manganese-Molybdenum and Manganese-Molybdenum-Nickel
ASTM A 304-96	Standard Specification for Carbon and Alloy Steel Bars Subject to End-Quench Hardenability Requirements
ASTM A 307-00	Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 308-99	Standard Specification for Steel Sheet, Terne (Lead-Tin Alloy) Coated by the Hot-Dip Process
ASTM A 309-94a (1999)	Standard Test Method for Weight and Composition of Coating on Terne Sheet by the Triple-Spot Test
ASTM A 311/A 311M-95 (2000)	Standard Specification for Cold-Drawn, Stress-Relieved Carbon Steel Bars Subject to Mechanical Property Requirements
ASTM A 312/A 312M-00c	Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipes
ASTM A 313/A 313M-98	Standard Specification for Stainless Steel Spring Wire
ASTM A 314-97	Standard Specification for Stainless Steel Billets and Bars for Forging
ASTM A 319-71 (1995)	Standard Specification for Gray Iron Castings for Elevated Temperatures for Non-Pressure Containing Parts
ASTM A 320/A 320M-00b	Standard Specification for Alloy/Steel Bolting Materials for Low-Temperature Service
ASTM A 321-90 (1995)e1	Standard Specification for Steel Bars, Carbon, Quenched and Tempered
ASTM A 322-91 (1996)	Standard Specification for Steel Bars, Alloy, Standard Grades
ASTM A 323-93 (2000)	Standard Specification for Ferroboration
ASTM A 324-73 (2000)	Standard Specification for Ferrotitanium
ASTM A 325M-00	Standard Specification for High-Strength Bolts for Structural Steel Joints [Metric]
ASTM A 325-00	Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 327M-91 (1997)	Standard Test Methods for Impact Testing of Cast Irons (Metric)
ASTM A 327-91 (1997)	Standard Test Methods for Impact Testing of Cast Irons
ASTM A 328/A 328M-00	Standard Specification for Steel Sheet Piling
ASTM A 331-95 (2000)	Standard Specification for Steel Bars, Alloy, Cold-Finished
ASTM A 333/A 333M-99	Standard Specification for Seamless and Welded Steel Pipe for Low-Temperature Service
ASTM A 334/A 334M-99	Standard Specification for Seamless and Welded Carbon and Alloy-Steel Tubes for Low-Temperature Service
ASTM A 335/A 335M-00	Standard Specification for Seamless Ferritic Alloy-Steel Pipe for High-Temperature Service
ASTM A 336/A 336M-99e1	Standard Specification for Alloy Steel Forgings for Pressure and High-Temperature Parts
ASTM A 338-84 (1998)	Standard Specification for Malleable Iron Flanges, Pipe Fittings, and Valve Parts for Railroad, Marine, and Other Heavy Duty Service at Temperatures Up to 650°F (345°C)
ASTM A 340-99a	Standard Terminology of Symbols and Definitions Relating to Magnetic Testing
ASTM A 341/A 341M-00	Standard Test Method for Direct Current Magnetic Properties of Materials Using D-C Permeameters and the Ballistic Test Methods
ASTM A 342/A 342M-99	Standard Test Methods for Permeability of Feebly Magnetic Materials
ASTM A 343-97	Standard Test Method for Alternating-Current Magnetic Properties of Materials at Power Frequencies Using Wattmeter-Ammeter-Voltmeter Method and 25-cm Epstein Test Frame
ASTM A 345-98	Standard Specification for Flat-Rolled Electrical Steels for Magnetic Applications
ASTM A 348/A 348M-00	Standard Test Method for Alternating Current Magnetic Properties of Materials Using the Wattmeter-Ammeter-Voltmeter Method, 100 to 10 000 Hz and 25-cm Epstein Frame
ASTM A 350/A 350M-00c	Standard Specification for Carbon and Low-Alloy Steel Forgings, Requiring Notch Toughness Testing for Piping Components
ASTM A 351/A 351M-00	Standard Specification for Castings, Austenitic, Austenitic-Ferritic (Duplex), for Pressure-Containing Parts
ASTM A 352/A 352M-93 (1998)	Standard Specification for Steel Castings, Ferritic and Martensitic, for Pressure-Containing Parts, Suitable for Low-Temperature Service
ASTM A 353/A 353M-93 (1999)	Standard Specification for Pressure Vessel Plates, Alloy Steel, 9 Percent Nickel, Double-Normalized and Tempered
ASTM A 354-00a	Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners
ASTM A 355-89 (2000)	Standard Specification for Steel Bars, Alloys, for Nitriding
ASTM A 356/A 356M-98e1	Standard Specification for Steel Castings, Carbon, Low Alloy, and Stainless Steel, Heavy-Walled for Steam Turbines
ASTM A 358/A 358M-00	Standard Specification for Electric-Fusion-Welded Austenitic Chromium-Nickel Alloy Steel Pipe for High-Temperature Service

Designation	Title
ASTM A 363-98	Standard Specification for Zinc-Coated (Galvanized) Steel Overhead Ground Wire Strand
ASTM A 367-60 (1999)	Standard Test Methods of Chill Testing of Cast Iron
ASTM A 368-95a (2000)	Standard Specification for Stainless Steel Wire Strand
ASTM A 369/A 369M-00	Standard Specification for Carbon and Ferritic Alloy Steel Forged and Bored Pipe for High-Temperature Service
ASTM A 370-97a	Standard Test Methods and Definitions for Mechanical Testing of Steel Products
ASTM A 372/A 372M-99	Standard Specification for Carbon and Alloy Steel Forgings for Thin-Walled Pressure Vessels
ASTM A 376/A 376M-00a	Standard Specification for Seamless Austenitic Steel Pipe for High-Temperature Central-Station Service
ASTM A 377-99	Standard Index of Specifications for Ductile-Iron Pressure Pipe
ASTM A 380-99e1	Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems
ASTM A 381-96	Standard Specification for Metal-Arc-Welded Steel Pipe for Use With High-Pressure Transmission Systems
ASTM A 384-76 (1996)	Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies
ASTM A 385-00	Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip)
ASTM A 387/A 387M-99	Standard Specification for Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum
ASTM A 388/A 388M-95 (2001)e1	Standard Practice for Ultrasonic Examination of Heavy Steel Forgings
ASTM A 389/A 389M-93 (1998)	Standard Specification for Steel Castings, Alloy, Specially Heat-Treated, for Pressure-Containing Parts, Suitable for High-Temperature Service
ASTM A 390-95	Standard Specification for Zinc-Coated (Galvanized) Steel Poultry Fence Fabric (Hexagonal and Straight Line)
ASTM A 391/A 391M-98	Standard Specification for Grade 80 Alloy Steel Chain
ASTM A 392-96	Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric
ASTM A 394-00	Standard Specification for Steel Transmission Tower Bolts, Zinc-Coated and Bare
ASTM A 395/A 395M-99	Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures
ASTM A 400-69 (2000)	Standard Practice for Steel Bars, Selection Guide, Composition, and Mechanical Properties
ASTM A 401/A 401M-98	Standard Specification for Steel Wire, Chromium-Silicon Alloy
ASTM A 403/A 403M-00b	Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings
ASTM A 407-93 (1998)	Standard Specification for Steel Wire, Cold-Drawn, for Coiled-Type Springs
ASTM A 409/A 409M-95ae1	Standard Specification for Welded Large Diameter Austenitic Steel Pipe for Corrosive or High-Temperature Service
ASTM A 411-98	Standard Specification for Zinc-Coated (Galvanized) Low-Carbon Steel Armor Wire
ASTM A 413/A 413M-00	Standard Specification for Carbon Steel Chain
ASTM A 414/A 414M-00	Standard Specification for Steel, Sheet, Carbon, for Pressure Vessels
ASTM A 416/A 416M-99	Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete
ASTM A 417-93 (1998)	Standard Specification for Steel Wire, Cold-Drawn, for Zig-Zag, Square-Formed, and Sinuous-Type Upholstery Spring Units
ASTM A 418-99	Standard Test Method for Ultrasonic Examination of Turbine and Generator Steel Rotor Forgings
ASTM A 420/A 420M-00b	Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Low-Temperature Service
ASTM A 421/A 421M-98a	Standard Specification for Uncoated Stress-Relieved Steel Wire for Prestressed Concrete
ASTM A 423/A 423M-95 (2000)	Standard Specification for Seamless and Electric-Welded Low-Alloy Steel Tubes
ASTM A 424-00	Standard Specification for Steel, Sheet, for Porcelain Enameling
ASTM A 426-92 (1997)	Standard Specification for Centrifugally Cast Ferritic Alloy Steel Pipe for High-Temperature Service
ASTM A 427-74 (1996)e1	Standard Specification for Wrought Alloy Steel Rolls for Cold and Hot Reduction
ASTM A 428/A 428M-95	Standard Test Method for Weight [Mass] of Coating on Aluminum-Coated Iron or Steel Articles
ASTM A 434-90a (2000)	Standard Specification for Steel Bars, Alloy, Hot-Wrought or Cold-Finished, Quenched and Tempered
ASTM A 435/A 435M-90 (1996)	Standard Specification for Straight-Beam Ultrasonic Examination of Steel Plates
ASTM A 436-84 (1997)e1	Standard Specification for Austenitic Gray Iron Castings
ASTM A 437/A 437M-01	Standard Specification for Alloy-Steel Turbine-Type Bolting Material Specially Heat Treated for High-Temperature Service
ASTM A 438-80 (1997)	Standard Test Method for Transverse Testing of Gray Cast Iron
ASTM A 439-83 (1999)	Standard Specification for Austenitic Ductile Iron Castings
ASTM A 447/A 447M-93 (1998)	Standard Specification for Steel Castings, Chromium-Nickel-Iron Alloy (25-12 Class), for High-Temperature Service
ASTM A 449-00	Standard Specification for Quenched and Tempered Steel Bolts and Studs
ASTM A 450/A 450M-96a	Standard Specification for General Requirements for Carbon, Ferritic Alloy, and Austenitic Alloy Steel Tubes
ASTM A 451-93 (1997)	Standard Specification for Centrifugally Cast Austenitic Steel Pipe for High-Temperature Service
ASTM A 453/A 453M-00	Standard Specification for High-Temperature Bolting Materials, with Expansion Coefficients Comparable to Austenitic Stainless Steels

Designation	Title
ASTM A 455/A 455M-90 (1996)e1	Standard Specification for Pressure Vessel Plates, Carbon Steel, High-Strength Manganese
ASTM A 456/A 456M-99	Standard Specification for Magnetic Particle Examination of Large Crankshaft Forgings
ASTM A 459-97	Standard Specification for Zinc-Coated Flat Steel Armoring Tape
ASTM A 460-94 (1999)	Standard Specification for Copper-Clad Steel Wire Strand
ASTM A 463/A 463M-00	Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process
ASTM A 466/A 466M-98	Standard Specification for Weldless Chain
ASTM A 467/A 467M-98	Standard Specification for Machine and Coil Chain
ASTM A 469-94a (1999)	Standard Specification for Vacuum-Treated Steel Forgings for Generator Rotors
ASTM A 470-01	Standard Specification for Vacuum-Treated Carbon and Alloy Steel Forgings For Turbine Rotors and Shafts
ASTM A 471-94 (1999)	Standard Specification for Vacuum-Treated Alloy Steel Forgings for Turbine Rotor Disks and Wheels
ASTM A 472-98	Standard Test Method for Heat Stability of Steam Turbine Shafts and Rotor Forgings
ASTM A 473-01	Standard Specification for Stainless Steel Forgings
ASTM A 474-98	Standard Specification for Aluminum-Coated Steel Wire Strand
ASTM A 475-98	Standard Specification for Zinc-Coated Steel Wire Strand
ASTM A 476/A 476M-00	Standard Specification for Ductile Iron Castings for Paper Mill Dryer Rolls
ASTM A 478-97	Standard Specification for Chromium-Nickel Stainless Steel Weaving and Knitting Wire
ASTM A 479/A 479M-00	Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels
ASTM A 480/A 480M-00	Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
ASTM A 481-94 (2000)	Standard Specification for Chromium Metal
ASTM A 482-93 (2000)	Standard Specification for Ferrochrome-Silicon
ASTM A 483-64 (2000)	Standard Specification for Silicomanganese
ASTM A 484/A 484M-00	Standard Specification for General Requirements for Stainless Steel Bars, Billets, and Forgings
ASTM A 485-00	Standard Specification for High Hardenability Antifriction Bearing Steel
ASTM A 487/A 487M-93 (1998)	Standard Specification for Steel Castings Suitable for Pressure Service
ASTM A 488/A 488M-99	Standard Practice for Steel Castings, Welding, Qualifications of Procedures and Personnel
ASTM A 489-00	Standard Specification for Carbon Steel Lifting Eyes
ASTM A 490M-00	Standard Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints [Metric]
ASTM A 490-00	Standard Specification for Heat-Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength
ASTM A 491-96	Standard Specification for Aluminum-Coated Steel Chain-Link Fence Fabric
ASTM A 492-95 (2000)	Standard Specification for Stainless Steel Rope Wire
ASTM A 493-95 (2000)	Standard Specification for Stainless Steel Wire and Wire Rods for Cold Heading and Cold Forging
ASTM A 494/A 494M-00	Standard Specification for Castings, Nickel and Nickel Alloy
ASTM A 495-94 (2000)	Standard Specification for Calcium-Silicon Alloys
ASTM A 496-97a	Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement
ASTM A 497-99	Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement
ASTM A 498-98	Standard Specification for Seamless and Welded Carbon, Ferritic, and Austenitic Alloy Steel Heat-Exchanger Tubes with Integral Fins
ASTM A 499-89 (1997)e1	Standard Specification for Steel Bars and Shapes, Carbon Rolled from "T" Rails
ASTM A 500-01	Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 501-01	Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A 503/A 503M-01	Standard Specification for Ultrasonic Examination of Large Forged Crankshafts
ASTM A 504-93 (1999)	Standard Specification for Wrought Carbon Steel Wheels
ASTM A 505-00	Standard Specification for Steel, Sheet and Strip, Alloy, Hot-Rolled and Cold-Rolled, General Requirements for
ASTM A 506-00	Standard Specification for Alloy and Structural Alloy Steel, Sheet and Strip, Hot-Rolled and Cold-Rolled
ASTM A 507-00	Standard Specification for Drawing Alloy Steel, Sheet and Strip, Hot-Rolled and Cold-Rolled
ASTM A 508/A 508M-95 (1999)	Standard Specification for Quenched and Tempered Vacuum-Treated Carbon and Alloy Steel Forgings for Pressure Vessels
ASTM A 510M-00	Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel [Metric]
ASTM A 510-00	Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel
ASTM A 511-96	Standard Specification for Seamless Stainless Steel Mechanical Tubing
ASTM A 512-96	Standard Specification for Cold-Drawn Buttweld Carbon Steel Mechanical Tubing
ASTM A 513-00	Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing
ASTM A 514/A 514M-00a	Standard Specification for High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding
ASTM A 515/A 515M-92 (1997)	Standard Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service

Designation	Title
ASTM A 516/A 516M-90 (2001)	Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ASTM A 517/A 517M-93 (1999)	Standard Specification for Pressure Vessel Plates, Alloy Steel, High-Strength, Quenched and Tempered
ASTM A 518/A 518M-99	Standard Specification for Corrosion-Resistant High-Silicon Iron Castings
ASTM A 519-96	Standard Specification for Seamless Carbon and Alloy Steel Mechanical Tubing
ASTM A 521-96	Standard Specification for Steel, Closed-Impression Die Forgings for General Industrial Use
ASTM A 522/A 522M-95b	Standard Specification for Forged or Rolled 8 and 9% Nickel Alloy Steel Flanges, Fittings, Valves, and Parts for Low-Temperature Service
ASTM A 523-96	Standard Specification for Plain End Seamless and Electric-Resistance-Welded Steel Pipe for High-Pressure Pipe-Type Cable Circuits
ASTM A 524-96	Standard Specification for Seamless Carbon Steel Pipe for Atmospheric and Lower Temperatures
ASTM A 529/A 529M-00	Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality
ASTM A 530/A 530M-99e1	Standard Specification for General Requirements for Specialized Carbon and Alloy Steel Pipe
ASTM A 531/A 531M-91 (1996)	Standard Practice for Ultrasonic Examination of Turbine-Generator Steel Retaining Rings
ASTM A 532/A 532M-93a (1999)e1	Standard Specification for Abrasion-Resistant Cast Irons
ASTM A 533/A 533M-93 (1999)	Standard Specification for Pressure Vessel Plates, Alloy Steel, Quenched and Tempered, Manganese-Molybdenum and Manganese-Molybdenum-Nickel
ASTM A 534-94	Standard Specification for Carburizing Steels for Anti-Friction Bearings
ASTM A 536-84 (1999)e1	Standard Specification for Ductile Iron Castings
ASTM A 537/A 537M-95 (2000)	Standard Specification for Pressure Vessel Plates, Heat-Treated, Carbon-Manganese-Silicon Steel
ASTM A 539-99	Standard Specification for Electric-Resistance-Welded Coiled Steel Tubing for Gas and Fuel Oil Lines
ASTM A 540/A 540M-00	Standard Specification for Alloy-Steel Bolting Materials for Special Applications
ASTM A 541/A 541M-95 (1999)	Standard Specification for Quenched and Tempered Carbon and Alloy Steel Forgings for Pressure Vessel Components
ASTM A 542/A 542M-99	Standard Specification for Pressure Vessel Plates, Alloy Steel, Quenched-and-Tempered, Chromium-Molybdenum, and Chromium-Molybdenum-Vanadium
ASTM A 543/A 543M-93 (1999)	Standard Specification for Pressure Vessel Plates, Alloy Steel, Quenched and Tempered Nickel-Chromium-Molybdenum
ASTM A 550-78 (2000)	Standard Specification for Ferrocolumbium
ASTM A 551-94 (1999)	Standard Specification for Steel Tires
ASTM A 553/A 553M-95 (2000)	Standard Specification for Pressure Vessel Plates, Alloy Steel, Quenched and Tempered 8 and 9 Percent Nickel
ASTM A 554-98e1	Standard Specification for Welded Stainless Steel Mechanical Tubing
ASTM A 555/A 555M-97	Standard Specification for General Requirements for Stainless Steel Wire and Wire Rods
ASTM A 556/A 556M-96	Standard Specification for Seamless Cold-Drawn Carbon Steel Feedwater Heater Tubes
ASTM A 560/A 560M-93 (1998)	Standard Specification for Castings, Chromium-Nickel Alloy
ASTM A 561-71 (1999)	Standard Recommended Practice for Macrotech Testing of Tool Steel Bars
ASTM A 562/A 562M-90 (1996)e1	Standard Specification for Pressure Vessel Plates, Carbon Steel, Manganese-Titanium for Glass or Diffused Metallic Coatings
ASTM A 563M-00	Standard Specification for Carbon and Alloy Steel Nuts [Metric]
ASTM A 563-00	Standard Specification for Carbon and Alloy Steel Nuts
ASTM A 564/A 564M-99	Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes
ASTM A 565-97	Standard Specification for Martensitic Stainless Steel Bars, Forgings, and Forging Stock for High-Temperature Service
ASTM A 568/A 568M-00b	Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for
ASTM A 571M-84 (1997)	Standard Specification for Austenitic Ductile Iron Castings for Pressure-Containing Parts Suitable for Low-Temperature Service [Metric]
ASTM A 571-84 (1997)	Standard Specification for Austenitic Ductile Iron Castings for Pressure-Containing Parts Suitable for Low-Temperature Service
ASTM A 572/A 572M-00a	Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A 573/A 573M-00a	Standard Specification for Structural Carbon Steel Plates of Improved Toughness
ASTM A 574M-00	Standard Specification for Alloy Steel Socket-Head Cap Screws [Metric]
ASTM A 574-00	Standard Specification for Alloy Steel Socket-Head Cap Screws
ASTM A 575-96	Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades
ASTM A 576-90b (2000)	Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality
ASTM A 577/A 577M-90 (1996)	Standard Specification for Ultrasonic Angle-Beam Examination of Steel Plates
ASTM A 578/A 578M-96	Standard Specification for Straight-Beam Ultrasonic Examination of Plain and Clad Steel Plates for Special Applications
ASTM A 579-99	Standard Specification for Superstrength Alloy Steel Forgings
ASTM A 580/A 580M-98	Standard Specification for Stainless Steel Wire

Designation	Title
ASTM A 581/A 581M-95b (2000)	Standard Specification for Free-Machining Stainless Steel Wire and Wire Rods
ASTM A 582/A 582M-95b (2000)	Standard Specification for Free-Machining Stainless Steel Bars
ASTM A 583-93 (1999)	Standard Specification for Cast Steel Wheels for Railway Service
ASTM A 584-97	Standard Specification for Aluminum-Coated Steel Woven Wire Fence Fabric
ASTM A 585-97	Standard Specification for Aluminum-Coated Steel Barbed Wire
ASTM A 586-98	Standard Specification for Zinc-Coated Parallel and Helical Steel Wire Structural Strand and Zinc-Coated Wire for Spun-In-Place Structural Strand
ASTM A 587-96	Standard Specification for Electric-Resistance-Welded Low-Carbon Steel Pipe for the Chemical Industry
ASTM A 588/A 588M-00a	Standard Specification for High-Strength Low-Alloy Structural Steel with 50 ksi [345 MPa] Minimum Yield Point to 4-in. [100 mm] Thick
ASTM A 589-96	Standard Specification for Seamless and Welded Carbon Steel Water-Well Pipe
ASTM A 591/A 591M-98	Standard Specification for Steel Sheet, Electrolytic Zinc-Coated, for Light Coating Weight [Mass] Applications
ASTM A 592/A 592M-89 (1999)	Standard Specification for High-Strength Quenched and Tempered Low-Alloy Steel Forged Fittings and Parts for Pressure Vessels
ASTM A 595-98	Standard Specification for Steel Tubes, Low-Carbon, Tapered for Structural Use
ASTM A 596/A 596M-95 (1999)	Standard Test Method for Direct-Current Magnetic Properties of Materials Using the Ballistic Method and Ring Specimens
ASTM A 597-87 (1999)	Standard Specification for Cast Tool Steel
ASTM A 598-92 (1997)	Standard Test Method for Magnetic Properties Of Magnetic Amplifier Cores
ASTM A 599/A 599M-99	Standard Specification for Tin Mill Products, Electrolytic Tin-Coated, Cold-Rolled Sheet
ASTM A 600-92a (1999)	Standard Specification for Tool Steel High Speed
ASTM A 601-96 (2000)	Standard Specification for Electrolytic Manganese Metal
ASTM A 602-94 (1998)	Standard Specification for Automotive Malleable Iron Castings
ASTM A 603-98	Standard Specification for Zinc-Coated Steel Structural Wire Rope
ASTM A 604-93 (1998)	Standard Test Method for Macroetch Testing of Consumable Electrode Remelted Steel Bars and Billets
ASTM A 606-98	Standard Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance
ASTM A 608-91a (1998)	Standard Specification for Centrifugally Cast Iron-Chromium-Nickel High-Alloy Tubing for Pressure Application at High Temperatures
ASTM A 609/A 609M-91 (1997)	Standard Practice for Castings, Carbon, Low-Alloy, and Martensitic Stainless Steel, Ultrasonic Examination Thereof
ASTM A 610-79 (2000)	Standard Test Methods for Sampling and Testing Ferroalloys for Determination of Size
ASTM A 612/A 612M-00	Standard Specification for Pressure Vessel Plates, Carbon Steel, High Strength, for Moderate and Lower Temperature Service
ASTM A 615/A 615M-01	Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 618-01	Standard Specification for Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing
ASTM A 623M-00	Standard Specification for Tin Mill Products, General Requirements [Metric]
ASTM A 623-00	Standard Specification for Tin Mill Products, General Requirements
ASTM A 624/A 624M-98	Standard Specification for Tin Mill Products, Electrolytic Tin Plate, Single Reduced
ASTM A 625/A 625M-98	Standard Specification for Tin Mill Products, Black Plate, Single Reduced
ASTM A 626/A 626M-98	Standard Specification for Tin Mill Products, Electrolytic Tin Plate, Double Reduced
ASTM A 627-95	Standard Specification for Homogeneous Tool-Resisting Steel Bars for Security Applications
ASTM A 629-88 (1994)e1	Standard Specification for Tool-Resisting Steel Flat Bars and Shapes for Security Applications
ASTM A 630-98	Standard Test Methods for Determination of Tin Coating Weights for Electrolytic Tin Plate
ASTM A 632-98	Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing (Small-Diameter) for General Service
ASTM A 633/A 633M-00a	Standard Specification for Normalized High-Strength Low-Alloy Structural Steel Plates
ASTM A 635/A 635M-00	Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot-Rolled
ASTM A 636-76 (2000)	Standard Specification for Nickel Oxide Sinter
ASTM A 638/A 638M-00	Standard Specification for Precipitation Hardening Iron Base Superalloy Bars, Forgings, and Forging Stock for High-Temperature Service
ASTM A 640-97	Standard Specification for Zinc-Coated Steel Strand for Messenger Support of Figure 8 Cable
ASTM A 641/A 641M-98	Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM A 644-98	Standard Terminology Relating to Iron Castings
ASTM A 645/A 645M-99a	Standard Specification for Pressure Vessel Plates, Five Percent Nickel Alloy Steel, Specially Heat Treated
ASTM A 646-95 (1999)	Standard Specification for Premium Quality Alloy Steel Blooms and Billets for Aircraft and Aerospace Forgings
ASTM A 648-95 (2000)	Standard Specification for Steel Wire, Hard Drawn for Prestressing Concrete Pipe
ASTM A 649/A 649M-99	Standard Specification for Forged Steel Rolls Used for Corrugating Paper Machinery
ASTM A 650/A 650M-98	Standard Specification for Tin Mill Products, Black Plate, Double Reduced

Designation	Title
ASTM A 653/A 653M-00	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 656/A 656M-00a	Standard Specification for Hot-Rolled Structural Steel, High-Strength Low-Alloy Plate with Improved Formability
ASTM A 657/A 657M-98a	Standard Specification for Tin Mill Products, Black Plate Electrolytic Chromium-Coated, Single and Double Reduced
ASTM A 659/A 659M-97	Standard Specification for Commercial Steel (CS), Sheet and Strip, Carbon (0.16 Maximum to 0.25 Maximum Percent), Hot-Rolled
ASTM A 660-96	Standard Specification for Centrifugally Cast Carbon Steel Pipe for High-Temperature Service
ASTM A 662/A 662M-99	Standard Specification for Pressure Vessel Plates, Carbon-Manganese-Silicon Steel, for Moderate and Lower Temperature Service
ASTM A 663/A 663M-89 (2000)	Standard Specification for Steel Bars, Carbon, Merchant Quality, Mechanical Properties
ASTM A 664-99	Standard Practice for Identification of Standard Electrical Steel Grades in ASTM Specifications
ASTM A 666-00	Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
ASTM A 667/A 667M-87 (1998)	Standard Specification for Centrifugally Cast Dual Metal (Gray and White Cast Iron) Cylinders
ASTM A 668/A 668M-96e1	Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use
ASTM A 671-96	Standard Specification for Electric-Fusion-Welded Steel Pipe for Atmospheric and Lower Temperatures
ASTM A 672-96	Standard Specification for Electric-Fusion-Welded Steel Pipe for High-Pressure Service at Moderate Temperatures
ASTM A 673/A 673M-95	Standard Specification for Sampling Procedure for Impact Testing of Structural Steel
ASTM A 674-00	Standard Practice for Polyethylene Encasement for Ductile Iron Pipe for Water or Other Liquids
ASTM A 675/A 675M-90a (2000)	Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties
ASTM A 677/A 677M-99	Standard Specification for Nonoriented Electrical Steel Fully Processed Types
ASTM A 678/A 678M-00a	Standard Specification for Quenched-and-Tempered Carbon and High-Strength Low-Alloy Structural Steel Plates
ASTM A 679/A 679M-00	Standard Specification for Steel Wire, High Tensile Strength, Cold Drawn
ASTM A 681-94 (1999)	Standard Specification for Tool Steels Alloy
ASTM A 682/A 682M-00	Standard Specification for Steel, Strip, High-Carbon, Cold-Rolled, General Requirements For
ASTM A 683/A 683M-99	Standard Specification for Nonoriented Electrical Steel, Semiprocessed Types
ASTM A 684/A 684M-86 (1998)	Standard Specification for Steel, Strip, High-Carbon, Cold-Rolled
ASTM A 686-92 (1999)	Standard Specification for Tool Steel, Carbon
ASTM A 688/A 688M-00	Standard Specification for Welded Austenitic Stainless Steel Feedwater Heater Tubes
ASTM A 689-97	Standard Specification for Carbon and Alloy Steel Bars for Springs
ASTM A 690/A 690M-00a	Standard Specification for High-Strength Low-Alloy Steel H-Piles and Sheet Piling for Use in Marine Environments
ASTM A 691-98	Standard Specification for Carbon and Alloy Steel Pipe, Electric-Fusion-Welded for High-Pressure Service at High Temperatures
ASTM A 693-93 (1999)	Standard Specification for Precipitation-Hardening Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
ASTM A 694/A 694M-00	Standard Specification for Carbon and Alloy Steel Forgings for Pipe Flanges, Fittings, Valves, and Parts for High-Pressure Transmission Service
ASTM A 695-90b (1995)e1	Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, for Fluid Power Applications
ASTM A 696-90a (2000)	Standard Specification for Steel Bars, Carbon, Hot-Wrought or Cold-Finished, Special Quality, for Pressure Piping Components
ASTM A 697-98	Standard Test Method for Alternating Current Magnetic Properties of Laminated Core Specimen Using Voltmeter-Ammeter-Wattmeter Methods
ASTM A 698/A 698M-92 (1997)e1	Standard Test Method for Magnetic Shield Efficiency in Attenuating Alternating Magnetic Fields
ASTM A 700-99e1	Standard Practices for Packaging, Marking, and Loading Methods for Steel Products for Domestic Shipment
ASTM A 701-96 (2000)	Standard Specification for Ferromanganese-Silicon
ASTM A 702-89 (2000)	Standard Specification for Steel Fence Posts and Assemblies, Hot Wrought
ASTM A 703/A 703M-99	Standard Specification for Steel Castings, General Requirements, for Pressure-Containing Parts
ASTM A 704/A 704M-96	Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement
ASTM A 705/A 705M-95 (2000)	Standard Specification for Age-Hardening Stainless Steel Forgings
ASTM A 706/A 706M-01	Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 707/A 707M-00a	Standard Specification for Forged Carbon and Alloy Steel Flanges for Low-Temperature Service
ASTM A 709/A 709M-01	Standard Specification for Carbon and High-Strength Low-Alloy Structural Steel Shapes, Plates, and Bars and Quenched-and-Tempered Alloy Structural Steel Plates for Bridges
ASTM A 710/A 710M-00	Standard Specification for Age-Hardening Low-Carbon Nickel-Copper-Chromium-Molybdenum-Columbium Alloy Structural Steel Plates
ASTM A 711-92 (1996)e1	Standard Specification for Steel Forging Stock
ASTM A 712-97	Standard Test Method for Electrical Resistivity of Soft Magnetic Alloys

Designation	Title
ASTM A 713-93 (1998)	Standard Specification for Steel Wire, High-Carbon Spring, for Heat-Treated Components
ASTM A 714-99	Standard Specification for High-Strength Low-Alloy Welded and Seamless Steel Pipe
ASTM A 716-99	Standard Specification for Ductile Iron Culvert Pipe
ASTM A 717/A 717M-95	Standard Test Method for Surface Insulation Resistivity of Single-Strip Specimens
ASTM A 719-97	Standard Test Method for Lamination Factor of Magnetic Materials
ASTM A 720-97	Standard Test Method for Ductility of Nonoriented Electrical Steel
ASTM A 721-97	Standard Test Method for Ductility of Oriented Electrical Steel
ASTM A 722/A 722M-98	Standard Specification for Uncoated High-Strength Steel Bar for Prestressing Concrete
ASTM A 723/A 723M-94 (1999)	Standard Specification for Alloy Steel Forgings for High-Strength Pressure Component Application
ASTM A 724/A 724M-99	Standard Specification for Pressure Vessel Plates, Carbon-Manganese-Silicon Steel, Quenched and Tempered, for Welded Layered Pressure Vessels
ASTM A 726-00	Standard Specification for Cold-Rolled Magnetic Lamination Quality Steel, Semiprocessed Types
ASTM A 727/A 727M-00	Standard Specification for Carbon Steel Forgings for Piping Components with Inherent Notch Toughness
ASTM A 729-93 (1999)	Standard Specification for Alloy Steel Axles, Heat-Treated, for Mass Transit and Electric Railway Service
ASTM A 730-93 (1999)	Standard Specification for Forgings, Carbon and Alloy Steel, for Railway Use
ASTM A 732/A 732M-98	Standard Specification for Castings, Investment, Carbon and Low Alloy Steel for General Application, and Cobalt Alloy for High Strength at Elevated Temperatures
ASTM A 733-99	Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM A 734/A 734M-87a (1997)	Standard Specification for Pressure Vessel Plates, Alloy Steel and High-Strength Low-Alloy Steel, Quenched-and-Tempered
ASTM A 735/A 735M-99	Standard Specification for Pressure Vessel Plates, Low-Carbon Manganese-Molybdenum-Columbium Alloy Steel, for Moderate and Lower Temperature Service
ASTM A 736/A 736M-88 (2000)	Standard Specification for Pressure Vessel Plates, Low-Carbon Age-Hardening Nickel-Copper-Chromium-Molybdenum-Columbium and Nickel-Copper-Manganese-Molybdenum-Columbium Alloy Steel
ASTM A 737/A 737M-99	Standard Specification for Pressure Vessel Plates, High-Strength, Low-Alloy Steel
ASTM A 738/A 738M-00	Standard Specification for Pressure Vessel Plates, Heat-Treated, Carbon-Manganese-Silicon Steel, for Moderate and Lower Temperature Service
ASTM A 739-90a (2000)	Standard Specification for Steel Bars, Alloy, Hot-Wrought, for Elevated Temperature or Pressure-Containing Parts, or Both
ASTM A 740-98	Standard Specification for Hardware Cloth (Woven or Welded Galvanized Steel Wire Fabric)
ASTM A 741-98	Standard Specification for Zinc-Coated Steel Wire Rope and Fittings for Highway Guardrail
ASTM A 742/A 742M-98	Standard Specification for Steel Sheet, Metallic Coated and Polymer Precoated for Corrugated Steel Pipe
ASTM A 743/A 743M-98ae1	Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application
ASTM A 744/A 744M-00	Standard Specification for Castings, Iron-Chromium-Nickel, Corrosion Resistant, for Severe Service
ASTM A 745/A 745M-94 (1999)	Standard Practice for Ultrasonic Examination of Austenitic Steel Forgings
ASTM A 746-99	Standard Specification for Ductile Iron Gravity Sewer Pipe
ASTM A 747/A 747M-99	Standard Specification for Steel Castings, Stainless, Precipitation Hardening
ASTM A 748/A 748M-87 (1998)	Standard Specification for Statically Cast Chilled White Iron-Gray Iron Dual Metal Rolls for Pressure Vessel Use
ASTM A 749/A 749M-97	Standard Specification for Steel, Strip, Carbon and High-Strength, Low-Alloy, Hot-Rolled, General Requirements for
ASTM A 750-77 (1994)e1	Standard Specification for Steel Air Ventilating Grille Units for Detention Areas
ASTM A 751-96	Standard Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products
ASTM A 752M-93 (1998)	Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Alloy Steel [Metric]
ASTM A 752-93 (1998)	Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Alloy Steel
ASTM A 753-97	Standard Specification for Wrought Nickel-Iron Soft Magnetic Alloys (UNS K94490, K94840, N14076, N14080)
ASTM A 754/A 754M-96 (2000)	Standard Test Method for Coating Weight (Mass) of Metallic Coatings on Steel by X-Ray Fluorescence
ASTM A 755/A 755M-99	Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products
ASTM A 756-94 (2001)	Standard Specification for Stainless Anti-Friction Bearing Steel
ASTM A 757/A 757M-00	Standard Specification for Steel Castings, Ferritic and Martensitic, for Pressure-Containing and Other Applications, for Low-Temperature Service
ASTM A 758/A 758M-00	Standard Specification for Wrought-Carbon Steel Butt-Welding Piping Fittings with Improved Notch Toughness
ASTM A 759-00	Standard Specification for Carbon Steel Crane Rails
ASTM A 760/A 760M-00	Standard Specification for Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains

Designation	Title
ASTM A 761/A 761M-98	Standard Specification for Corrugated Steel Structural Plate, Zinc-Coated, for Field-Bolted Pipe, Pipe-Arches, and Arches
ASTM A 762/A 762M-00	Standard Specification for Corrugated Steel Pipe, Polymer Precoated for Sewers and Drains
ASTM A 763-93 (1999)e1	Standard Practices for Detecting Susceptibility to Intergranular Attack in Ferritic Stainless Steels
ASTM A 764-95 (2001)	Standard Specification for Metallic Coated Carbon Steel Wire, Coated at Size and Drawn to Size for Mechanical Springs
ASTM A 765/A 765M-98a	Standard Specification for Carbon Steel and Low-Alloy Steel Pressure-Vessel-Component Forgings with Mandatory Toughness Requirements
ASTM A 767/A 767M-00b	Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
ASTM A 768-95	Standard Specification for Vacuum-Treated 12% Chromium Alloy Steel Forgings for Turbine Rotors and Shafts
ASTM A 769/A 769M-00	Standard Specification for Carbon and High-Strength Electric Resistance Welded Steel Structural Shapes
ASTM A 770/A 770M-86 (1996)	Standard Specification for Through-Thickness Tension Testing of Steel Plates for Special Applications
ASTM A 771/A 771M-95	Standard Specification for Seamless Austenitic and Martensitic Stainless Steel Tubing for Liquid Metal-Cooled Reactor Core Components
ASTM A 772/A 772M-00	Standard Test Method for ac Magnetic Permeability of Materials Using Sinusoidal Current
ASTM A 773/A 773M-96	Standard Test Method for dc Magnetic Properties of Materials Using Ring and Permeameter Procedures with dc Electronic Hysteresisgraphs
ASTM A 774/A 774M-00	Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures
ASTM A 775/A 775M-00b	Standard Specification for Epoxy-Coated Reinforcing Steel Bars
ASTM A 778-00	Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products
ASTM A 779/A 779M-00	Standard Specification for Steel Strand, Seven-Wire, Uncoated, Compacted, Stress-Relieved for Prestressed Concrete
ASTM A 780-00	Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A 781/A 781M-00	Standard Specification for Castings, Steel and Alloy, Common Requirements, for General Industrial Use
ASTM A 782/A 782M-90 (1996)e1	Standard Specification for Pressure-Vessel Plates, Quenched-and-Tempered, Manganese-Chromium-Molybdenum-Silicon Zirconium Alloy Steel
ASTM A 786/A 786M-00b	Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates
ASTM A 787-01	Standard Specification for Electric-Resistance-Welded Metallic-Coated Carbon Steel Mechanical Tubing
ASTM A 788-98a	Standard Specification for Steel Forgings, General Requirements
ASTM A 789/A 789M-00b	Standard Specification for Seamless and Welded Ferritic/Austenitic Stainless Steel Tubing for General Service
ASTM A 790/A 790M-00a	Standard Specification for Seamless and Welded Ferritic/Austenitic Stainless Steel Pipe
ASTM A 792/A 792M-99	Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM A 793-96	Standard Specification for Rolled Floor Plate, Stainless Steel
ASTM A 794-97	Standard Specification for Commercial Steel (CS), Sheet, Carbon (0.16% Maximum to 0.25% Maximum), Cold-Rolled
ASTM A 795-00	Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use
ASTM A 796/A 796M-00	Standard Practice for Structural Design of Corrugated Steel Pipe, Pipe-Arches, and Arches for Storm and Sanitary Sewers and Other Buried Applications
ASTM A 798/A 798M-97a	Standard Practice for Installing Factory-Made Corrugated Steel Pipe for Sewers and Other Applications
ASTM A 799/A 799M-92 (1997)	Standard Practice for Steel Castings, Stainless, Instrument Calibration, for Estimating Ferrite Content
ASTM A 800/A 800M-91 (1997)e1	Standard Practice for Steel Casting, Austenitic Alloy, Estimating Ferrite Content Thereof
ASTM A 801/A 801M-99	Standard Specification for Iron-Cobalt High Magnetic Saturation Alloys UNS R30005 and K92650
ASTM A 802/A 802M-95 (2001)	Standard Practice for Steel Castings, Surface Acceptance Standards, Visual Examination
ASTM A 803/A 803M-98	Standard Specification for Welded Ferritic Stainless Steel Feedwater Heater Tubes
ASTM A 804/A 804M-99	Standard Test Methods for Alternating-Current Magnetic Properties of Materials at Power Frequencies Using Sheet-Type Test Specimens
ASTM A 805-93 (1998)	Standard Specification for Steel, Flat Wire, Carbon, Cold-Rolled
ASTM A 807/A 807M-97	Standard Practice for Installing Corrugated Steel Structural Plate Pipe for Sewers and Other Applications
ASTM A 808/A 808M-00a	Standard Specification for High-Strength, Low-Alloy Carbon, Manganese, Columbium, Vanadium Steel of Structural Quality with Improved Notch Toughness
ASTM A 809-98	Standard Specification for Aluminum-Coated (Aluminized) Carbon Steel Wire
ASTM A 810-00	Standard Specification for Zinc-Coated (Galvanized) Steel Pipe Winding Mesh
ASTM A 811-97	Standard Specification for Soft Magnetic Iron Parts Fabricated by Powder Metallurgy (P/M) Techniques
ASTM A 813/A 813M-95e2	Standard Specification for Single- or Double-Welded Austenitic Stainless Steel Pipe
ASTM A 814/A 814M-96 (1998)	Standard Specification for Cold-Worked Welded Austenitic Stainless Steel Pipe

Designation	Title
ASTM A 815/A 815M-00a	Standard Specification for Wrought Ferritic, Ferritic/Austenitic, and Martensitic Stainless Steel Piping Fittings
ASTM A 817-00	Standard Specification for Metallic-Coated Steel Wire for Chain-Link Fence Fabric and Marcellled Tension Wire
ASTM A 818-91 (1996)e1	Standard Specification for Coppered Carbon Steel Wire
ASTM A 820-96	Standard Specification for Steel Fibers for Fiber-Reinforced Concrete
ASTM A 821/A 821M-99	Standard Specification for Steel Wire, Hard Drawn for Prestressing Concrete Tanks
ASTM A 822-90 (2000)	Standard Specification for Seamless Cold-Drawn Carbon Steel Tubing for Hydraulic System Service
ASTM A 823-99	Standard Specification for Statically Cast Permanent Mold Gray Iron Castings
ASTM A 824-95	Standard Specification for Metallic-Coated Steel Marcellled Tension Wire for Use With Chain Link Fence
ASTM A 826/A 826M-95	Standard Specification for Seamless Austenitic and Martensitic Stainless Steel Duct Tubes for Liquid Metal-Cooled Reactor Core Components
ASTM A 827/A 827M-93a (1998)	Standard Specification for Plates, Carbon Steel, for Forging and Similar Applications
ASTM A 829/A 829M-00	Standard Specification for Alloy Structural Steel Plates
ASTM A 830/A 830M-00	Standard Specification for Plates, Carbon Steel, Structural Quality, Furnished to Chemical Composition Requirements
ASTM A 831/A 831M-95 (2000)	Standard Specification for Austenitic and Martensitic Stainless Steel Bars, Billets, and Forgings for Liquid Metal Cooled Reactor Core Components
ASTM A 832/A 832M-99	Standard Specification for Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum-Vanadium
ASTM A 833-84 (1996)	Standard Practice for Indentation Hardness of Metallic Materials by Comparison Hardness Testers
ASTM A 834-95	Standard Specification for Common Requirements for Iron Castings for General Industrial Use
ASTM A 835-84 (2000)	Standard Specification for Sizes of Ferroalloys and Alloy Additives
ASTM A 836/A 836M-95b	Standard Specification for Titanium-Stabilized Carbon Steel Forgings for Glass-Lined Piping and Pressure Vessel Service
ASTM A 837-91 (1996)e1	Standard Specification for Steel Forgings, Alloy, for Carburizing Applications
ASTM A 838/A 838M-97	Standard Specification for Free-Machining Ferritic Stainless Soft Magnetic Alloys for Relay Applications
ASTM A 839/A 839M-96	Standard Specification for Iron-Phosphorus Powder Metallurgy (P/M) Parts for Soft Magnetic Applications
ASTM A 840/A 840M-00	Standard Specification for Fully Processed Magnetic Lamination Steel
ASTM A 841/A 841M-01	Standard Specification for Steel Plates for Pressure Vessels, Produced by Thermo-Mechanical Control Process (TMCP)
ASTM A 842-85 (1997)	Standard Specification for Compacted Graphite Iron Castings
ASTM A 844/A 844M-93 (1999)	Standard Specification for Steel Plates, 9% Nickel Alloy, for Pressure Vessels, Produced by the Direct-Quenching Process
ASTM A 845-85 (2000)	Standard Specification for Titanium Scrap for Use in Deoxidation and Alloying of Steel
ASTM A 846-85 (2000)	Standard Specification for Aluminum Scrap for Use in Deoxidation and Alloying of Steel
ASTM A 847-99a	Standard Specification for Cold-Formed Welded and Seamless High Strength, Low Alloy Structural Tubing with Improved Atmospheric Corrosion Resistance
ASTM A 848/A 848M-96	Standard Specification for Low-Carbon Magnetic Iron
ASTM A 849-00	Standard Specification for Post-Applied Coatings, Pavings, and Linings for Corrugated Steel Sewer and Drainage Pipe
ASTM A 851-96	Standard Specification for High-Frequency Induction Welded, Unannealed, Austenitic Steel Condenser Tubes
ASTM A 852/A 852M-00a	Standard Specification for Quenched and Tempered Low-Alloy Structural Steel Plate with 70 ksi [485 MPa] Minimum Yield Strength to 4 in. [100 mm] Thick
ASTM A 853-93 (1998)	Standard Specification for Steel Wire, Carbon, for General Use
ASTM A 854/A 854M-98	Standard Specification for Metallic-Coated Steel Smooth High-Tensile Fence and Trellis Wire
ASTM A 855/A 855M-98	Standard Specification for Zinc-5% Aluminum-Mischmetal Alloy-Coated Steel Wire Strand
ASTM A 856/A 856M-98	Standard Specification for Zinc-5% Aluminum-Mischmetal Alloy-Coated Carbon Steel Wire
ASTM A 857/A 857M-00a	Standard Specification for Steel Sheet Piling, Cold Formed, Light Gage
ASTM A 858/A 858M-00	Standard Specification for Heat-Treated Carbon Steel Fittings for Low-Temperature and Corrosive Service
ASTM A 859/A 859M-95 (1999)	Standard Specification for Age-Hardening Alloy Steel Forgings for Pressure Vessel Components
ASTM A 860/A 860M-00	Standard Specification for Wrought High-Strength Low-Alloy Steel Butt-Welding Fittings
ASTM A 861-94e1	Standard Specification for High-Silicon Iron Pipe and Fittings
ASTM A 862/A 862M-98	Standard Practice for Application of Asphalt Coatings to Corrugated Steel Sewer and Drainage Pipe
ASTM A 865-97	Standard Specification for Threaded Couplings, Steel, Black or Zinc-Coated (Galvanized) Welded or Seamless, for Use in Steel Pipe Joints
ASTM A 866-94	Standard Specification for Medium Carbon Anti-Friction Bearing Steel
ASTM A 867/A 867M-94 (1998)e1	Standard Specification for Iron-Silicon Relay Steels
ASTM A 871/A 871M-00a	Standard Specification for High-Strength Low-Alloy Structural Steel Plate With Atmospheric Corrosion Resistance
ASTM A 872-91 (1997)	Standard Specification for Centrifugally Cast Ferritic/Austenitic Stainless Steel Pipe for Corrosive Environments

Designation	Title
ASTM A 874/A 874M-98	Standard Specification for Ferritic Ductile Iron Castings Suitable for Low-Temperature Service
ASTM A 875/A 875M-99	Standard Specification for Steel Sheet, Zinc-5% Aluminum Alloy-Coated by the Hot-Dip Process
ASTM A 876/A 876M-98	Standard Specification for Flat-Rolled, Grain-Oriented, Silicon-Iron, Electrical Steel, Fully Processed Types
ASTM A 877/A 877M-99	Standard Specification for Steel Wire, Chromium-Silicon Alloy Valve Spring Quality
ASTM A 878/A 878M-99	Standard Specification for Steel Wire, Modified Chromium Vanadium Valve Spring Quality
ASTM A 879-00	Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface
ASTM A 880-95	Standard Practice for Criteria for Use in Evaluation of Testing Laboratories and Organizations for Examination and Inspection of Steel, Stainless Steel, and Related Alloys
ASTM A 881/A 881M-99	Standard Specification for Steel Wire, Deformed, Stress-Relieved or Low-Relaxation for Prestressed Concrete Railroad Ties
ASTM A 882/A 882M-96e1	Standard Specification for Epoxy-Coated Seven-Wire Prestressing Steel Strand
ASTM A 883-96	Standard Test Method for Ferrimagnetic Resonance Linewidth and Gyromagnetic Ratio of Nonmetallic Magnetic Materials
ASTM A 884/A 884M-01	Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Fabric for Reinforcement
ASTM A 885/A 885M-96	Standard Specification for Steel Sheet, Zinc and Aramid Fiber Composite Coated for Corrugated Steel Sewer, Culvert, and Underdrain Pipe
ASTM A 886/A 886M-99	Standard Specification for Steel Strand, Indented, Seven-Wire Stress-Relieved for Prestressed Concrete
ASTM A 887-89 (2000)	Standard Specification for Borated Stainless Steel Plate, Sheet, and Strip for Nuclear Application
ASTM A 888-98e1	Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
ASTM A 889/A 889M-93 (1998)	Standard Test Method for Alternating-Current Magnetic Properties of Materials at Low Inductions Using the Wattmeter-Varmeter-Ammeter-Voltmeter Method and 25-cm (250-mm) Epstein Frame
ASTM A 890/A 890M-99	Standard Specification for Castings, Iron-Chromium-Nickel-Molybdenum Corrosion-Resistant, Duplex (Austenitic/Ferritic) for General Application
ASTM A 891-98	Standard Specification for Precipitation Hardening Iron Base Superalloy Forgings for Turbine Rotor Disks and Wheels
ASTM A 892-88 (2001)	Standard Guide for Defining and Rating the Microstructure of High Carbon Bearing Steels
ASTM A 893-97	Standard Test Method for Complex Dielectric Constant of Nonmetallic Magnetic Materials at Microwave Frequencies
ASTM A 894/A 894M-00	Standard Test Method for Saturation Magnetization or Induction of Nonmetallic Magnetic Materials
ASTM A 895-89 (2000)	Standard Specification for Free-Machining Stainless Steel Plate, Sheet, and Strip
ASTM A 896-89 (1999)	Standard Practice for Conducting Case Studies on Galvanized Structures
ASTM A 897M-90 (1997)	Standard Specification for Austempered Ductile Iron Castings [Metric]
ASTM A 897-90 (1997)	Standard Specification for Austempered Ductile Iron Castings
ASTM A 898/A 898M-91 (1996)	Standard Specification for Straight Beam Ultrasonic Examination of Rolled Steel Structural Shapes
ASTM A 899-91 (1996)	Standard Specification for Steel Wire, Epoxy-Coated
ASTM A 900-91 (1996)e1	Standard Test Method for Lamination Factor of Amorphous Magnetic Strip
ASTM A 901-97	Standard Specification for Amorphous Magnetic Core Alloys, Semi-Processed Types
ASTM A 902-99	Standard Terminology Relating to Metallic Coated Steel Products
ASTM A 903/A 903M-99	Standard Specification for Steel Castings, Surface Acceptance Standards, Magnetic Particle and Liquid Penetrant Inspection
ASTM A 904-98	Standard Specification for 50 Nickel-50 Iron Powder Metallurgy (P/M) Soft Magnetic Alloys
ASTM A 905-93 (1998)	Standard Specification for Steel Wire, Pressure Vessel Winding
ASTM A 906/A 906M-99	Standard Specification for Grade 80 and Grade 100 Alloy Steel Chain Slings for Overhead Lifting
ASTM A 907/A 907M-96	Standard Specification for Steel, Sheet and Strip, Heavy Thickness Coils, Carbon, Hot-Rolled, Structural Quality
ASTM A 908-91 (1998)	Standard Specification for Stainless Steel Needle Tubing
ASTM A 909-94 (1999)	Standard Specification for Steel Forgings, Microalloy, for General Industrial Use
ASTM A 910/A 910M-99	Standard Specification for Uncoated, Weldless, 2- and 3-Wire Steel Strand for Prestressed Concrete
ASTM A 911/A 911M-99	Standard Specification for Uncoated, Stress-Relieved Steel Bars for Prestressed Concrete Ties
ASTM A 912-93 (1998)	Standard Test Method for Alternating-Current Magnetic Properties of Amorphous Materials at Power Frequencies Using Wattmeter-Ammeter-Voltmeter Method with Toroidal Specimens
ASTM A 913/A 913M-00a	Standard Specification for High-Strength Low-Alloy Steel Shapes of Structural Quality, Produced by Quenching and Self-Tempering Process (QST)
ASTM A 914/A 914M-92 (1999)	Standard Specification for Steel Bars Subject to Restricted End-Quench Hardenability Requirements
ASTM A 915/A 915M-93 (1998)	Standard Specification for Steel Castings, Carbon, and Alloy, Chemical Requirements Similar to Standard Wrought Grades
ASTM A 917-00	Standard Specification for Steel Sheet, Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface (General Requirements)
ASTM A 918-00	Standard Specification for Steel Sheet, Zinc-Nickel Alloy Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface

Designation	Title
ASTM A 920/A 920M-97	Standard Specification for Steel Bars, Microalloy, Hot-Wrought, Special Quality, Mechanical Properties
ASTM A 921/A 921M-93 (1999)	Standard Specification for Steel Bars, Microalloy, Hot-Wrought, Special Quality, for Subsequent Hot Forging
ASTM A 922-93 (2000)	Standard Specification for Silicon Metal
ASTM A 923-98	Standard Test Methods for Detecting Detrimental Intermetallic Phase in Wrought Duplex Austenitic/Ferritic Stainless Steels
ASTM A 924/A 924M-99	Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM A 925-98	Standard Specification for Zinc-5% Aluminum-Mischmetal Alloy-Coated Steel Overhead Ground Wire Strand
ASTM A 926-97	Standard Test Method for Comparing the Abrasion Resistance of Coating Materials for Corrugated Metal Pipe
ASTM A 927/A 927M-99	Standard Test Method for Alternating-Current Magnetic Properties of Toroidal Core Specimens Using the Voltmeter-Ammeter-Wattmeter Method
ASTM A 928/A 928M-00	Standard Specification for Ferritic/Austenitic (Duplex) Stainless Steel Pipe Electric Fusion Welded with Addition of Filler Metal
ASTM A 929/A 929M-01	Standard Specification for Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe
ASTM A 930-99	Standard Practice for Life-Cycle Cost Analysis of Corrugated Metal Pipe Used for Culverts, Storm Sewers, and Other Buried Conduits
ASTM A 931-96	Standard Test Method for Tension Testing of Wire Ropes and Strand
ASTM A 932/A 932M-95	Standard Test Method for Alternating-Current Magnetic Properties of Amorphous Materials at Power Frequencies Using Wattmeter-Ammeter-Voltmeter Method with Sheet Specimens
ASTM A 933/A 933M-95	Standard Specification for Vinyl (PVC) Coated Steel Wire and Welded Wire Fabric for Reinforcement
ASTM A 934/A 934M-00b	Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars
ASTM A 935/A 935M-97a	Standard Specification for Steel, Sheet and Strip, Heavy Thickness Coils, High Strength, Low-Alloy, Columbium or Vanadium, or Both, Hot-Rolled
ASTM A 936/A 936M-97a	Standard Specification for Steel, Sheet and Strip, Heavy Thickness Coils, High Strength, Low-Alloy, Hot-Rolled, with Improved Formability
ASTM A 937-95	Standard Test Method for Determining Interlaminar Resistance of Insulating Coatings Using Two Adjacent Test Surfaces
ASTM A 938-97	Standard Test Method for Torsion Testing of Wire
ASTM A 939-96	Standard Test Method for Ultrasonic Examination from Bored Surfaces of Cylindrical Forgings
ASTM A 940-96	Standard Specification for Vacuum Treated Steel Forgings, Alloy, Differentially Heat Treated, for Turbine Rotors
ASTM A 941-00a	Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys
ASTM A 942-95	Standard Specification for Centrifugally Cast White Iron/Gray Iron Dual Metal Abrasion- Resistant Roll Shells
ASTM A 943/A 943M-00	Standard Specification for Spray-Formed Seamless Austenitic Stainless Steel Pipes
ASTM A 944-99	Standard Test Method for Comparing Bond Strength of Steel Reinforcing Bars to Concrete Using Beam-End Specimens
ASTM A 945/A 945M-00	Standard Specification for High-Strength Low-Alloy Structural Steel Plate with Low Carbon and Restricted Sulfur for Improved Weldability, Formability, and Toughness
ASTM A 946-95 (2000)	Standard Specification for Chromium, Chromium-Nickel and Silicon Alloy Steel Plate, Sheet, and Strip for Corrosion and Heat Resisting Service
ASTM A 947M-95 (2000)	Standard Specification for Textured Stainless Steel Sheet [Metric]
ASTM A 949/A 949M-00a	Standard Specification for Spray-Formed Seamless Ferritic/Austenitic Stainless Steel Pipe
ASTM A 950/A 950M-99	Standard Specification for Fusion Bonded Epoxy-Coated Structural Steel H-Piles and Sheet Piling
ASTM A 951-00	Standard Specification for Masonry Joint Reinforcement
ASTM A 952/A 952M-98	Standard Specification for Forged Grade 80 and Grade 100 Steel Lifting Components and Welded Attachment Links
ASTM A 953-96	Standard Specification for Austenitic Chromium-Nickel-Silicon Alloy Steel Seamless and Welded Tubing
ASTM A 954-96	Standard Specification for Austenitic Chromium-Nickel-Silicon Alloy Steel Seamless and Welded Pipe
ASTM A 955M-96	Standard Specification for Deformed and Plain Stainless Steel Bars For Concrete Reinforcement [Metric]
ASTM A 956-00	Standard Test Method for Leeb Hardness Testing of Steel Products
ASTM A 957-96	Standard Specification for Investment Castings, Steel and Alloy, Common Requirements, for General Industrial Use
ASTM A 958-00	Standard Specification for Steel Castings, Carbon, and Alloy, with Tensile Requirements, Chemical Requirements Similar to Standard Wrought Grades
ASTM A 959-00a	Standard Guide for Specifying Harmonized Standard Grade Compositions for Wrought Stainless Steels
ASTM A 960-00	Standard Specification for Common Requirements for Wrought Steel Piping Fittings
ASTM A 961-00b	Standard Specification for Common Requirements for Steel Flanges, Forged Fittings, Valves, and Parts for Piping Applications

Designation	Title
ASTM A 962/A 962M-00	Standard Specification for Common Requirements for Steel Fasteners or Fastener Materials, or Both, Intended for Use at Any Temperature from Cryogenic to the Creep Range
ASTM A 964/A 964M-96	Standard Specification for Corrugated Steel Box Culverts
ASTM A 965/A 965M-01	Standard Specification for Steel Forgings, Austenitic, for Pressure and High Temperature Parts
ASTM A 966/A 966M-96	Standard Test Method for Magnetic Particle Examination of Steel Forgings Using Alternating Current
ASTM A 967-99e1	Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts
ASTM A 968-96	Standard Specification for Chromium, Chromium-Nickel, and Silicon Alloy Steel Bars and Shapes for Corrosion and Heat-Resisting Service
ASTM A 970/A 970M-98	Standard Specification for Welded or Forged Headed Bars for Concrete Reinforcement
ASTM A 971-00	Standard Test Method for Measuring Edge Taper and Crown of Flat-Rolled Electrical Steel Coils
ASTM A 972/A 972M-00	Standard Specification for Fusion Bonded Epoxy-Coated Pipe Piles
ASTM A 973/A 973M-00	Standard Specification for Grade 100 Alloy Steel Chain
ASTM A 974-97	Standard Specification for Welded Wire Fabric Gabions and Gabion Mattresses (Metallic Coated or Polyvinyl Chloride (PVC) Coated)
ASTM A 975-97	Standard Specification for Double-Twisted Hexagonal Mesh Gabions and Revet Mattresses (Metallic-Coated Steel Wire or Metallic-Coated Steel Wire With Poly(Vinyl Chloride) (PVC) Coating)
ASTM A 976-97	Standard Classification of Insulating Coatings by Composition, Relative Insulating Ability and Application
ASTM A 977-97	Standard Test Method for Magnetic Properties of High-Coercivity Permanent Magnet Materials Using Hysteresisgraphs
ASTM A 978/A 978M-97	Standard Specification for Composite Ribbed Steel Pipe, Precoated and Polyethylene Lined for Gravity Flow Sanitary Sewers, Storm Sewers, and Other Special Applications
ASTM A 979/A 979M-97	Standard Specification for Concrete Pavements and Linings Installed in Corrugated Steel Structures in the Field
ASTM A 980-97	Standard Specification for Steel, Sheet, Carbon, Ultra High Strength Cold Rolled
ASTM A 981-97	Standard Test Method for Evaluating Bond Strength for 15.2 mm (0.6 in.) Diameter Prestressing Steel Strand, Grade 270, Uncoated, Used in Prestressed Ground Anchors
ASTM A 982-00	Standard Specification for Steel Forgings, Stainless, for Compressor and Turbine Airfoils
ASTM A 983/A 983M-98	Standard Specification for Continuous Grain Flow Forged Carbon and Alloy Steel Crankshafts for Medium Speed Diesel Engines
ASTM A 984/A 984M-00	Standard Specification for Steel Line Pipe, Black, Plain-End, Electric-Resistance-Welded
ASTM A 985-98a	Standard Specification for Steel Investment Casting General Requirements, for Pressure-Containing Parts
ASTM A 986/A 986M-98	Standard Specification for Magnetic Particle Examination of Continuous Grain Flow Crankshaft Forgings
ASTM A 987-00	Standard Test Method for Measuring Shape Characteristics of Tin Mill Products
ASTM A 988-98	Standard Specification for Hot Isostatically-Pressed Stainless Steel Flanges, Fittings, Valves, and Parts for High Temperature Service
ASTM A 989-98	Standard Specification for Hot Isostatically-Pressed Alloy Steel Flanges, Fittings, Valves, and Parts for High Temperature Service
ASTM A 990-00	Standard Specification for Chastings, Iron-Nickel-Chromium and Nickel Alloys, Specially Controlled for Pressure Retaining Parts for Corrosion Service
ASTM A 991/A 991M-98	Standard Test Method for Conducting Temperature Uniformity Surveys of Furnaces Used to Heat Treat Steel Products
ASTM A 992/A 992M-00	Standard Specification for Steel for Structural Shapes For Use in Building Framing
ASTM A 993-98	Standard Test Method for Dynamic Tear Testing of Cast Irons to Establish Transition Temperature
ASTM A 994-98	Standard Guide for Editorial Procedures and Form of Product Specifications for Steel, Stainless Steel, and Related Alloys
ASTM A 995-98	Standard Specification for Casting, Austenitic-Ferritic (Duplex) Stainless Steel, for Pressure-Containing Parts
ASTM A 996/A 996M-01	Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
ASTM A 997-98	Standard Practice for Investment Castings, Surface Acceptance Standards, Visual Examination
ASTM A 998/A 998M-98	Practice for Structural Design of Reinforcements for Fittings in Factory-Made Corrugated Steel Pipe for Sewers and Other Applications
ASTM A 999/A 999M-98	Standard Specification for General Requirements for Alloy and Stainless Steel Pipe
ASTM A 1000-99	Standard Specification for Steel Wire, Carbon and Alloy Specialty Spring Quality
ASTM A 1001-99	Standard Specification for High Strength Steel Castings in Heavy Sections
ASTM A 1002-99	Standard Specification for Castings, Nickel-Aluminum Ordered Alloy
ASTM A 1003/A 1003M-00	Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members
ASTM A 1004/A 1004M-99	Standard Practice for Establishing Conformance to the Minimum Expected Corrosion Characteristics of Metallic, Painted-Metallic, and Nonmetallic-Coated Steel Sheet Intended for Use as Cold Formed Framing Members
ASTM A 1005/A 1005M-00e1	Standard Specification for Steel Line Pipe, Black, Plain End, Longitudinal and Helical Seam, Double Submerged-Arc Welded

Designation	Title
ASTM A 1006/A 1006M-00	Standard Specification for Steel Line Pipe, Black, Plain End, Laser Beam Welded
ASTM A 1007-00	Standard Specification for Carbon Steel Wire for Wire Rope
ASTM A 1008-01	Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
ASTM A 1009-00	Standard Specification for Soft Magnetic MnZn Ferrite Core Materials for High Frequency (10 kHz-1 MHz) Power Transformer and Filter Inductor Applications
ASTM A 1010-00	Standard Specification for Higher-Strength Martensitic Stainless Steel Plate, Sheet , and Strip
ASTM A 1011/A 1011M-01	Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
ASTM A 1012-00	Standard Specification for Seamless and Welded Ferritic, Austenitic and Duplex Alloy Steel Condenser and Heat Exchanger Tubes With Integral Fins
ASTM A 1013-00	Standard Test Method for High-Frequency (10 kHz-1 MHz) Core Loss of Soft Magnetic Core Components at Controlled Temperatures Using the Voltmeter-Ammeter-Wattmeter Method
ASTM A 1014-00	Standard Specification for Precipitation-Hardening Bolting Material (UNS N07718) for High Temperature Service
ASTM A 1015-01	Standard Guide for Videoborescoping of Tubular Products for Sanitary Applications
ASTM A 1016/A 1016M-01	Standard Specification for General Requirements for Ferritic Alloy Steel, Austenitic Alloy Steel, and Stainless Steel Tubes
ASTM A 1017/A 1017M-01	Standard Specification for Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum-Tungsten

Appendix

2

***ASTM DISCONTINUED
FERROUS METAL STANDARDS***

Discontinued	Replaced By
A 4 (1965)	A 3 – Steel Joint Bars, Low, Medium and High Carbon (Non-Heat-Treated)
A 5 (1979)	A 3 – Steel Joint Bars, Low, Medium and High Carbon (Non-Heat-Treated)
A 7 (1967)	A 36 – Carbon Structural Steel (For Rolled Shapes) A 283 – Low and Intermediate Tensile Strength Carbon Steel Plates A 306 – Discontinued 1975; Replaced by A 663 – Steel Bars, Carbon, Merchant Quality, Mechanical Properties, and A 675 – Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties
A 8 (1963)	No Replacement
A 9 (1940)	No Replacement
A 10 (1970)	A 283 – Low and Intermediate Tensile Strength Carbon Steel Plates
A 11 (1930)	A 113 – Discontinued 1979; No Replacement
A 12 (1934)	A 131 – Structural Steel for Ships
A 13 (1934)	A 131 – Structural Steel for Ships
A 14 (1950)	A 68 – Discontinued 1975; Replaced by A 689 – Carbon and Alloy Steel Bars for Springs
A 15 (1969)	A 615 – Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
A 16 (1969)	A 616 – Rail-Steel Deformed and Plain Bars for Concrete Reinforcement
A 17 (1945)	A 273 & A 274 – Discontinued 1975; Replaced by A 711 – Steel Forging Stock
A 18 (1940)	A 236 – Discontinued 1981; No Replacement
A 19	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

Discontinued	Replaced By
A 61 (1969)	A 616 – Rail-Steel Deformed and Plain Bars for Concrete Reinforcement
A 62 (1949)	No Replacement
A 63 (1941)	A 237 – Discontinued 1975; Replaced by A 668 – Steel Forgings, Carbon and Alloy, for General Industrial Use A 238 – Discontinued 1989; Replaced by A 730 – Forgings, Carbon and Alloy Steel, for Railway Use
A 64 (1937)	E 30 – Discontinued 1995; No Replacement
A 68 (1975)	A 689 – Carbon and Alloy Steel Bars for Springs
A 69 (1927)	No Replacement
A 70 (1947)	A 285 – Pressure Vessel Plates, Carbon Steel, Low- and Intermediate-Tensile Strength
A 71 (1937)	No Replacement
A 72 (1972)	No Replacement
A 73 (1972)	No Replacement
A 75 (1921)	A 47 – Ferritic Malleable Iron Castings
A 76 (1981)	A 183 – Carbon Steel Track Bolts and Nuts
A 77 (1935)	No Replacement
A 78 (1947)	A 283 – Low and Intermediate Tensile Strength Carbon Steel Plates
A 79 (1921)	A 84 – Discontinued 1972; No Replacement
A 80 (1927)	A 107 – Discontinued 1968; Replaced by A 575 – Steel Bars, Carbon, Merchant Quality, M-Grades, and A 576 – Steel Bars, Carbon, Hot-Wrought, Special Quality A 108 – Steel Bars, Carbon, Cold Finished, Standard Quality
A 81 (1972)	No Replacement
A 83 (1967)	A 192 – Seamless Carbon Steel Boiler Tubes for High-Pressure Service
A 84 (1972)	No Replacement
A 85 (1953)	No Replacement
A 86 (1963)	No Replacement
A 87 (1947)	A 27 – Steel Castings, Carbon, for General Application
A 88 (1933)	A 48 – Gray Iron Castings [Metric]
A 89 (1947)	A 285 – Pressure Vessel Plates, Carbon Steel, Low- and Intermediate-Tensile Strength
A 91 (1940)	No Replacement
A 92 (1937)	No Replacement
A 93 (1965)	A 525 – Discontinued 1994; Replaced by A 653 – Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process, and A 924 – General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
A 94 (1966)	No Replacement
A 95 (1957)	A 216 – Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service
A 96 (1965)	A 193 – Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
A 97 (1935)	No Replacement
A 98 (1992)	No Replacement
A 103	E 32 – Practices for Sampling Ferrous Alloys and Steel Additives for Determination of Chemical Composition
A 104 (1939)	E 31 – Discontinued 1995; No Replacement
A 107 (1968)	A 575 – Steel Bars, Carbon, Merchant Quality, M-Grades A 576 – Steel Bars, Carbon, Hot-Wrought, Special Quality
A 109M (1998)	A 109/A 109M
A 110 (1936)	A 90 – Test Method for Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings
A 112 (1990)	No Replacement
A 113 (1979)	No Replacement
A 114 (1940)	No Replacement
A 115 (1937)	No Replacement
A 117 (1956)	A 392 – Zinc-Coated Steel Chain-Link Fence Fabric
A 118 (1933)	No Replacement
A 119 (1943)	E 44 – Discontinued; Redesignated A 919 – Terminology Relating to Heat Treatment of Metals
A 120 (1987)	A 53 – Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
A 122 (1963)	A 475 – Zinc-Coated Steel Wire Strand
A 124 (1940)	No Replacement
A 127	Redesignated A 340 – Terminology of Symbols and Definitions Relating to Magnetic Testing
A 129 (1969)	No Replacement
A 130 (1937)	E 30 – Discontinued 1995; No Replacement

Discontinued	Replaced By
A 133 (1941)	A 237 – Discontinued 1975; Replaced by A 668 – Steel Forgings, Carbon and Alloy, for General Industrial Use A 238 – Discontinued 1989; Replaced by A 730 – Forgings, Carbon and Alloy Steel, for Railway Use
A 136 (1945)	No Replacement
A 137 (1943)	No Replacement
A 138 (1945)	No Replacement
A 140 (1935)	No Replacement
A 141 (1967)	A 502 – Steel Structural Rivets
A 142 (1977)	A 716 – Ductile Iron Culvert Pipe
A 145 (1940)	A 132 – Ferromolybdenum
A 147 (1984)	No Replacement
A 149 (1940)	A 212 – Discontinued 1967; Replaced by A 515 – Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service, and A 516 – Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
A 150 (1940)	A 212 – Discontinued 1967; Replaced by A 515 – Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service, and A 516 – Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
A 151 (1938)	No Replacement
A 152 (1972)	No Replacement
A 154 (1936)	A 180 – Discontinued 1937; Replaced by A 27 – Steel Castings, Carbon, for General Application
A 155 (1978)	A 671 – Electric-Fusion-Welded Steel Pipe for Atmospheric and Lower Temperatures A 672 – Electric-Fusion-Welded Steel Pipe for High-Pressure Service at Moderate Temperatures A 691 – Carbon and Alloy Steel Pipe, Electric Fusion-Welded for High-Pressure Service at High Temperatures
A 156 (1936)	A 146 – Molybdenum Oxide Products
A 157 (1953)	A 217 – Steel Castings, Martensitic Stainless and Alloy, for Pressure-Containing Parts Suitable for High-Temperature Service A 351 – Castings, Austenitic, Austenitic-Ferritic (Duplex), for Pressure-Containing Parts
A 158 (1953)	A 335 – Seamless Ferritic Alloy-Steel Pipe for High-Temperature Service
A 160 (1969)	A 617 – Axle-Steel Deformed and Plain Bars for Concrete Reinforcement
A 161 (1999)	A 192 – Seamless Carbon Steel Boiler Tubes for High Pressure Service A 209 – Seamless Carbon-Molybdenum Alloy-Steel Boiler and Superheater Tubes
A 162 (1973)	No Replacement
A 163 (1972)	No Replacement
A 164 (1981)	B 663 – Silver-Tungsten Carbide Electrical Contact Material
A 165 (1988)	B 766 – Electrodeposited Coatings of Cadmium
A 166 (1968)	B 456 – Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium
A 168 (1947)	A 296 – Discontinued 1980; Replaced by A 743 – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A 744 – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service A 297 – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application
A 169 (1947)	A 296 – Discontinued 1980; Replaced by A 743 – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A 744 – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service A 297 – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application
A 170 (1947)	A 296 – Discontinued 1980; Replaced by A 743 – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A 744 – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service A 297 – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application
A 171 (1947)	A 296 – Discontinued 1980; Replaced by A 743 – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A 744 – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service A 297 – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application
A 172 (1947)	A 296 – Discontinued 1980; Replaced by A 743 – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A 744 – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service A 297 – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application
A 173 (1954)	A 296 – Discontinued 1980; Replaced by A 743 – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A 744 – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service A 297 – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application

Discontinued	Replaced By
A 174 (1940)	A 296 – Discontinued 1980; Replaced by A 743 – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A 744 – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service A 297 – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application
A 175 (1947)	A 296 – Discontinued 1980; Replaced by A 743 – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A 744 – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service A 297 – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application
A 177 (1989)	A 666 – Annealed or Cold-Worked Austenitic Stainless Steel, Sheet, Strip, Plate, and Flat Bar
A 180 (1937)	A 27 – Steel Castings, Carbon, for General Application
A 186 (1966)	A 504 – Wrought Carbon Steel Wheels
A 187 (1943)	No Replacement
A 188 (1943)	No Replacement
A 189 (1972)	No Replacement
A 190 (1962)	No Replacement
A 191 (1942)	A 239 – Test Method for Locating the Thinnest Spot in a Zinc (Galvanized) Coating on Iron or Steel Articles by the Preece Test (Copper Sulfate Dip)
A 195	A 502 – Steel Structural Rivets
A 196 (1962)	No Replacement
A 197M (1998)	A 197/A 197M
A 198 (1947)	A 296 – Discontinued 1980; Replaced by A 743 – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A 744 – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service A 297 – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application
A 199/A 199M (1995)	A 200 – Seamless Intermediate Alloy-Steel Still Tubes for Refinery Service
A 200 (1999)	A 213 – Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater, and Heat-Exchanger Tubes
A 201 (1967)	A 515 – Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service A 516 – Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
A 205 (1967)	A 233 – Discontinued 1970; No Replacement A 251 – Discontinued 1970; No Replacement
A 206 (1953)	A 335 – Seamless Ferritic Alloy-Steel Pipe for High-Temperature Service
A 207 (1972)	No Replacement
A 208 (1941)	A 239 – Test Method for Locating the Thinnest Spot in a Zinc (Galvanized) Coating on Iron or Steel Articles by the Preece Test (Copper Sulfate Dip)
A 211 (1993)	No Replacement
A 212 (1967)	A 515 Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service A 516 – Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
A 215 (1947)	A 27 – Steel Castings, Carbon, for General Application
A 218 (1963)	A 475 – Zinc-Coated Steel Wire Strand
A 219 (1972)	B 487 – Test Method for Measurement of Metal and Oxide Coating Thicknesses by Microscopical Examination of a Cross Section B 499 – Test Method for Measurement of Coating Thicknesses by the Magnetic Method: Nonmagnetic Coatings on Magnetic Basis Metals B 504 – Test Method for Measurement of Thickness of Metallic Coatings by the Coulometric Method B 529 – Discontinued 1979; Replaced by B 244 – Test Method for Measurement of Thickness of Anodic Coatings on Aluminum and of Other Nonconductive Coatings on Nonmagnetic Basis Metals with Eddy-Current Instruments B 530 – Test Method for Measurement of Coating Thicknesses by the Magnetic Method: Electrodeposited Nickel Coatings on Magnetic and Nonmagnetic Substrates
A 220M (1999)	A 220/A 220M
A 221 (1947)	A 296 – Discontinued 1980; Replaced by A 743 – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A 744 – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service A 297 – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application
A 222 (1947)	A 296 – Discontinued 1980; Replaced by A 743 – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A 744 – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service A 297 – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application

Discontinued	Replaced By
A 223 (1947)	A 296 – Discontinued 1980; Replaced by A 743 – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application, and A 744 – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service A 297 – Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat-Resistant, for General Application
A 224 (1969)	G 4 – Guide for Conducting Corrosion Coupon Tests in Field Applications
A 226/A 226M (1997)	No Replacement
A 233 (1970)	No Replacement
A 235 (1975)	A 668 – Steel Forgings, Carbon and Alloy, for General Industrial Use
A 236 (1981)	No Replacement
A 237 (1975)	A 668 – Steel Forgings, Carbon and Alloy, for General Industrial Use
A 238 (1989)	A 730 – Forgings, Carbon and Alloy Steel, for Railway Use
A 241 (1979)	A 67 – Steel Tie Plates, Low-Carbon and High-Carbon Hot-Worked
A 243 (1975)	A 668 – Steel Forgings, Carbon and Alloy, for General Industrial Use
A 244 (1947)	A 504 – Wrought Carbon Steel Wheels
A 245 (1972)	A 570 – Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality A 611 – Structural Steel (SS), Sheet, Carbon, Cold-Rolled
A 246 (1958)	A 245 – Discontinued 1972; Replaced by A 570 – Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality A 611 – Structural Steel (SS), Sheet, Carbon, Cold-Rolled
A 248 (1972)	A 273 & A 274 – Discontinued 1975; Replaced by A 711 – Steel Forging Stock
A 251 (1970)	No Replacement
A 253 (1962)	No Replacement
A 256 (1990)	No Replacement
A 257 (1945)	A 34 – Practice for Sampling and Procurement Testing of Magnetic Materials
A 258 (1945)	A 34 – Practice for Sampling and Procurement Testing of Magnetic Materials
A 259 (1945)	A 34 – Practice for Sampling and Procurement Testing of Magnetic Materials
A 260 (1966)	No Replacement
A 261 (1959)	No Replacement
A 267 (1954)	No Replacement
A 271 (1999)	A 213 – Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater, and Heat-Exchanger Tubes
A 272 (1945)	E 109 – Discontinued 1981; Replaced by E 709 – Guide for Magnetic Particle Examination
A 273 (1975)	A 711 – Steel Forging Stock
A 274 (1975)	A 711 – Steel Forging Stock
A 277 (1952)	A 338 – Malleable Iron Flanges, Pipe Fittings, and Valve Parts for Railroad, Marine, and Other Heavy Duty Service at Temperatures up to 650°F (345°C)
A 279 (1945)	G 31 – Practice for Laboratory Immersion Corrosion Testing of Metals
A 280 (1953)	A 335 – Seamless Ferritic Alloy-Steel Pipe for High-Temperature Service
A 281 (1947)	A 27 – Steel Castings, Carbon, for General Application
A 282 (1945)	A 148 – Steel Castings, High Strength, for Structural Purposes
A 284/A 284M (1992)	A 283 – Low and Intermediate Tensile Strength Carbon Steel Plates
A 286 (1960)	A 434 – Steel Bars, Alloy, Hot-Wrought or Cold-Finished, Quenched and Tempered
A 287 (1955)	No Replacement
A 292 (1968)	A 469 – Vacuum-Treated Steel Forgings for Generator Rotors
A 293 (1984)	A 470 – Vacuum-Treated Carbon and Alloy Steel Forgings for Turbine Rotors and Shafts
A 294 (1988)	A 471 – Vacuum-Treated Alloy Steel Forgings for Turbine Rotor Disks and Wheels
A 296 (1980)	A 743 – Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion-Resistant, for General Application A 744 – Castings, Iron-Chromium-Nickel, Corrosion-Resistant, for Severe Service
A 298 (1970)	No Replacement
A 300 (1975)	No Replacement
A 301 (1956)	A 387 – Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum
A 303 (1970)	A 570 – Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality
A 305 (1968)	A 615 – Deformed and Plain Billet-Steel Bars for Concrete Reinforcement A 616 – Rail-Steel Deformed and Plain Bars for Concrete Reinforcement A 617 – Axle-Steel Deformed and Plain Bars for Concrete Reinforcement
A 306 (1975)	A 663 – Steel Bars, Carbon, Merchant Quality, Mechanical Properties A 675 – Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties
A 310 (1949)	Redesignated A 345 – Flat-Rolled Electrical Steels for Magnetic Applications

Discontinued	Replaced By
A 315 (1952)	A 335 – Seamless Ferritic Alloy-Steel Pipe for High-Temperature Service
A 316 (1969)	No Replacement
A 317 (1975)	E 381 – Method of Macroetch Testing Steel Bars, Billets, Blooms, and Forgings
A 318 (1976)	A 370 – Test Methods and Definitions for Mechanical Testing of Steel Products
A 326 (1990)	No Replacement
A 329 (1965)	A 551 – Steel Tires
A 330 (1954)	A 370 – Test Methods and Definitions for Mechanical Testing of Steel Products
A 332 (1965)	A 689 – Carbon and Alloy Steel Bars for Springs
A 337 (1955)	A 392 – Zinc-Coated Steel Chain-Link Fence Fabric
A 339 (1965)	A 536 – Ductile Iron Castings
A 344 (1977)	A 370 – Test Methods and Definitions for Mechanical Testing of Steel Products A 712 – Test Method for Electrical Resistivity of Soft Magnetic Alloys A 717 – Test Method for Surface Insulation Resistivity of Single-Strip Specimens A 718 – Discontinued 1996; No Replacement A 719 – Test Method for Lamination Factor of Magnetic Materials A 720 – Test Method for Ductility of Nonoriented Electrical Steel
A 346 (1998)	No Replacement
A 347 (1996)	No Replacement
A 349 (1984)	No Replacement
A 357 (1973)	A 387 – Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum
A 359 (1954)	A 370 – Test Methods and Definitions for Mechanical Testing of Steel Products
A 360/A 360M (1993)	No Replacement
A 361/A 361M (1995)	No Replacement
A 362 (1977)	No Replacement
A 364 (1959)	A 434 – Steel Bars, Alloy, Hot-Wrought or Cold-Finished, Quenched and Tempered
A 365 (1968)	A 619 – Discontinued 1997; No Replacement A 620 – Drawing Steel (DS) Sheet, Carbon, Cold-Rolled
A 366/A 366M (2000)	A 1008 - Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
A 371 (1969)	No Replacement
A 373 (1966)	Combined with A 36 – Carbon Structural Steel
A 374 (1971)	A 606 – Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance A 607 – Steel, Sheet and Strip, High-Strength, Low-Alloy, Columbium or Vanadium, or Both, Hot-Rolled and Cold-Rolled
A 375 (1971)	A 606 – Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance A 607 – Steel, Sheet and Strip, High-Strength, Low-Alloy, Columbium or Vanadium, or Both, Hot-Rolled and Cold-Rolled
A 378 (1955)	A 345 – Flat-Rolled Electrical Steels for Magnetic Applications
A 379 (1955)	A 345 – Flat-Rolled Electrical Steels for Magnetic Applications
A 382 (1971)	No Replacement
A 383 (1996)	No Replacement
A 386 (1984)	A 123 – Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
A 393 (1974)	A 262 – Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels
A 395 (1988)	A 395/A 395M – Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures
A 396 (1965)	A 536 – Ductile Iron Castings
A 397 (1958)	No Replacement
A 398 (1969)	No Replacement
A 399 (1969)	No Replacement
A 402 (1958)	No Replacement
A 404	No Replacement
A 405 (1995)	No Replacement
A 406 (1965)	No Replacement
A 407M (1989)	No Replacement
A 408 (1968)	A 615 – Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
A 410 (1976)	No Replacement

Discontinued	Replaced By
A 412 (1989)	No Replacement
A 415 (1970)	A 569 – Steel, Carbon (0.15 Maximum, Percent) Hot-Rolled Sheet and Strip Commercial Quality
A 417M (1989)	No Replacement
A 419 (1971)	No Replacement
A 422 (1994)	No Replacement
A 425 (1970)	A 569 – Steel, Carbon (0.15 Maximum, Percent) Hot-Rolled Sheet and Strip Commercial Quality
A 429 (1976)	A 276 – Stainless Steel Bars and Shapes
A 430/A 430M (1995)	A 312 – Seamless and Welded Austenitic Stainless Steel Pipes
A 431 (1968)	A 615 – Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
A 432 (1968)	A 615 – Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
A 433 (1972)	No Replacement
A 440 (1979)	No Replacement
A 441/A 441M (1989)	A 572/A 572M – High-Strength Low-Alloy Columbium-Vanadium Structural Steel
A 442/A 442M (1991)	No Replacement
A 443 (1966)	Combined with A 370 – Test Methods and Definitions for Mechanical Testing of Steel Products
A 444/A 444M (1995)	A 929/A 929M – Steel Sheet Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe
A 445 (1974)	A 395 – Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures
A 446/A 446M (1994)	A 653/A 653M – Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process A 924/A 924M – General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
A 448 (1976)	No Replacement
A 452 (1995)	No Replacement
A 454 (1980)	No Replacement
A 457 (1990)	No Replacement
A 458 (1991)	No Replacement
A 461 (1971)	A 564 – Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes A 637 – Discontinued; Redesignated B 637 – Precipitation-Hardening Nickel Alloy Bars, Forgings, and Forging Stock for High-Temperature Service A 638 – Precipitation Hardening Iron Base Superalloy Bars, Forgings, and Forging Stock for High-Temperature Service A 639 – Discontinued; Redesignated B 639 – Precipitation Hardening Cobalt-Containing Alloys (UNS R30155 and UNS R30816) Rod, Bar, Forgings, and Forging Stock for High-Temperature Service
A 462	E 165 – Test Method for Liquid Penetrant Examination
A 464 (1968)	A 376 – Seamless Austenitic Steel Pipe for High-Temperature Central-Station Service
A 465 (1975)	No Replacement
A 468 (1969)	A 6 – General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling A 341 – Test Method for Direct Current Magnetic Properties of Materials Using D-C Permeameters and the Ballistic Test Methods
A 476 (2000)	A 476/A 476M-00 – Ductile Iron Castings for Paper Mill Dryer Rolls
A 476M (2000)	A 476/A 476M-00 – Ductile Iron Castings for Paper Mill Dryer Rolls
A 477 (1991)	No Replacement
A 486/A 486M (1989)	No Replacement
A 502 (1999)	F 1470 – Guide for Fastener Sampling for Specified Mechanical Properties and Performance Inspection
A 509 (1983)	A 788 – General Requirements for Steel Forgings
A 518 M (1999)	A 518/A 518 M – Standard Specification for Corrosion-Resistant High-Silicon Iron Castings
A 520-97	No Replacement
A 525/A 525M (1994)	A 653/A 653M – Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process A 924/A 924M – General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
A 526/A 526M (1994)	A 653/A 653M – Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process A 924/A 924M – General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
A 527/A 527M (1994)	A 653/A 653M – Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process A 924/A 924M – General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
A 528/A 528M (1994)	A 653/A 653M – Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process A 924/A 924M – General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

Discontinued	Replaced By
A 535 (1999)	No Replacement
A 538/A 538M (1989)	No Replacement
A 544 (1991)	No Replacement
A 545 (1991)	No Replacement
A 546 (1991)	No Replacement
A 547 (1991)	No Replacement
A 548 (1991)	No Replacement
A 549 (1991)	No Replacement
A 552 (1974)	A 689 – Carbon and Alloy Steel Bars for Springs
A 557/A 557M (1995)	A 178 – Electric-Resistance-Welded Carbon Steel and Carbon-Manganese Steel Boiler and Superheater Tubes
A 558 (1969)	No Replacement
A 559 (1969)	No Replacement
A 566 (1984)	No Replacement
A 567/A 567M (1987)	No Replacement
A 568M (1991)	A 568/A 568M – General Requirements for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled
A 569/A 569M (2000)	A 1011/A 1011M - Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
A 570/A 570M (2000)	A 1011/A 1011M - Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
A 590 (1984)	No Replacement
A 593 (1976)	No Replacement
A 594 (1986)	No Replacement
A 599	A 599/A 599M-99 – Tin Mill Products, Electrolytic Tin-Coated, Cold-Rolled Sheet
A 605/A 605M (1989)	No Replacement
A 607 (2000)	A 1011/A 1011M - Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
A 611 (2000)	A 1008 - Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
A 613 (1984)	No Replacement
A 614 (1987)	No Replacement
A 615M (1993)	A 615/A 615M – Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
A 616/A 616M (1999)	A 996/A 996M - Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
A 617/A 617M (1999)	A 996/A 996M - Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
A 619/A 619M (1997)	No Replacement
A 620/A 620M (2000)	A 1008 - Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
A 621/A 621M (1997)	No Replacement
A 622/A 622M (2000)	A 1011/A 1011M - Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
A 624M (1995)	A 624/A 624M – Tin Mill Products, Electrolytic Tin Plate, Single Reduced
A 625M (1992)	A 625/A 625M – Tin Mill Products, Black Plate, Single Reduced
A 626M (1995)	A 626/A 626M – Tin Mill Products, Electrolytic Tin Plate, Double Reduced
A 628 (1982)	No Replacement
A 631 (1993)	A 583 – Cast Steel Wheels for Railway Service
A 634 (1978)	No Replacement
A 635M (1991)	A 635/A 635M – Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot-Rolled
A 637	Redesignated B 637 – Precipitation-Hardening Nickel Alloy Bars, Forgings, and Forging Stock for High-Temperature Service
A 639	Redesignated B 639 – Precipitation Hardening Cobalt-Containing Alloys (UNS R30155 and UNS R30816) Rod, Bar, Forgings, and Forging Stock for High-Temperature Service
A 641M (1997)	A 641/A 641M – Zinc-Coated (Galvanized) Carbon Steel Wire
A 642/A 642M (1994)	A 653/A 653M – Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process A 924/A 924M – General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
A 643 (1982)	No Replacement

Discontinued	Replaced By
A 647 (1982)	No Replacement
A 650M-88	A 650/A 650M – Tin Mill Products, Black Plate, Double Reduced
A 651 (1987)	No Replacement
A 652 (1984)	No Replacement
A 654 (1984)	No Replacement
A 655 (1984)	No Replacement
A 658/A 658M (1989)	No Replacement
A 661	Not Yet Assigned
A 665/A 665M (1998)	A 876/A 876M – Flat-Rolled, Grain-Oriented, Silicon-Iron, Electrical Steel, Fully Processed Types [Metric]
A 667M (1987)	A 667/A 667M – Centrifugally Cast Dual Metal (Gray and White Cast Iron) Cylinders
A 669 (1984)	A 789 – Seamless and Welded Ferritic/Austenitic Stainless Steel Tubing for General Service
A 670	Redesignated B 670 – Precipitation-Hardening Nickel Alloy (UNS N07718) Plate, Sheet, and Strip for High-Temperature Service
A 676 (1990)	No Replacement
A 677M (2000)	A 677/A 677M – Nonoriented Electrical Steel, Fully Processed Types
A 680/A 680M (1986)	A 684/A 684M – Steel, Strip, High-Carbon, Cold-Rolled
A 682M (1998)	A 682/A 682M – General Requirements for Steel, Strip, High-Carbon, Cold-Rolled, Spring Quality
A 683M (1999)	A 683/A 683M – Nonoriented Electrical Steel, Semiprocessed Types
A 685 (1986)	A 681 – Tool Steels Alloy
A 687 (1999)	No Replacement
A 698 (1992)	A 698/A 698M – Test Method for Magnetic Shield Efficiency in Attenuating Alternating Magnetic Fields
A 692 (1995)	A 209 – Seamless Carbon-Molybdenum Alloy-Steel Boiler and Superheater Tubes
A 699 (1986)	No Replacement
A 708 (1989)	No Replacement
A 715 (2000)	A 1011/A 1011M - Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
A 718 (1996)	No Replacement
A 722 (1995)	A 722/A 722M – Uncoated High-Strength Steel Bar for Prestressing Concrete
A 725/A 725M (1988)	A 876/A 876M – Flat-Rolled, Grain-Oriented, Silicon-Iron, Electrical Steel, Fully Processed Types [Metric]
A 726M (1998)	A 726 – Cold-Rolled Magnetic Lamination Quality Steel, Semiprocessed Types
A 728	Not Yet Assigned
A 731/A 731M (1995)	A 268 – Seamless and Welded Ferritic and Martensitic Stainless Steel Tubing for General Service
A 749M (1991)	A 749/A 749M – General Requirements for Steel, Strip, Carbon and High-Strength, Low-Alloy, Hot-Rolled
A 766/A 766M (1991)	No Replacement
A 776	Not Yet Assigned
A 777 (1995)	No Replacement
A 783 (1987)	No Replacement
A 784 (1988)	No Replacement
A 785 (1988)	No Replacement
A 791/A 791M (1995)	A 268 – Seamless and Welded Ferritic and Martensitic Stainless Steel Tubing for General Service
A 792M (1994)	A 792/A 792M – Steel Sheet, 55 Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
A 797 (1990)	No Replacement
A 806/A 806M (1995)	A 929/A 929M – Steel Sheet Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe
A 812/A 812M (1997)	No Replacement
A 816/A 816M (1994)	A 653/A 653M – Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process A 924/A 924Ma – General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
A 819 (1995)	A 929/A 929M – Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe
A 825 (1991)	No Replacement
A 828	Not Yet Assigned
A 829 (1992)	A 829/A 829M – Alloy Structural Steel Plates
A 830 (1992)	A 830/A 830M - Plates, Carbon Steel, Structural Quality, Furnished to Chemical Composition Requirements
A 831 (1994)	No Replacement
A 840 (2000)	A 840/A 840M – Fully Processed Magnetic Lamination Steel
A 843 (1988)	A 876/A 876M – Flat-Rolled, Grain-Oriented, Silicon-Iron, Electrical Steel, Fully Processed Types [Metric]
A 850 (1991)	No Replacement

Discontinued	Replaced By
A 863 (1991)	No Replacement
A 864/A 864M (1997)	No Replacement
A 868	Not Yet Assigned
A 869	Not Yet Assigned
A 870	Not Yet Assigned
A 873/A 873M (1997)	No Replacement
A 874M (1999)	A 874/A 874M – Ferritic Ductile Iron Castings Suitable for Low-Temperature Service
A 876M (1998)	A 876/A 876M – Flat-Rolled, Grain-Oriented, Silicon-Iron, Electrical Steel, Fully Processed Types
A 890 (1989)	A 890/A 890M – Castings, Iron-Chromium-Nickel-Molybdenum Corrosion-Resistant, Duplex (Austenitic/Ferritic) for General Application
A 906 (1993)	A 906/A 906M – Grade 80 and Grade 100 Alloy Steel Chain Slings for Overhead Lifting
A 916 (1995)	A 929/A 929M – Steel Sheet Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe
A 919 (1999)	A 941 – Terminology Relating to Steel, Stainless Steel, Related Alloys and Ferroalloys
A 929	Redesignated A 929/A 929M – Steel Sheet Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe
A 948	Not listed
A 949	Redesignated A 949/A 949M– Spray-Formed Seamless Ferritic/Austenitic Stainless Steel Pipe
A 963/A 963M (2000)	A 1008 - Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
A 969/A 969M (2000)	A 1008 - Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability

Appendix

3

JIS STEEL AND RELATED STANDARDS

Designation	Title
G 3101:1995	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	Title
G 3318:1994	Prepainted hot-dip zinc-5% aluminium alloy-coated steel sheets and coils
G 3320:1991	Coated stainless steel sheets
G 3321:1998	Hot-dip 55% aluminium-zinc alloy-coated steel sheets and coils
G 3322:1998	Prepainted hot-dip 55% aluminium-zinc alloy-coated steel sheets and coils
G 3350:1987	Light gauge steels for general structure
G 3351:1987	Expanded metals
G 3352:1979	Steel decks
G 3353:1990	Welded light gauge H steels for general structures
G 3429:1988	Seamless steel tubes for high pressure gas cylinder
G 3441:1988	Alloy steel tubes for machine purposes
G 3442:1997	Galvanized steel pipes for ordinary piping
G 3443:1987	Coated steel pipes for water service
G 3444:1994	Carbon steel tubes for general structural purposes
G 3445:1988	Carbon steel tubes for machine structural purposes
G 3446:1994	Stainless steel pipes for machine and structural purposes
G 3447:1997	Stainless steel sanitary pipes
G 3448:1997	Light gauge stainless steel tubes for ordinary piping
G 3451:1987	Fittings of coated steel pipes for water service
G 3452:1997	Carbon steel pipes for ordinary piping
G 3454:1988	Carbon steel pipes for pressure service
G 3455:1988	Carbon steel pipes for high pressure service
G 3456:1988	Carbon steel pipes for high temperature service
G 3457:1988	Arc welded carbon steel pipes
G 3458:1988	Alloy steel pipes
G 3459:1997	Stainless steel pipes
G 3460:1988	Steel pipes for low temperature service
G 3461:1988	Carbon steel boiler and heat exchanger tubes
G 3462:1988	Alloy steel boiler and heat exchanger tubes
G 3463:1994	Stainless steel boiler and heat exchanger tubes
G 3464:1988	Steel heat exchanger tubes for low temperature service
G 3465:1988	Seamless steel tubes for drilling
G 3466:1988	Carbon steel square pipes for general structural purposes
G 3467:1988	Steel tubes for fired heaters
G 3468:1994	Large diameter welded stainless steel pipes
G 3469:1992	Polyethylene coated steel pipes
G 3471:1977	Corrugated steel pipes and sections
G 3472:1985	Electric resistance welded carbon steel tubes for automobile structural purposes
G 3473:1988	Carbon steel tubes for cylinder barrels
G 3474:1995	High tensile strength steel tubes for tower structural purposes
G 3475:1996	Carbon steel tubes for building structure
G 3491:1993	Asphalt protective coatings for steel water pipe
G 3492:1993	Coal-tar enamel protective coatings for steel water pipe
G 3502:1996	Piano wire rods
G 3503:1980	Wire rods for core wire of covered electrode
G 3505:1996	Low carbon steel wire rods
G 3506:1996	High carbon steel wire rods
G 3507:1991	Carbon steel wire rods for cold heading and cold forging
G 3508:1991	Boron steel wire rods for cold heading and cold forging
G 3510:1992	Testing methods for steel tire cords
G 3521:1991	Hard drawn steel wires
G 3522:1991	Piano wires
G 3523:1980	Core wires for covered electrode
G 3525:1998	Wire ropes
G 3532:1993	Low carbon steel wires
G 3533:1993	Barbed wires
G 3535:1998	Wire ropes for aircraft control
G 3536:1994	Uncoated stress-relieved steel wires and strands for prestressed concrete
G 3537:1994	Zinc-coated steel wire strands
G 3538:1994	Hard drawn steel wire for prestressed concrete
G 3539:1991	Carbon steel wires for cold heading and cold forging
G 3540:1995	Wire ropes for mechanical control
G 3542:1993	Precoated color zinc-coated steel wires

Designation	Title
G 3543:1993	Polyvinyl chloride coated color steel wires
G 3544:1993	Hot-dip aluminium-coated steel wires
G 3545:1991	Boron steel wires for cold heading and cold forging
G 3546:1993	Wire ropes with profile wires
G 3547:1993	Zinc-coated low carbon steel wires
G 3548:1994	Zinc-coated steel wires
G 3551:1993	Welded steel wire fabrics
G 3552:1993	Chain link wire netting
G 3553:1983	Crimped wire cloth
G 3554:1983	Hexagonal wire netting
G 3555:1983	Woven wire cloth
G 3556:1989	Industrial woven wire cloths
G 3560:1994	Oil tempered wire for mechanical springs
G 3581:1994	Oil tempered wire for valve springs
G 3601:1989	Stainless-clad steels
G 3602:1992	Nickel and nickel alloy clad steels
G 3603:1992	Titanium clad steels
G 3604:1992	Copper and copper alloy clad steels
G 4051:1979	Carbon steels for machine structural use
G 4052:1979	Structural steels with specified hardenability bands
G 4102:1979	Nickel chromium steels
G 4103:1979	Nickel chromium molybdenum steels
G 4104:1979	Chromium steels
G 4105:1979	Chromium molybdenum steels
G 4108:1979	Manganese steels and manganese chromium steels for machine structural use
G 4107:1994	Alloy steel bolting materials for high temperature service
G 4108:1994	Alloy steel bars for special application bolting materials
G 4109:1987	Chromium-molybdenum alloy steel plates for boilers and pressure vessels
G 4110:1993	High strength chromium-molybdenum alloy steel plates for pressure vessels under high-temperature service
G 4202:1979	Aluminium chromium molybdenum steels
G 4303:1998	Stainless steel bars
G 4304:1991	Hot rolled stainless steel plates, sheets and strip
G 4305:1991	Cold rolled stainless steel plates, sheets and strip
G 4308:1998	Stainless steel wire rods
G 4309:1994	Stainless steel wires
G 4310:1991	Method of mass calculation for stainless steel plates and sheets, and heat-resisting steel plates and sheets
G 4311:1991	Heat-resisting steel bars
G 4312:1991	Heat-resisting steel plates and sheets
G 4313:1996	Cold rolled stainless steel strip for springs
G 4314:1994	Stainless steel wires for springs
G 4315:1994	Stainless steel wires for cold heading and cold forging
G 4318:1991	Stainless steel wire rods for welding
G 4317:1991	Hot rolled stainless steel equal leg angles
G 4318:1998	Cold finished stainless steel bars
G 4319:1991	Stainless steel blooms and billets for forgings
G 4320:1991	Cold formed stainless steel equal leg angles
G 4401:1983	Carbon tool steels
G 4403:1983	High speed tool steels
G 4404:1983	Alloy tool steels
G 4410:1984	Hollow drill steels
G 4801:1984	Spring steels
G 4802:1999	Cold-rolled steel strips for springs
G 4804:1999	Free cutting carbon steel
G 4805:1999	High carbon chromium bearing steels
G 4901:1991	Corrosion-resisting and heat-resisting superalloy bars
G 4902:1991	Corrosion-resisting and heat-resisting superalloy plates and sheets
G 4903:1991	Seamless nickel-chromium-iron alloy pipes
G 4904:1991	Seamless nickel-chromium-iron alloy heat exchanger tubes
G 5101:1991	Carbon steel castings
G 5102:1991	Steel castings for welded structure
G 5111:1991	High tensile strength carbon steel castings and low alloy steel castings for structural purposes
G 5121:1991	Stainless steel castings

Designation	Title
G 5122:1991	Heat resisting steel castings
G 5131:1991	High manganese steel castings
G 5151:1991	Steel castings for high temperature and high pressure service
G 5152:1991	Steel castings for low temperature and high pressure service
G 5201:1991	Centrifugally cast steel pipes for welded structure
G 5202:1991	Centrifugally cast steel pipes for high temperature and high pressure service
G 5501:1995	Grey iron castings
G 5502:1995	Spheroidal graphite iron castings
G 5503:1995	Austempered spheroidal graphite iron castings
G 5504:1992	Heavy-walled ferritic spheroidal graphite iron castings for low temperature service
G 5510:1987	Austenitic iron castings
G 5526:1998	Ductile iron pipes
G 5527:1998	Ductile iron fittings
G 5528:1984	Epoxy-powder coating for interior of ductile iron pipes and fittings
G 5702:1988	Blackheart malleable iron castings
G 5703:1988	Whiteheart malleable iron castings
G 5704:1988	Pearlitic malleable iron castings
G 5901:1974	Molding silica sand
G 5902:1974	Molding natural sand
G 5903:1975	Cast shot and grit
G 5904:1966	Testing method of cast shot and grit grain size

Appendix

4

JIS DISCONTINUED STEEL AND RELATED STANDARDS

Designation	Date Withdrawn/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	Date Withdrawn/Replaced by
JIS G 3309	Withdrawn in: 1953-05-08
JIS G 3310	Withdrawn in: 1969-08-06 Replaced by: G3141
JIS G 3391:1953	Withdrawn in: 1988-10-01
JIS G 3421	Withdrawn in: 1955-02-12 Replaced by: G3432;G3433;G3434;G3435;G3436
JIS G 3422	Withdrawn in: 1955-02-12 Replaced by: G3433
JIS G 3423	Withdrawn in: 1955-02-12 Replaced by: G3435
JIS G 3424	Withdrawn in: 1955-02-12 Replaced by: G3436
JIS G 3425	Withdrawn in: 1955-02-12 Replaced by: G3437
JIS G 3426	Withdrawn in: 1955-02-12 Replaced by: G3438
JIS G 3427	Withdrawn in: 1955-02-12 Replaced by: G3432
JIS G 3428	Withdrawn in: 1956-04-18 Replaced by: G3440
JIS G 3430	Withdrawn in: 1957-10-30 Replaced by: G3443
JIS G 3431	Withdrawn in: 1957-10-30 Replaced by: G3443
JIS G 3432	Withdrawn in: 1962-03-01 Replaced by: G3452
JIS G 3433	Withdrawn in: 1962-03-01 Replaced by: G3454;G3456
JIS G 3434	Withdrawn in: 1962-03-01 Replaced by: G3455
JIS G 3435	Withdrawn in: 1962-03-01 Replaced by: G3458;G3459
JIS G 3436	Withdrawn in: 1962-03-01 Replaced by: G3461;G3462;G3463
JIS G 3437	Withdrawn in: 1968-05-01
JIS G 3438	Withdrawn in: 1962-03-01 Replaced by: G3459;G3461;G3462;G3463
JIS G 3439:1988	Withdrawn in: 1996-01-01
JIS G 3440	Withdrawn in: 1961-02-01 Replaced by: G3444;G3445
JIS G 3501	Withdrawn in: 1956-08-21 Replaced by: G3505;G3506
JIS G 3524	Withdrawn in: 1957-10-30 Replaced by: Z3211
JIS G 3526	Withdrawn in: 1980-03-01
JIS G 3527	Withdrawn in: 1954-01-30 Replaced by: G3532
JIS G 3528	Withdrawn in: 1954-01-30 Replaced by: G3533
JIS G 3529	Withdrawn in: 1954-01-30
JIS G 3530	Withdrawn in: 1980-03-01
JIS G 3531	Withdrawn in: 1980-03-01
JIS G 3534	Withdrawn in: 1957-06-21 Replaced by: Z3201
JIS G 3534:1988	Withdrawn in: 1994-06-01
JIS G 3541:1988	Withdrawn in: 1992-02-01
JIS G 3565:1988	Withdrawn in: 1994-06-01
JIS G 3566:1988	Withdrawn in: 1994-06-01 Replaced by: G3561
JIS G 3567:1988	Withdrawn in: 1994-06-01 Replaced by: G3560
JIS G 3568:1989	Withdrawn in: 1994-06-01 Replaced by: G3560
JIS G 4201	Withdrawn in: 1953-11-07 Replaced by: G3102;G4102;G4103;G4104;G4105
JIS G 4301	Withdrawn in: 1959-12-01 Replaced by: G4303;G4304;G4305;G4306;G4307;G4308;G4309
JIS G 4302	Withdrawn in: 1964-09-01 Replaced by: G4311;G4312
JIS G 4306:1988	Withdrawn in: 1991-11-01 Replaced by: G4304
JIS G 4307:1987	Withdrawn in: 1991-11-01 Replaced by: G4305
JIS G 4402	Withdrawn in: 1956-04-18 Replaced by: G4404
JIS G 4405	Withdrawn in: 1956-04-18
JIS G 4406	Withdrawn in: 1956-04-18
JIS G 4407	Withdrawn in: 1956-04-18 Replaced by: G4404
JIS G 5521	Withdrawn in: 1983-02-01
JIS G 5522	Withdrawn in: 1983-02-01
JIS G 5523	Withdrawn in: 1983-02-01
JIS G 5524:1977	Withdrawn in: 1989-01-01
JIS G 5701	Withdrawn in: 1960-03-01 Replaced by: G5702;G5703;G5704
JIS G 5702:1988	Withdrawn in: 2000-02-20 Replaced by: JIS G 5705:2000
JIS G 5703:1988	Withdrawn in: 2000-02-20 Replaced by: JIS G 5705:2000
JIS G 5704:1988	Withdrawn in: 2000-02-20 Replaced by: JIS G 5705:2000
JIS G 9071:1976	Withdrawn in: 1992-02-01
JIS G 9072:1976	Withdrawn in: 1992-02-01

Appendix

5

CEN CURRENT STEEL STANDARDS

Designation	Title
EN ISO 683-17:1999	Heat-Treated Steels, Alloy Steels and Free-Cutting Steels. Ball and Roller Bearing Steels
EN ISO 1127:1997	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

Designation	Title
EN 10083-1:1991	Quenched and Tempered Steels. Technical Delivery Conditions for Special Steels
EN 10083-2:1991	Quenched and Tempered Steels. Technical Delivery Conditions for Unalloyed Quality Steels
EN 10083-3:1996	Quenched and Tempered Steels. Technical Delivery Conditions for Boron Steels
EN 10084:1998	Case Hardening Steels. Technical Delivery Conditions
EN 10085:2001	Nitriding Steel. Technical Delivery Conditions
EN 10087:1999	Free Cutting Steels. Technical Delivery Conditions for Semi-Finished Products, Hot Rolled Bars and Rods
EN 10088-1:1995	Stainless Steels. List of Stainless Steels
EN 10088-2:1995	Stainless Steels. Technical Delivery Conditions for Sheet/Plate and Strip for General Purposes
EN 10088-3:1995	Stainless Steels. Technical Delivery Conditions for Semi-Finished Products, Bars, Rods and Sections for General Purposes
EN 10090:1998	Valve Steels and Alloys for Internal Combustion Engines
EN 10095:1999	Heat Resisting Steels and Nickel Alloys
EN 10106:1996	Cold Rolled Non-Oriented Electrical Steel Sheet and Strip Delivered In the Fully Processed State
EN 10107:1996	Grain-Oriented Electrical Steel Sheet and Strip Delivered In the Fully Processed State
EN 10111:1998	Continuously Hot-Rolled Low Carbon Steel Sheet and Strip for Cold Forming. Technical Delivery Conditions
EN 10113-1:1993	Hot-Rolled Products In Weldable Fine Grain Structural Steels. General Delivery Conditions
EN 10113-2:1993	Hot-Rolled Products In Weldable Fine Grain Structural Steels. Delivery Conditions for Normalized/Normalized Rolled Steels
EN 10113-3:1993	Hot-Rolled Products In Weldable Fine Grain Structural Steels. Delivery Conditions for Thermomechanical Rolled Steels
EN 10120:1997	Steel Sheet and Strip for Welded Gas Cylinders
EN 10126:1996	Cold Rolled Electrical Non-Alloyed Steel Sheet and Strip Delivered In the Semi-Processed State
EN 10130:1999	Cold-Rolled Low-Carbon Steel Flat Products for Cold Forming. Technical Delivery Conditions
EN 10131:1991	Cold-Rolled Uncoated Low Carbon and High Yield Strength Steel Flat Products for Cold Forming. Tolerances On Dimensions and Shape
EN 10132-1:2000	Cold Rolled Narrow Steel Strip for Heat Treatment. Technical Delivery Conditions. General
EN 10132-2:2000	Cold Rolled Narrow Steel Strip for Heat Treatment. Technical Delivery Conditions. Case Hardening Steels
EN 10132-3:2000	Cold Rolled Narrow Steel Strip for Heat Treatment. Technical Delivery Conditions. Steels for Quenching and Tempering
EN 10132-4:2000	Cold Rolled Narrow Steel Strip for Heat Treatment. Technical Delivery Conditions. Spring Steels and Other Applications
EN 10137-1:1996	Plates and Wide Flats Made of High Yield Strength Structural Steels In the Quenched and Tempered or Precipitation Hardened Conditions. General Delivery Conditions
EN 10137-2:1996	Plates and Wide Flats Made of High Yield Strength Structural Steels In the Quenched and Tempered or Precipitation Hardened Conditions. Delivery Conditions for Quenched and Tempered Steels
EN 10137-3:1996	Plates and Wide Flats Made of High Yield Strength Structural Steels In the Quenched and Tempered or Precipitation Hardened Conditions. Delivery Conditions for Precipitation Hardened Steels
EN 10139:1998	Cold Rolled Uncoated Mild Steel Narrow Strip for Cold Forming. Technical Delivery Conditions
EN 10140:1997	Cold Rolled Narrow Steel Strip. Tolerances On Dimensions and Shape
EN 10142:2000	Continuously Hot-Dip Zinc Coated Low Carbon Steels Strip and Sheet for Cold Forming. Technical Delivery Conditions
EN 10143:1993	Continuously Hot-Dip Metal Coated Steel Sheet and Strip. Tolerances On Dimensions and Shape
EN 10147:2000	Continuously Hot-Dip Zinc Coated Structural Steels Strip and Sheet. Technical Delivery Conditions
EN 10149-1:1996	Specification for Hot-Rolled Flat Products Made of High Yield Strength Steels for Cold Forming. General Delivery Conditions
EN 10149-2:1996	Specification for Hot-Rolled Flat Products Made of High Yield Strength Steels for Cold Forming. Delivery Conditions for Thermomechanically Rolled Steels
EN 10149-3:1996	Specification for Hot-Rolled Flat Products Made of High Yield Strength Steels for Cold Forming. Delivery Conditions for Normalized or Normalized Rolled Steels
EN 10152:1994	Specification for Electrolytically Zinc Coated Cold Rolled Steel Flat Products. Technical Delivery Conditions
EN 10154:1996	Continuously Hot-Dip Aluminium-Silicon (AS) Coated Steel Strip and Sheet. Technical Delivery Conditions
EN 10155:1993	Structural Steels with Improved Atmospheric Corrosion Resistance. Technical Delivery Conditions
EN 10160:1999	Ultrasonic Testing of Steel Flat Product of Thickness Equal or Greater Than 6 Mm (Reflection Method)
EN 10163-1:1991	Specification for Delivery Requirements for Surface Condition of Hot Rolled Steel Plates, Wide Flats and Sections. General Requirements
EN 10163-2:1991	Specification for Delivery Requirements for Surface Condition of Hot Rolled Steel Plates, Wide Flats and Sections. Plates and Wide Flats
EN 10163-3:1991	Specification for Delivery Requirements for Surface Condition of Hot Rolled Steel Plates, Wide Flats and Sections. Sections
EN 10164:1993	Steel Products with Improved Deformation Properties Perpendicular To the Surface of the Product. Technical Delivery Conditions
EN 10165:1996	Cold Rolled Electrical Alloyed Steel Sheet and Strip Delivered In the Semi-Processed State

Designation	Title
EN 10169-1:1997	Continuously Organic Coated (Coil Coated) Steel Flat Products. General Information (Definitions, Materials, Tolerances, Test Methods)
EN 10202:2001	Cold Reduced Tinmill Products. Electrolytic Tinplate and Electrolytic Chromium/Chromium Oxide Coated Steel
EN 10204:1991	Metallic Products. Types of Inspection Documents
EN 10205:1992	Specification for Cold Reduced Blackplate In Coil Form for the Production of Tinplate or Electrolytic Chromium/Chromium Oxide Coated Steel
EN 10207:1992	Steels for Simple Pressure Vessels. Technical Delivery Requirements for Plates, Strips and Bars
EN 10208-1:1998	Steel Pipes for Pipelines for Combustible Fluids. Technical Delivery Conditions. Pipes of Requirement Class A
EN 10208-2:1997	Steel Pipes for Pipelines for Combustible Fluids. Technical Delivery Conditions. Pipes of Requirement Class B
EN 10209:1996	Cold Rolled Low Carbon Steel Flat Products for Vitreous Enamelling. Technical Delivery Conditions
EN 10210-1:1994	Hot Finished Structural Hollow Sections of Non-Alloy and Fine Grain Structural Steels. Technical Delivery Requirements
EN 10210-2:1997	Hot Finished Structural Hollow Sections of Non-Alloy and Fine Grain Structural Steels. Tolerances, Dimensions and Sectional Properties
EN 10213-1:1996	Technical Delivery Conditions for Steel Castings for Pressure Purposes. General
EN 10213-2:1996	Technical Delivery Conditions for Steel Castings for Pressure Purposes. Steel Grades for Use At Room Temperature and At Elevated Temperature
EN 10213-3:1996	Technical Delivery Conditions for Steel Castings for Pressure Purposes. Steels for Use At Low Temperatures
EN 10213-4:1996	Technical Delivery Conditions for Steel Castings for Pressure Purposes. Austenitic and Austenitic-Ferritic Steel Grades
EN 10214:1995	Continuously Hot-Dip Zinc-Aluminium (ZA) Coated Steel Strip and Sheet. Technical Delivery Conditions
EN 10215:1995	Continuously Hot-Dip Zinc-Aluminium (AZ) Coated Steel Strip and Sheet. Technical Delivery Conditions
EN 10218-1:1994	Steel Wire and Wire Products. General. Test Methods
EN 10218-2:1997	Steel Wire and Wire Products. General. Wire Dimensions and Tolerances
EN 10219-1:1997	Cold Formed Welded Structural Sections of Non-Alloy and Fine Grain Steels. Technical Delivery Requirements
EN 10219-2:1997	Cold Formed Welded Structural Sections of Non-Alloy and Fine Grain Steels. Tolerances, Dimensions and Sectional Properties
EN 10221:1996	Specification for Surface Quality Classes for Hot-Rolled Bars and Rods. Technical Delivery Conditions
EN 10222-1:1998	Steel Forgings for Pressure Purposes. General Requirements for Open Die Forgings
EN 10222-2:2000	Steel Forgings for Pressure Purposes. Ferritic and Martensitic Steels with Specified Elevated Temperature Properties
EN 10222-3:1999	Steel Forgings for Pressure Purposes. Nickel Steels with Specified Low-Temperature Properties
EN 10222-4:1999	Steel Forgings for Pressure Purposes. Weldable Fine-Grain Steels with High Proof Strength
EN 10222-5:2000	Steel Forgings for Pressure Purposes. Martensitic, Austenitic and Austenitic-Ferritic Stainless Steels
EN 10223-1:1998	Steel Wire and Wire Products for Fences. Zinc and Zinc Alloy Coated Steel Barbed Wire
EN 10223-2:1998	Steel Wire and Wire Products for Fences. Hexagonal Steel Wire Netting for Agricultural, Insulation and Fencing Purposes
EN 10223-3:1998	Steel Wire and Wire Products for Fences. Hexagonal Steel Wire Netting for Engineering Purposes
EN 10223-4:1998	Steel Wire and Wire Products for Fences. Steel Wire Welded Mesh Fencing
EN 10223-5:1998	Steel Wire and Wire Products for Fences. Steel Wire Woven Hinged Joint and Knotted Mesh Fencing
EN 10223-6:1998	Steel Wire and Wire Products for Fences. Steel Wire Chain Link Fencing
EN 10228-1:1999	Non-Destructive Testing of Steel Forgings. Magnetic Particle Inspection
EN 10228-2:1998	Non-Destructive Testing of Steel Forgings. Penetrant Testing
EN 10228-3:1998	Non-Destructive Testing of Steel Forgings. Ultrasonic Testing of Ferritic or Martensitic Steel Forgings
EN 10228-4:1999	Non-Destructive Testing of Steel Forgings. Ultrasonic Testing of Austenitic and Austenitic-Ferritic Stainless Steel Forgings
EN 10238:1997	Automatically Blast Cleaned and Automatically Primed Structural Steel Products
EN 10240:1998	Internal and/or External Protective Coatings for Steel Tubes. Specification for Hot Dip Galvanized Coatings Applied In Automatic Plants
EN 10241:2000	Steel Threaded Pipe Fittings
EN 10243-1:1999	Steel Die Forgings. Tolerances On Dimensions. Drop and Vertical Press Forgings
EN 10243-2:1999	Steel Die Forgings. Tolerances On Dimensions. Upset Forgings Made On Horizontal Forging Machines
EN 10244-1:2001	Steel Wire and Wire Products. Non-Ferrous Metallic Coatings On Steel Wire. General Principles
EN 10244-2:2001	Steel Wire and Wire Products. Non-Ferrous Metallic Coatings On Steel Wire. Zinc or Zinc Alloy Coatings
EN 10244-3:2001	Steel Wire and Wire Products. Non-Ferrous Metallic Coatings On Steel Wire. Aluminium Coatings
EN 10244-4:2001	Steel Wire and Wire Products. Non-Ferrous Metallic Coatings On Steel Wire. Tin Coatings
EN 10244-5:2001	Steel Wire and Wire Products. Non-Ferrous Metallic Coatings On Steel Wire. Nickel Coatings
EN 10244-6:2001	Steel Wire and Wire Products. Non-Ferrous Metallic Coatings On Steel Wire. Copper, Bronze or Brass Coatings
EN 10245-1:2001	Steel Wire and Wire Products. Organic Coatings On Steel Wire. General Rules
EN 10245-2:2001	Steel Wire and Wire Products. Organic Coatings On Steel Wire. PVC Finished Wire
EN 10245-3:2001	Steel Wire and Wire Products. Organic Coatings On Steel Wire. PE Coated Wire
EN 10246-1:1996	Non-Destructive Testing of Steel Tubes. Automatic Electromagnetic Testing of Seamless and Welded (Except Submerged Arc Welded) Ferromagnetic Steel Tubes for Verification of Hydraulic Leak-Tightness

Designation	Title
EN 10246-2:2000	Non-Destructive Testing of Steel Tubes. Automatic Eddy Current Testing of Seamless and Welded (Except Submerged Arc Welded) Austenitic and Austenitic-Ferritic Steel Tubes for Verification of Hydraulic Leak-Tightness
EN 10246-3:2000	Non-Destructive Testing of Steel Tubes. Automatic Eddy Current Testing of Seamless and Welded (Except Submerged Arc-Welded) Steel Tubes for the Detection of Imperfections
EN 10246-4:2000	Non-Destructive Testing of Steel Tubes. Automatic Full Peripheral Magnetic Transducer/Flux Leakage Testing of Seamless Ferromagnetic Steel Tubes for the Detection of Transverse Imperfections
EN 10246-5:2000	Non-Destructive Testing of Steel Tubes. Automatic Full Peripheral Magnetic Transducer/Flux Leakage Testing of Seamless and Welded (Except Submerged Arc-Welded) Ferromagnetic Steel Tubes for the Detection of Longitudinal Imperfections
EN 10246-6:2000	Non-Destructive Testing of Steel Tubes. Automatic Full Peripheral Ultrasonic Testing of Seamless Steel Tubes for the Detection of Transverse Imperfections
EN 10246-7:1996	Non-Destructive Testing of Steel Tubes. Automatic Full Peripheral Ultrasonic Testing of Seamless and Welded (Except Submerged Arc Welded) Steel Tubes for the Detection of Longitudinal Imperfections
EN 10246-8:2000	Non-Destructive Testing of Steel Tubes. Automatic Ultrasonic Testing of the Weld Seam of Electric Welded Steel Tubes for the Detection of Longitudinal Imperfections
EN 10246-9:2000	Non-Destructive Testing of Steel Tubes. Automatic Ultrasonic Testing of the Weld Seam of Submerged Arc Welded Steel Tubes for the Detection of Longitudinal and/or Transverse Imperfections
EN 10246-10:2000	Non-Destructive Testing of Steel Tubes. Radiographic Testing of the Weld Seam of Automatic Fusion Arc Welded Steel Tubes for the Detection of Imperfections
EN 10246-11:2000	Non-Destructive Testing of Steel Tubes. Liquid Penetrant Testing of Seamless and Welded Steel Tubes for the Detection of Surface Imperfections
EN 10246-12:2000	Non-Destructive Testing of Steel Tubes. Magnetic Particle Inspection of Seamless and Welded Ferromagnetic Steel Tubes for the Detection of Surface Imperfections
EN 10246-13:2000	Non-Destructive Testing of Steel Tubes. Automatic Full Peripheral Ultrasonic Thickness Testing for Seamless and Welded (Except Submerged Arc Welded) Steel Tubes
EN 10246-14:2000	Non-Destructive Testing of Steel Tubes. Automatic Ultrasonic Testing of Seamless and Welded (Except Submerged Arc-Welded) Steel Tubes for the Detection of Laminar Imperfections
EN 10246-15:2000	Non-Destructive Testing of Steel Tubes. Automatic Ultrasonic Testing of Strip/Plate Used In the Manufacture of Welded Steel Tubes for the Detection of Laminar Imperfections
EN 10246-16:2000	Non-Destructive Testing of Steel Tubes. Automatic Ultrasonic Testing of the Area Adjacent To the Weld Seam of Welded Steel Tubes for the Detection of Laminar Imperfections
EN 10246-17:2000	Non-Destructive Testing of Steel Tubes. Ultrasonic Testing of Tube Ends of Seamless and Welded Steel Tubes for the Detection of Laminar Imperfections
EN 10246-18:2000	Non-Destructive Testing of Steel Tubes. Magnetic Particle Inspection of Tube Ends of Seamless and Welded Ferromagnetic Steel Tubes for the Detection of Laminar Imperfections
EN 10248-1:1996	Hot Rolled Sheet Piling of Non Alloy Steels. Technical Delivery Conditions
EN 10248-2:1996	Hot Rolled Sheet Piling of Non Alloy Steels. Tolerances On Shape and Dimensions
EN 10249-1:1996	Cold Formed Sheet Piling of Non Alloy Steels. Technical Delivery Conditions
EN 10249-2:1996	Cold Formed Sheet Piling of Non Alloy Steels. Tolerances On Shape and Dimensions
EN 10250-1:1999	Open Steel Die Forgings for General Engineering Purposes. General Requirements
EN 10250-2:2000	Open Steel Die Forgings for General Engineering Purposes. Non-Alloy Quality and Special Steels
EN 10250-3:2000	Open Steel Die Forgings for General Engineering Purposes. Alloy Special Steels
EN 10250-4:2000	Open Steel Die Forgings for General Engineering Purposes. Stainless Steels
EN 10251:1997	Magnetic Materials. Methods of Determination of the Geometrical Characteristics of Electrical Steel Sheet and Strip
EN 10252:1997	Magnetic Materials. Methods of Measurement of Magnetic Properties of Magnetic Steel Sheet and Strip At Medium Frequencies
EN 10253-1:1999	Butt-Welding Pipe Fittings. Wrought Carbon Steel for General Use and Without Specific Inspection Requirements
EN 10254:1999	Steel Closed Die Forgings. General Technical Delivery Conditions
EN 10256:2000	Non-Destructive Testing On Steel Tubes. Qualification and Competence of Level 1 and Level 2 Non-Destructive Testing Personnel
EN 10257-1:1998	Zinc or Zinc Alloy Coated Non-Alloy Steel Wire for Armouring Either Power Cables or Telecommunication Cables. Land Cables
EN 10257-2:1998	Zinc or Zinc Alloy Coated Non-Alloy Steel Wire for Armouring Either Power Cables or Telecommunication Cables. Submarine Cables
EN 10258:1997	Cold-Rolled Stainless Steel Narrow Strip and Cut Lengths. Tolerances On Dimensions and Shape
EN 10259:1997	Cold-Rolled Stainless and Heat Resisting Steel Wide Strip and Plate/Sheet. Tolerances On Dimensions and Shape
EN 10267:1998	Ferritic-Pearlitic Steels for Precipitation Hardening from Hot-Working Temperatures
EN 10268:1999	Cold-Rolled Flat Products Made of High Yield Strength Micro-Alloyed Steels for Cold Forming. General Delivery Conditions
EN 10269:1999	Steels and Nickel Alloys for Fasteners with Specified Elevated and/or Low Temperature Properties
EN 10270-1:2001	Steel Wire for Mechanical Springs. Patented Cold Drawn Unalloyed Spring Steel Wire
EN 10270-2:2001	Steel Wire for Mechanical Springs. Oil Hardened and Tempered Spring Steel Wire
EN 10270-3:2001	Steel Wire for Mechanical Springs. Stainless Spring Steel Wire
EN 10271:1999	Electrolytically Zinc-Nickel (ZN) Coated Steel Flat Products. Technical Delivery Conditions

Designation	Title
EN 10272:2000	Stainless Steel Bars for Pressure Purposes
EN 10273:2000	Hot Rolled Weldable Steel Bars for Pressure Purposes with Specified Elevated Temperature Properties
EN 10277-1:1999	Bright Steel Products. Technical Delivery Conditions. General
EN 10277-2:1999	Bright Steel Products. Technical Delivery Conditions. Steels for General Engineering Purposes
EN 10277-3:1999	Bright Steel Products. Technical Delivery Conditions. Free Cutting Steels
EN 10277-4:1999	Bright Steel Products. Technical Delivery Conditions. Case-Hardening Steels
EN 10277-5:1999	Bright Steel Products. Technical Delivery Conditions. Steels for Quenching and Tempering
EN 10278:1999	Dimensions and Tolerances of Bright Steel Products
EN 10279:2000	Hot Rolled Steel Channels. Tolerances On Shape, Dimension and Mass
EN 10283:1999	Corrosion Resistant Steel Castings
EN 10292:2000	Continuously Hot-Dip Coated Strip and Sheet of Steels with Higher Yield Strength for Cold Forming. Technical Delivery Conditions
EN 10303:2001	Thin Magnetic Steel Sheet and Strip for Use At Medium Frequencies
EN 12007-3:2000	Gas Supply Systems. Pipelines for Maximum Operating Pressure Up To and Including 16 Bar. Specific Functional Recommendations for Steel
EN 12269-1:2000	Determination of the Bond Behaviour Between Reinforcing Steel and Autoclaved Aerated Concrete by the "Beam Test". Short Term Test
EN 12454:1998	Founding. Visual Examination of Surface Discontinuities. Steel Sand Castings
EN 10028-1:1993	Specification for Flat Products Made of Steels for Pressure Purposes. General Requirements
EN 10142:1991	Specification for Continuously Hot-Dip Zinc Coated Low Carbon Steel Sheet and Strip for Cold Forming: Technical Delivery Conditions
EN 10147:1992	Specification for Continuously Hot-Dip Zinc Coated Structural Steel Sheet and Strip. Technical Delivery Conditions
EN 10202:1990	Specification for Cold Reduced Electrolytic Chromium/Chromium Oxide Coated Steel
EN 10203:1991	Specification for Cold Reduced Electrolytic Tinplate

Appendix

6

***CEN STANDARDS WITH SUPERSEDED
FORMER NATIONAL STANDARDS***

Chapter 2: Carbon and Alloy Steels for General Use	
Current CEN Standard	Former National Standards Superseded by CEN Standards
EN 10083–1:1991+A1:1996 Quenched and Tempered Steels 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 3: Structural Steel Plates	
Current CEN Standards	Former National Standards Superseded by CEN Standards
EN 10025:1993 Hot Rolled Products of Non-Alloy Structural Steels - Technical Delivery Conditions	Supersedes: BSI BS 4360:1986 Specification for Weldable Structural Steels (Withdrawn)
EN 10113 Hot-Rolled Products in Weldable Fine Grain Structural Steels EN 10113-Part 1:1993 General Delivery Conditions EN 10113-Part 2:1993 Delivery Conditions for Normalized/Normalized Rolled Steels EN 10113-Part 3:1993 Delivery Conditions for Thermomechanical Rolled Steels EN 10155:1993 Structural Steels with Improved Atmospheric Corrosion Resistance. Technical Delivery Conditions	Supersedes: BSI BS 4360:1990 Weldable Structural Steels (Withdrawn)
EN 10137 Plates and Wide Flats Made of High Yield Strength Structural Steels in the Quenched and Tempered or Precipitation Hardened Conditions EN 10137-Part 1:1996 General Delivery Conditions EN 10137-Part 2:1996 Delivery Conditions for Quenched and Tempered Steels EN 10137-Part 3:1996 Delivery Conditions for Precipitation Hardened Steels	Supersedes: BSI BS 7613:1994 Hot Rolled Quenched and Tempered Weldable Structural Steel Plates (Withdrawn)
EN 10025:1993 Hot Rolled Products of Non-Alloy Structural Steels - Technical Delivery Conditions	Supersedes: DIN 17100:1980 Steels for General Structural Purposes; Quality Standard (Withdrawn)
EN 10113 Hot Rolled Products Made from Weldable, Fine Grain Structural Steel; EN 10113-Part 1:1993 General Technical Delivery Conditions EN 10113-Part 2:1993 Delivery Conditions for Normalized/Normalized Rolled Steels EN 10028 Flat Products Made from Steel for Pressure Purposes EN 10028Part 1:1993 General Requirements EN 10028-Part 3:1993 Weldable Fine Grain Steels, Normalized	Supersedes : DIN 17102:1983 Weldable Normalized Fine Grain Structural Steels; Technical Delivery Conditions for Plate, Strip, Wide Flats, Sections and Bars (Withdrawn)
EN 10113 Hot-Rolled Products in Weldable Fine Grain Structural Steels EN 10113-Part 2:1993 Delivery Conditions for Normalized/Normalized Rolled Steels.	Supersedes : AFNOR NF A 35-504:1984 Poutrelles et Profils en Aciers à Haute Limite d'Élasticité pour Constructions Soudées - Nuances et Qualités AFNOR NF A 36-Part 201:1984 Tôles en Aciers à Haute Limite d'Élasticité pour Constructions Soudées - Nuances et Qualités
EN 10137 Plates and Wide Flats Made of High Yield Strength Structural Steels in the Quenched and Tempered or Precipitation Hardened Conditions EN 10137-Part 2:1995 Delivery Conditions for Quenched and Tempered Steels EN 10137-Part 3:1995 Delivery Conditions for Precipitation Hardened Steels	Supersedes: AFNOR NF A 36-Part 204:1992 Produits Sidérurgiques – Tôles en Aciers à Haute Limite d'Élasticité Livrées à l'État Traité pour Construction Soudée – Nuances et Qualité
EN 10155:1993 Structural Steels With Improved Atmospheric Corrosion Resistance - Technical Delivery Conditions	Supersedes: AFNOR NF A35-502:1984 Aciers de Construction à Résistance Améliorée à la Corrosion Atmosphérique – Tôles Minces Moyennes et Fortes, Larges Plats, Laminés Marchands et Poutrelles

Chapter 4: Pressure Vessel Steel Plates	
Current CEN Standard	Former National Standards Superseded by CEN Standards
EN 10028 Specification for Flat Products Made of Steels for Pressure Purposes. EN 10028-Part 2:1993 Non-Alloy and Alloy Steels with Specified Elevated Temperature Properties EN 10028-Part 3:1993 Weldable Fine Grain Steels, Normalized	Supersedes: BSI BS 1501 Steels for Pressure Purposes. BSI BS 1501-Part 1:1980 Specification for Carbon and Carbon Manganese Steels: Plates (Withdrawn) BSI BS 1501-Part 2:1988. Specification for Alloy Steels: Plates (Withdrawn)
EN 10028-Part 4:1995 Specification for Flat Products Made of Steels for Pressure Purposes. Nickel Alloy Steels with Specified Low Temperature Properties	Supersedes: BSI BS 1501-Part 2:1988 Steels for Pressure Purposes. Specification for Alloy Steels: Plates (Withdrawn)
EN 10028-Part 1:2000 Specification For Flat Products Made of Steels for Pressure Purposes. General Requirements	Supersedes: BSI BS 1501-Part 1:1980 Steels For Pressure Purposes. Specification for Carbon and Carbon Manganese Steels: Plates (Withdrawn) BSI BS 1501-Part 2:1988 Steels for Pressure Purposes. Specification for Alloy Steels: Plates (Withdrawn)
EN 10028-Part 7:2000 Flat Products Made of Steels for Pressure Purposes Stainless Steels	Supersedes: BSI BS 1501-Part 3:1990 Amd 5 Steels for Pressure Purposes Specification for Corrosion- and Heat-Resisting Steels: Plates, Sheet and Strip (Withdrawn)
EN 10028 Flat Products Made from Steel for Pressure Purposes; EN 10028-Part 1:2000 General requirements EN 10028-Part 2:1993 Unalloyed and Alloy Steels with Elevated Temperature Properties	Supersedes: DIN 17155:1983 Weldable Normalized Fine Grain Structural Steels; Technical Delivery Conditions for Plate Strip, Wide Flats, Sections and Bars
EN 10028:1993 Flat Products Made from Steel for Pressure Purposes; EN 10028-Part 1: 2000 General requirements EN 10028-Part 3:1993 Weldable, Normalized, Fine Grain Steels EN 10113:1993 Hot Rolled Products Made from Weldable, Fine Grain Structural Steel; EN 10113-Part 1:1993 General Technical Delivery Conditions EN 10113-Part 2:1993 Technical Delivery Conditions for Normalized Rolled Steel	Supersedes: DIN 17102:1983 Creep Resistant Steel Plate and Strip; Technical Delivery Conditions
EN 10028-Part 4 1994 Flat Products Made of Steels for Pressure Purposes; Nickel-Alloy Steels with Specified Low Temperature Properties EN 10028-Part 1:2000 Flat Products Made of Steel for Pressure Purposes - General Requirements	Partially Supersedes: DIN 17280:1985 Steels With Low Temperature Toughness; Technical Delivery Conditions for Plate. Sheet, Strip, Wide Flats,Sections,Bars and Forgings
EN 10028-Part 7:2000 Flat Products Made of Steels for Pressure Purposes Stainless Steels	Supersedes: DIN 17441:1997 Technical Delivery Conditions for Stainless Steel Cold-Rolled Strip, Slit Strip and Plate Cut Therefrom for Pressure Purposes Partially Supersedes: DIN 17440:1996 Technical Delivery Conditions for Stainless Steel Plate, Hot Rolled Strip, and Bars for Pressure Purposes DIN 17460:1992 High-Temperature Austenitic Steel Plate and Sheet, Cold and Hot Rolled Strip, Bars and Forgings; Technical Delivery Conditions

Chapter 4: Pressure Vessel Steel Plates (Continued)	
Current CEN Standard	Former National Standards Superseded by CEN Standards
EN 10028-Part 2:1992 Flat Products Made of Steels for Pressure Purposes. Non-Alloy and Alloy Steels with Specified Elevated Temperature Properties.	Supersedes: AFNOR NF A36-205:1982 AFNOR NF A36-206:1983
EN 10028-Part 3:1992 Flat Products Made of Steels for Pressure Purposes. Weldable Fine Grain Steels, Normalized.	Supersedes: AFNOR NF A36-207:1982
EN 10028-Part 4:1994 Flat Products Made of Steels for Pressure Purposes. Nickel Alloy Steels with Specified Low Temperature Properties.	Supersedes: AFNOR NF A36-208:1982 Tôles en Aciers au Nickel pour Appareils à Pression à Basse Température
EN 10028-Part 7:2000 Flat Products Made of Steels for Pressure Purposes Stainless Steels	Partially Supersedes: AFNOR NF A36-209:1990 Austenitic and Austenitic-Ferritic Stainless Steels Plates for Boilers and Pressure Vessels

Chapter 6: Steel Forgings	
Current CEN Standard	Former National Standards Superseded by CEN Standards
EN 10222 Steel forgings for Pressure Purposes EN 10222-Part 1:1998 General Requirements for Open Die Forgings EN 10222 Steel forgings for Pressure Purposes EN 10222-Part 3:1999 Nickel Steels with Specified Low-Temperature EN 10222-Part 4:1999 Weldable Fine-Grain Steels with High Proof Strength EN 10222:Steel forgings for Pressure Purposes EN 10222-Part 2:2000 Ferritic and Martensitic Steels with Specified Elevated Temperature Properties EN 10222-Part 5:2000 Martensitic, Austenitic and Austenitic-Ferritic Stainless Steels	Supersedes: BSI BS 1503:1989 Amd 3 Steel Forgings for Pressure Purposes (Withdrawn)
EN 10250 Corr 1 Open Die Steel Forgings for General engineering Purposes EN 10250-Part 2:2000 Non-Alloy Quality and Special Steels CORR 11041	Supersedes: BSI BS 29:1976 Carbon Steel Forgings Above 150 mm Ruling Section (Withdrawn)
EN 10250 Open Die Steel Forgings for General engineering Purposes EN 10250-Part 3:2000 Alloy Special Steels	Supersedes: BSI BS 4670:1971 Alloy Steel Forgings (Withdrawn)
EN 10250: Open Die Steel Forgings for General engineering Purposes EN 10250-Part 4: 2000 Stainless Steels	Partially 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 10222-Part 1:1998 Steel Forgings for Pressure Purposes General Requirements for Open Die Forgings	Supersedes: DIN 17103:1989 Weldable Fine Grain Structural Steel Forgings; Technical Delivery Conditions (Withdrawn) DIN 17243:1987 Weldable Heat Resisting Steel Forgings and Rolled or Forged Steel Bars; Technical Delivery Conditions (Withdrawn) Partially Supersedes: DIN 17280:1985 Steels with Low Temperature Toughness; Technical Delivery Conditions for Plate, Sheet, Strip, Wide Flats, Sections, Bars and Forgings (Withdrawn) DIN 17440:1996 Stainless Steels- Technical Delivery Conditions for Plates, Hot Rolled Strip and Bars for Pressure Purposes, Drawn Wire and Forgings (Withdrawn) DIN 17100:1980 Steels for General Structural Purposes; Quality Standard (Withdrawn)
EN 10222 Steel Forgings for Pressure Purposes EN 10222-Part 1:2000 General Requirements for Open Die Forgings EN 10222-Part 2:2000 Ferritic and Martensitic Steels with Specified Elevated Temperature Properties (Includes Corrigendum AC: 2000) EN 10273:2000 Hot Rolled Weldable Steel Bars for Pressure Purposes with Specified Elevated Temperature	Supersedes: DIN 17243:1987 Weldable Heat Resisting Steel Forgings and Rolled or Forged Steel Bars; Technical Delivery Conditions (Withdrawn)

Chapter 6: Steel Forgings (Continued)	
Current CEN Standard	Former National Standards Superseded by CEN Standards
EN 10250 Open Die Steel Forgings for General engineering Purposes EN 10250-Part 1:1999 General EN 10250-Part 2:1999 Non-Alloy Quality and Special Steels	Supersedes: DIN 17100:1980 Steels for General Structural Purposes; Quality Standard (Withdrawn) Partially Supersedes: DIN 17440:1996 Stainless Steels-Technical Delivery Conditions for Plates, Hot Rolled Strip and Bars for Pressure Purposes, Drawn Wire and Forgings (Withdrawn)
EN 10250 Open Die Steel Forgings for General engineering Purposes EN 10250-Part 1:1999 General Requirements for Open Die Forgings EN 10250-Part 2:1999 Non-Alloy Quality and Special Steels	Supersedes: DIN 17100:1980 Steels for General Structural Purposes; Quality Standard (Withdrawn)
EN 10250 Open Die Steel Forgings for General engineering Purposes EN 10250-Part 1:1999 General Requirements for Open Die Forgings EN 10250-Part 4:2000 Stainless Steels	Partially Supersedes: DIN 17440:1996 Stainless Steels-Technical Delivery Conditions for Plates, Hot Rolled Strip and Bars for Pressure Purposes, Drawn Wire and Forgings (Withdrawn)
EN 10222 Steel Forgings for Pressure Purposes EN 10222-Part 1:1998 General Requirements for Open Die Forgings EN 10222 Steel Forgings for Pressure Purposes EN 10222-Part 3 :1999 Nickel Steels with Specified Low Temperature Properties. EN 10222-Part 4 :1999 Weldable Fine Grain Steels with High Proof Strength EN 10222 Steel Forgings for Pressure Purposes EN 10222-Part 2:2000 Ferritic and Martensitic Steels with Specified Elevated Temperature Properties EN 10222-Part 5:2000 Martensitic, Austenitic and Austenitic-Ferritic Stainless Steels	Supersedes: AFNOR NF A36-601:1980 Pièces Forgées en Acier Soudable pour Chaudières et Appareils à Pression - Aciers au Carbone et Carbone-Manganèse – Nuances et Qualités (Withdrawn) AFNOR NF A36-602:1988 Pièces Forgées en Acier Soudable pour Chaudières et Appareils à Pression – Aciers Alliés au Mo, au Mn-Mo et au Cr-Mo - Nuances et Qualités (Withdrawn) AFNOR NF A36-603:1988 Pièces Forgées en Acier Soudable pour Chaudières et Appareils à Pression - Aciers Alliés à Haute Limite d'Élasticité - Nuances et Qualités (Withdrawn) AFNOR NF A36-607:1984 Pièces Obtenues par Forgeage Libre ou Estampage en Aciers Inoxydables Austénitiques pour Chaudières et Appareils à Pression – Nuances et Qualités (Withdrawn)
EN 10250 Open Die Steel Forgings for General engineering Purposes EN 10250-Part 1:1999 General Requirements	Supersedes: AFNOR NF A36-612:1982 Pièces Forgées d'Usage Général – Aciers Non Alliés (Withdrawn) AFNOR NF A36-613:1986 Pièces Forgées d'Usage Général – Aciers Inoxydables (Withdrawn)
EN 10250 Open Die Steel Forgings for General engineering Purposes EN 10250-Part 2:1999 Non-Alloy Quality and Special Steels	Supersedes: AFNOR NF A36-612:1982 Pièces Forgées d'Usage Général – Aciers Non Alliés (Withdrawn)
EN 10250 Open Die Steel Forging for General engineering Purposes EN 10250-Part 4:1999 Stainless Steels	Supersedes: AFNOR NF A36-613:1986 Pièces Forgées d'Usage Général – Aciers Inoxydables (Withdrawn)

Chapter 7: Steel Castings	
Current CEN Standard	Former National Standards Superseded by CEN Standards
EN 10213 Steel Castings for Pressure Purposes EN 10213-Part 1:1996 General EN 10213-Part 2:1996 Steel Grades for Use at Room Temperature and at Elevated Temperature EN 10213-Part 3:1996 Steels for Use at Low Temperatures EN 10213-Part 4:1996 Austenitic and Austenitic-Ferritic Steel Grades	Supersedes: BSI BS 1504:1976 Steel Castings for Pressure Purposes (Withdrawn)
EN 10213: Steel Castings for Pressure Purposes EN 10213-Part 1:1996 General EN 10213-Part 2:1996 Steel Grades for Use at Room Temperature and at Elevated Temperature	Supersedes: DIN 17245:1987 Ferritic Steel Castings with Elevated Temperature Properties; Technical Delivery Conditions (Withdrawn)
EN 10213 Steel Castings for Pressure Purposes EN 10213:1:1996 General EN 10213-Part 3:1996 Steels for Use at Low Temperatures	Supersedes: DIN 17182:1992 General Purpose Steel Castings with enhanced Weldability and Higher Toughness; Technical Delivery Conditions (Withdrawn)
EN 10213 Steel Castings for Pressure Purposes EN 10213-Part 1:1996 General EN 10213-Part 4:1996 Austenitic and Austenitic-Ferritic Steel Grades	Supersedes: DIN 17445:1984 Stainless Steel Castings; Technical Delivery Conditions (Withdrawn)
EN 10283:1999 Corrosion resistant steel castings	Supersedes: DIN 17445:1984 Stainless Steel Castings; Technical Delivery Conditions
EN 10213 Steel Castings for Pressure Purposes EN 10213-Part 1:1996 General EN 10213-Part 2:1996 Steel Grades for Use at Room Temperature and at Elevated Temperature EN 10213-Part 3:1996 Steels for Use at Low Temperatures EN 10213-Part 4:1996 Austenitic and Austenitic-Ferritic Steel Grades	Supersedes: AFNOR NF A32-055:1985 Produits de Fonderie – Aciers Moulés Soudables pour Chaudières et Appareils à Pression (Withdrawn)

Chapter 8: Wrought Stainless Steels and Heat-Resisting Steels	
Current CEN Standards	Former National Standards Superseded by CEN Standards
EN 10088-Part 2:1995 Stainless Steels Technical Delivery Conditions for Sheet/Plate and Strip for General Purpose	Partially Supersedes:
EN 10088-Part 3:1995 Stainless Steels Technical Delivery Conditions for Semi-Finished Products, Bars, Rods and Sections for General Purposes	BSI BS 970-Part 1:1991 Wrought Steels for Mechanical and Allied engineering Purposes General Inspection and Testing Procedures and Specific Requirements for Carbon, Carbon Manganese, Alloy and Stainless Steels (Withdrawn)
EN 10095:1999 Heat Resisting Steels and Nickel Alloys	Supersedes: BSI BS 1449-Part 2:1983 Amd 4 Steel Plate, Sheet and Strip Specification for Stainless and Heat-Resisting Steel Plate, Sheet and Strip AMD 9648 (Withdrawn) BSI BS 970-Part 1:1996 Wrought Steels for Mechanical and Allied engineering Purposes-Part 1: General Inspection and Testing Procedures and Specific Requirements for Carbon, Carbon Manganese, Alloy and Stainless Steels
EN 10088-Part 2:1995 Stainless Steels Technical Delivery Conditions for Sheet/Plate and Strip for General Purpose	Partially Supersedes: DIN 17440:1985 Stainless Steels; Technical Delivery Conditions for Plate and Sheet, Hot Rolled Strip, Wire Rod, Drawn Wire, Steel Bars, Forgings and Semi-Finished Products DIN 17441:1985 Stainless Steels; Technical Delivery Conditions for Cold Rolled Strip and Slit Strip and for Plate And Sheet Cut Therefrom
EN 10088-Part 3:1995 Stainless Steels; Technical Delivery Conditions for General Purpose Semi-Finished Products, Bars, Rod and Sections	Partially Supersedes: DIN 17440:1985 Stainless Steels; Technical Delivery Conditions for Plate and Sheet, Hot Rolled Strip, Wire Rod, Drawn Wire, Steel Bars, Forgings and Semi-Finished Products
EN 10088-Part 2:1995 Stainless Steels Technical Delivery Conditions for Sheet/Plate and Strip for General Purposes	Supersedes: AFNOR NF A35-573:1990 Produits Sidérurgiques - Aciers Inoxydables d'Usage Général - Tôles, Grandes Bandes et Feuillards
EN 10088-Part 3:1995 Stainless Steels Technical Delivery Conditions for Semi-Finished Products, Bars, Rods, and Sections for General Purposes.	Supersedes: AFNOR NF A35-574:1990 Produits Sidérurgiques - Aciers Inoxydables d'Usage Général - Demi-Produits, Barres et Fil Machine

Chapter 9: Steels for Special Use	
Current CEN Standard	Former National Standards Superseded by CEN Standards
EN 10087:1999 Free Cutting Steels-Technical Delivery Conditions for Semi-Finished Products, Hot-Rolled Bars and Rods	Partially Supersedes: BSI BS 970-Part 1:1996 Wrought Steels for Mechanical and Allied Engineering Purposes: General Inspection and Testing Procedures and Specific Requirements for Carbon, Carbon Manganese, Alloy and Stainless Steels
EN 10095:1999 Heat Resisting Steels and Nickel Alloys	Supersedes: BSI BS 1449-Part 2:1983 Steel Plate, Sheet and Strip. Specification for Stainless and Heat-Resisting Steel Plate, Sheet and Strip (Withdrawn) Partially Supersedes: 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
EN 10277 Bright Steel Products. Technical Delivery Conditions EN 10277-Part 1:1999. General EN 10277-Part 2:1999 Steels for General Engineering Purposes EN 10277-Part 3:1999 Free-Cutting Steels EN 10277-Part 4:1999 Case-Hardening Steels EN 10277-Part 5:1999 Bright Steel Products. Technical Delivery Conditions. Steels for Quenching and Tempering EN 10278:1999 Dimensions and Tolerances of Bright Steel Products	Supersedes: BSI BS 970-Part 3:1991 Wrought Steel for Mechanical and Allied Engineering Purposes: Bright Bars for General Engineering Purposes;
EN 10132-Part 4: 2000 Cold Rolled Narrow Steel Strip for Heat Treatment-Technical Delivery Conditions-Spring Steels and Other Applications EN 10132-1:2000 Cold Rolled Narrow Steel Strip for Heat Treatment. Technical Delivery Conditions. General	Supersedes: BSI BS 5770:1981 Steel Strip Intended for the Manufacture of Springs BSI BS 5770-Part 1:1981: Hot Rolled Steel and Low Alloy Steel (Withdrawn) BSI BS 5770-Part 2:1981 Amd 1 Cold Rolled Carbon and Low Alloy Steel (Withdrawn) BSI BS 5770-Part 3:1981 Pre-Hardened and Tempered Carbon Steel (Withdrawn)
EN ISO 4957:2000 Tool Steels	Supersedes: BSI BS 4659:1989 Tool and Die Steels
EN 10087:1999 Free-Cutting Steels; Technical Delivery Conditions for Semi-Finished Products, Hot-Rolled Bars and Rods	Partially Supersedes: DIN 1651:1988 Free-Cutting Steels; Technical Delivery Conditions
EN 10132-4-Part 4:2000 Cold-Rolled Narrow Steel Strip for Heat-Treatment - Technical Delivery Conditions: Spring Steels and Other Applications EN 10132--Part 1:2000 Cold-Rolled Narrow Steel Strip for Heat Treatment - Technical Delivery Conditions: General	Supersedes: DIN 17222:1979 Cold Rolled Steel Strips for Springs; Technical Conditions of Delivery
EN ISO 4957:2000 Tool Steels	Supersedes: DIN 17350:1980 Tool Steel

Chapter 9: Steels for Special Use (Continued)	
Current CEN Standard	Former National Standards Superseded by CEN Standards
EN ISO 683-Part 17:1999 Heat-Treated Steels, Alloy Steels and Free-Cutting Steels: Ball and Roller Bearing Steels	Supersedes: DIN 17230:1980 Ball and Roller Bearing Steels; Technical Conditions of Delivery
EN 10087:1999 Free-Cutting Steels. Technical Delivery Conditions for Semi-Finished Products, Hot-Rolled Bars and Rods.	Supersedes: NF A35-561:1992 Produits Sidérurgiques-Barres, Fil Machine en Acier de Décolletage d'Usage Général-Conditions Techniques de Livraison NF A35-562:1986 Barres et Fils Machine en Aciers de Décolletage Spéciaux pour Traitement Thermique
EN 10277-Part 3:1999 Bright Steel Products. Technical Delivery Conditions. Free-Cutting Steels.	Supersedes: NF A37-401:1993 Produits en Acier Transformés à Froid-Barres Étirées et Ronds Écroulés-Galètes-Caractéristiques Mécaniques
EN ISO 683-Part 17:1999 Heat-Treated Steels, Alloy Steels and Free-Cutting Steels: Ball and Roller Bearing Steels	Supersedes: AFNOR NF A 35-565: 1999 Aciers pour Traitement Thermique, Aciers Alliés et Aciers pour Décolletage. Partie 17:Aciers pour Roulements
EN ISO 4957:2000 Tool Steels	Supersedes: AFNOR NF A35-590:1992 Aciers Outils

Appendix

7

FORMER NATIONAL STANDARDS SUPERSEDED BY CEN STANDARDS

Chapter 2: Carbon and Alloy Steels for General Use	
Former National Standards Superseded by EN Standards	Current Standards
BSI BS 970-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

Chapter 3: Structural Steel Plates	
Former National Standards	Current Standards
BSI BS 4360:1986 Specification for Weldable Structural Steels (Withdrawn)	Partially Superseded by: EN 10025:1993 Hot Rolled Products of Non-Alloy Structural Steels—Technical Delivery Conditions
BSI BS 4360:1990 Weldable Structural Steels (Withdrawn)	Superseded by: BS 7613:1994 Specification for Hot Rolled Quenched and Tempered Weldable Structural Steel Plates (Withdrawn) BS 7668:1994 Specification for Weldable Structural Steels. Hot Finished Structural Hollow Sections in Weather Resistant Steels EN 10113 Hot-Rolled Products in Weldable Fine Grain Structural Steels EN 10113-Part 1:1993 General Delivery Conditions EN 10113-Part 2:1993 Delivery Conditions for Normalized/Normalized Rolled Steels EN 10113-Part 3:1993 Delivery Conditions for Thermomechanical Rolled Steels EN 10155:1993 Structural Steels with Improved Atmospheric Corrosion Resistance. Technical Delivery Conditions EN 10029:1991 Tolerances on Dimensions, Shape and Mass for Hot Rolled Steel Plates 3 mm Thick or Above EN 10210-Part 1: 1994 Hot Finished Structural Hollow Sections of Non-Alloy and Fine Grain Structural Steels. Technical Delivery Requirements
BSI BS 7613:1994 Hot Rolled Quenched and Tempered Weldable Structural Steel Plates (Withdrawn)	Superseded by: EN 10137 Plates and Wide Flats Made of High Yield Strength Structural Steels in the Quenched and Tempered or Precipitation Hardened Conditions EN 10137-Part 1:1996 General Delivery Conditions EN 10137-Part 2:1996 Delivery Conditions for Quenched and Tempered Steels EN 10137-Part 3:1996 Delivery Conditions for Precipitation Hardened Steels
DIN 17100:1980 Steels for General Structural Purposes; Quality Standard	Partially Superseded by: EN 10025:1993 Hot Rolled Products of Non-Alloy Structural Steels—Technical Delivery Conditions
DIN 17102:1983 Weldable Normalized Fine Grain Structural Steels; Technical Delivery Conditions for Plate, Strip, Wide Flats, Sections And Bars (Withdrawn)	Superseded by: EN 10113 Hot Rolled Products Made from Weldable, Fine Grain Structural Steel; EN 10113-Part 1:1993 General Technical Delivery Conditions EN 10113-Part 2:1993 Delivery Conditions for Normalized/Normalized Rolled Steels EN 10028 Flat Products Made from Steel for Pressure Purposes EN 10028-Part 1:1993 General Requirements EN 10028-Part 3:1993 Weldable Fine Grain Steels, Normalized
AFNOR NF A 35-504:1984 Poutrelles et Profils en Aciers à Haute Limite d'Élasticité pour Constructions Soudées Nuances et Qualités AFNOR NF A 36-201:1984 Tôles en Aciers à Haute Limite D'Élasticité pour Constructions Soudées-Nuances et Qualités	Superseded by: EN 10113 Hot-Rolled Products in Weldable Fine Grain Structural Steels EN 10113-Part 2:1993 Delivery Conditions for Normalized/Normalized Rolled Steels.

Chapter 3: Structural Steel Plates (Continued)	
Former National Standards	Current Standards
AFNOR NF A 36-204:1992 Produits Sidérurgiques – Tôles en Aciers à Haute Limite d'Élasticité Livrées à l'État Traité pour Construction Soudée – Nuances et Qualité	Superseded by: EN 10137 Plates and Wide Flats Made of High Yield Strength Structural Steels in the Quenched and Tempered or Precipitation Hardened Conditions EN 10137-Part 2:1995 Delivery Conditions for Quenched and Tempered Steels EN 10137-Part 3:1995 Delivery Conditions for Precipitation Hardened Steels
AFNOR NF A35-502:1984 Aciers de Construction à Résistance Améliorée à la Corrosion Atmosphérique – Tôles Minces Moyennes et Fortes, Grandes Plats, Laminés Marchands et Poutrelles	Superseded by: EN 10155:1993 Structural Steels with Improved Atmospheric Corrosion Resistance - Technical Delivery Conditions

Chapter 4: Pressure Vessel Steel Plates	
Former National Standards Superseded by EN Standards	Current EN Standards
<p>BSI BS 1501 Steels for Pressure Purposes.</p> <p>BSI BS 1501-Part 1:1980 Specification for Carbon and Carbon Manganese Steels: Plates (Withdrawn)</p>	<p>Superseded by:</p> <p>EN 10028 Specification for Flat Products Made of Steels for Pressure Purposes.</p> <p>EN 10028-Part 2:1993 Non-Alloy and Alloy Steels with Specified Elevated Temperature Properties</p> <p>EN 10028-Part 3:1993 Weldable Fine Grain Steels, Normalized</p> <p>EN 10029:1991 Specification for Tolerances on Dimensions, Shape and Mass for Hot Rolled Steel Plates 3 Mm Thick or Above</p>
<p>BSI BS 1501-Part 2:1988 Steels for Pressure Purposes. Specification for Alloy Steels: Plates (Withdrawn)</p>	<p>Superseded by:</p> <p>EN 10028-Part 2:1993 Non-Alloy and Alloy Steels with Specified Elevated Temperature Properties</p> <p>EN 10028-Part 3:1993 Weldable Fine Grain Steels, Normalized</p> <p>EN 10028-Part 4:1995 Specification for Flat Products Made of Steels for Pressure Purposes. Nickel Alloy Steels with Specified Low Temperature Properties</p> <p>EN 10029:1991 Specification for Tolerances on Dimensions, Shape and Mass for Hot Rolled Steel Plates 3 Mm Thick or Above</p>
<p>BSI BS 1501-Part 1:1980 Steels for Pressure Purposes. Specification for Carbon and Carbon Manganese Steels: Plates (Withdrawn)</p> <p>BSI BS 1501-Part 2:1988 Steels for Pressure Purposes. Specification for Alloy Steels: Plates (Withdrawn)</p>	<p>Superseded by:</p> <p>EN 10028-Part 1:2000 Specification for Flat Products Made of Steels for Pressure Purposes. General Requirements</p>
<p>BSI BS 1501-Part 3:1990 Amd 5 Steels for Pressure Purposes Specification for Corrosion- and Heat-Resisting Steels: Plates, Sheet and Strip (Withdrawn)</p>	<p>Superseded by:</p> <p>EN 10028-Part 7:2000 Flat Products Made of Steels for Pressure Purposes Stainless Steels</p> <p>Partially Superseded by:</p> <p>EN 10029:1991 Specification for Tolerances on Dimensions, Shape And Mass for Hot Rolled Steel Plates 3 Mm Thick or Above</p> <p>EN 10048:1997 Hot Rolled Narrow Steel Strip. Tolerances on Dimensions and Shape</p> <p>EN 10051:1992 Specification for Continuously Hot-Rolled Uncoated Plate, Sheet and Strip of Non-Alloy and Alloy Steels. Tolerances on Dimensions and Shape</p> <p>EN 10258:1997 Cold-Rolled Stainless Steel Narrow Strip and Cut Lengths. Tolerances on Dimensions and Shape</p> <p>EN 10259:1997 Cold-Rolled Stainless and Heat Resisting Steel Wide Strip and Plate/Sheet. Tolerances on Dimensions and Shape</p>
<p>DIN 17280:1985 Steels With Low Temperature Toughness; Technical Delivery Conditions for Plate. Sheet, Strip, Wide Flats, Sections, Bars and Forgings</p>	<p>Partially Superseded by:</p> <p>EN 10028-Part 1:2000 Flat Products Made of Steel for Pressure Purposes - General Requirements</p> <p>EN 10028-Part 4 1994 Flat Products Made of Steels for Pressure Purposes; Nickel-Alloy Steels with Specified Low Temperature Properties</p>
<p>DIN 17441:1997 Technical Delivery Conditions for Stainless Steel Cold-Rolled Strip, Slit Strip and Plate Cut Therefrom for Pressure Purposes</p>	<p>Superseded by:</p> <p>EN 10028-Part 7:2000 Flat Products Made of Steels for Pressure Purposes Stainless Steels</p>

Chapter 4: Pressure Vessel Steel Plates (Continued)	
Former National Standards Superseded by EN Standards	Current EN Standards
DIN 17440:1996 Technical Delivery Conditions for Stainless Steel Plate, Hot Rolled Strip, and Bars for Pressure Purposes DIN 17460:1992 High-Temperature Austenitic Steel Plate and Sheet, Cold and Hot Rolled Strip, Bars and Forgings; Technical Delivery Conditions	Partially Superseded by: EN 10028-Part 7:2000 Flat Products Made of Steels for Pressure Purposes Stainless Steels
AFNOR NF A36-205:1982 (Title Not Found) AFNOR NF A36-206:1983 (Title Not Found)	Superseded by: EN 10028-Part 2:1992 Flat Products Made of Steels for Pressure Purposes. Non-Alloy and Alloy Steels with Specified Elevated Temperature Properties.
AFNOR NF A36-207:1982 (Title Not Found)	Superseded by: EN 10028-Part 3:1992 Flat Products Made of Steels for Pressure Purposes. Weldable Fine Grain Steels, Normalized.
AFNOR NF A36-208:1982 Tôles en Aciers au Nickel pour Appareils à Pression à Basse Température	Superseded by: EN 10028-Part 4:1994 Flat Products Made of Steels for Pressure Purposes. Nickel Alloy Steels with Specified Low Temperature Properties.

Chapter 6: Steel Forgings	
Former National Standards Superseded by EN Standards	Current Standards
BSI BS 1503:1989 Amd 3 Steel Forgings for Pressure Purposes (Withdrawn)	Superseded by: EN 10222 Steel Forgings for Pressure Purposes EN 10222-Part 1:1998 General Requirements for Open Die Forgings EN 10222-Part 2:2000 Ferritic and Martensitic Steels with Specified Elevated Temperature Properties EN 10222-Part 3:1999 Nickel Steels with Specified Low-Temperature EN 10222-Part 4:1999 Weldable Fine-Grain Steels with High Proof Strength EN 10222-Part 5:2000 Martensitic, Austenitic and Austenitic-Ferritic Stainless Steels
BSI BS 29:1976 Carbon Steel Forgings Above 150 mm Ruling Section (Withdrawn)	Superseded by: EN 10250-Part 2:2000 Corr 1 Open Die Steel Forgings for General Engineering Purposes Non-Alloy Quality and Special Steels CORR 11041
BSI BS 4670:1971 Alloy Steel Forgings (Withdrawn)	Superseded by: EN 10250-Part 3:2000 Open Die Steel Forgings for General Engineering Purposes
DIN 17103:1989 Weldable Fine Grain Structural Steel Forgings; Technical Delivery Conditions (Withdrawn) DIN 17243:1987 Weldable Heat Resisting Steel Forgings and Rolled or Forged Steel Bars; Technical Delivery Conditions (Withdrawn)	Superseded by: EN 10222-Part 1:1998 Steel Forgings for Pressure Purposes General Requirements for Open Die Forgings
DIN 17280:1985 Steels with Low Temperature Toughness; Technical Delivery Conditions for Plate, Sheet, Strip, Wide Flats, Sections, Bars and Forgings (Withdrawn) DIN 17440:1996 Stainless Steels- Technical Delivery Conditions for Plates, Hot Rolled Strip and Bars for Pressure Purposes, Drawn Wire and Forgings (Withdrawn) DIN 17100:1980 Steels for General Structural Purposes; Quality Standard (Withdrawn)	Partially Superseded by: EN 10222-Part 1:1998 Steel Forgings for Pressure Purposes General Requirements for Open Die Forgings
DIN 17243:1987 Weldable Heat Resisting Steel Forgings and Rolled or Forged Steel Bars; Technical Delivery Conditions (Withdrawn)	Superseded by: EN 10222 Steel Forgings for Pressure Purposes EN 10222-Part 1:2000 General Requirements for Open Die Forgings EN 10222-Part 2:2000 Ferritic and Martensitic Steels with Specified Elevated Temperature Properties (Includes Corrigendum AC: 2000) EN 10273:2000 Hot Rolled Weldable Steel Bars for Pressure Purposes with Specified Elevated Temperature
DIN 17100:1980 Steels for General Structural Purposes; Quality Standard (Withdrawn)	Superseded by: EN 10250 Open Die Steel Forgings for General Engineering Purposes EN 10250-Part 1:1999 General EN 10250-Part 2:1999 Non-Alloy Quality and Special Steels
DIN 17440:1996 Stainless Steels-Technical Delivery Conditions for Plates, Hot Rolled Strip and Bars for Pressure Purposes, Drawn Wire and Forgings (Withdrawn)	Partially Superseded by: EN 10250-Part 1:1999 General EN 10250-Part 4:2000 Open Die Steel Forgings for General Engineering Purposes

Chapter 6: Steel Forgings (Continued)	
Former National Standards Superseded by EN Standards	Current Standards
<p>AFNOR NF A36-601:1980 Pièces Forgées en Acier Soudable pour Chaudières et Appareils à Pression- Aciers au Carbone et Carbone-Manganèse-Nuances et Qualités (Withdrawn)</p> <p>AFNOR NF A36-602:1988 Pièces Forgées en Acier Soudable pour Chaudières et Appareils à Pression – Aciers Alliés au Mo, au Mn-Mo et au Cr-Mo Nuances et Qualités (Withdrawn)</p> <p>AFNOR NF A36-603:1988 Pièces Forgées en Acier Soudable pour Chaudières et Appareils à Pression-Aciers Alliés à Haute Limite d'Élasticité Nuances et Qualités (Withdrawn)</p> <p>AFNOR NF A36-607:1984 Pièces Obtenues par Forgeage Libre ou Estampage en Aciers Inoxydables Austénitiques pour Chaudières et Appareils à Pression – Nuances et Qualités (Withdrawn)</p>	<p>Superseded by:</p> <p>EN 10222 Steel Forgings for Pressure Purposes EN 10222-Part 1:1998 General Requirements for Open Die Forgings</p> <p>EN 10222 Steel Forgings for Pressure Purposes EN 10222-Part 3 :1999 Nickel Steels with Specified Low Temperature Properties. EN 10222-Part 4 :1999 Weldable Fine Grain Steels with High Proof Strength</p> <p>EN 10222 Steel Forgings for Pressure Purposes EN 10222-Part 2:2000 Ferritic and Martensitic Steels with Specified Elevated Temperature Properties EN 10222-Part 5:2000 Martensitic, Austenitic and Austenitic-Ferritic Stainless Steels</p>
<p>AFNOR NF A36-612:1982 Pièces Forgées d'Usage Général – Aciers Non Alliés (Withdrawn)</p> <p>AFNOR NF A36-613:1986 Pièces Forgées d'Usage Général – Aciers Inoxydables (Withdrawn)</p>	<p>Superseded by:</p> <p>EN 10250 Open Die Steel Forgings for General Engineering Purposes EN 10250-Part 1:1999 General Requirements</p>
<p>AFNOR NF A36-612:1982 Pièces Forgées d'Usage Général – Aciers Non Alliés (Withdrawn)</p>	<p>Superseded by:</p> <p>EN 10250 Open Die Steel Forgings for General Engineering Purposes EN 10250-Part 2:1999 Non-Alloy Quality and Special Steels</p>
<p>AFNOR NF A36-613:1986 Pièces Forgées d'Usage Général – Aciers Inoxydables (Withdrawn)</p>	<p>Superseded by:</p> <p>EN 10250-Part 4:1999 Open Die Steel Forging for General Engineering Purposes</p>

Chapter 7: Steel Castings	
Former National Standards Superseded by EN Standards	Current EN Standard
BSI BS 1504:1976 Steel Castings for Pressure Purposes (Withdrawn)	Superseded by: EN 10213 Steel Castings for Pressure Purposes EN 10213-Part 1:1996 General EN 10213-Part 2:1996 Steel Grades for Use at Room Temperature and at Elevated Temperature EN 10213-Part 3:1996 Steels for Use at Low Temperatures EN 10213-Part 4:1996 Austenitic and Austenitic-Ferritic Steel Grades
DIN 17245:1987 Ferritic Steel Castings with Elevated Temperature Properties; Technical Delivery Conditions (Withdrawn)	Superseded by: EN 10213: Steel Castings for Pressure Purposes EN 10213-Part 1:1996 General EN 10213-Part 2:1996 Steel Grades for Use at Room Temperature and at Elevated Temperature
DIN 17182:1992 General Purpose Steel Castings with Enhanced Weldability and Higher Toughness; Technical Delivery Conditions (Withdrawn)	Partially Superseded by: EN 10213 Steel Castings for Pressure Purposes EN 10213-Part 1:1996 General EN 10213-Part 3:1996 Steels for Use at Low Temperatures
DIN 17445:1984 Stainless Steel Castings; Technical Delivery Conditions (Withdrawn)	Partially Superseded by: EN 10213 Steel Castings for Pressure Purposes EN 10213-Part 1:1996 General EN 10213-Part 4:1996 Austenitic and Austenitic-Ferritic Steel Grades
DIN 17445:1984 Stainless Steel Castings; Technical Delivery Conditions (Withdrawn)	Superseded by: EN 10213 Steel Castings for Pressure Purposes EN 10213-Part 1:1996 General EN 10213-Part 4:1996 Austenitic and Austenitic-Ferritic Steel Grades EN 10283:1999 Corrosion Resistant Steel Castings
AFNOR NF A32-055:1985 Produits de Fonderie—Aciers Moulés Soudables pour Chaudières et Appareils à Pression (Withdrawn)	Superseded by: EN 10213 Steel Castings for Pressure Purposes EN 10213-Part 1:1996 General EN 10213-Part 2:1996 Steel Grades for Use at Room Temperature and at Elevated Temperature EN 10213-Part 3:1996 Steels for Use at Low Temperatures EN 10213-Part 4:1996 Austenitic and Austenitic-Ferritic Steel Grades

Chapter 8: Wrought Stainless Steels and Heat-Resisting Steels	
Former National Standards Superseded by EN Standards	Current EN Standards
BSI BS 970-Part 1:1991 Wrought Steels for Mechanical and Allied Engineering Purposes General Inspection and Testing Procedures and Specific Requirements for Carbon, Carbon Manganese, Alloy and Stainless Steels (Withdrawn)	<p>Partially Superseded by:</p> <p>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</p> <p>EN 10083-Part 3:1996 Quenched and Tempered Steels. Technical Delivery Conditions for Boron Steels</p> <p>EN 10088-Part 2:1995 Stainless Steels Technical Delivery Conditions for Sheet/Plate and Strip for General Purpose</p> <p>EN 10088-Part 3:1995 Stainless Steels Technical Delivery Conditions for Semi-Finished Products, Bars, Rods and Sections for General Purposes</p>
BSI BS 1449-Part 2:1983 Amd 4 Steel Plate, Sheet and Strip Specification for Stainless and Heat-Resisting Steel Plate, Sheet and Strip AMD 9648 (Withdrawn)	<p>Superseded by:</p> <p>EN 10029:1991 Specification for Tolerances on Dimensions, Shape and Mass for Hot Rolled Steel Plates 3 Mm Thick or Above</p> <p>EN 10048:1997 Hot Rolled Narrow Steel Strip. Tolerances on Dimensions and Shape</p> <p>EN 10051:1992 Specification for Continuously Hot-Rolled Uncoated Plate, Sheet and Strip of Non-Alloy and Alloy Steels. Tolerances on Dimensions and Shape</p> <p>EN 10095:1999 Heat Resisting Steels and Nickel Alloys</p> <p>EN 10258:1997 Cold-Rolled Stainless Steel Narrow Strip and Cut Lengths. Tolerances on Dimensions and Shape</p> <p>EN 10259:1997 Cold-Rolled Stainless and Heat Resisting Steel Wide Strip and Plate/Sheet. Tolerances on Dimensions and Shape</p>
BSI BS 970-Part 1:1996 Wrought Steels for Mechanical and Allied Engineering Purposes-Part 1: General Inspection and Testing Procedures and Specific Requirements for Carbon, Carbon Manganese, Alloy and Stainless Steels	<p>Partially Superseded by:</p> <p>EN 10084:1998 Case Hardening Steels. Technical Delivery Conditions</p> <p>EN 10085:2001 Nitriding Steel. Technical Delivery Conditions</p> <p>EN 10087:1999 Free Cutting Steels. Technical Delivery Conditions for Semi-Finished Products, Hot Rolled Bars and Rods</p> <p>EN 10095:1999 Heat Resisting Steels and Nickel Alloys</p> <p>EN 10250-Part 4:2000. Open Steel Die Forgings for General Engineering Purposes. Stainless Steels</p> <p>EN 10095:1999 Heat Resisting Steels and Nickel Alloys</p>
<p>DIN 17440:1985 Stainless Steels; Technical Delivery Conditions for Plate and Sheet, Hot Rolled Strip, Wire Rod, Drawn Wire, Steel Bars, Forgings and Semi-Finished Products</p> <p>DIN 17441:1985 Stainless Steels; Technical Delivery Conditions for Cold Rolled Strip and Slit Strip and for Plate and Sheet Cut Therefrom</p>	<p>Superseded by:</p> <p>EN 10088-Part 2:1995 Stainless Steels Technical Delivery Conditions for Sheet/Plate and Strip for General Purpose</p>
DIN 17440:1985 Stainless Steels; Technical Delivery Conditions for Plate and Sheet, Hot Rolled Strip, Wire Rod, Drawn Wire, Steel Bars, Forgings and Semi-Finished Products	<p>Partially Superseded by:</p> <p>EN 10088-Part 3:1995 Stainless Steels; Technical Delivery Conditions for General Purpose Semi-Finished Products, Bars, Rod and Sections</p>

Chapter 8: Wrought Stainless Steels and Heat-Resisting Steels (Continued)	
Former National Standards Superseded by EN Standards	Current EN Standards
DIN 17440:1985 Stainless Steels; Technical Delivery Conditions for Plate and Sheet, Hot Rolled Strip, Wire Rod, Drawn Wire, Steel Bars, Forgings and Semi-Finished Products	Partially Superseded by: EN 10250-Part 4:2000 Open Die Steel Forgings for General Engineering Purposes. Stainless Steels
AFNOR NF A35-573:1990 Produits Sidérurgiques- Aciers Inoxydables d'Usage Général-Tôles, Larges Bandes et Feuillards	Superseded by: EN 10088-Part 2:1995 Stainless Steels Technical Delivery Conditions for Sheet/Plate And Strip for General Purposes
AFNOR NF A35-574:1990 Produits Sidérurgiques-Aciers Inoxydables d'Usage Général-Demi-Produits, Barres et Fil Machine	Superseded by: EN 10088-Part 3:1995 Stainless Steels Technical Delivery Conditions for Semi-Finished Products, Bars, Rods, and Sections For General Purposes.

Chapter 9: Steels for Special Use	
Former National Standards Superseded by EN Standards	Current EN Standard
BSI BS 970-Part 1:1996 Wrought Steels for Mechanical and Allied Engineering Purposes: General Inspection and Testing Procedures and Specific Requirements for Carbon, Carbon Manganese, Alloy and Stainless Steels	Superseded by: EN 10095:1999 Heat resisting steels and nickel alloys
BSI BS 970-Part 1:1996 Wrought Steels for Mechanical and Allied Engineering Purposes General Inspection and Testing Procedures and Specific Requirements for Carbon, Carbon Manganese, Alloy and Stainless Steels	Partially Superseded by: EN 10084:1998 Case Hardening Steels. Technical Delivery Conditions EN 10085:2001 Nitriding Steel. Technical Delivery Conditions EN 10087:1999 Free Cutting Steels-Technical Delivery Conditions for Semi-Finished Products, Hot-Rolled Bars and Rods EN 10250-4:2000 Open Steel Die Forgings for General Engineering Purposes. Stainless Steels
BSI BS 1449-Part 2:1983 Steel Plate, Sheet and Strip. Specification for Stainless and Heat-Resisting Steel Plate, Sheet and Strip (Withdrawn)	Superseded by: EN 10095:1999 Heat Resisting Steels and Nickel Alloys EN 10029:1991 Specification for Tolerances on Dimensions, Shape and Mass for Hot Rolled Steel Plates 3 Mm Thick or Above EN 10048:1997 Hot Rolled Narrow Steel Strip. Tolerances on Dimensions and Shape EN 10051:1992 Specification for Continuously Hot-Rolled Uncoated Plate, Sheet and Strip of Non-Alloy and Alloy Steels. Tolerances on Dimensions and Shape EN 10258:1997 Cold-Rolled Stainless Steel Narrow Strip and Cut Lengths. Tolerances on Dimensions and Shape EN 10259:1997 Cold-Rolled Stainless and Heat Resisting Steel Wide Strip and Plate/Sheet. Tolerances on Dimensions and Shape
BSI BS 970-Part 3:1991 Wrought Steel for Mechanical and Allied Engineering Purposes: Bright Bars for General Engineering Purposes	Superseded by: EN 10277 Bright Steel Products. Technical Delivery Conditions EN 10277-Part 1:1999. General EN 10277-Part 2:1999 Steels for General Engineering Purposes EN 10277-Part 3:1999 Free-Cutting Steels EN 10277-Part 4:1999 Case-Hardening Steels EN 10277-Part 5:1999 Bright Steel Products. Technical Delivery Conditions. Steels for Quenching and Tempering EN 10278:1999 Dimensions and Tolerances of Bright Steel Products
BSI BS 5770:1981 Steel Strip Intended for the Manufacture of Springs BSI BS 5770-Part 1:1981: Hot Rolled Steel and Low Alloy Steel (Withdrawn) BSI BS 5770-Part 2:1981 Amd 1 Cold Rolled Carbon and Low Alloy Steel (Withdrawn) BSI BS 5770-Part 3:1981 Pre-Hardened and Tempered Carbon Steel (Withdrawn)	Superseded by: EN 10132-Part 1:2000 Cold Rolled Narrow Steel Strip for Heat Treatment. Technical Delivery Conditions. General EN 10132-Part 4:2000 Cold Rolled Narrow Steel Strip for Heat Treatment-Technical Delivery Conditions-Spring Steels and Other Applications
BSI BS 4659:1989 Tool and Die Steels	Superseded by: EN ISO 4957:2000 Tool Steels

Chapter 9: Steels for Special Use (Continued)	
Former National Standards Superseded by EN Standards	Current EN Standard
DIN 1651:1988 Free-Cutting Steels; Technical Delivery Conditions	Partially Superseded by: EN 10087:1999 Free-Cutting Steels; Technical Delivery Conditions for Semi-Finished Products, Hot-Rolled Bars and Rods
DIN 17222:1979 Cold Rolled Steel Strips for Springs; Technical Conditions of Delivery	Superseded by: EN 10132-4-Part 4:2000 Cold-Rolled Narrow Steel Strip for Heat-Treatment - Technical Delivery Conditions: Spring Steels and Other Applications EN 10132--Part 1:2000 Cold-Rolled Narrow Steel Strip for Heat Treatment - Technical Delivery Conditions: General
DIN 17350:1980 Tool Steel	Superseded by: EN ISO 4957:2000 Tool Steels
DIN 17230:1980 Ball and Roller Bearing Steels; Technical Conditions of Delivery	Superseded by: EN ISO 683-Part 17:1999 Heat-Treated Steels, Alloy Steels and Free-Cutting Steels: Ball and Roller Bearing Steels
AFNOR NF A35-561:1992 Produits Sidérurgiques-Barres, Fil Machine en Acier de Décolletage d'Usage Général-Conditions Techniques de Livraison NF A35-562:1986 Barres et Fils Machine en Aciers de Décolletage Spéciaux pour Traitement Thermique	Superseded by: EN 10087:1999 Free-Cutting Steels. Technical Delivery Conditions for Semi-Finished Products, Hot-Rolled Bars and Rods.
AFNOR NF A37-401:1993 Produits en Acier Transformés à Froid-Barres Étirées et Ronds Écroutés-Galètes-Caractéristiques Mécaniques	Superseded by: EN 10277-Part 3:1999 Bright Steel Products. Technical Delivery Conditions. Free-Cutting Steels.
AFNOR NF A 35-565: 1999 Aciers pour Traitement Thermique, Aciers Alliés et Aciers pour Décolletage. Partie 17:Aciers pour Roulements	Superseded by: EN ISO 683-Part 17:1999 Heat-Treated Steels, Alloy Steels and Free-Cutting Steels: Ball and Roller Bearing Steels
AFNOR NF A35-590:1992 Aciers Outils	Superseded by: EN ISO 4957:2000 Tool Steels

Appendix

8

***ISO IRON AND STEEL
PRODUCT STANDARDS***

Designation	Title
ISO 404:1992	Steel and steel products -- General technical delivery requirements
ISO 630:1995	Structural steels -- Plates, wide flats, bars, sections and profiles
ISO 1052:1982	Steels for general engineering purposes
ISO 3755:1991	Cast carbon steels for general engineering purposes
ISO 4885:1996	Ferrous products -- Heat treatments -- Vocabulary
ISO 6929:1987	Steel products -- Definitions and classification
ISO 9477:1992	High strength cast steels for general engineering and structural purposes
ISO 10474:1991	Steel and steel products -- Inspection documents
ISO 683-1:1987	Heat-treatable steels, alloy steels and free-cutting steels -- Part 1: Direct-hardening unalloyed and low-alloyed wrought steel in form of different black products
ISO 683-9:1988	Heat-treatable steels, alloy steels and free-cutting steels -- Part 9: Wrought free-cutting steels
ISO 683-10:1987	Heat-treatable steels, alloy steels and free-cutting steels -- Part 10: Wrought nitriding steels
ISO 683-11:1987	Heat-treatable steels, alloy steels and free-cutting steels -- Part 11: Wrought case-hardening steels
ISO 683-15:1992	Heat-treatable steels, alloy steels and free-cutting steels -- Part 15: Valve steels for internal combustion engines
ISO 683-17:1999	Heat-treated steels, alloy steels and free-cutting steels -- Part 17: Ball and roller bearing steels
ISO 683-18:1996	Heat-treatable steels, alloy steels and free-cutting steels -- Part 18: Bright products of unalloyed and low alloy steels
ISO 4954:1993	Steels for cold heading and cold extruding
ISO 4955:1994	Heat-resisting steels and alloys
ISO 5949:1983	Tool steels and bearing steels -- Micrographic method for assessing the distribution of carbides using reference photomicrographs
ISO 9443:1991	Heat-treatable and alloy steels -- Surface quality classes for hot-rolled round bars and wire rods -- Technical delivery conditions
ISO 9444:1990	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
ISO 6934-1:1991	Steel for the prestressing of concrete -- Part 1: General requirements
ISO 6934-2:1991	Steel for the prestressing of concrete -- Part 2: Cold-drawn wire
ISO 6934-3:1991	Steel for the prestressing of concrete -- Part 3: Quenched and tempered wire
ISO 6934-4:1991	Steel for the prestressing of concrete -- Part 4: Strand
ISO 6934-5:1991	Steel for the prestressing of concrete -- Part 5: Hot-rolled steel bars with or without subsequent processing
ISO 6935-1:1991	Steel for the reinforcement of concrete -- Part 1: Plain bars
ISO 6935-2:1991	Steel for the reinforcement of concrete -- Part 2: Ribbed bars
ISO 6935-3:1992	Steel for the reinforcement of concrete -- Part 3: Welded fabric
ISO 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
ISO 11082:1992	Certification scheme for welded fabric for the reinforcement of concrete structures
ISO/TR 12662:1997	Certification scheme for prestressing steels
ISO 14654:1999	Epoxy-coated steel for the reinforcement of concrete
ISO 14655:1999	Epoxy-coated strand for the prestressing of concrete
ISO 14656:1999	Epoxy powder and sealing material for the coating of steel for the reinforcement of concrete
ISO 11692:1994	Ferritic-pearlitic engineering steels for precipitation hardening from hot-working temperatures
ISO 683-1:1987	Heat-treatable steels, alloy steels and free-cutting steels -- Part 1: Direct-hardening unalloyed and low-alloyed wrought steel in form of different black products
ISO 683-9:1988	Heat-treatable steels, alloy steels and free-cutting steels -- Part 9: Wrought free-cutting steels
ISO 683-10:1987	Heat-treatable steels, alloy steels and free-cutting steels -- Part 10: Wrought nitriding steels
ISO 683-11:1987	Heat-treatable steels, alloy steels and free-cutting steels -- Part 11: Wrought case-hardening steels
ISO 683-15:1992	Heat-treatable steels, alloy steels and free-cutting steels -- Part 15: Valve steels for internal combustion engines
ISO 683-17:1999	Heat-treated steels, alloy steels and free-cutting steels -- Part 17: Ball and roller bearing steels
ISO 683-18:1996	Heat-treatable steels, alloy steels and free-cutting steels -- Part 18: Bright products of unalloyed and low alloy steels
ISO 4952:1981	Structural steels with improved atmospheric corrosion resistance
ISO 4954:1993	Steels for cold heading and cold extruding
ISO 4955:1994	Heat-resisting steels and alloys
ISO 5949:1983	Tool steels and bearing steels -- Micrographic method for assessing the distribution of carbides using reference photomicrographs
ISO 7153-1:1991	Surgical instruments -- Metallic materials -- Part 1: Stainless steel Amd 1:1999
ISO 9443:1991	Heat-treatable and alloy steels -- Surface quality classes for hot-rolled round bars and wire rods -- Technical delivery conditions
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	Title
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 11692:1994	Ferritic-pearlitic engineering steels for precipitation hardening from hot-working temperatures
ISO 11972:1998	Corrosion-resistant cast steels for general applications
ISO 11973:1999	Heat-resistant cast steels and alloys for general applications
ISO/TR 15510:1997	Stainless steels -- Chemical composition
ISO 683-14:1992	Heat-treatable steels, alloy steels and free-cutting steels -- Part 14: Hot-rolled steels for quenched and tempered springs
ISO 6931-1:1994	Stainless steels for springs -- Part 1: Wire
ISO 6931-2:1989	Stainless steels for springs -- Part 2: Strip
ISO 8458-1:1989	Steel wire for mechanical springs -- Part 1: General requirements
ISO 8458-2:1989	Steel wire for mechanical springs -- Part 2: Cold-drawn carbon steel wire
ISO 8458-3:1992	Steel wire for mechanical springs -- Part 3: Oil-hardened and tempered wire
ISO 9442:1988	Steel -- Hot-rolled ribbed and grooved flats for spring leaves -- Tolerances and dimensions
ISO 2605-1:1976	Steel products for pressure purposes -- Derivation and verification of elevated temperature properties -- Part 1: Yield or proof stress of carbon and low alloy steel products
ISO 2605-2:1976	Steel products for pressure purposes -- Derivation and verification of elevated temperature properties -- Part 2: Proof stress of austenitic steel products
ISO 2605-3:1985	Steel products for pressure purposes -- Derivation and verification of elevated temperature properties -- Part 3: An alternative procedure for deriving the elevated temperature yield or proof stress properties when data are limited
ISO 4978:1983	Flat rolled steel products for welded gas cylinders
ISO 4991:1994	Steel castings for pressure purposes
ISO 6303:1981	Pressure vessel steels not included in ISO 2604, Parts 1 to 6 -- Derivation of long-time stress rupture properties
ISO/TR 7468:1981	Summary of average stress rupture properties of wrought steels for boilers and pressure vessels
ISO 9327-1:1999	Steel forgings and rolled or forged bars for pressure purposes -- Technical delivery conditions -- Part 1: General requirements
ISO 9327-2:1999	Steel forgings and rolled or forged bars for pressure purposes -- Technical delivery conditions -- Part 2: Non-alloy and alloy (Mo, Cr and CrMo) steels with specified elevated temperature properties
ISO 9327-3:1999	Steel forgings and rolled or forged bars for pressure purposes -- Technical delivery conditions -- Part 3: Nickel steels with specified low temperature properties
ISO 9327-4:1999	Steel forgings and rolled or forged bars for pressure purposes -- Technical delivery conditions -- Part 4: Weldable fine grain steels with high proof strength
ISO 9327-5:1999	Steel forgings and rolled or forged bars for pressure purposes -- Technical delivery conditions -- Part 5: Stainless steels
ISO 9328-1:1991	Steel plates and strips for pressure purposes -- Technical delivery conditions -- Part 1: General requirements
ISO 9328-2:1991	Steel plates and strips for pressure purposes -- Technical delivery conditions -- Part 2: Unalloyed and low-alloyed steels with specified room temperature and elevated temperature properties
ISO 9328-3:1991	Steel plates and strips for pressure purposes -- Technical delivery conditions -- Part 3: Nickel-alloyed steels with specified low temperature properties
ISO 9328-4:1991	Steel plates and strips for pressure purposes -- Technical delivery conditions -- Part 4: Weldable fine grain steels with high proof stress supplied in the normalized or quenched and tempered condition
ISO 9328-5:1991	Steel plates and strips for pressure purposes -- Technical delivery conditions -- Part 5: Austenitic steels
ISO 4957:1999	Tool steels
ISO 5949:1983	Tool steels and bearing steels -- Micrographic method for assessing the distribution of carbides using reference photomicrographs
ISO 11054:1993	Cutting tools -- Designation of high-speed steel groups
ISO 683-1:1987	Heat-treatable steels, alloy steels and free-cutting steels -- Part 1: Direct-hardening unalloyed and low-alloyed wrought steel in form of different black products
ISO 683-18:1996	Heat-treatable steels, alloy steels and free-cutting steels -- Part 18: Bright products of unalloyed and low alloy steels
ISO 3573:1999	Hot-rolled carbon steel sheet of commercial and drawing qualities
ISO 3574:1999	Cold-reduced carbon steel sheet of commercial and drawing qualities
ISO 3575:1996	Continuous hot-dip zinc-coated carbon steel sheet of commercial, lock-forming and drawing qualities
ISO 4950-1:1995	High yield strength flat steel products -- Part 1: General requirements
ISO 4950-2:1995	High yield strength flat steel products -- Part 2: Products supplied in the normalized or controlled rolled condition
ISO 4950-3:1995	High yield strength flat steel products -- Part 3: Products supplied in the heat-treated (quenched + tempered) condition
ISO 4960:1999	Cold-reduced carbon steel strip with a carbon content over 0,25 %
ISO 4995:1993	Hot-rolled steel sheet of structural quality
ISO 4996:1999	Hot-rolled steel sheet of high yield stress structural quality
ISO 4997:1999	Cold-reduced steel sheet of structural quality
ISO 4998:1996	Continuous hot-dip zinc-coated carbon steel sheet of structural quality
ISO 4999:1999	Continuous hot-dip terne (lead alloy) coated cold-reduced carbon steel sheet of commercial drawing and structural qualities
ISO 5000:1993	Continuous hot-dip aluminium/silicon-coated cold-reduced carbon steel sheet of commercial and drawing qualities
ISO 5001:1999	Cold-reduced carbon steel sheet for vitreous enamelling

Designation	Title
ISO 5002:1999	Hot-rolled and cold-reduced electrolytic zinc-coated carbon steel sheet of commercial and drawing qualities
ISO 5950:2000	Continuous electrolytic tin-coated cold-reduced carbon steel sheet of commercial and drawing qualities
ISO 5951:1993	Hot-rolled steel sheet of higher yield strength with improved formability
ISO 5952:1998	Continuously hot-rolled steel sheet of structural quality with improved atmospheric corrosion resistance
ISO 5954:1998	Cold-reduced carbon steel sheet according to hardness requirements
ISO 6316:2000	Hot-rolled steel strip of structural quality
ISO 6317:2000	Hot-rolled carbon steel strip of commercial and drawing qualities
ISO 6930-1:2001	High yield strength steel plates and wide flats for cold forming -- Part 1: Delivery conditions for thermomechanically-rolled steels
ISO 6932:1986	Cold-reduced carbon steel strip with a maximum carbon content of 0,25 %
ISO 7452:1984	Hot-rolled structural steel plates -- Tolerances on dimensions and shape
ISO 7778:1983	Steel plate with specified through-thickness characteristics
ISO 7788:1985	Steel -- Surface finish of hot-rolled plates and wide flats -- Delivery requirements
ISO 9034:1987	Hot-rolled structural steel wide flats -- Tolerances on dimensions and shape
ISO 9328-1:1991	Steel plates and strips for pressure purposes -- Technical delivery conditions -- Part 1: General requirements
ISO 9328-2:1991	Steel plates and strips for pressure purposes -- Technical delivery conditions -- Part 2: Unalloyed and low-alloyed steels with specified room temperature and elevated temperature properties
ISO 9328-3:1991	Steel plates and strips for pressure purposes -- Technical delivery conditions -- Part 3: Nickel-alloyed steels with specified low temperature properties
ISO 9328-4:1991	Steel plates and strips for pressure purposes -- Technical delivery conditions -- Part 4: Weldable fine grain steels with high proof stress supplied in the normalized or quenched and tempered condition
ISO 9328-5:1991	Steel plates and strips for pressure purposes -- Technical delivery conditions -- Part 5: Austenitic steels
ISO 9364:1991	Continuous hot-dip aluminium/zinc-coated steel sheet of commercial, lock-forming and structural qualities
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 9473:1988	Textile machinery and accessories -- Strip steel for dents of reeds
ISO 10384:1992	Hot-rolled carbon steel sheet for machinery
ISO 11949:1995	Cold-reduced electrolytic tinplate
ISO 11950:1995	Cold-reduced electrolytic chromium/chromium oxide-coated steel
ISO 11951:1995	Cold-reduced blackplate in coil form for the production of tinplate or electrolytic chromium/chromium oxide-coated steel
ISO 13887:1995	Cold-reduced steel sheet of higher yield strength with improved formability
ISO 13976:1998	Hot-rolled steel sheet in coils of structural quality and heavy thickness
ISO 14590:1999	Cold-reduced steel sheet of high tensile strength and low yield point with improved formability
ISO 14788:1998	Continuous hot-dip zinc-5 %/aluminium alloy coated steel sheets and coils
ISO 16160:2000	Continuously hot-rolled steel sheet products -- Dimensional and shape tolerances
ISO 16162:2000	Continuously cold-rolled steel sheet products -- Dimensional and shape tolerances
ISO 16163:2000	Continuously hot-dipped coated steel sheet products -- Dimensional and shape tolerances
ISO 722:1991	Rock drilling equipment -- Hollow drill steels in bar form, hexagonal and round
ISO 1035-1:1980	Hot-rolled steel bars -- Part 1: Dimensions of round bars
ISO 1035-2:1980	Hot-rolled steel bars -- Part 2: Dimensions of square bars
ISO 1035-3:1980	Hot-rolled steel bars -- Part 3: Dimensions of flat bars
ISO 1035-4:1982	Hot-rolled steel bars -- Part 4: Tolerances
ISO 2938:1974	Hollow steel bars for machining
ISO 4951-1:2001	High yield strength steel bars and sections -- Part 1: General delivery requirements
ISO 4951-2:2001	High yield strength steel bars and sections -- Part 2: Delivery conditions for normalized, normalized rolled and as-rolled steels
ISO 4951-3:2001	High yield strength steel bars and sections -- Part 3: Delivery conditions for thermomechanically-rolled steels
ISO 9443:1991	Heat-treatable and alloy steels -- Surface quality classes for hot-rolled round bars and wire rods -- Technical delivery conditions
ISO 2232:1990	Round drawn wire for general purpose non-alloy steel wire ropes and for large diameter steel wire ropes -- Specifications
ISO 2408:1985	Steel wire ropes for general purposes -- Characteristics
ISO 2532:1974	Steel wire ropes -- Vocabulary
ISO 2701:1977	Drawn wire for general purpose non-alloy steel wire ropes -- Terms of acceptance
ISO 3108:1974	Steel wire ropes for general purposes -- Determination of actual breaking load
ISO 3178:1988	Steel wire ropes for general purposes -- Terms of acceptance
ISO 3189-1:1985	Sockets for wire ropes for general purposes -- Part 1: General characteristics and conditions of acceptance
ISO 3189-2:1985	Sockets for wire ropes for general purposes -- Part 2: Special requirements for sockets produced by forging or machined from the solid
ISO 3189-3:1985	Sockets for wire ropes for general purposes -- Part 3: Special requirements for sockets produced by casting
ISO 3578:1980	Steel wire ropes -- Standard designations
ISO 4101:1983	Drawn steel wire for elevator ropes -- Specifications

Designation	Title
ISO 4344:1983	Steel wire ropes for lifts
ISO 4345:1988	Steel wire ropes -- Fibre main cores -- Specification
ISO 4346:1977	Steel wire ropes for general purposes -- Lubricants -- Basic requirements
ISO 6984:1990	Round non-alloy steel wires for stranded wire ropes for mine hoisting -- Specifications
ISO 7531:1987	Wire rope slings for general purposes -- Characteristics and specifications
ISO 7595:1984	Socketing procedures for wire ropes -- Molten metal socketing
ISO/TR 7596:1982	Socketing procedures for wire ropes -- Resin socketing
ISO 7900:1988	Zinc-coated steel wire for fencing
ISO 7989:1988	Zinc coatings for steel wire
ISO 8369:1986	Large diameter steel wire ropes
ISO 8457-1:1989	Steel wire rod -- Part 1: Dimensions and tolerances
ISO 8457-2:1989	Steel wire rod -- Part 2: Quality requirements for unalloyed steel wire rods for conversion to wire
ISO 8792:1986	Wire rope slings -- Safety criteria and inspection procedures for use
ISO 8793:1986	Steel wire ropes -- Ferrule-secured eye terminations
ISO 8794:1986	Steel wire ropes -- Spliced eye terminations for slings
ISO 9975:1990	Round non-alloy steel wires for locked coil mine winding ropes -- Specifications
ISO 10092:1990	High breaking load steel wire ropes -- Specifications
ISO 657-1:1989	Hot-rolled steel sections -- Part 1: Equal-leg angles -- Dimensions
ISO 657-2:1989	Hot-rolled steel sections -- Part 2: Unequal-leg angles -- Dimensions
ISO 657-5:1976	Hot-rolled steel sections -- Part 5: Equal-leg angles and unequal-leg angles -- Tolerances for metric and inch series
ISO 657-11:1980	Hot-rolled steel sections -- Part 11: Sloping flange channel sections (Metric series) -- Dimensions and sectional properties
ISO 657-13:1981	Hot-rolled steel sections -- Part 13: Tolerances on sloping flange beam, column and channel sections
ISO 657-15:1980	Hot-rolled steel sections -- Part 15: Sloping flange beam sections (Metric series) -- Dimensions and sectional properties
ISO 657-16:1980	Hot-rolled steel sections -- Part 16: Sloping flange column sections (metric series) -- Dimensions and sectional properties
ISO 657-18:1980	Hot-rolled steel sections -- Part 18: L sections for shipbuilding (metric series) -- Dimensions, sectional properties and tolerances
ISO 657-19:1980	Hot-rolled steel sections -- Part 19: Bulb flats (metric series) -- Dimensions, sectional properties and tolerances
ISO 657-21:1983	Hot-rolled steel sections -- Part 21: T-sections with equal depth and flange width -- Dimensions
ISO 4951-1:2001	High yield strength steel bars and sections -- Part 1: General delivery requirements
ISO 4951-2:2001	High yield strength steel bars and sections -- Part 2: Delivery conditions for normalized, normalized rolled and as-rolled steels
ISO 4951-3:2001	High yield strength steel bars and sections -- Part 3: Delivery conditions for thermomechanically-rolled steels
ISO 559:1991	Steel tubes for water and sewage
ISO 630-2:2000	Structural steels -- Part 2: Technical delivery requirements for hot-finished hollow sections
ISO 657-14:2000	Hot-rolled steel sections -- Part 14: Hot-finished structural hollow sections -- Dimensions and sectional properties
ISO 1129:1980	Steel tubes for boilers, superheaters and heat exchangers -- Dimensions, tolerances and conventional masses per unit length
ISO 2037:1992	Stainless steel tubes for the food industry
ISO 2604-2:1975	Steel products for pressure purposes -- Quality requirements -- Part 2: Wrought seamless tubes
ISO 2604-3:1975	Steel products for pressure purposes -- Quality requirements -- Part 3: Electric resistance and induction-welded tubes
ISO 2604-5:1978	Steel products for pressure purposes -- Quality requirements -- Part 5: Longitudinally welded austenitic stainless steel tubes
ISO 2604-6:1978	Steel products for pressure purposes -- Quality requirements -- Part 6: Submerged arc longitudinally or spirally welded steel tubes
ISO 2937:1974	Plain end seamless steel tubes for mechanical application
ISO 3183-1:1996	Petroleum and natural gas industries -- Steel pipe for pipelines -- Technical delivery conditions -- Part 1: Pipes of requirement class A
ISO 3183-2:1996	Petroleum and natural gas industries -- Steel pipe for pipelines -- Technical delivery conditions -- Part 2: Pipes of requirements class B
ISO 3183-3:1999	Petroleum and natural gas industries -- Steel pipe for pipelines -- Technical delivery conditions -- Part 3: Pipes of requirement class C, Cor 1:2000
ISO 4019:1982	Cold-finished steel structural hollow sections -- Dimensions and sectional properties
ISO 6594:1983	Cast iron drainage pipes and fittings -- Spigot series
ISO 6600:1980	Ductile iron pipes -- Centrifugal cement mortar lining -- Composition controls of freshly applied mortar
ISO 6758:1980	Welded steel tubes for heat exchangers
ISO 6759:1980	Seamless steel tubes for heat exchangers
ISO 9302:1994	Seamless and welded (except submerged arc-welded) steel tubes for pressure purposes -- Electromagnetic testing for verification of hydraulic leak-tightness
ISO 9303:1989	Seamless and welded (except submerged arc-welded) steel tubes for pressure purposes -- Full peripheral ultrasonic testing for the detection of longitudinal imperfections
ISO 9304:1989	Seamless and welded (except submerged arc-welded) steel tubes for pressure purposes -- Eddy current testing for the detection of imperfections

Designation	Title
ISO 9305:1989	Seamless steel tubes for pressure purposes -- Full peripheral ultrasonic testing for the detection of transverse imperfections
ISO 9329-1:1989	Seamless steel tubes for pressure purposes -- Technical delivery conditions -- Part 1: Unalloyed steels with specified room temperature properties
ISO 9329-2:1997	Seamless steel tubes for pressure purposes -- Technical delivery conditions -- Part 2: Unalloyed and alloyed steels with specified elevated temperature properties
ISO 9329-3:1997	Seamless steel tubes for pressure purposes -- Technical delivery conditions -- Part 3: Unalloyed and alloyed steels with specified low temperature properties
ISO 9329-4:1997	Seamless steel tubes for pressure purposes -- Technical delivery conditions -- Part 4: Austenitic stainless steels
ISO 9330-1:1990	Welded steel tubes for pressure purposes -- Technical delivery conditions -- Part 1: Unalloyed steel tubes with specified room temperature properties
ISO 9330-2:1997	Welded steel tubes for pressure purposes -- Technical delivery conditions -- Part 2: Electric resistance and induction welded unalloyed and alloyed steel tubes with specified elevated temperature properties
ISO 9330-3:1997	Welded steel tubes for pressure purposes -- Technical delivery conditions -- Part 3: Electric resistance and induction welded unalloyed and alloyed steel tubes with specified low temperature properties
ISO 9330-4:2000	Welded steel tubes for pressure purposes -- Technical delivery conditions -- Part 4: Submerged arc-welded unalloyed and alloyed steel tubes with specified elevated temperature properties
ISO 9330-5:2000	Welded steel tubes for pressure purposes -- Technical delivery conditions -- Part 5: Submerged arc-welded unalloyed and alloyed steel tubes with specified low temperature properties
ISO 9330-6:1997	Welded steel tubes for pressure purposes -- Technical delivery conditions -- Part 6: Longitudinally welded austenitic stainless steel tubes
ISO 9402:1989	Seamless and welded (except submerged arc-welded) steel tubes for pressure purposes -- Full peripheral magnetic transducer/flux leakage testing of ferromagnetic steel tubes for the detection of longitudinal imperfections
ISO 9598:1989	Seamless steel tubes for pressure purposes -- Full peripheral magnetic transducer/flux leakage testing of ferromagnetic steel tubes for the detection of transverse imperfections
ISO 9764:1989	Electric resistance and induction welded steel tubes for pressure purposes -- Ultrasonic testing of the weld seam for the detection of longitudinal imperfections
ISO 9765:1990	Submerged arc-welded steel tubes for pressure purposes -- Ultrasonic testing of the weld seam for the detection of longitudinal and/or transverse imperfections
ISO 10124:1994	Seamless and welded (except submerged arc-welded) steel tubes for pressure purposes -- Ultrasonic testing for the detection of laminar imperfections
ISO 10332:1994	Seamless and welded (except submerged arc-welded) steel tubes for pressure purposes -- Ultrasonic testing for the verification of hydraulic leak-tightness
ISO 10543:1993	Seamless and hot-stretch-reduced welded steel tubes for pressure purposes -- Full peripheral ultrasonic thickness testing
ISO 10763:1994	Hydraulic fluid power -- Plain-end, seamless and welded precision steel tubes -- Dimensions and nominal working pressures
ISO 10799:2001	Structural steels -- Cold-formed, welded, structural hollow sections -- Technical delivery requirements
ISO 11484:1994	Steel tubes for pressure purposes -- Qualification and certification of non-destructive testing (NDT) personnel
ISO 11496:1993	Seamless and welded steel tubes for pressure purposes -- Ultrasonic testing of tube ends for the detection of laminar imperfections
ISO 11960:1996	Petroleum and natural gas industries -- Steel pipes for use as casing or tubing for wells
ISO 11961:1996	Petroleum and natural gas industries -- Steel pipes for use as drill pipe -- Specification
ISO 12094:1994	Welded steel tubes for pressure purposes -- Ultrasonic testing for the detection of laminar imperfections in strips/plates used in the manufacture of welded tubes
ISO 12095:1994	Seamless and welded steel tubes for pressure purposes -- Liquid penetrant testing
ISO 12096:1996	Submerged arc-welded steel tubes for pressure purposes -- Radiographic testing of the weld seam for the detection of imperfections
ISO 13663:1995	Welded steel tubes for pressure purposes -- Ultrasonic testing of the area adjacent to the weld seam for the detection of laminar imperfections
ISO 13664:1997	Seamless and welded steel tubes for pressure purposes -- Magnetic particle inspection of the tube ends for the detection of laminar imperfections
ISO 13665:1997	Seamless and welded steel tubes for pressure purposes -- Magnetic particle inspection of the tube body for the detection of surface imperfections
ISO 13680:2000	Petroleum and natural gas industries -- Corrosion-resistant alloy seamless tubes for use as casing, tubing and coupling stock -- Technical delivery conditions
ISO 13:1978	Grey iron pipes, special castings and grey iron parts for pressure main lines
ISO 65:1981	Carbon steel tubes suitable for screwing in accordance with ISO 7-1
ISO 1127:1992	Stainless steel tubes -- Dimensions, tolerances and conventional masses per unit length
ISO 2531:1998	Ductile iron pipes, fittings, accessories and their joints for water or gas applications
ISO 2604-2:1975	Steel products for pressure purposes -- Quality requirements -- Part 2: Wrought seamless tubes
ISO 2604-3:1975	Steel products for pressure purposes -- Quality requirements -- Part 3: Electric resistance and induction-welded tubes
ISO 2604-5:1978	Steel products for pressure purposes -- Quality requirements -- Part 5: Longitudinally welded austenitic stainless steel tubes
ISO 2604-6:1978	Steel products for pressure purposes -- Quality requirements -- Part 6: Submerged arc longitudinally or spirally welded steel tubes

Designation	Title
ISO 3304:1985	Plain end seamless precision steel tubes -- Technical conditions for delivery
ISO 3305:1985	Plain end welded precision steel tubes -- Technical conditions for delivery
ISO 3306:1985	Plain end as-welded and sized precision steel tubes -- Technical conditions for delivery
ISO 3545-1:1989	Steel tubes and fittings -- Symbols for use in specifications -- Part 1: Tubes and tubular accessories with circular cross-section
ISO 3545-2:1989	Steel tubes and fittings -- Symbols for use in specifications -- Part 2: Square and rectangular hollow sections
ISO 4179:1985	Ductile iron pipes for pressure and non-pressure pipelines -- Centrifugal cement mortar lining -- General requirements
ISO 4200:1991	Plain end steel tubes, welded and seamless -- General tables of dimensions and masses per unit length
ISO 5252:1991	Steel tubes -- Tolerance systems
ISO 5256:1985	Steel pipes and fittings for buried or submerged pipe lines -- External and internal coating by bitumen or coal tar derived materials
ISO 6761:1981	Steel tubes -- Preparation of ends of tubes and fittings for welding
ISO 7598:1988	Stainless steel tubes suitable for screwing in accordance with ISO 7-1
ISO 8179-1:1995	Ductile iron pipes -- External zinc coating -- Part 1: Metallic zinc with finishing layer
ISO 8179-2:1995	Ductile iron pipes -- External zinc coating -- Part 2: Zinc rich paint with finishing layer
ISO 8180:1985	Ductile iron pipes -- Polyethylene sleeving
ISO 9095:1990	Steel tubes -- Continuous character marking and colour coding for material identification
ISO 9302:1994	Seamless and welded (except submerged arc-welded) steel tubes for pressure purposes -- Electromagnetic testing for verification of hydraulic leak-tightness
ISO 9303:1989	Seamless and welded (except submerged arc-welded) steel tubes for pressure purposes -- Full peripheral ultrasonic testing for the detection of longitudinal imperfections
ISO 9304:1989	Seamless and welded (except submerged arc-welded) steel tubes for pressure purposes -- Eddy current testing for the detection of imperfections
ISO 9305:1989	Seamless steel tubes for pressure purposes -- Full peripheral ultrasonic testing for the detection of transverse imperfections
ISO 9329-1:1989	Seamless steel tubes for pressure purposes -- Technical delivery conditions -- Part 1: Unalloyed steels with specified room temperature properties
ISO 9329-2:1997	Seamless steel tubes for pressure purposes -- Technical delivery conditions -- Part 2: Unalloyed and alloyed steels with specified elevated temperature properties
ISO 9329-3:1997	Seamless steel tubes for pressure purposes -- Technical delivery conditions -- Part 3: Unalloyed and alloyed steels with specified low temperature properties
ISO 9329-4:1997	Seamless steel tubes for pressure purposes -- Technical delivery conditions -- Part 4: Austenitic stainless steels
ISO 9330-1:1990	Welded steel tubes for pressure purposes -- Technical delivery conditions -- Part 1: Unalloyed steel tubes with specified room temperature properties
ISO 9330-2:1997	Welded steel tubes for pressure purposes -- Technical delivery conditions -- Part 2: Electric resistance and induction welded unalloyed and alloyed steel tubes with specified elevated temperature properties
ISO 9330-3:1997	Welded steel tubes for pressure purposes -- Technical delivery conditions -- Part 3: Electric resistance and induction welded unalloyed and alloyed steel tubes with specified low temperature properties
ISO 9330-4:2000	Welded steel tubes for pressure purposes -- Technical delivery conditions -- Part 4: Submerged arc-welded unalloyed and alloyed steel tubes with specified elevated temperature properties
ISO 9330-5:2000	Welded steel tubes for pressure purposes -- Technical delivery conditions -- Part 5: Submerged arc-welded unalloyed and alloyed steel tubes with specified low temperature properties
ISO 9330-6:1997	Welded steel tubes for pressure purposes -- Technical delivery conditions -- Part 6: Longitudinally welded austenitic stainless steel tubes
ISO 9402:1989	Seamless and welded (except submerged arc-welded) steel tubes for pressure purposes -- Full peripheral magnetic transducer/flux leakage testing of ferromagnetic steel tubes for the detection of longitudinal imperfections
ISO 9598:1989	Seamless steel tubes for pressure purposes -- Full peripheral magnetic transducer/flux leakage testing of ferromagnetic steel tubes for the detection of transverse imperfections
ISO 9764:1989	Electric resistance and induction welded steel tubes for pressure purposes -- Ultrasonic testing of the weld seam for the detection of longitudinal imperfections
ISO 9765:1990	Submerged arc-welded steel tubes for pressure purposes -- Ultrasonic testing of the weld seam for the detection of longitudinal and/or transverse imperfections
ISO 10124:1994	Seamless and welded (except submerged arc-welded) steel tubes for pressure purposes -- Ultrasonic testing for the detection of laminar imperfections
ISO 10332:1994	Seamless and welded (except submerged arc-welded) steel tubes for pressure purposes -- Ultrasonic testing for the verification of hydraulic leak-tightness
ISO 10543:1993	Seamless and hot-stretch-reduced welded steel tubes for pressure purposes -- Full peripheral ultrasonic thickness testing
ISO 10803:1999	Design method for ductile iron pipes
ISO 11484:1994	Steel tubes for pressure purposes -- Qualification and certification of non-destructive testing (NDT) personnel
ISO 11496:1993	Seamless and welded steel tubes for pressure purposes -- Ultrasonic testing of tube ends for the detection of laminar imperfections
ISO 12094:1994	Welded steel tubes for pressure purposes -- Ultrasonic testing for the detection of laminar imperfections in strips/plates used in the manufacture of welded tubes
ISO 12095:1994	Seamless and welded steel tubes for pressure purposes -- Liquid penetrant testing

Designation	Title
ISO 12096:1996	Submerged arc-welded steel tubes for pressure purposes -- Radiographic testing of the weld seam for the detection of imperfections
ISO 13663:1995	Welded steel tubes for pressure purposes -- Ultrasonic testing of the area adjacent to the weld seam for the detection of laminar imperfections
ISO 13664:1997	Seamless and welded steel tubes for pressure purposes -- Magnetic particle inspection of the tube ends for the detection of laminar imperfections
ISO 13665:1997	Seamless and welded steel tubes for pressure purposes -- Magnetic particle inspection of the tube body for the detection of surface imperfections
ISO 4986:1992	Steel castings -- Magnetic particle inspection
ISO 4987:1992	Steel castings -- Penetrant inspection
ISO 4990:1986	Steel castings -- General technical delivery requirements
ISO 4991:1994	Steel castings for pressure purposes
ISO 4993:1987	Steel castings -- Radiographic inspection
ISO 7186:1996	Ductile iron products for sewage applications
ISO 11970:2001	Specification and approval of welding procedures for production welding of steel castings
ISO 11971:1997	Visual examination of surface quality of steel castings
ISO 11972:1998	Corrosion-resistant cast steels for general applications
ISO 11973:1999	Heat-resistant cast steels and alloys for general applications
ISO 13521:1999	Austenitic manganese steel castings
ISO 13583-1:2000	Centrifugally cast steel and alloy products -- Part 1: General testing and tolerances
ISO 9327-1:1999	Steel forgings and rolled or forged bars for pressure purposes -- Technical delivery conditions -- Part 1: General requirements
ISO 9327-2:1999	Steel forgings and rolled or forged bars for pressure purposes -- Technical delivery conditions -- Part 2: Non-alloy and alloy (Mo, Cr and CrMo) steels with specified elevated temperature properties
ISO 9327-3:1999	Steel forgings and rolled or forged bars for pressure purposes -- Technical delivery conditions -- Part 3: Nickel steels with specified low temperature properties
ISO 9327-4:1999	Steel forgings and rolled or forged bars for pressure purposes -- Technical delivery conditions -- Part 4: Weldable fine grain steels with high proof strength
ISO 9327-5:1999	Steel forgings and rolled or forged bars for pressure purposes -- Technical delivery conditions -- Part 5: Stainless steels
ISO/TR 15461:1997	Steel forgings -- Testing frequency, sampling conditions and test methods for mechanical tests
ISO 1834:1999	Short link chain for lifting purposes -- General conditions of acceptance
ISO 1835:1980	Short link chain for lifting purposes -- Grade M (4), non-calibrated, for chain slings etc.
ISO 1837:1973	Lifting hooks -- Nomenclature
ISO 2262:1984	General purpose thimbles for use with steel wire ropes -- Specification
ISO 2308:1972	Hooks for lifting freight containers of up to 30 tonnes capacity -- Basic requirements
ISO 2415:1987	Forged shackles for general lifting purposes -- Dee shackles and bow shackles
ISO 3056:1986	Non-calibrated round steel link lifting chain and chain slings -- Use and maintenance
ISO 3075:1980	Short link chain for lifting purposes -- Grade S (6) non calibrated, for chain slings etc.
ISO 3076:1984	Short link chain for lifting purposes -- Grade T (8), non-calibrated, for chain slings etc.
ISO 3077:1984	Short link chain for lifting purposes -- Grade T (8), calibrated, for chain hoists and other lifting appliances
ISO 3266:1984	Eyebolts for general lifting purposes
ISO 4308-1:1986	Cranes and lifting appliances -- Selection of wire ropes -- Part 1: General
ISO 4308-2:1988	Cranes and lifting appliances -- Selection of wire ropes -- Part 2: Mobile cranes -- Coefficient of utilization
ISO 4309:1990	Cranes -- Wire ropes -- Code of practice for examination and discard
ISO 4778:1981	Chain slings of welded construction -- Grades M (4), S (6) and T (8)
ISO 4779:1986	Forged steel lifting hooks with point and eye for use with steel chains of grade M(4)
ISO 7592:1983	Calibrated round steel link lifting chains -- Guidelines to proper use and maintenance
ISO 7593:1986	Chain slings assembled by methods other than welding -- Grade T(8)
ISO 7597:1987	Forged steel lifting hooks with point and eye for use with steel chains of grade T(8)
ISO 8539:1986	Forged steel lifting components for use with grade T(8) chain

Appendix

9

ASTM A 941-00 Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys



Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys¹

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 Size²

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.

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.

DISCUSSION—Where it is necessary to be more definitive, the following more specific terms are used: **primary heat**, **multiple heat**, and **remelted heat**. In product specifications, the term **heat** generally is used, without qualification, to mean the **primary**, **multiple**, or **remelted heat**, whichever is applicable.

heat analysis, *n*—the chemical analysis determined by the steel producer as being representative of a specific **heat of steel**.

heat number, *n*—the alpha, numeric, or alphanumeric designator used to identify a specific **heat of steel**.

high-strength low-alloy steel, *n*—a **steel**, other than a **carbon steel** or an **interstitial-free steel**, that conforms to a specification that requires the minimum content for each specified alloying element to be lower than the applicable limit in the definition for **alloy steel**, and the yield point or yield strength of the product to be at least 36 ksi or 250 MPa.

hot-cold working, *n*—the mechanical deformation of austenitic and precipitation hardening steels at a temperature just below the **recrystallization temperature** to increase the yield strength and hardness by plastic deformation or precipitation hardening effects induced by plastic deformation, or both.

hot working, *n*—mechanical deformation of a metal at temperatures above its **recrystallization temperature**.

imperfection, *n*—a material discontinuity or irregularity that is detectable by **inspection**.

inspection, *n*—the process of measuring, examining, testing, gaging, or otherwise comparing the unit of product with the applicable requirements.

interstitial-free steel, *n*—a **steel** that has essentially all of its carbon and nitrogen chemically combined with stabilization elements rather than being present interstitially.

DISCUSSION—The heat analysis limits (minimum or maximum, or both) that are permitted to be prescribed in interstitial-free steel specifications are as given in the definition for **carbon steel**, except that the 0.050 % maximum limit for titanium does not apply.

killed steel, *n*—a **steel** deoxidized to such a level that essentially no reaction occurred between carbon and oxygen during solidification.

laser beam welding, *n*—a welding process that uses a laser beam as the heat source.

lot, *n*—a definite quantity of product manufactured under conditions that are considered uniform.

low-alloy steel, *n*—a **steel**, other than a **carbon steel** or an **interstitial-free steel**, that conforms to a specification that requires the minimum content for each specified alloying element to be lower than the applicable limit in the definition for **alloy steel**.

manufacturer, *n*—the organization responsible for the conversion of materials into products meeting the requirements of a product specification.

multiple heat, *n*—two or more molten **primary heats**, in whole or in part, combined in a common ladle or in a common non-oscillating mold.

DISCUSSION—A **multiple heat** is identified by a single **heat number** representative of the **multiple heat**, or by the individual **heat numbers** of the **primary heats** contained in the **multiple heat**. The **heat analysis** of a **multiple heat** identified by a single **heat number** is the

weighted average analysis of the individual **primary heats** contained in the **multiple heat**. Two or more molten **primary heats** sequentially strand cast (poured into an oscillating mold) constitute a series of individual **heats**, not a **multiple heat**.

plate-as-rolled, *n*—the quantity of plate product rolled at one time, either from an individual slab or directly from an ingot.

DISCUSSION—This term does not refer to the surface condition or the heat-treatment state of the material; a **plate-as-rolled** may be in the as-rolled condition, or may have received one or more surface treatments or **heat treatments**, or both.

primary heat, *n*—the product of a single cycle of a batch melting process.

DISCUSSION—In the investment casting industry, the term *master heat* is used.

remelted heat, *n*—the product of the remelting of a **primary heat**, in whole or in part.

DISCUSSION—In the investment casting industry, the term *sub-heat* is used.

rimmed steel, *n*—a **steel** that contained sufficient oxygen to generate carbon monoxide at the boundary between the solid metal and the remaining molten metal during solidification, resulting in an outer layer low in carbon.

semikilled steel, *n*—an incompletely deoxidized **steel** that contained sufficient oxygen to form enough entrapped carbon monoxide during solidification to offset solidification shrinkage.

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

steel, *n*—a material that conforms to a specification that requires, by mass percent, more iron than any other element and a maximum carbon content of generally less than 2.

DISCUSSION—The iron content requirement is not normally stated in the specification and is not normally determined by chemical analysis, but is taken to be 100 % minus the sum of the mean values permitted by the specification for all other elements having a specified range or a specified maximum. For conformance purposes, this calculated value for iron is compared on an individual basis to the mean values permitted by the specification for each of the other elements having a specified range or a specified maximum. Some chromium-containing steels may contain more than 2 % carbon; however, 2 % carbon is generally considered to be the demarcation between **steel** and cast iron.

strain hardening, *n*—an increase in hardness and strength of a metal caused by plastic deformation at temperatures below its **recrystallization temperature**. (Syn. *work hardening*)

test record, *n*—a document or electronic record that contains the observations and derived data obtained by applying a given test method.

test report, *n*—a document that presents the applicable qualitative or quantitative results obtained by applying one or more given test methods.

DISCUSSION—A single document, containing test report information and certificate of compliance information, may be used.

3.2 *Definitions of Terms Relating to Heat Treatment of Steels:*

Ac_{cm} , Ac_1 , Ac_3 , Ac_4 —See **transformation temperature**.

Ae_{cm} , Ae_1 , Ae_3 , Ae_4 —See **transformation temperature**.

age hardening, *n*—hardening by **aging**, usually after rapid cooling or **cold working**.

aging, *n*—a change in the properties of certain **steels** that occurs at ambient or moderately elevated temperatures after hot working or a heat treatment (**quench aging**, **natural aging**, or **artificial aging**) or after a cold-working operation (**strain aging**).

DISCUSSION—The change in properties is often, but not always, due to **precipitation hardening**, but never involves a change in the chemical composition of the **steel**.

annealing, *n*—a generic term covering any of several **heat treatments**.

DISCUSSION—This treatment is used for purposes such as reducing hardness, improving machinability, facilitating **cold working**, producing a desired microstructure, or obtaining desired mechanical, physical, or other properties. Where applicable, it is preferred that the following more specific terms be used: **black annealing**, **box annealing**, **bright annealing**, **flame annealing**, **full annealing**, **graphitization annealing**, **intermediate annealing**, **isothermal annealing**, **process annealing**, **quench annealing**, **recrystallization annealing**, **spheroidizing**, and **subcritical annealing**. The term “**annealing**,” without qualification, implies **full annealing**. Any process of **annealing** will usually reduce stresses; however, if the treatment is applied for the sole purpose of stress reduction, it should be designated **stress relieving**.

Ar_{cm} , Ar_1 , Ar_3 , Ar_4 —See **transformation temperature**.

artificial aging, *n*—aging above room temperature.

austempering, *n*—**heat treatment** involving **quenching** a steel object from a temperature above the **transformation range** in a medium maintained at a temperature above the **martensite range** sufficiently fast to avoid the formation of high temperature transformation products, and then holding it at that temperature until transformation is complete.

austenitizing, *n*—forming austenite by heating a steel object above the **transformation range**.

baking, *n*—heating to a low temperature in order to remove gases.

black annealing, *n*—**box annealing** steel sheet, strip, or wire.

blank carburizing, *n*—simulating the **carburizing** operation without introducing carbon.

DISCUSSION—This is usually accomplished by using an inert material in place of the carburizing agent, or by applying a suitable protective coating on the object being heat treated.

blank nitriding, *n*—simulating the nitriding operation without introducing nitrogen.

DISCUSSION—This is usually accomplished by using an inert material in place of the nitriding agent, or by applying a suitable protective coating on the object being heat treated.

bluing, *n*—subjecting the scale-free surface of a steel object to the action of air, steam, or other agents at a suitable temperature, thereby forming a thin blue film of oxide and improving the object’s appearance and corrosion resistance.

DISCUSSION—This term is ordinarily applied to sheet, strip, or finished parts. It is used also to denote the heating of springs after fabrication in order to improve their properties.

box annealing, *n*—**annealing** in a sealed container under

conditions that minimize oxidation.

DISCUSSION—The charge is usually heated slowly to a temperature below the **transformation range**, but sometimes above or within it, and is then cooled slowly.

bright annealing, *n*—**annealing** in a protective medium to prevent discoloration of the bright surface.

carbon potential, *n*—the carbon content at the surface of a specimen of pure iron in equilibrium with the carburizing medium considered, and under the conditions specified.

carbon restoration, *n*—replacing the carbon lost from the surface layer in previous processing by carburizing this layer to substantially the original carbon level.

carbonitriding, *n*—**case hardening** in which a suitable steel object is heated above Ac_1 in a gaseous atmosphere of such composition as to cause simultaneous absorption of carbon and nitrogen by the surface and, by diffusion, to create a concentration gradient.

carburizing, *n*—a process in which an austenitized steel object is brought into contact with a carbonaceous environment of sufficient carbon potential to cause absorption of carbon at the surface and, by diffusion, to create a concentration gradient.

case, *n*—*in case hardening*, the outer portion that has been made harder than the **core** as a result of altered composition or microstructure, or both, from treatments such as **carburizing**, **nitriding**, and **induction hardening**.

case hardening, *n*—a generic term covering any of several processes applicable to **steel** that change the chemical composition or microstructure, or both, of the surface layer.

DISCUSSION—The processes commonly used are: **carburizing** and **quench hardening**; **cyaniding**; **nitriding**; and **carbonitriding**. It is preferred that the applicable specific process name be used.

cementation, *n*—the introduction of one or more elements into the outer portion of a steel object by means of diffusion at high temperature.

cold treatment, *n*—exposing a steel object to temperatures below room temperature for the purpose of obtaining desired conditions or properties, such as dimensional or structural stability.

conditioning heat treatment, *n*—a preliminary **heat treatment** used to prepare a steel object for a desired reaction to a subsequent **heat treatment**.

controlled cooling, *n*—cooling a steel object from an elevated temperature in a predetermined manner to avoid hardening, cracking, or internal damage, or to produce a desired microstructure or mechanical properties.

core, *n*—*in case hardening*, the interior portion of unaltered composition or microstructure, or both, of a case hardened steel object.

core, *n*—*in clad products*, the central portion of a multilayer composite metallic material.

critical cooling rate, *n*—the slowest rate of continuous cooling at which austenite can be cooled from above the **transformation range** to prevent its transformation above M_s .

cyaniding, *n*—introducing carbon and nitrogen into a solid steel object by holding it above Ac_1 in contact with molten cyanide of suitable composition.

cycle annealing, *n*—**annealing** employing a predetermined and closely controlled time-temperature cycle to produce specific properties or a specific microstructure.

decarburization, *n*—the loss of carbon from the surface of a steel object as a result of its being heated in a medium that reacts with the carbon.

differential heating, *n*—heating that intentionally produces a temperature gradient within a steel object such that, after cooling, a desired stress distribution or variation in properties is present within the object.

diffusion coating, *n*—any process whereby a base metal is either coated with another metal and heated to a sufficient temperature in a suitable environment, or exposed to a gaseous or liquid medium containing the other metal, thereby causing diffusion of the coating or other metal into the base metal, with a resultant change in the composition and properties of its surface.

direct quenching, *n*—*in thermochemical processing*, **quenching** immediately following the thermochemical treatment.

double aging, *n*—employment of two different aging treatments, in sequence, to control the type of precipitate formed from a supersaturated alloy matrix in order to obtain the desired properties.

DISCUSSION—The first aging treatment, sometimes referred to as intermediate or stabilizing, is usually carried out at a higher temperature than the second.

double tempering, *n*—a treatment in which a quench-hardened steel object is given two complete tempering cycles at substantially the same temperature for the purpose of ensuring completion of the tempering reaction and promoting stability of the resultant microstructure.

ferritizing anneal, *n*—a **heat treatment** that produces a predominantly ferritic matrix in a steel object.

flame annealing, *n*—**annealing** in which the heat is applied directly by a flame.

flame hardening, *n*—a process in which only the surface layer of a suitable steel object is heated by flame to above A_{c3} or A_{cm} , and then the object is **quenched**.

fog quenching, *n*—**quenching** in a mist.

full annealing, *n*—**annealing** a steel object by **austenitizing** it and then cooling it slowly through the **transformation range**.

DISCUSSION—The austenitizing temperature is usually above A_{c3} for hypoeutectoid steels and between A_{c1} and A_{cm} for hypereutectoid steels.

grain growth, *n*—an increase in the grain size of a steel object, usually as a result of exposure to elevated temperatures.

graphitization annealing, *n*—**annealing** a steel object in such a way that some or all of the carbon is precipitated as graphite.

hardenability, *n*—the property that determines the depth and distribution of hardness induced by **quenching** a steel object.

hardening, *n*—increasing the hardness by suitable treatment, usually involving heating and cooling.

DISCUSSION—Where applicable, it is preferred that the following more specific terms be used: **age hardening**, **case hardening**, **flame**

hardening, **induction hardening**, **precipitation hardening**, and **quench hardening**.

heat treatment, *n*—heating and cooling a steel object in such a way as to obtain desired conditions or properties.

DISCUSSION—Heating for the sole purpose of hot working is excluded from the meaning of this definition.

homogeneous carburizing, *n*—a process that converts a low-carbon steel to one of substantially uniform and higher carbon content throughout the section, so that a specific response to **hardening** may be obtained.

homogenizing, *n*—holding a steel object at high temperature to eliminate or decrease chemical segregation by diffusion.

hot quenching, *n*—an imprecise term used to cover a variety of quenching procedures in which the quenching medium is maintained at a prescribed temperature above 160°F or 70°C.

induction hardening, *n*—*in surface hardening*, a process in which only the surface layer of a suitable steel object is heated by electrical induction to above A_{c3} or A_{cm} , and then the object is **quenched**.

induction hardening, *n*—*in through hardening*, a process in which a suitable steel object is heated by electrical induction to above A_{c3} or A_{cm} throughout its section, and then the object is **quenched**.

induction heating, *n*—heating by electrical induction.

intermediate annealing, *n*—**annealing** wrought steel objects at one or more stages during manufacture prior to final thermal treatment.

interrupted aging, *n*—**aging** at two or more temperatures, by steps, and cooling to room temperature after each step.

interrupted quenching, *n*—**quenching** in which the object being quenched is removed from the quenching medium while the object is at a temperature substantially higher than that of the quenching medium.

isothermal annealing, *n*—**austenitizing** a steel object and then cooling it to, and holding it at, a temperature at which austenite transforms to a ferrite-carbide aggregate.

isothermal transformation, *n*—a change in phase at any constant temperature.

M_f , M_s —See **transformation temperature**.

maraging, *n*—a precipitation hardening treatment applied to a special group of **alloy steels** to precipitate one or more intermetallic compounds in a matrix of essentially carbon-free martensite.

martempering, *n*—**quenching** an austenitized steel object in a medium at a temperature in the upper part of, or slightly above, the **martensite range**, holding it in the medium until its temperature is substantially uniform throughout, and then cooling it in air through the **martensite range**.

martensite range, *n*—the temperature interval between M_s and M_f .

natural aging, *n*—spontaneous aging of a super-saturated solid solution at room temperature.

nitriding, *n*—introducing nitrogen into a solid steel object by holding it at a suitable temperature in contact with a nitrogenous environment.

normalizing, *n*—heating a steel object to a suitable temperature above the **transformation range** and then cooling it in

air to a temperature substantially below the **transformation range**.

overaging, *n*—**aging** under conditions of time and temperature greater than those required to obtain maximum change in a certain property, so that the property is altered away from the maximum.

overheating, *n*—heating a steel object to such a high temperature that excessive grain growth occurs.

DISCUSSION—Unlike burning, it may be possible to restore the original properties/microstructure by further heat treatment or mechanical working, or a combination thereof.

patenting, *n*—*in wire making*, heating a medium-carbon or high-carbon steel before wire drawing, or between drafts, to a temperature above the **transformation range**, and then cooling it in air, or a bath of molten lead or salt, to a temperature below A_{e1} .

post-weld heat treatment, *n*—heating weldments immediately after welding, to provide **tempering**, **stress relieving**, or a controlled rate of cooling to prevent formation of a hard or brittle microstructure.

precipitation hardening, *n*—**hardening** caused by the precipitation of a constituent from a supersaturated solid solution.

precipitation heat treatment, *n*—**artificial aging** in which a constituent precipitates from a supersaturated solid solution.

preheating, *n*—*for tool steels*, heating to an intermediate temperature immediately before final **austenitizing**.

preheating, *n*—heating before welding, a mechanical treatment, or some further thermal treatment.

process annealing, *n*—*in the sheet and wire industries*, heating a steel object to a temperature close to, but below, A_{c1} and then cooling it, in order to soften it for further cold working.

progressive aging, *n*—**aging** by increasing the temperature in steps, or continuously, during the aging cycle.

quench aging, *n*—**aging** associated with **quenching** after **solution heat treatment**.

quench annealing, *n*—**annealing** an austenitic steel object by **solution heat treatment**.

quench hardening, *n*—**hardening** a steel object by **austenitizing** it, and then cooling it rapidly enough that some or all of the austenite transforms to martensite.

DISCUSSION—The austenitizing temperature is usually above A_{c3} for hypoeutectoid steels and between A_{c1} and A_{cm} for hypereutectoid steels.

quenching, *n*—rapid cooling.

DISCUSSION—Where applicable, it is preferred that the following more specific terms be used: **fog quenching**, **hot quenching**, **interrupted quenching**, **selective quenching**, **spray quenching**, and **time quenching**.

recrystallization, *n*—the formation of a new grain structure through a nucleation and growth process.

DISCUSSION—This is commonly produced by subjecting a steel object, which may be strained, to suitable conditions of time and temperature.

recrystallization annealing, *n*—**annealing** a cold-worked

steel object to produce a new grain structure without a change in phase.

recrystallization temperature, *n*—the approximate minimum temperature at which recrystallization of a cold-worked steel object occurs within a specified time.

secondary hardening, *n*—the hardening phenomenon that occurs during high-temperature **tempering** of certain **steels** containing one or more carbide-forming alloying elements.

selective heating, *n*—intentionally heating only certain portions of a steel object.

selective quenching, *n*—**quenching** only certain portions of a steel object.

shell hardening, *n*—a surface hardening process in which a suitable steel object, when heated through and quench hardened, develops a martensitic layer or shell that closely follows the contour of the piece and surrounds a **core** of essentially pearlitic transformation product.

DISCUSSION—This result is accomplished by a proper balance between section size, **hardenability**, and severity of quench.

slack quenching, *n*—the incomplete **hardening** of a steel object due to **quenching** from the austenitizing temperature at a rate slower than the **critical cooling rate** for the particular steel composition, resulting in the formation of one or more transformation products in addition to martensite.

snap temper, *n*—a precautionary interim stress-relieving treatment applied to a high-hardenability steel immediately after **quenching** to prevent cracking because of delay in **tempering** it at the prescribed higher temperature.

soaking, *n*—prolonged holding at a selected temperature.

solution heat treatment, *n*—heating a steel object to a suitable temperature, holding it at that temperature long enough to cause one or more constituents to enter into solid solution, and then cooling it rapidly enough to hold such constituents in solution.

spheroidizing, *n*—heating and cooling a steel object to produce a spheroidal or globular form of carbide in its microstructure.

DISCUSSION—Spheroidizing methods commonly used are the following: (1) prolonged holding at a temperature just below A_{e1} ; (2) heating and cooling alternately between temperatures that are just above, and just below, A_{e1} ; (3) heating to a temperature above A_{e1} or A_{e3} and then cooling very slowly in the furnace or holding at a temperature just below A_{e1} ; (4) cooling, from the minimum temperature at which all carbide is dissolved, at a rate suitable to prevent the reformation of a carbide network, and then reheating in accordance with Method (1) or (2) above. (Applicable to hypereutectoid steels containing a carbide network.)

spray quenching, *n*—**quenching** in a spray of liquid.

stabilizing treatment, *n*—any treatment intended to stabilize the microstructure or dimensions of a steel object.

strain aging, *n*—**aging** induced by cold working.

stress relieving, *n*—heating a steel object to a suitable temperature, holding it long enough to reduce residual stresses, and then cooling it slowly enough to minimize the development of new residual stresses.

subcritical annealing, *n*—**annealing** at a temperature slightly below A_{c1} .

surface hardening, *n*—a generic term covering any of several processes that, by **quench hardening** only, produce in a steel object a surface layer that is harder or more wear resistant than the **core**.

DISCUSSION—There is no significant alteration of the chemical composition of the surface layer. Where applicable, it is preferred that the following more specific terms be used: **induction hardening**, **flame hardening**, and **shell hardening**.

temper brittleness, *n*—brittleness that results when certain steels are held within, or are cooled slowly through, a certain range of temperature below the **transformation range**.

tempering, *n*—reheating a quench hardened or normalized steel object to a temperature below A_{c1} , and then cooling it at any desired rate.

thermochemical treatment, *n*—a **heat treatment** carried out in a medium suitably chosen to produce a change in the chemical composition of the steel object by exchange with the medium.

time quenching, *n*—interrupted **quenching** in which the duration of holding in the quenching medium is controlled.

transformation ranges, *n*—those ranges of temperature within which austenite forms during heating and transforms during cooling.

DISCUSSION—The two ranges are distinct, sometimes overlapping but never coinciding. The limiting temperatures of the ranges are dependent upon the steel composition and the rate of change of temperature, particularly during cooling.

transformation temperature, *n*—the temperature at which a

change in phase occurs, with the limiting temperatures of the **transformation ranges** designated using the following symbols:

A_{cm} —the temperature at which the solution of cementite in austenite is completed during heating.

A_{c1} —the temperature at which austenite begins to form during heating.

A_{c3} —the temperature at which transformation of ferrite to austenite is completed during heating.

A_{c4} —the temperature at which austenite transforms to delta ferrite during heating.

A_{e1} , A_{e3} , $A_{e_{cm}}$, A_{e4} —the temperatures of phase change at equilibrium.

$A_{r_{cm}}$ —the temperature at which precipitation of cementite starts during cooling.

A_{r1} —the temperature at which transformation of austenite to ferrite or to ferrite plus cementite is completed during cooling.

A_{r3} —the temperature at which austenite begins to transform to ferrite during cooling.

A_{r4} —the temperature at which delta ferrite transforms to austenite during cooling.

M_f —the temperature at which transformation of austenite to martensite is substantially completed during cooling.

M_s —the temperature at which transformation of austenite to martensite starts during cooling.

DISCUSSION—All of the above changes, except the formation of martensite, occur at lower temperatures during cooling than during heating, and are dependent upon the rate of change of temperature.

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Appendix

10

***ASTM E 527–83 (1997)
Numbering Metals and Alloys (UNS)***



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 (€) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

€¹ 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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TABLE 1 Primary Series of Numbers

<i>Nonferrous Metals and Alloys</i>	
A00001–A99999	aluminum and aluminum alloys
C00001–C99999	copper and copper alloys
E00001–E99999	rare earth and rare earth-like metals and alloys (18 items; see Table 2)
L00001–L99999	low melting metals and alloys (15 items; see Table 2)
M00001–M99999	miscellaneous nonferrous metals and alloys (12 items; see Table 2)
N00001–N99999	nickel and nickel alloys
P00001–P99999	precious metals and alloys (8 items; see Table 2)
R00001–R99999	reactive and refractory metals and alloys (14 items; see Table 2)
Z00001–Z99999	zinc and zinc alloys
<i>Ferrous Metals and Alloys</i>	
D00001–D99999	specified mechanical properties steels
F00001–F99999	cast irons and cast steels
G00001–G99999	AISI and SAE carbon and alloy steels
H00001–H99999	AISI H-steels
J00001–J99999	cast steels (except tool steels)
K00001–K99999	miscellaneous steels and ferrous alloys
S00001–S99999	heat and corrosion resistant (stainless) steels
T00001–T99999	tool steels
<i>Specialized Metals and Alloys</i>	
W00001–W99999	welding filler metals, covered and tubular electrodes, classified by weld deposit composition (see Table 2)

TABLE 2 Secondary Division of Some Series of Numbers

<i>E00001–E99999 Rare Earth and Rare Earth-Like Metals and Alloys</i>	
E00000–E00999	actinium
E01000–E20999	cerium
E21000–E45999	mixed rare earths ^A
E46000–E47999	dysprosium
E48000–E49999	erbium
E50000–E51999	europium
E52000–E55999	gadolinium
E56000–E57999	holmium
E58000–E67999	lanthanum
E68000–E68999	lutetium
E69000–E73999	neodymium
E74000–E77999	praseodymium
E78000–E78999	promethium
E79000–E82999	samarium
E83000–E84999	scandium
E85000–E86999	terbium
E87000–E87999	thulium
E88000–E89999	ytterbium
E90000–E99999	yttrium
<i>F00001–F9999 Cast Irons</i>	
<i>K00001–K99999 Miscellaneous Steels and Ferrous Alloys</i>	
<i>L00001–L99999 Low-Melting Metals and Alloys</i>	
L00001–L00999	bismuth
L01001–L01999	cadmium
L02001–L02999	cesium
L03001–L03999	gallium
L04001–L04999	indium
L05001–L05999	lead
L06001–L06999	lithium
L07001–L07999	mercury
L08001–L08999	potassium
L09001–L09999	rubidium
L10001–L10999	selenium
L11001–L11999	sodium
L12001–L12999	thallium
L13001–L13999	tin
<i>M00001–M99999 Miscellaneous Nonferrous Metals and Alloys</i>	
M00001–M00999	antimony
M01001–M01999	arsenic
M02001–M02999	barium
M03001–M03999	calcium

TABLE 2 Continued

M04001–M04999	germanium
M05001–M05999	plutonium
M06001–M06999	strontium
M07001–M07999	tellurium
M08001–M08999	uranium
M10001–M19999	magnesium
M20001–M29999	manganese
M30001–M39999	silicon
<i>P00001–P99999 Precious Metals and Alloys</i>	
P00001–P00999	gold
P01001–P01999	iridium
P02001–P02999	osmium
P03001–P03999	palladium
P04001–P04999	platinum
P05001–P05999	rhodium
P06001–P06999	ruthenium
P07001–P07999	silver
<i>R00001–R99999 Reactive and Refractory Metals and Alloys</i>	
R01001–R01999	boron
R02001–R02999	hafnium
R03001–R03999	molybdenum
R04001–R04999	niobium (columbium)
R05001–R05999	tantalum
R06001–R06999	thorium
R07001–R07999	tungsten
R08001–R08999	vanadium
R10001–R19999	beryllium
R20001–R29999	chromium
R30001–R39999	cobalt
R40001–R49999	rhenium
R50001–R59999	titanium
R60001–R69999	zirconium
<i>W00001–W99999 Welding Filler Metals Classified by Weld Deposit Composition</i>	
W00001–W09999	carbon steel with no significant alloying elements
W10000–W19999	manganese-molybdenum low alloy steels
W20000–W29999	nickel low alloy steels
W30000–W39999	austenitic stainless steels
W40000–W49999	ferritic stainless steels
W50000–W59999	chromium low alloy steels
W60000–W69999	copper base alloys
W70000–W79999	surfacing alloys
W80000–W89999	nickel base alloys
<i>Z00001–Z99999 Zinc and Zinc Alloys</i>	

^A Alloys in which the rare earths are used in the ratio of their natural occurrence (that is, unseparated rare earths). In this mixture, cerium is the most abundant of the rare earth elements.

2.4 Welding filler metals fall into two general categories: those whose compositions are determined by the filler metal analysis (e.g. solid bare wire or rods and cast rods) and those whose composition is determined by the weld deposit analysis (e.g. covered electrodes, flux-cored and other composite wire electrodes). The latter are assigned to a new primary series with the letter W as shown in Table 1. The solid bare wire and rods continue to be assigned in the established number series according to their composition.

NOTE 5—Readers are cautioned *not* to make their own assignments of numbers from such listings, as this can result in unintended and unexpected duplication and conflict.

2.5 ASTM and SAE periodically publish up-to-date listings of all UNS numbers assigned to specific metals and alloys, with appropriate reference information on each.² Many trade

associations also publish similar listings related to materials of primary interest to their organizations.

3. Organization for Administering the UNS for Metals and Alloys

3.1 The organization for administering the UNS consists of the following:

3.1.1 *Advisory Board*—The Advisory Board has approximately 20 volunteer members who are affiliated with major producing and using industries, trade associations, government agencies, and standards societies, and who have extensive experience with identification, classification, and specification of materials. The Board is the administrative arm of SAE and ASTM on all matters pertaining to the UNS. It coordinates thinking on the format of each series of numbers and the administration of each by selected experts. It sets up ground rules for determining eligibility of any material for a UNS number, for requesting such numbers, and for appealing unfavorable rulings. It is the final referee on matters of disagreement between requesters and assigners.

² Request ASTM DS 56A and SAE Handbook Supplement HS 1086a, *Unified Numbering System for Metals and Alloys*, (a joint ASTM–SAE publication), PCN 05-056001-01.

3.1.2 *Several Number-Assigning Offices*— UNS number assigners for certain materials are set up at trade associations which have successfully administered their own numbering systems; for other materials, assigners are located at offices of SAE and ASTM. Each of these assigners has the responsibility for administering a specific series of numbers, as shown in Table 3. Each considers requests for assignment of new UNS numbers, and informs applicants of the action taken. Trade association UNS number assigners report immediately to both SAE and ASTM details of each number assignment. ASTM and SAE assigners collaborate with designated consultants when considering requests for assignment of new numbers.

3.1.3 *Corps of Volunteer Consultants*— Consultants are selected by the Advisory Board to provide expert knowledge of a specific field of materials. Since they are utilized primarily by the Board and the SAE and ASTM number assigners, they are not listed in this recommended practice. At the request of the ASTM (or SAE) number assigner, a consultant considers a

request for a new number in the light of the ground rules established for the material involved, decides whether a new number is justified, and informs the ASTM or the SAE number assigner accordingly. This utilization of experts (consultants and number assigners) is intended to ensure prompt and fair consideration of all requests. It permits each decision to be based on current knowledge of the needs of a specific industry of producers and users.

3.1.4 *Staffs at ASTM and SAE*—Staff members at SAE and ASTM maintain duplicate master listings of all UNS numbers assigned.

3.1.5 In addition, established SAE and ASTM committees which normally deal with standards and specifications for the materials covered by the UNS, and other knowledgeable persons, are called upon by the Advisory Board for advice when considering appeals from unfavorable rulings in the matter of UNS number assignments.

TABLE 3 Number Assigners and Areas of Responsibility

The Aluminum Association 818 Connecticut Ave. N.W. Washington, D.C. 20006 Attention: Office for Unified Numbering System for Metals Telephone: (202)862-5100	Aluminum and Aluminum Alloys UNS Number Series: A 00001–A 99999
American Iron and Steel Institute 1000 16th St., N.W. Washington, D.C. 20036 Attention: Office for Unified Numbering System for Metals Telephone: (202)452-7236	Carbon and Alloy Steels UNS Number Series: G 00001–G 99999 H-Steels UNS Number Series: H 00001–H 99999 Tool Steels UNS Number Series: T 00001–T 99999
American Welding Society 550 N. W. LeJeune Road P.O. Box 351040 Miami, FL 33135 Attention: Office for Unified Numbering System for Metals Telephone: (305)642-7090	Welding Filler Metals UNS Number Series: W 00001–W 99999
Copper Development Association 405 Lexington Ave. New York, N. Y. 10017 Attention: Office for Unified Numbering System for Metals Telephone: (212)953-7321	Copper and Copper Alloys UNS Number Series: C 00001–C 99999
ASTM 100 Barr Harbor Drive West Conshohocken, Pa. 19428 Attention: Office for Unified Numbering System for Metals Telephone: (610)832-9652	Rare Earth and Rare Earth-Like Metals and Alloys UNS Number Series: E 00001–E 99999 Low Melting Metals and Alloys UNS Number Series: L 00001–L 99999 Miscellaneous Steels and Ferrous Alloys UNS Number Series: K 00001–K 99999 Miscellaneous Nonferrous Metals and Alloys UNS Number Series: M 00001–M 99999 Cast Steels UNS Number Series: J 00001–J 99999 Heat and Corrosion Resistant (Stainless) Steels UNS Number Series: S 00001–S 99999 Zinc and Zinc Alloys UNS Number Series: Z 00001–Z 99999 Precious Metals and Alloys UNS Number Series: P 00001–P 99999 Cast Irons and Cast Steels UNS Number Series: F 00001–F 99999
Society of Automotive Engineers 400 Commonwealth Drive Warrendale, Pa. 15096 Attention: Office for Unified Numbering System for Metals Telephone: (412)776-4841	Nickel and Nickel Alloys UNS Number Series: N 00001–N 99999 Steels Specified by Mechanical Properties UNS Number Series: D 00001–D 99999 Reactive and Refractory Metals and Alloys UNS Number Series: R 00001–R 99999

4. Procedure for Requesting Number Assignment to Metals and Alloys Not Already Covered by UNS Numbers (or Codes)

4.1 UNS numbers are assigned only to metals and alloys that have a commercial standing (as defined in Note 2).

4.2 The need for a new number should always be verified by determining from the latest complete listing of already assigned UNS numbers that a usable number is or is not available.

NOTE 6—In assigning UNS numbers, and consequently in searching complete listings of numbers, the predominant element of the metal or alloy usually determines the prefix letter of the series to which it is assigned. In certain instances where no one element predominates, arbitrary decisions are made as to what prefix letter to use, depending on the producing industry and other factors.

4.3 For a new UNS number to be assigned, the composition (or other properties, as applicable) must be significantly different from that of any metal or alloy which has already been assigned a UNS number.

4.3.1 In the case of metals or alloys that are normally identified or specified by chemical composition, the chemical composition limits must be reported.

4.3.2 In the case of metals or alloys that are normally identified or specified by mechanical (or other) properties, such properties and limits thereof must be reported. Only those chemical elements and limits, if any, which are significant in defining such materials need be reported.

4.4 Requests for new numbers shall be submitted on “Application for UNS Number Assignment” forms (see Fig. 1 and Fig. 2). Copies of these are available from any UNS number-assigning office (see Table 3) or facsimiles may be made of the one herein.

4.5 All instructions on the printed application form should be read carefully and all information provided as indicated.

NOTE 7—The application form is designed to serve also as a data input sheet to facilitate processing each request through to final print-out of the data on electronic data-processing equipment and to minimize transcription errors at number-assigning offices and data-processing centers.

4.6 To further assist in assigning UNS numbers, the requester is encouraged to suggest a possible UNS number in each request, giving appropriate consideration to any existing number presently used by a trade association, standards society, producer, or user.

4.7 Each completed application form shall be sent to the UNS number-assigning office having responsibility for the series of numbers that appears to most closely relate to the material described on the form (see Table 3).

5. Keywords

5.1 aluminum alloy numbering system; aluminum alloy UNS numbering; cast iron numbering system; cast iron UNS numbering; copper alloy numbering system; copper alloy UNS numbering; ferrous alloys numbering system; ferrous alloys UNS numbering; nickel alloy numbering system; nickel alloy UNS numbering; reactive metals and alloys numbering system; reactive metals and alloys UNS numbering; refractory metals and alloys numbering system; refractory metals and alloys UNS numbering; steel alloy numbering system; steel alloy UNS numbering; stainless steel alloy numbering system; stainless steel alloy UNS numbering; unified numbering system; UNS metal and alloy numbering system; weld filler metal numbering system; weld filler metal numbering; welding electrode numbering system; welding electrode UNS numbering

APPLICATION FOR UNS NUMBER ASSIGNMENT
and
Data Input Sheet for Entering a Specific Material in the
SAE-ASTM Unified Numbering System for Metals and Alloys
(See Reverse Side for Instructions for Completing This Form)

Material Description _____

Suggested UNS No. _____

* UNS Assigned Description _____

* UNS Assigned No. _____

* Chemical Composition

Aluminum	Al	_____	Indium	In	_____	Selenium	Se	_____
Antimony	Sb	_____	Iridium	Ir	_____	Silicon	Si	_____
Arsenic	As	_____	Iron	Fe	_____	Silver	Ag	_____
Beryllium	Be	_____	Lead	Pb	_____	Sulfur	S	_____
Bismuth	Bi	_____	Lithium	Li	_____	Tantalum	Ta	_____
Boron	B	_____	Magnesium	Mg	_____	Tellurium	Te	_____
Cadmium	Cd	_____	Manganese	Mn	_____	Thorium	Th	_____
Carbon	C	_____	Mercury	Hg	_____	Tin	Sn	_____
Chromium	Cr	_____	Molybdenum	Mo	_____	Titanium	Ti	_____
Cobalt	Co	_____	Nickel	Ni	_____	Tungsten	W	_____
Columbium	Cb	_____	Nitrogen	N	_____	Uranium	U	_____
Copper	Cu	_____	Oxygen	O	_____	Vanadium	V	_____
Germanium	Ge	_____	Phosphorus	P	_____	Zinc	Zn	_____
Gold	Au	_____	Platinum	Pt	_____	Zirconium	Zr	_____
Hafnium	Hf	_____	Rhenium	Re	_____	Other		_____
Hydrogen	H	_____	Rhodium	Rh	_____			

* Cross References

AA _____

ACI _____

AISI _____

ANSI _____

AMS _____

ASME _____

ASTM _____

AWS _____

CDA _____

FED _____

MIL SPEC _____

SAE _____

OTHERS _____

Requesting Person and Organization (full address) _____

Date of Request _____

* Assigning Org _____

* Date of UNS Assignment _____

Assigner's Name and Office _____

Applicant do not write in shaded areas.

* These items for Computer Operator.

NOTE—Reverse side of Fig. 1 is located on the next page.

FIG. 1 Sample Application Form.

General:

Before attempting to complete this form, the applicant should be thoroughly familiar with the objectives of the UNS and the “ground rules” for assigning numbers, as stated in SAE J 1086 and ASTM E 527, Section 4.

Material Description:

Identify the base element; the single alloying element that constitutes 50 % or more of the total alloy content; other distinguishing predominant characteristics (such as “casting”); and common or generic names if any (such as “ounce metal” or “Waspalloy”). When no single element makes up 50 % or more of the total alloy content, list in decreasing order of abundance the two alloying elements that together constitute the largest portion of the total alloy contents; except that if no two elements make up at least 50 % of the total alloy content, list the three most abundant, and so on. Instead of “iron,” use “steel” to identify the base element of those iron-low-carbon alloys commonly known as steels.

When mechanical properties or physical characteristics are the primary defining criteria and chemical composition is secondary or nonsignificant, enter such properties and characteristics with the appropriate values or limits for each.

Suggested UNS No.:

While applicant’s suggestion may or may not be the one finally assigned, it will assist proper identification of the material by the UNS Number Assigner.

Chemical Composition:

Enter limits such as 0.13–0.18 (*not* .13–.18, or 0.13 to 0.18), 1.5 max, 0.040 min, and balance. In space designated “other” enter information such as “Each 0.05 max, Total 0.15 max” and “Sn plus Pb 2.0 min.”

Cross References:

Letter-symbols listed indicate widely known trade associations and standards-issuing organizations. Enter after appropriate symbols any known specification numbers or identification numbers issued by such groups to cover material equivalent to, similar to, or closely resembling the subject material.

Examples: SAE J 404 (50B44), AISI 415, ASTM A 638 (660)

In space designated “other” enter any pertinent numbers issued by groups not listed above. In these instances, the full name and address of the issuing group shall be included.

SUBMIT COMPLETED FORM TO
APPROPRIATE UNS NUMBER
ASSIGNER, AS LISTED IN
SAE J 1086 AND ASTM E 527.

FIG. 2 Sample Application Form (Reverse Side).

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Appendix

11

SI QUICK REFERENCE GUIDE

SI QUICK REFERENCE GUIDE:

International System of Units (SI)

*The Modernized Metric System**

UNITS

The International System of Units (SI) is based on seven fundamental (base) units:

Base Units		
<i>Quantity</i>	<i>Name</i>	<i>Symbol</i>
length	metre	m
mass	kilogram	kg
time	second	s
electric current	ampere	A
thermodynamic temperature	kelvin	K
amount of substance	mole	mol
luminous intensity	candela	cd

and a number of derived units which are combinations of base units and which may have special names and symbols:

Examples of Derived Units			
<i>Quantity</i>	<i>Expression</i>	<i>Name</i>	<i>Symbol</i>
acceleration			
angular	rad/s ²		
linear	m/s ²		
angle			
plane	dimensionless	radian	rad
solid	dimensionless	steradian	sr
area	m ²		
Celsius temperature	K	degree Celsius	°C
density			
heat flux	W/m ²		
mass	kg/m ³		
current	A/m ²		
energy, enthalpy			
work, heat	N·m	joule	J
specific	J/kg		
entropy			
heat capacity	J/K		
specific	J/(kg·K)		
flow, mass	kg/s		
flow, volume	m ³ /s		
force	kg·m/s ²	newton	N
frequency			
periodic	1/s	hertz	Hz
rotating	rev/s		
inductance	Wb/A	henry	H
magnetic flux	V·s	weber	Wb
mass flow	kg/s		
moment of a force	N·m		
potential, electric	W/A	volt	V
power, radiant flux	J/s	watt	W
pressure, stress	N/m ²	pascal	Pa
resistance, electric	V/A	ohm	Ω
thermal conductivity	W/(m·K)		
velocity			
angular	rad/s		
linear	m/s		
viscosity			
dynamic (absolute)(μ)	Pa·s		
kinematic (ν)	m ² /s		
volume	m ³		
volume, specific	m ³ /kg		

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

SYMBOLS

<i>Symbol</i>	<i>Name</i>	<i>Quantity</i>	<i>Formula</i>
A	ampere	electric current	base unit
Bq	becquerel	activity (of a radio nuclide)	1/s
C	coulomb	electric charge	A·s
°C	degree Celsius	temperature interval	°C = K
cd	candela	luminous intensity	base unit
F	farad	electric capacitance	C/V
Gy	gray	absorbed dose	J/kg
g	gram	mass	kg/1000
H	henry	inductance	Wb/A
Hz	hertz	frequency	1/s
ha	hectare*	area	10 000 m ²
J	joule	energy, work, heat	N·m
K	kelvin	temperature	base unit
kg	kilogram	mass	base unit
L	litre	volume	m ³ /1000
lm	lumen	luminous flux	cd·sr
lx	lux	illuminance	lm/m ²
m	metre	length	base unit
mol	mole	amount of substance	base unit
N	newton	force	kg·m/s ²
Ω	ohm	electric resistance	V/A
Pa	pascal	pressure, stress	N/m ²
rad	radian	plane angle	m/m (dimensionless)
S	siemens	electric conductance	A/V
Sv	sievert	dose equivalent	J/kg
s	second	time	base unit
sr	steradian	solid angle	m ² /m ² (dimensionless)
T	tesla	magnetic flux density	Wb/m ²
t	tonne, metric ton	mass	1000 kg; Mg
V	volt	electric potential	W/A
W	watt	power, radiant flux	J/s
Wb	weber	magnetic flux	V·s

*allowed with SI

Use of Symbols

The correct use of symbols is important because an incorrect symbol may change the meaning of a quantity. Some SI symbols are listed in the Symbol table.

SI has no abbreviations—only symbols. Therefore, no periods follow a symbol except at the end of a sentence.

Examples: A, not amp; s, not sec; SI, not S.I.

Symbols appear in lower case unless the unit name has been taken from a proper name. In this case the first letter of the symbol is capitalized.

Examples: m, metre; Pa, pascal; W, watt

Exception: L, litre

Symbols and prefixes are printed in upright (roman) type regardless of the type style in surrounding text.

Example: . . . a distance of 73 km between . . .

Unit symbols are the same whether singular or plural.

Examples: 1 mm, 100 mm; 1 kg, 65 kg

Leave a space between the value and the symbol.

Examples: 115 W, not 115W; 0.75 L, not 0.75L
88 °C, not 88°C or 88° C

Exception: No space is left between the numerical value and symbol for degree of plane angle.

Examples: 73°, not 73 °

Note: Symbol for coulomb is C; for degree Celsius it is °C

Do not mix symbols and names in the same expression.

Examples: radians per second or rad/s
not radians/second; not radians/s
m/s or metres per second,
not metres/second; not metres/s
J/kg or joules per kilogram,
not joules/kilogram; not joules/kg

Symbol for product—use the raised dot (·)

Examples: N·m; mPa·s; W/(m²·K)

Symbol for quotient—use one of the following forms:

Examples: m/s or $\frac{\text{m}}{\text{s}}$ or use negative exponent

Note: Use only one solidus (/) per expression and parentheses to avoid any ambiguity.

Do not use modifying terms such as electrical, alternating current, etc.

Examples: kPa (gage); MW (e); V (ac)

PREFIXES

Most prefixes indicate orders of magnitude in steps of 1000 and provide a convenient way to express large and small numbers and to eliminate nonsignificant digits and leading zeros in decimal fractions.

Examples: 64 000 watts is the same as 64 kilowatts*
0.057 metre is the same as 57 millimetres
16 000 metres is the same as 16 kilometres*

*except for intended accuracy

Prefix	Symbol	Represents
yotta	Y	10^{24}
zetta	Z	10^{21}
exa	E	10^{18}
peta	P	10^{15}
tera	T	10^{12}
giga	G	10^9
mega	M	10^6
kilo	k	10^3
hecto	h*	10^2
deka	da*	10^1
deci	d*	10^{-1}
centi	c*	10^{-2}
milli	m	10^{-3}
micro	μ	10^{-6}
nano	n	10^{-9}
pico	p	10^{-12}
femto	f	10^{-15}
atto	a	10^{-18}
zepto	z	10^{-21}
yocto	y	10^{-24}

To realize the full benefit of the prefixes when expressing a quantity by numerical value, choose a prefix so that the number lies between 0.1 and 1000. For simplicity, give preference to prefixes representing 1000 raised to an integral power (i.e., μm , mm, km).

**Exceptions:*

In expressing area and volume, the prefixes hecto, deka, deci, and centi may be required; for example, cubic decimetre (L), square hectometre (hectare), cubic centimetre.

Tables of values of the same quantity.

Comparison of values.

For certain quantities in particular applications. For example, the millimetre is used for linear dimensions in architectural and engineering drawings even when the values lie far outside the range of 0.1 mm to 1000 mm; the centimetre is usually used for anatomical measurements and clothing sizes.

Compound units. A compound unit is a derived unit expressed with two or more units. The prefix is attached to a unit in the numerator.

Examples: V/m *not* mV/mm
MJ/kg *not* kJ/g

Compound prefixes formed by a combination of two or more prefixes are not used. Use only one prefix.

Examples: 2 nm *not* 2 m μ m
6 m³ *not* 6 kL
6 MPa *not* 6 kPa

Exponential Powers. An exponent attached to a symbol containing a prefix indicates that the multiple (of the unit with its prefix) is raised to the power of 10 expressed by the exponent.

Examples: 1 mm³ = $(10^{-3} \text{ m})^3 = 10^{-9} \text{ m}^3$
1 ns⁻¹ = $(10^{-9} \text{ s})^{-1} = 10^9 \text{ s}^{-1}$
1 mm²/s = $(10^{-3} \text{ m})^2/\text{s} = 10^{-6} \text{ m}^2/\text{s}$

NUMBERS

International practice separates the digits of large numbers into groups of three, counting from the decimal to the left and to the right, and inserts a space to separate the groups. In numbers of four digits, the space is not necessary except for uniformity in tables.

Examples: 6.358 568; 85 365; 51 845 953; 88 000;
0.246 113 562; 7 258

Small Numbers. When writing numbers less than one, always put a zero before the decimal marker.

Example: 0.046

Decimal Marker. The recommended decimal marker is a dot on the line (period). (In some countries, a comma is used as the decimal marker.)

Because **billion** means a million million in most countries but a thousand million in the United States, avoid using billion in technical writing.

DO'S AND DON'TS

The units in the international system of units are called SI units—*not* Metric Units and *not* SI Metric Units.

Non-SI units in the US are called Inch-Pound units (I-P units)—*not* conventional units, *not* U.S. customary units, *not* English units, and *not* Imperial units.)

Treat all spelled out names as nouns. Therefore, do not capitalize the first letter of a unit except at the beginning of a sentence or in capitalized material such as a title.

Examples: watt; pascal; ampere; volt; newton; kelvin
Exception: Always capitalize the first letter of Celsius.

Do not begin a sentence with a unit symbol—either rearrange the words or write the unit name in full.

Use plurals for spelled out words when required by the rules of grammar.

Examples: metre—metres; henry—henries;
kilogram—kilograms; kelvin—kelvins
Irregular: hertz—hertz; lux—lux; siemens—siemens

Do not put a space or hyphen between the prefix and unit name.

Examples: kilometre *not* kilo metre or kilo-metre;
milliwatt *not* milli watt or milli-watt

SI QUICK REFERENCE GUIDE

When a prefix ends with a vowel and the unit name begins with a vowel, retain and pronounce both vowels.

Example: kiloampere

Exceptions: hectare; kilohm; megohm

When compound units are formed by multiplication, leave a space between units that are multiplied.

Examples: newton metre, *not* newton-metre;

volt ampere, *not* volt-ampere

Use the modifier squared or cubed after the unit name.

Example: metre per second squared

Exception: For area or volume the modifier may be placed before the units.

Example: square millimetre; cubic metre

When compound units are formed by division, use the word *per*, not a solidus (/).

Examples: metre per second, *not* metre/second; watt per

square metre, *not* watt/square meter

Do not use modifying terms such as electrical, alternating current, etc. after the symbol.

Examples: kPa (gage); MW (e); V (ac)

SELECTED CONVERSION FACTORS

CAUTION: These conversion values are rounded to three or four significant figures, which is sufficiently accurate for most applications. When making conversions, remember that a converted value is no more precise than the original value. Round off the final value to the same number of significant figures as those in the original value. See ANSI SI 10 for additional conversions with more significant figures.

<i>Multiply</i>	<i>By</i>	<i>To Obtain</i>
acre	0.4047	ha
atmosphere, standard	*101.325	kPa
bar	*100	kPa
barrel (42 US gal, petroleum)	159	L
Btu, (International Table)	1.055	kJ
Btu / lb · °F (specific heat, c_p)	4.184	kJ/(kg·K)
bushel	0.03524	m ³
calorie, kilogram (kilocalorie)	4.187	kJ
candle, candlepower	*1.0	cd
centipoise, dynamic viscosity, μ	*1.00	mPa·s
centistokes, kinematic viscosity, ν	*1.00	mm ² /s
ft	*0.3048	m
ft	*304.8	mm
ft/min, fpm	*0.00508	m/s
ft/s, fps	*0.3048	m/s
ft of water	2.99	kPa
ft ²	0.09290	m ²
ft ² /s, kinematic viscosity, ν	92 900	mm ² /s
ft ³	28.32	L
ft ³	0.02832	m ³
ft ³ /h, cfh	7.866	mL/s
ft ³ /min, cfm	0.4719	L/s
ft ³ /s, cfs	28.32	L/s
footcandle	10.76	lx
ft · lb _t (torque or moment)	1.36	N · m

<i>Multiply</i>	<i>By</i>	<i>To Obtain</i>
ft · lb _t (work)	1.36	J
ft · lb _t /lb (specific energy)	2.99	J/kg
ft · lb _t /min (power)	0.0226	W
gallon, US (*231 in ³)	3.785	L
gph	1.05	mL/s
gpm	0.0631	L/s
gpm/ft ²	0.6791	L/(s·m ²)
gr/gal	17.1	g/m ³
horsepower (550 ft · lb _t /s)	0.746	kW
inch	*25.4	mm
in of mercury (60°F)	3.377	kPa
in of water (60°F)	248.8	Pa
in · lb _t (torque or moment)	113	mN · m
in ²	645	mm ²
in ³ (volume)	16.4	mL
in ³ (section modulus)	16 400	mm ³
in ⁴ (section moment)	416 200	mm ⁴
km/h	0.278	m/s
kWh	*3.60	MJ
kip/in ² (ksi)	6.895	MPa
litre	*0.001	m ³
micron (μ m) of mercury (60°F)	133	mPa
mil (0.001 in.)	*25.4	μ m
mile	1.61	km
mile, nautical	1.85	km
mph	1.61	km/h
mph	0.447	m/s
millibar	*0.100	kPa
mm of mercury (60°F)	0.133	kPa
mm of water (60°F)	9.80	Pa
ounce (mass, avoirdupois)	28.35	g
ounce (force of thrust)	0.278	N
ounce (liquid, US)	29.6	mL
ounce (avoirdupois) per gallon	7.49	kg/m ³
pint (liquid, US)	473	mL
pound		
lb _m (mass)	0.4536	kg
lb _m (mass)	453.6	g
lb _t (force or thrust)	4.45	N
lb _m /ft (uniform load)	1.49	kg/m
lb _m /(ft · h) (dynamic viscosity, μ)	0.413	mPa·s
lb _m /(ft · s) (dynamic viscosity, μ)	1490	mPa·s
lb _t · s/ft ² (dynamic viscosity, μ)	47 880	mPa·s
lb _m /min	0.00756	kg/s
lb _m /h	0.126	g/s
lb _t /ft ²	47.9	Pa
lb _m /ft ²	4.88	kg/m ²
lb _m /ft ³ (density, ρ)	16.0	kg/m ³
lb _m /gallon	120	kg/m ³
ppm (by mass)	*1.00	mg/kg
psi	6.895	kPa
quad (10 ¹⁵ Btu)	1.06	EJ
quart (liquid, US)	0.946	L
rpm	0.105	rad/s
tablespoon (approx.)	15	mL
teaspoon (approx.)	5	mL
therm (100,000 Btu)	105.5	MJ
ton, short (2000 lb)	0.907	Mg; t (tonne)
yd	*0.9144	m
yd ²	0.836	m ²
yd ³	0.7646	m ³

*Conversion factor is exact.

Note: In this list the kelvin (K) expresses temperature intervals. The degree Celsius symbol (°C) may be used for this purpose as well.

STEEL GRADE/NAME INDEX

598 Steel Grade/Name Index

Steel Grade/Name	Specification	Page No.	Steel Grade/Name	Specification	Page No.
1	ASTM A 242/A 242M-00	73	1011	ASTM A 29/A 29M-99	39
	ASTM A 537/A 537M-95	102, 106		ASTM A 512-96	166, 186
	ASTM A 334/A 334M-99	238, 240	1012	ASTM A 29/A 29M-99	19, 39
	ASTM A 333/A 333M-99	288, 291		ASTM A 576-90	19
	ASTM A 266/A 266M-99	320, 323		SAE J403 AUG95	19
	ASTM A 485-00	492	1013	ASTM A 29/A 29M-99	39
	ASTM	418	1015	ASTM A 29/A 29M-99	20
	A 487/A 487M-93 (1998)			ASTM A 108-99	20
	ASTM	321, 323		ASTM A 513-00	157, 158, 161, 164, 166, 180, 183, 185
	A 508/A 508M-95 (1999)				
	ASTM	321, 323		ASTM A 576-90	20
	A 541/A 541M-95 (1999)			SAE J403 AUG95	20
	ASTM A 735/A 735M-99	144		ASTM A 29/A 29M-99	20
1 C 22	EN 10083-2:1991	21	1016	ASTM A 108-99	20
1 C 25	EN 10083-2:1991	22		ASTM A 512-96	167, 187
1 C 30	EN 10083-2:1991	22		ASTM A 576-90	20
1 C 35	EN 10083-2:1991	23		SAE J403 AUG95	20
1 C 40	EN 10083-2:1991	24	1017	ASTM A 29/A 29M-99	20
1 C 45	EN 10083-2:1991	25		ASTM A 576-90	20
1 C 50	EN 10083-2:1991	26		SAE J403 AUG95	20
1 C 55	EN 10083-2:1991	27		ASTM A 29/A 29M-99	20
1 C 60	EN 10083-2:1991	27		ASTM A 576-90	20
10	ASTM A 333/A 333M-99	288, 291	1018	SAE J403 AUG95	20
	ASTM	418		ASTM A 29/A 29M-99	20
	A 487/A 487M-93 (1998)			ASTM A 108-99	20
10 CrMo 9 10	DIN 17175:1979	264		ASTM A 512-96	167, 187
	EN 10028-2:1992	118, 119		ASTM A 576-90	20
10 N14-M	AFNOR	419	1019	SAE J403 AUG95	20
	NF A 32-053:1992			ASTM A 29/A 29M-99	20
10 N19-M	AFNOR	419		ASTM A 576-90	20
	NF A 32-053:1992		1020	ASTM A 108-99	21
10 N6-M	AFNOR	419		ASTM A 29/A 29M-99	21
	NF A 32-053:1992			ASTM A 513-00	159, 160, 164, 166, 168, 181, 182, 185, 188
10 Ni 14	DIN 17173:1985	241, 244			
	DIN 17174:1985	241, 244		ASTM A 519-96	158, 159, 161, 166, 168, 180, 183, 186, 188
10 S 20	ISO 683-9:1988	476			
10 SMn 20	ISO 983-9:1988	476		ASTM A 576-90	21
10 SPb 20	ISO 683-9:1988	476		SAE J403 AUG95	21
1005	ASTM A 29/A 29M-99	19	1021	ASTM A 29/A 29M-99	21
	SAE J403 AUG95	19		ASTM A 513-00	159, 161, 165, 167, 169, 181, 183, 185, 187, 189
1006	ASTM A 29/A 29M-99	19			
	SAE J403 AUG95	19		ASTM A 576-90	21
1008	ASTM A 29/A 29M-99	19, 39		SAE J403 AUG95	21
	ASTM A 108-99	19		ASTM A 29/A 29M-99	21
	ASTM A 513-00	156, 158, 161, 164, 179, 180, 183, 185		ASTM A 513-00	159, 161, 165, 167, 169, 181, 183, 185, 187, 189
	ASTM A 576-90	19			
	SAE J403 AUG95	19		ASTM A 576-90	21
1010	ASTM A 29/A 29M-99	19	1022	SAE J403 AUG95	21
	ASTM A 108-99	19		ASTM A 108-99	21
	ASTM A 513-00	156, 157, 159, 161, 164, 179, 180, 183, 185		ASTM A 29/A 29M-99	21
	ASTM A 576-90	19		ASTM A 576-90	21
	SAE J403 AUG95	19	1023	SAE J403 AUG95	21
				ASTM A 29/A 29M-99	21
				ASTM A 576-90	21
				SAE J403 AUG95	21
			1025	ASTM A 108-99	22
				ASTM A 29/A 29M-99	22

Steel Grade/Name	Specification	Page No.	Steel Grade/Name	Specification	Page No.
1025 (Continued)	ASTM A 512-96	169, 183	1040 (Continued)	ASTM A 513-00	166, 167, 174, 175, 186, 187, 192, 194
	ASTM A 513-00	161, 166, 168, 171, 183, 186, 188, 190		ASTM A 576-90	24
	ASTM A 519-96	161, 168, 171, 183, 188, 189, 190		ASTM A 682/A 682M-00	494
	ASTM A 576-90	22		SAE J403 AUG95	24
	SAE J403 AUG95	22		ASTM A 29/A 29M-99	24
	ASTM A 108-99	22		ASTM A 576-90	24
	ASTM A 29/A 29M-99	22		SAE J403 AUG95	24
	ASTM A 513-00	164, 165, 168, 171, 173, 185, 188, 190, 192		ASTM A 29/A 29M-99	24
	ASTM A 576-90	22		ASTM A 576-90	24
	SAE J403 AUG95	22		SAE J403 AUG95	24
1026	ASTM A 108-99	22	1042	ASTM A 29/A 29M-99	24
	ASTM A 29/A 29M-99	22		ASTM A 576-90	24
	ASTM A 513-00	164, 165, 168, 171, 173, 185, 188, 190, 192		SAE J403 AUG95	24
1029	ASTM A 576-90	22	1043	ASTM A 29/A 29M-99	24
	SAE J403 AUG95	22		ASTM A 576-90	24
	ASTM A 29/A 29M-99	22		SAE J403 AUG95	24
102Cr6	EN 10132-4:2000	494	1044	ASTM A 29/A 29M-99	25
	EN ISO 4957:2000	495		ASTM A 576-90	25
1030	ASTM A 108-99	22	1045	SAE J403 AUG95	25
	ASTM A 29/A 29M-99	22		ASTM A 108-99	25
	ASTM A 512-96	173, 192		ASTM A 29/A 29M-99	25
1034	ASTM A 513-00	164, 165, 168, 173, 174, 185, 188, 192	1046	ASTM A 519-96	166, 171, 173, 175, 186, 190, 192, 194
	ASTM A 576-90	22		ASTM A 576-90	25
	ASTM A 682/A 682M-00	494		ASTM A 682/A 682M-00	494
1035	SAE J403 AUG95	22	1049	SAE J403 AUG95	25
	ASTM A 29/A 29M-99	23		ASTM A 29/A 29M-99	25
	ASTM A 108-99	23		ASTM A 576-90	25
1037	ASTM A 29/A 29M-99	23	1050	SAE J403 AUG95	25
	ASTM A 513-00	166, 167, 173, 174, 175, 186, 187, 192, 194		ASTM A 29/A 29M-99	26
	ASTM A 519-96	164, 166, 171, 174, 185, 186, 190, 192		ASTM A 576-90	26
1038	ASTM A 576-90	23	1053	SAE J403 AUG95	26
	ASTM A 682/A 682M-00	494		ASTM A 108-99	26
	SAE J403 AUG95	23		ASTM A 29/A 29M-99	26
1039	ASTM A 29/A 29M-99	23	1055	ASTM A 519-96	167, 172, 173, 187, 191, 192
	ASTM A 576-90	23		ASTM A 576-90	26
	SAE J403 AUG95	23		ASTM A 682/A 682M-00	481
1040	ASTM A 29/A 29M-99	24	1058	SAE J403 AUG95	26
	ASTM A 576-90	24		ASTM A 29/A 29M-99	26
	SAE J403 AUG95	24		ASTM A 576-90	26
1042	ASTM A 29/A 29M-99	24	1059	SAE J403 AUG95	26
	ASTM A 576-90	24		ASTM A 29/A 29M-99	27
	SAE J403 AUG95	24	1060	ASTM A 576-90	27
1043	ASTM A 29/A 29M-99	24		ASTM A 682/A 682M-00	481
	ASTM A 576-90	24		SAE J403 AUG95	27
	SAE J403 AUG95	24	1064	ASTM A 148/A 148M-93 (1998)	370, 374
1044	ASTM A 29/A 29M-99	25		ASTM A 29/A 29M-99	27
	ASTM A 576-90	25		EN ISO 4957:1999	485, 489
	SAE J403 AUG95	25	1065	ASTM A 29/A 29M-99	27
1045	ASTM A 108-99	25		ASTM A 576-90	27
	ASTM A 29/A 29M-99	25		ASTM A 682/A 682M-00	481
1046	ASTM A 519-96	166, 171, 173, 175, 186, 190, 192, 194	1064	SAE J403 AUG95	27
	ASTM A 576-90	25		ASTM A 29/A 29M-99	28
	ASTM A 682/A 682M-00	494		ASTM A 682/A 682M-00	481
1049	SAE J403 AUG95	25	1065	ASTM A 29/A 29M-99	28
	ASTM A 29/A 29M-99	26		ASTM A 682/A 682M-00	481
	ASTM A 576-90	26		SAE J403 AUG95	28
1050	SAE J403 AUG95	26	1066	ASTM A 29/A 29M-99	28
	ASTM A 108-99	26		ASTM A 576-90	28
	ASTM A 29/A 29M-99	26		ASTM A 682/A 682M-00	481
1053	ASTM A 519-96	167, 172, 173, 187, 191, 192	1067	SAE J403 AUG95	28
	ASTM A 576-90	26		ASTM A 29/A 29M-99	28
	ASTM A 682/A 682M-00	481		ASTM A 576-90	28
1058	SAE J403 AUG95	26	1068	ASTM A 682/A 682M-00	481
	ASTM A 29/A 29M-99	26		SAE J403 AUG95	28
	ASTM A 576-90	26		ASTM A 29/A 29M-99	28
1059	SAE J403 AUG95	26	1069	ASTM A 576-90	28
	ASTM A 29/A 29M-99	27		ASTM A 682/A 682M-00	481
	ASTM A 576-90	27		SAE J403 AUG95	28
1060	ASTM A 682/A 682M-00	481	1070	ASTM A 29/A 29M-99	28
	SAE J403 AUG95	27		ASTM A 576-90	28
	ASTM A 29/A 29M-99	28		ASTM A 682/A 682M-00	481
1064	ASTM A 29/A 29M-99	28	1071	SAE J403 AUG95	28
	ASTM A 682/A 682M-00	481		ASTM A 29/A 29M-99	28
	SAE J403 AUG95	28		ASTM A 576-90	28
1065	ASTM A 29/A 29M-99	28	1072	ASTM A 682/A 682M-00	481
	ASTM A 682/A 682M-00	481		SAE J403 AUG95	28
	SAE J403 AUG95	28		ASTM A 29/A 29M-99	28

600 Steel Grade/Name Index

Steel Grade/Name	Specification	Page No.	Steel Grade/Name	Specification	Page No.
1069 (Continued)	ASTM A 29/A 29M-99	28	11 MnNi 5 3 (Continued)	ISO 9327-3:1999	241
1070	ASTM A 29/A 29M-99	28		ISO 9328-3:1991	122
	ASTM A 576-90	28		ISO 9329-3:1997	243
	ASTM A 682/A 682M-00	481		ISO 9330-3:1997	241, 243
1070	SAE J403 AUG95	28		ISO 9330-5:2000	241, 243
1070M	ASTM A 295-98	496	11 SMn 28	ISO 683-9	479
1071	ASTM A 29/A 29M-99	28	11 SMnPb 28	ISO 683-9	479
1074	ASTM A 29/A 29M-99	28	11, Cl 4	ASTM	360
	ASTM A 682/A 682M-00	481		A 541/A 541M-95 (1999)	
1075	ASTM A 29/A 29M-99	28	1108	ASTM A 29/A 29M-99	493
1078	ASTM A 29/A 29M-99	28	1109	ASTM A 29/A 29M-99	476
	ASTM A 576-90	28		ASTM A 576-90 (2000)	476
	ASTM A 689-97	481	1110	ASTM A 29/A 29M-99	476
	SAE J403 AUG95	28		ASTM A 512-96	165, 186
1080	ASTM A 29/A 29M-99	29		ASTM A 576-90 (2000)	476
	ASTM A 576-90	29	1116	ASTM A 29/A 29M-99	493
	ASTM A 682/A 682M-00	494		ASTM A 576-90 (2000)	493
	SAE J403 AUG95	29	1117	ASTM A 29/A 29M-99	476
1084	ASTM A 29/A 29M-99	29		ASTM A 576-90 (2000)	476
	ASTM A 576-90	29		SAE J403-2000	476
1085	ASTM A 682/A 682M-00	481	1118	ASTM A 29/A 29M-99	493
1086	ASTM A 29/A 29M-99	29		ASTM A 576-90 (2000)	493
	ASTM A 682/A 682M-00	481		SAE J403-2000	493
	SAE J403 AUG95	29	1119	ASTM A 29/A 29M-99	493
1090	ASTM A 29/A 29M-99	29		ASTM A 576-90 (2000)	493
	ASTM A 576-90	29	1126	SAE J403-2000	493
	SAE J403 AUG95	29	1132	ASTM A 29/A 29M-99	493
1095	ASTM A 108-99	29		ASTM A 576-90 (2000)	493
	ASTM A 29/A 29M-99	29		SAE J403-2000	493
	ASTM A 576-90	29	1137	ASTM A 29/A 29M-99	477
	ASTM A 682/A 682M-00	481		ASTM A 576-90 (2000)	477
	SAE J403 AUG95	29		SAE J403-2000	477
10NiCr5-4	EN 10084:1998	40	1138	SAE J403-2000	493
10S20	EN 10087:1998	476	1139	ASTM A 29/A 29M-99	493
	EN 10277:1999	476		ASTM A 576-90 (2000)	493
10SPb20	EN 10087:1998	476	1140	ASTM A 29/A 29M-99	493
	EN 10277:1999	476		ASTM A 576-90 (2000)	493
11	ASTM A 334/A 334M-99	308		SAE J403-2000	493
	ASTM A 333/A 333M-99	308	1141	ASTM A 29/A 29M-99	477
	ASTM	418		ASTM A 576-90 (2000)	477
	A 487/A 487M-93 (1998)			SAE J403-2000	477
11 CrMo 9-10	EN 10028-2:1992	118, 119	1144	ASTM A 29/A 29M-99	478
11 L 09	ASTM A 29/A 29M-99	476		ASTM A 576-90 (2000)	478
	ASTM A 576-90 (2000)	476		SAE J403-2000	478
11 L 17	ASTM A 29/A 29M-99	476	1145	ASTM A 29/A 29M-99	493
	ASTM A 576-90 (2000)	476		ASTM A 576-90 (2000)	493
11 L 37	ASTM A 29/A 29M-99	477	1146	ASTM A 29/A 29M-99	478
	ASTM A 576-90 (2000)	477		ASTM A 576-90 (2000)	478
11 L 41	ASTM A 29/A 29M-99	477		SAE J403-2000	478
	SAE J403-2000	477	1151	ASTM A 576-90 (2000)	493
11 L 44	ASTM A 29/A 29M-99	478		SAE J403-2000	493
	ASTM A 576-90 (2000)	478	115-95	ASTM	418
11 L 46	ASTM A 29/A 29M-99	478		A 148/A 148M-93 (1998)	
	ASTM A 576-90 (2000)	478	11CrMo9-10	EN 10222-2:1999	332, 333
11 MnNi 5 3	DIN 17173:1985	241, 243	11L17	SAE J403-2000	476
	DIN 17174:1985	241, 243	11L37	SAE J403-2000	477
	EN 10028-4:1994	122	11L41	ASTM A 576-90 (2000)	477

Steel Grade/Name	Specification	Page No.	Steel Grade/Name	Specification	Page No.
11L44	SAE J403-2000	478	13 MnNi 6 3	DIN 17173:1985	241, 243
11L46	SAE J403-2000	478		DIN 17174:1985	241, 243
11SMn30	EN 10087:1998	479		ISO 9328-3:1991	122
	EN 10277:1999	479		ISO 9329-3:1997	241, 243
11SMn37	EN 10087:1998	480		ISO 9330-3:1997	241, 243
	EN 10277:1999	480		ISO 9330-5:2000	241, 243
11SMnPb30	EN 10087:1998	479	130-115	ASTM	418
	EN 10277:1999	479		A 148/A 148M-93 (1998)	
11SMnPb37	EN 10087:1998	480	1330	ASTM A 29/A 29M-99	39
	EN 10277:1999	480		ASTM A 322-91 (1996)	39
12	ASTM	418		ASTM A 519-96	305
	A 487/A 487M-93 (1998)		1335	ASTM A 29/A 29M-99	39
12 L 13	ASTM A 29/A 29M-99	479		ASTM A 322-91 (1996)	39
	ASTM A 576-90 (2000)	479		ASTM A 519-96	305
12 L 14	ASTM A 29/A 29M-99	479		SAE J404 APR94	40
	ASTM A 576-90 (2000)	479	1340	ASTM A 29/A 29M-99	39
12 L 15	ASTM A 29/A 29M-99	480		ASTM A 322-91 (1996)	39
	ASTM A 576-90 (2000)	480		ASTM A 519-96	305
12 Ni 14	ISO 9329-3:1997	241		SAE J404 APR94	40
	ISO 9330-3:1997	241	1345	ASTM A 29/A 29M-99	39
	ISO 9330-5:2000	241		ASTM A 322-91 (1996)	39
12 Ni 14 G1	ISO 9328-3:1991	125, 126		ASTM A 519-96	305
12 Ni 14 G2	ISO 9328-3:1991	125, 126	135-125	ASTM	418
12 Ni 19	DIN 17173:1985	241, 245		A 148/A 148M-93 (1998)	
	DIN 17174:1985	241, 245	13CrMo4-5	EN 10222-2:1999	15, 330
12 SMn 35	ISO 683-9	480	13CrMo9-10	ISO 9327-2:1999	332, 333
12 SMnPb 35	ISO 683-9	480	13MnNi6-3	EN 10028-4:1994	122
1211	ASTM A 29/A 29M-99	493		EN 10222-3:1999	340
	ASTM A 576-90 (2000)	493		SO 9327-3:1999	340
1212	ASTM A 29/A 29M-99	479	13MoCrNi42-16-14	EN ISO 683-17:1999	496
	ASTM A 576-90 (2000)	479	14	ASTM	418
	SAE J403-2000	479		A 487/A 487M-93 (1998)	
1213	ASTM A 29/A 29M-99	479	14 CrMo 4 5	ISO 9328-2:1991	116
	ASTM A 576-90 (2000)	479	14 MoV 6 3	DIN 17175:1979	262, 266
	SAE J403-2000	479	14CrMo4-5	ISO 9327-2:1999	330
1215	ASTM A 29/A 29M-99	479	14MoV6-3	EN 10222-2:1999	360
	ASTM A 576-90 (2000)	479	14NiCrMo13-4	EN 10084:1998	35
	SAE J403-2000	479	15 Mo 3	DIN 17175:1979	262, 266
125Cr2	EN 10132-4:2000	494		DIN 17177:1979	262, 266
12Cr-2Mo	ASTM A 268/A 268M-00	305		DIN 28180:1985	216, 219
12L13	SAE J403-2000	479	15 NiCr 13	ISO 683-11:1987	40
12L14	SAE J403-2000	479	15 NiMn 6	ISO 9328-3:1991	123
12L15	SAE J403-2000	480	150-135	ASTM	418
12Ni14	EN 10028-4:1994	125, 126		A 148/A 148M-93 (1998)	
	EN 10222-3:1999	339	1513	ASTM A 29/A 29M-99	39
12Ni14G1	ISO 9327-3:1999	339		ASTM A 576-90 (1995)	39
12Ni14G2	ISO 9327-3:1999	339	1518	ASTM A 29/A 29M-99	39
12Ni19	EN 10028-4:1994	127		ASTM A 576-90 (1995)	39
	ISO 9327-3:1999	339	1522	ASTM A 29/A 29M-99	30
13	ASTM	418		ASTM A 576-90	30
	A 487/A 487M-93 (1998)			SAE J403 AUG95	30
13 CrMo 4 4	DIN 17175:1979	263	1524	ASTM A 29/A 29M-99	39
	DIN 28180:1985	217, 220		ASTM A 513-00	167, 174, 175, 187, 192, 194
13 CrMo 4-5	EN 10028-2:1992	116		ASTM A 576-90 (1995)	39
13 CrMo 9 10 T1	ISO 9328-2:1991	118, 119		SAE J403 AUG95	39
13 CrMo 9 10 T2	ISO 9328-2:1991	118, 119			

602 Steel Grade/Name Index

Steel Grade/Name	Specification	Page No.	Steel Grade/Name	Specification	Page No.
1525	ASTM A 29/A 29M-99	39	16NiCrS4	EN 10084:1998	40
	ASTM A 576-90 (1995)	39	17 Mn 4	DIN 17175:1979	253, 260
1526	ASTM A 29/A 29M-99	39	17 NiCrMo 6	ISO 683-11:1987	35
	ASTM A 576-90 (1995)	39	17 SMn 20	ISO 683-9-1988	493
	SAE J403 AUG95	39	172 - Cat I	CSA Z245.1-98	293, 295
1527	ASTM A 29/A 29M-99	39	172 Category II or III	CSA Z245.1-98	310
	ASTM A 576-90 (1995)	39	17Cr3	EN 10084:1998	31
	SAE J403 AUG95	39	17CrNi6-6	EN 10084:1998	40
1536	ASTM A 29/A 29M-99	30	17CrS3	EN 10084:1998	31
	ASTM A 576-90	30	17MnCr5	EN ISO 683-17:1999	496
1541	ASTM A 29/A 29M-99	30	17NiCrMo6-4	EN 10084:1998	40
	ASTM A 576-90	30	17NiCrMoS6-4	EN 10084:1998	40
	SAE J403 AUG95	30	18 CrMo 4	ISO 683-11:1987	33
1547	ASTM A 29/A 29M-99	39	18 CrMoS 4	ISO 683-11:1987	33
	ASTM A 576-90 (1995)	39	18 CrNiMo 7	ISO 683-11:1987	40
1548	ASTM A 29/A 29M-99	39	18 MF6	AFNOR NF A 49-310	171, 175, 177, 191, 194, 195
	ASTM A 576-90 (1995)	39			
	SAE J403 AUG95	39	18 NCD12.6-M	AFNOR	419
1551	ASTM A 29/A 29M-99	39		NF A 32-053:1992	
	ASTM A 576-90 (1995)	39	18-2	ASTM A 803/A 803M-98	307
1552	ASTM A 29/A 29M-99	39	18Cr-2Mo	ASTM A 213/A 213M-99	307
	ASTM A 576-90 (1995)	39	18CrMo4	EN 10084:1998	33
	SAE J403 AUG95	39		EN 10250-3:1999	359
1561	ASTM A 29/A 29M-99	39	18CrMoS4	EN 10084:1998	33
	ASTM A 576-90 (1995)	39	18CrNiMo7-6	EN 10084:1998	40
1566	ASTM A 29/A 29M-99	39		EN ISO 683-17:1999	496
	ASTM A 576-90 (1995)	39	18MnMoNi5-5	EN 10222-2:1999	360
	SAE J403 AUG95	39	18NiCr5-4	EN 10084:1998	40
1572	ASTM A 29/A 29M-99	39	18NiCrMo14-6	EN ISO 683-17:1999	496
	SAE J403 AUG95	39	19 Mn 5	DIN 17175:1979	254, 261
15CrMo4	EN ISO 683-17:1999	496	19MnCr5	EN ISO 683-17:1999	496
15MnCrMoNiV5-3	EN 10222-2:1999	360	1A	ASTM	321, 323
15MnMoV4-5	EN 10222-2:1999	360		A 541/A 541M-95 (1999)	
15NiCr13	EN 10084:1998	40		ASTM	321, 323
15NiMn6	EN 10028-4:1994	123		A 508/A 508M-95 (1999)	
15SMn13	EN 10087:1998	476	1C	ASTM	360
	EN 10277:1999	476		A 541/A 541M-95 (1999)	
16	ASTM	418	1XCrNiMoN25-22-2	EN 10088-2:1995	468
	A 487/A 487M-93 (1998)		1XNiCrMoCuN25-20-7	EN 10088-2:1995	430, 441
16 M5-M	AFNOR	419	2	ASTM A 266/A 266M-99	321, 323
	NF A 32-053:1992			ASTM	418
16 MnCr 5	ISO 683-11:1987	40		A 487/A 487M-93 (1998)	
	EN 10084:1998	40		ASTM A 606-98	86, 91
16 MnCrS 5	ISO 683-11:1987	40		ASTM A 735/A 735M-99	144
16 Mo 3	EN 10028-2:1993	145	2 C 22	EN 10083-1:1991	21
	ISO 9328-2:1991	145	2 C 25	EN 10083-1:1991	22
160-145	ASTM	418	2, 3	ASTM A 537/A 537M-95	103
	A 148/A 148M-93 (1998)		2, Cl 1	ASTM	107
165-150	ASTM	418		A 541/A 541M-95 (1999)	
	A 148/A 148M-93 (1998)		2, Cl 1	ASTM	341
165-150L	ASTM	418		A 508/A 508M-95 (1999)	
	A 148/A 148M-93 (1998)		2, Cl 2	ASTM	341
16MnCrB	EN 10084:1998	40		A 541/A 541M-95 (1999)	
16MnCrS5	EN 10084:1998	40	2, Cl 2	ASTM	341
16Mo3	EN 10222-2:1999	328		A 508/A 508M-95 (1999)	
	ISO 9327-2:1999	328	20 Cr 4	ISO 683-11:1987	341
16NiCr4	EN 10084:1998	40	20 CrS 4	ISO 683-11:1987	31
16NiCrMo16-5	EN ISO 683-17:1999	496	20 D5-M	AFNOR	31
				NF A 32-053:1992	

Steel Grade/Name	Specification	Page No.	Steel Grade/Name	Specification	Page No.
20 M5-M	AFNOR	383, 384	22, CI 5	ASTM	360
20 NCD4-M	NF A 32-053:1992		A 541/A 541M-95 (1999)		
	AFNOR	368, 372	ASTM A 240/A 240M-00		141, 142
20 NiCrMo 2	NF A 32-053:1992	2, 419	2205	EN 10084:1998	33
20 NiCrMoS 2	ISO 683-11:1987	35	22CrMoS3-5	ASTM	332, 333
200-400	ISO 3755:1991	35	22V	A 541/A 541M-95 (1999)	
200-400W	ISO 3755:1991	367, 371		ASTM A 832/A 832M-99	144
201	ASTM A 240/A 240M-00	146	2304	ASTM A 240/A 240M-00	141, 142
	ASTM A 276-00	454, 457	230-450	ISO 3755:1991	367, 371
	ASTM A 666-00	428, 432	230-450W	ISO 3755:1991	367, 371
201L	ASTM A 666-00	428, 432	23V	ASTM A 832/A 832M-99	144
201LN	ASTM A 666-00	428, 432	241 - Cat I	CSA Z245.1-98	293, 295
202	ASTM A 240/A 240M-00	146	241 - Cat II or III	CSA Z245.1-98	298, 301
	ASTM A 276-00	454, 457	243	BSI BS 3059-2:1990	216, 219
	ASTM A 666-00	433, 428		BSI BS 3606:1992	216, 219
205	ASTM A 276-00	470	25 CrMo 4	DIN 17204:1990	196, 197
	ASTM A 666-00	468		EN 10083-1:1991	33
207 - Cat I	CSA Z245.1-98	293, 295		ISO 683-1:1987	33
207 Category II or III	CSA Z245.1-98	310	25 CrMoS 4	EN 10083-1:1991	33
20Cr3	EN ISO 683-17:1999	496		ISO 683-1:1987	33
20Cr4	EN ISO 683-17:1999	496	2507	ASTM A 240/A 240M-00	141, 142
20CrMo4	EN ISO 683-17:1999	496	251A58	BSI BS 970-2:1988	494
20Mn5	EN 10250-2:1999	359		AMD 2:1992	
20MnCr4-2	EN ISO 683-17:1999	496	251A60	BSI BS 970-2:1988	494
20MnCr5	EN 10084:1998	40		AMD 2:1992	
20MnCrMo4-2	EN ISO 683-17:1999	496	251H60	BSI BS 970-2:1988	494
20MnCrS5	EN 10084:1998	40		AMD 2:1992	
20MnMoNi4-5	EN 10250-3:1999	359	25-4-4	ASTM A 268/A 268M-00	305
20MnMoNi5	ISO 9327-2:1999	360		ASTM A 803/A 803M-98	307
20MoCr3	EN 10084:1998	33	255	ASTM A 240/A 240M-00	146
20MoCr4	EN 10084:1998	33	25CrMo4	EN 10250-3:1999	325, 326
20MoCrS3	EN 10084:1998	33	26 CrMo 4	DIN 17173:1985	242, 246
20MoCrS4	EN 10084:1998	33		ISO 9329-3:1997	242, 246
20NiCrMo2	EN ISO 683-17:1999	496	260-210	ASTM	418
20NiCrMo2-2	EN 10084:1998	35		A 148/A 148M-93 (1998)	
20NiCrMo7	EN ISO 683-17:1999	496	260-210L	ASTM	418
20NiCrMoS2-2	EN 10084:1998	35		A 148/A 148M-93 (1998)	
20NiCrMoS6-4	EN 10084:1998	35	260WT (38WT)	CSA G40.21:1998	68, 71
210-180	ASTM	418	261	BSI BS 3606:1992	307
	A 148/A 148M-93 (1998)		26-3-3	ASTM A 268/A 268M-00	305
210-180L	ASTM	418		ASTM A 803/A 803M-98	307
	A 148/A 148M-93 (1998)		270-480	ISO 3755:1991	368, 372
215S15	BSI BS 3059-2:1990	307	270-480W	ISO 3755:1991	368, 372
	BSI BS 3605-1:1991	309	27MnCrB5-2	EN 10083-3:1995	37
	AMD 2:1997		28 Mn 6	DIN 17204:1990	306
21MnCr5	EN ISO 4957:2000	495		EN 10083-1:1991	30
21V	ASTM A 832/A 832M-99	144		ISO 683-1:1987	30
22 L, CI. 1	ASTM A 387/A 387M-99	118	28Cr4	EN 10084:1998	31
22 Mn 6	ISO 683-1:1987	30	28CrS4	EN 10084:1998	31
22, CI. 1	ASTM A 387/A 387M-99	118	28Mn6	EN 10250-2:1999	359
22, CI. 2	ASTM A 387/A 387M-99	118	28NiCrMoV8-5	EN 10250-3:1999	359
22, CI 3	ASTM	332, 333	290 - Cat I	CSA Z245.1-98	293, 295
	A 508/A 508M-95 (1999)		290 - Cat II or III	CSA Z245.1-98	298, 301
22, CI 3	ASTM	332, 333	29-4	ASTM A 268/A 268M-00	305
	A 541/A 541M-95 (1999)			ASTM A 511-96	306
22, CI 4	ASTM	360		ASTM A 803/A 803M-98	307
	A 541/A 541M-95 (1999)		29-4-2	ASTM A 268/A 268M-00	305
				ASTM A 511-96	306

604 Steel Grade/Name Index

Steel Grade/Name	Specification	Page No.	Steel Grade/Name	Specification	Page No.
29-4-2 (Continued)	ASTM A 803/A 803M-98	307	304H	ASTM A 240/A 240M-00	134, 137
29-4C	ASTM A 803/A 803M-98	307		ASTM A 358/A 358M-98	271, 280
3	ASTM A 333/A 333M-99	288, 291	304L	ASTM A 240/A 240M-00	134, 137
	ASTM A 334/A 334M-99	241, 244		ASTM A 276-00	454, 458
	ASTM A 735/A 735M-99	144		ASTM A 358/A 358M-98	270, 279
3 C 22	EN 10083-1:1991	21		ASTM A 666-00	428, 436
3 C 25	EN 10083-1:1991	22	304LN	ASTM A 240/A 240M-00	134, 137
3 C 30	EN 10083-1:1991	22		ASTM A 276-00	454, 459
3 C 35	EN 10083-1:1991	23		ASTM A 358/A 358M-98	308
3 C 40	EN 10083-1:1991	24		ASTM A 666-00	429, 437
3 C 45	EN 10083-1:1991	25	304N	ASTM A 240/A 240M-00	134, 137
3 C 50	EN 10083-1:1991	26		ASTM A 276-00	454, 459
3 C 55	EN 10083-1:1991	27		ASTM A 358/A 358M-98	308
3 C 60	EN 10083-1:1991	27		ASTM A 666-00	429, 437
3, CI 1	ASTM	342	304S11	BSI BS 3605-1:1991	270, 279
	A 508/A 508M-95 (1999)			Issue 2, 1997	
	ASTM	342		BSI BS 3605-2:1992	270, 279
	A 541/A 541M-95 (1999)			Issue 2 1997	
3, CI 2	ASTM	342		BSI BS 3606:1992	225, 231
	A 508/A 508M-95 (1999)		304S31	BSI BS 3605-1:1991	270, 278
	ASTM	342		Issue 2, 1997	
	A 541/A 541M-95 (1999)			BSI BS 3605-2:1992	270, 278
30	ASTM A 570/A 570M-98	46, 62		Issue 2, 1997	
30 CrMoV 9	DIN 17204:1990	306		BSI BS 3606:1992	225, 231
30 CrNiMo 8	DIN 17204:1990	306	304S51	BSI BS 3059-2:1990	225, 232
	EN 10083-1:1991	40		BSI BS 3605-1:1991	271, 280
300WT (44WT)	CSA G40.21:1998	68, 72		Issue 2, 1997	
301	ASTM A 240/A 240M-00	146	305	ASTM A 240/A 240M-00	146
	ASTM A 666-00	428, 433		ASTM A 276-00	455, 459
301L	ASTM A 240/A 240M-00	146	308	ASTM A 167-99	468
	ASTM A 666-00	428, 434		ASTM A 276-00	470
301LN	ASTM A 240/A 240M-00	134, 137	309	ASTM A 167-99	429, 437
	ASTM A 666-00	428, 434		ASTM A 276-00	456, 463
301S21	BSI BS 5770-4:1981	484	309C30	BSI BS 3100:1991	408, 414
302	ASTM A 240/A 240M-00	146		AMD 1: 1992	
	ASTM A 276-00	454, 457	309C32	BSI BS 3100:1991	408, 414
	ASTM A 666-00	428, 435		AMD 1: 1992	
302B	ASTM A 167-00	428, 435	309C35	BSI BS 3100:1991	408, 414
	ASTM A 276-00	470		AMD 1: 1992	
302C25	BSI BS 3100:1991	419	309C40	BSI BS 3100:1991	407, 413
	AMD 1:1992			AMD 1: 1992	
	BSI BS 3100:1991	494	309Cb	ASTM A 240/A 240M-00	146
	AMD 1: 1992			ASTM A 276-00	470
302S25	BSI BS 5770-4:1981	454, 457		ASTM A 358/A 358M-98	308
303	ASTM A 582/A 582M-95	478	309H	ASTM A 240/A 240M-00	134, 138
	ASTM A 895-89 (2000)	454, 458	309HCb	ASTM A 240/A 240M-00	146
303Se	ASTM A 582/A 582M-95	134, 137	309S	ASTM A 240/A 240M-00	146
304	ASTM A 240/A 240M-00	454, 458		ASTM A 276-00	455, 460
	ASTM A 276-00	270		ASTM A 358/A 358M-98	271, 280
	ASTM A 358/A 358M-98	278	30CrMoV9	EN 10250-3:1999	359
	ASTM A 666-00	428, 436	30CrNiMo8	EN 10250-3:1999	359
304C12	BSI BS 3100:1991	396, 399	3½% Ni, 503 LT	BSI BS 3603:1991	241
	AMD 1:1992		31 CrMo 12	ISO 683-10:1987	40
304C12LT196	BSI BS 3100:1991	396, 399	31 CrNiMo 8	ISO 683-1:1987	40
	AMD 1:1992		310	ASTM A 167-99	429, 438
304C15	BSI BS 3100:1991	396, 399		ASTM A 276-00	456
	AMD 1:1992		310C40	BSI BS 3100:1991	409, 415
304C15LT196	BSI BS 3100:1991	396, 399		AMD 1: 1992	
	AMD 1:1992		310C45	BSI BS 3100:1991	409, 415
				AMD 1: 1992	

Steel Grade/Name	Specification	Page No.	Steel Grade/Name	Specification	Page No.
310Cb	ASTM A 240/A 240M-00	146	316S51	BSI BS 3059-2:1990	228, 234
	ASTM A 276-00	470		BSI BS 3605-1:1991	274, 283
	ASTM A 358/A 358M-98	308		Issue 2, 1997	
310H	ASTM A 240/A 240M-00	134, 138	316S52	BSI BS 3059-2:1990	228, 234
310HCb	ASTM A 240/A 240M-00	146		BSI BS 3605-1:1991	274, 283
310MoLN	ASTM A 240/A 240M-00	146		Issue 2, 1997	
310S	ASTM A 240/A 240M-00	146	316Ti	ASTM A 240/A 240M-00	135, 139
	ASTM A 276-00	455, 460		ASTM A 276-00	455, 462
	ASTM A 358/A 358M-98	271, 280	317	ASTM A 240/A 240M-00	146
311C11	BSI BS 3100:1991	409, 415		ASTM A 276-00	456, 462
	AMD 1: 1992		317 - Cat I	CSA Z245.1-98	293, 296
314	ASTM A 276-00	470	317 - Cat II or III	CSA Z245.1-98	298, 301
3140	ASTM A 519-96	305	317C16	BSI BS 3100:1991	397, 400
316	ASTM A 240/A 240M-00	134, 138		AMD 1:1992	
	ASTM A 276-00	455, 460	317L	ASTM A 240/A 240M-00	135, 139
	ASTM A 358/A 358M-98	272, 281	317LM	ASTM A 240/A 240M-00	146
	ASTM A 666-00	429, 438	317LMN	ASTM A 240/A 240M-00	136, 139
316C12	BSI BS 3100:1991	397, 400	317LN	ASTM A 240/A 240M-00	135, 139
	AMD 1:1992		318C17	BSI BS 3100:1991	397, 400
316C16	BSI BS 3100:1991	397, 400		AMD 1:1992	
	AMD 1:1992		320	BSI BS 3606:1992	208, 212
316C16LT196	BSI BS 3100:1991	397, 400	320 Seamless	BSI BS 3059-1:1987	208, 212
	AMD 1:1992		320 Welded	BSI BS 3059-1:1987	208, 212
316Cb	ASTM A 240/A 240M-00	135, 139	320 Welded (BW and ERW)	BSI BS 3601:1987	247, 256
	ASTM A 276-00	470	321	ASTM A 240/A 240M-00	136, 140
316H	ASTM A 240/A 240M-00	135, 138		ASTM A 276-00	456, 462
	ASTM A 358/A 358M-98	274, 283		ASTM A 358/A 358M-98	275, 285
316L	ASTM A 240/A 240M-00	135, 138		ASTM A 240/A 240M-00	136, 140
	ASTM A 276-00	4, 455, 461	321H	BSI BS 3605-1:1991	275, 285
	ASTM A 358/A 358M-98	273, 282		Issue 2, 1997	
	ASTM A 666-00	429, 439	321S31	BSI BS 3605-2:1992	275, 285
316LN	ASTM A 240/A 240M-00	135, 139		Issue 2, 1997	
	ASTM A 276-00	455, 461		BSI BS 3606:1992	228, 235
	ASTM A 358/A 358M-98	308	321S51	BSI BS 3605-1:1991	275, 285
316N	ASTM A 240/A 240M-00	146		Issue 2, 1997	
	ASTM A 276-00	455, 461	321S51 (1010)	BSI BS 3059-2:1990	229, 236
	ASTM A 358/A 358M-98	308	321S51 (1105)	BSI BS 3059-2:1990	229, 236
	ASTM A 666-00	430, 439	329	ASTM A 240/A 240M-00	146
316S11	BSI BS 3605-1:1991	273, 282	32CrMo12	EN 10250-3:1999	359
	Issue 2, 1997		32CrMoV12-28	EN ISO 4957:1999	490
	BSI BS 3605-2:1992	273, 282	33	ASTM A 570/A 570M-98	48, 63
	Issue 2, 1997		33 CrAlMo 5 4	ISO 683-10:1987	40
	BSI BS 3606:1992	227, 234	330C11	BSI BS 3100:1991	410, 416
316S13	BSI BS 3605-1:1991	273, 282		AMD 1: 1992	
	Issue 2, 1997		330C12	BSI BS 3100:1991	410, 416
	BSI BS 3605-2:1992	273, 282		AMD 1: 1992	
	Issue 2, 1997		331C40	BSI BS 3100:1991	410, 416
	BSI BS 3606:1992	227, 234		AMD 1: 1992	
316S16	BSI BS 5770-4:1981	494	331C60	BSI BS 3100:1991	410, 416
316S31	BSI BS 3605-1:1991	272, 281		AMD 1: 1992	
	Issue 2, 1997		332C11	BSI BS 3100:1991	398, 401
	BSI BS 3605-2:1992	272, 281		AMD 1:1992	
	Issue 2, 1997		332C13	BSI BS 3100:1991	398, 401
	BSI BS 3606:1992	227, 233		AMD 1:1992	
316S33	BSI BS 3605-1:1991	272, 281	332C15	BSI BS 3100:1991	398, 401
	Issue 2, 1997			AMD 1:1992	
	BSI BS 3605-2:1992	272, 281	334	ASTM A 240/A 240M-00	146
	Issue 2, 1997		334C11	BSI BS 3100:1991	411, 417
	BSI BS 3606:1992	227, 233		AMD 1: 1992	
			33MnCrB5-2	EN 10083-3:1995	37

606 Steel Grade/Name Index

Steel Grade/Name	Specification	Page No.	Steel Grade/Name	Specification	Page No.
33NiCrMoV14-5	EN 10250-3:1999	359	36 [250]	ASTM A 709/A 709M-00	50, 64
34 Cr 4	EN 10083-1:1991	31	36 CrNiMo 4	DIN 17204:1990	306
	ISO 683-1:1987	31		EN 10083-1:1991	40
34 CrAlMo 5	DIN 17211:1987	3, 36		ISO 683-1:1987	40
34 CrMo 4	DIN 17204:1990	196, 197	36 CrNiMo 6	ISO 683-1:1987	40
	EN 10083-1:1991	34	36 Mn 4	DIN 17204:1990	306
	ISO 683-1:1987	34	36 Mn 5	DIN 17204:1990	306
34 CrMoS 4	EN 10083-1:1991	34	36 Mn 6	ISO 683-1:1987	30
	ISO 683-1:1987	34	36 NiCrMo 16	EN 10083-1:1991	40
34 CrNiMo 6	DIN 17204:1990	306	360	BSI BS 3059-2:1990	209, 213
	EN 10083-1:1991	40	360 ERW	BSI BS 3601:1987	248, 257
34 CrS 4	EN 10083-1:1991	31	360 S	BSI BS 3601:1987	248, 257
	ISO 683-1:1987	31	360 Seamless	BSI BS 3602-1:1987	248, 257
340-550	ISO 3755:1991	369, 373	360 Welded	BSI BS 3602-1:1987	248, 257
340-550W	ISO 3755:1991	369, 373	36CrNiMo4	EN 10250-3:1999	359
347	ASTM A 240/A 240M-00	136, 140	36NiCrMo16	EN 10250-3:1999	359
	ASTM A 276-00	456, 463	36SMn14	EN 10087:1998	477
	ASTM A 358/A 358M-98	276, 286		EN 10277:1999	477
347C17	BSI BS 3100:1991	396, 399	37 Cr 4	EN 10083-1:1991	31
	AMD 1:1992			ISO 683-1:1987	31
347H	ASTM A 240/A 240M-00	136, 140	37 CrS 4	EN 10083-1:1991	31
347S31	BSI BS 3605-1:1991	276, 286		ISO 683-1:1987	31
	Issue 2, 1997		37 MF6	AFNOR	177, 178,
	BSI BS 3605-2:1990	276, 286		NF A 49-310: 1994	195
	Issue 2, 1997		37Cr4	EN 10250-3:1999	359
	BSI BS 3606:1992	229, 236	38 Si 7	DIN 17221-1988	494
347S51	BSI BS 3059-2:1990	229, 236	386 - Cat I	CSA Z245.1-98	293, 296
	BSI BS 3605-1:1991	276	386 - Cat II	CSA Z245.1-98	299, 302
	Issue 2, 1997		386 - Cat III	CSA Z245.1-98	299, 302
	BSI BS 3605-1:1990	286	38Cr2	EN 10250-3:1999	359
	Issue 2, 1997		38CrCoWV18-17-17	EN ISO 4957:1999	490
348	ASTM A 240/A 240M-00	146	38SMn28	EN 10087:1998	477
	ASTM A 276-00	470		EN 10277:1999	477
	ASTM A 358/A 358M-98	308	38SMnPb28	EN 10087:1998	477
348H	ASTM A 240/A 240M-00	146		EN 10277:1999	477
34Cr4	EN 10250-3:1999	359	39MnCrB5-2	EN 10083-3:1995	37
34CrMo4	EN 10250-3:1999	325	3V	ASTM	334, 335
34CrNiMo6	EN 10250-3:1999	359		A 508/A 508-95 (1999)	
35	ASTM	298, 301		ASTM	334, 335
	A 1005/A 1005M-00			A 541/A 541M-95 (1999)	
	ASTM A 984/A 984M-00	298, 301	3VCb	ASTM	360
35 S 20	ISO 683-9-1988	493		A 508/A 508M-95 (1999)	
35 SMn 20	ISO 683-9-1988	493		ASTM	360
	ISO 983-9:1988	477		A 541/A 541M-95 (1999)	
350A (50A)	CSA G40.21:1998	86, 91	4	ASTM A 266/A 266M-99	321, 323
350AT (50AT)	CSA G40.21:1998	86, 91		ASTM A 333/A 333M-99	308
350R (50R)	CSA G40.21:1998	86, 91		ASTM A 606-98	91
350WT (50WT)	CSA G40.21-98	69, 73		ASTM A 735/A 735M-99	144
359 - Cat I	CSA Z245.1-98	293, 296	40	ASTM A 570/A 570M-98	50, 64
359 - Cat II	CSA Z245.1-98	299, 302	400	BSI BS 3606:1992	210, 214
359 - Cat III	CSA Z245.1-98	299, 302	400A (60A)	CSA G40.21:1998	92
35CrMo7	EN ISO 4957:2000	495	400AT (60AT)	CSA G40.21:1998	89, 92
35S20	EN 10087:1999	493	400WT (60WT)	CSA G40.21:1998	70, 74
	EN 10277-3:1999	493	4012	ASTM A 29/A 29M-99	39
35SMnPb14	EN 10087:1998	477		ASTM A 519-96	305
	EN 10277:1999	477	4023	ASTM A 29/A 29M-99	39
35SPb20	EN 10087:1999	483		ASTM A 322-91 (1996)	39
	EN 10277-3:1999	483		ASTM A 519-96	305

Steel Grade/Name	Specification	Page No.	Steel Grade/Name	Specification	Page No.
4023 (Continued)	SAE J404 APR94	40	4130 (Continued)	SAE J404 APR94	33
4024	ASTM A 29/A 29M-99	39	4135	ASTM A 29/A 29M-99	39
	ASTM A 322-91 (1996)	39		ASTM A 519-96	196, 197
	ASTM A 519-96	305	4137	ASTM A 29/A 29M-99	34
4027	ASTM A 29/A 29M-99	39		ASTM A 322-91 (1996)	34
	ASTM A 322-91 (1996)	39		ASTM A 519-96	196, 197
	ASTM A 519-96	40		SAE J404 APR94	34
	SAE J404 APR94	305	414	ASTM A 276-00	470
4028	ASTM A 29/A 29M-99	39	414 - Cat I	CSA Z245.1-98	294, 296
	ASTM A 322-91 (1996)	39	414 - Cat II	CSA Z245.1-98	299, 303
	ASTM A 519-96	196, 197	414 - Cat III	CSA Z245.1-98	299, 303
403	ASTM A 176-99	424, 425	4140	ASTM A 29/A 29M-99	34
	ASTM A 276-00	446, 448		ASTM A 322-91 (1996)	34
4032	ASTM A 29/A 29M-99	39		ASTM A 513-00	196, 198
4037	ASTM A 29/A 29M-99	39		ASTM A 519-96	196, 198
	ASTM A 322-91 (1996)	39		SAE J404 APR94	34
	ASTM A 519-96	305	4142	ASTM A 29/A 29M-99	39
	SAE J404 APR94	40		ASTM A 322-91 (1996)	39
4042	ASTM A 29/A 29M-99	39		ASTM A 519-96	196, 198, 305
	ASTM A 519-96	305		SAE J404 APR94	40
4047	ASTM A 29/A 29M-99	39	4145	ASTM A 29/A 29M-99	34
	ASTM A 322-91 (1996)	39		ASTM A 322-91 (1996)	34
	ASTM A 519-96	305		ASTM A 519-96	196, 198
	SAE J404 APR94	40		SAE J404 APR94	34
405	ASTM A 240/A 240M-00	132, 133	4147	ASTM A 29/A 29M-99	39
	ASTM A 276-00	451, 452		ASTM A 322-91 (1996)	39
4063	ASTM A 519-96	305		ASTM A 519-96	305
409	ASTM A 240/A 240M-00	146	4150	ASTM A 29/A 29M-99	34
40CrMnNiMo8-6-4	EN ISO 4957:2000	495		ASTM A 322-91 (1996)	34
40CrMoV13-9	EN 10250-3:1999	359		ASTM A 519-96	305
41 Cr 4	DIN 17204:1990	306		SAE J404 APR94	34
	EN 10083-1:1991	32	416	ASTM A 582/A 582M-95	446, 448
	ISO 683-1:1987	32		ASTM A 895-89 (2000)	478
41 CrAlMo 74	ISO 683-10:1987	36	4161	ASTM A 29/A 29M-99	39
41 CrNiMo 2	ISO 683-1:1987	35		ASTM A 322-91 (1996)	39
41 CrNiMoS 2	ISO 683-1:1987	35		ASTM A 689-97	483
41 CrS 4	EN 10083-1:1991	32	416Se	ASTM 582/A 582M-95	470
	ISO 683-1:1987	32	41Cr4	EN 10250-3:1999	359
410	ASTM A 240/A 240M-00	146	42 [290] Type 1	ASTM A 572/A 572M-00	71
	ASTM A 276-00	446, 448	42 [290] Type 2	ASTM A 572/A 572M-00	71
410C21	BSI BS 3100:1991	393, 394	42 [290] Type 3	ASTM A 572/A 572M-00	71
	AMD 1:1992		42 [290] Type 4	ASTM A 572/A 572M-00	71
410S	ASTM A 240/A 240M-00	146	42 [290] Type 5	ASTM A 572/A 572M-00	71
4118	ASTM A 29/A 29M-99	33	42 CrMo 4	DIN 17204:1990	196, 198
	ASTM A 322-91 (1996)	33		EN 10083-1:1991	34
	ASTM A 513-00	196, 197		ISO 683-1:1987	34
	ASTM A 519-96	196, 197	42 CrMoS 4	EN 10083-1:1991	34
	SAE J404 APR94	33		ISO 683-1:1987	34
4120	ASTM A 29/A 29M-99	33	42 Mn 6	ISO 683-1:1987	30
	ASTM A 322-91 (1996)	33	420	ASTM A 176-99	424, 425
	SAE J404 APR94	33	420C24	BSI BS 3100:1991	406, 412
4121	ASTM A 29/A 29M-99	33		AMD 1: 1992	
	ASTM A 322-91 (1996)	33	420C28	BSI BS 3100:1991	393, 394
4130	ASTM A 29/A 29M-99	33		AMD 1:1992	
	ASTM A 322-91 (1996)	33	420C29	BSI BS 3100:1991	393, 394
	ASTM A 513-00	196, 197		AMD 1:1992	
	ASTM A 519-96	196, 197			

608 Steel Grade/Name Index

Steel Grade/Name	Specification	Page No.	Steel Grade/Name	Specification	Page No.
420F	ASTM A 582/A 582M-95	446, 449	448 - Cat II	CSA Z245.1-98	300, 303
420FSe	ASTM 582/A 582M-95	470	448 - Cat III	CSA Z245.1-98	300, 303
420S29	BSI BS 5770-4:1981	494	44SMn28	EN 10087:1998	478
420S45	BSI BS 5770-4:1981	484		EN 10277:1999	478
422	ASTM A 176-99	468	44SMnPb28	EN 10087:1998	478
425C11	BSI BS 3100:1991	393, 394		EN 10277:1999	478
	AMD 1:1992		45	ASTM A 570/A 570M-98	52, 65
425C12	BSI BS 3100:1991	393, 395		ASTM A 984/A 984M-00	298, 301
	AMD 1:1992		4520	ASTM A 519-96	305
429	ASTM A 240/A 240M-00	146	452C11	BSI BS 3100:1991	406, 412
	ASTM A 276-00	470		AMD 1: 1992	
42CrMo4	EN 10250-3:1999	325, 326	452C12	BSI BS 3100:1991	406, 412
430	ASTM A 240/A 240M-00	146		AMD 1: 1992	
	ASTM A 182/A 182M-00	346	45NiCrMo16	EN ISO 4957:2000	495
	ASTM A 276-00	451, 452	46 S 20	ISO 683-9:1988	478
	BSI BS 3602-2:1991	251, 259	4615	ASTM A 29/A 29M-99	39
430 ERW	BSI BS 3601:1987	252, 259		ASTM A 322-91 (1996)	39
430 SAW	BSI BS 3601:1987	252, 259		ASTM A 519-96	305
430 Seamless	BSI BS 3601:1987	259	4617	ASTM A 519-96	305
	BSI BS 3602-1:1987	252, 259	4620	ASTM A 29/A 29M-99	39
430 Welded	BSI BS 3602-1:1987	252, 259		ASTM A 322-91 (1996)	39
430F	ASTM A 582/A 582M-95	451, 452		ASTM A 519-96	305
430FSe	ASTM 582/A 582M-95	470		SAE J404 APR94	40
431	ASTM A 176-99	468	4621	ASTM A 29/A 29M-99	39
	ASTM A 276-00	446, 449		ASTM A 322-91 (1996)	39
4320	ASTM A 29/A 29M-99	35		ASTM A 519-96	305
	ASTM A 322-91 (1996)	35	4626	ASTM A 29/A 29M-99	39
	ASTM A 519-96	305		ASTM A 322-91 (1996)	39
	SAE J404 APR94	35	46Cr2	EN 10250-3:1999	359
4337	ASTM A 519-96	305	46S20	EN 10087:1998	478
434	ASTM A 240/A 240M-00	146		EN 10277:1999	478
4340	ASTM A 29/A 29M-99	35	46SPb20	EN 10087:1998	478
	ASTM A 322-91 (1996)	35		EN 10277:1999	478
	ASTM A 519-96	305	4715	ASTM A 29/A 29M-99	39
	SAE J404 APR94	35	4718	ASTM A 29/A 29M-99	39
436	ASTM A 240/A 240M-00	146		ASTM A 519-96	305
439	ASTM A 240/A 240M-00	132, 133	4720	ASTM A 29/A 29M-99	39
	BSI BS 3606:1992	223, 224		ASTM A 322-91 (1996)	39
43CrMo4	EN ISO 683-17:1999	496		ASTM A 519-96	305
44 SMn 28	ISO 683-9:1988	478	480A (70A)	CSA G40.21:1998	89, 92
440	BSI BS 3059-2:1990	210, 214	480AT (70AT)	CSA G40.21:1998	89, 92
	BSI BS 3606:1992	210, 214	4815	ASTM A 29/A 29M-99	39
440A	ASTM A 276-00	446, 449		ASTM A 322-91 (1996)	39
440B	ASTM A 276-00	446, 450		ASTM A 519-96	305
440C	ASTM A 276-00	447, 450	4817	ASTM A 29/A 29M-99	39
4419	ASTM A 29/A 29M-99	39		ASTM A 322-91 (1996)	39
442	ASTM A 176-99	468		ASTM A 519-96	305
4422	ASTM A 29/A 29M-99	39	4820	ASTM A 29/A 29M-99	39
	ASTM A 519-96	305		ASTM A 322-91 (1996)	39
4427	ASTM A 29/A 29M-99	39		ASTM A 519-96	305
	ASTM A 519-96	305		SAE J404 APR94	40
444	ASTM A 240/A 240M-00	132, 133	483 - Cat I	CSA Z245.1-98	294, 297
	ASTM A 276-00	470	483 - Cat II or III	CSA Z245.1-98	300, 304
446	ASTM A 176-99	426, 427	48Si7	EN 10132-4:2000	494
	ASTM A 276-00	451, 453	490	BSI BS 3602-2:1991	253, 260
447	ASTM A 276-00	451, 452	4N, Cl 1	ASTM	360
448 - Cat I	CSA Z245.1-98	294, 296		A 508/A 508M-95 (1999)	

Steel Grade/Name	Specification	Page No.	Steel Grade/Name	Specification	Page No.
	ASTM	360	50CrMoV13-15	EN ISO 4957:2000	495
4N, CI 2	A 541/A 541M-95 (1999)		50W [345W] A	ASTM A 709/A 709M-00	80
	ASTM	360	50W [345W] B	ASTM A 709/A 709M-00	80
	A 508/A 508M-95 (1999)		50W [345W] C	ASTM A 709/A 709M-00	80
	ASTM	360	50WCrv8	EN ISO 4957:2000	495
4N, CI 3	A 541/A 541M-95 (1999)		51 B 60	ASTM A 689-97	482
	ASTM	343	51 CrMo 4	DIN 17221-1988	494
	A 508/A 508M-95 (1999)		51 CrV 4	EN 10083-1:1991	38
	ASTM	343		ISO 683-1:1987	38, 40
5, CI 1	A 541/A 541M-95 (1999)			ISO 683-14:1992	482
	ASTM	360		ASTM A 29/A 29M-99	39
	A 508/A 508M-95 (1999)		5115	ASTM A 519-96	305
	ASTM	360		ASTM A 322-91 (1996)	39
5, CI 2	A 541/A 541M-95 (1999)		5117	ASTM A 29/A 29M-99	31
	ASTM	360	5120	ASTM A 322-91 (1996)	31
	A 508/A 508M-95 (1999)			ASTM A 519-96	305
50	A 541/A 541M-95 (1999)			SAE J404 APR94	31
	ASTM A 570/A 570M-98	54, 65		ASTM A 29/A 29M-99	31
	ASTM	310		ASTM A 322-91 (1996)	31
	A 1005/A 1005M-00			ASTM A 513-00	305
50 [345]	ASTM A 529/A 529M-96	55, 66	5130	ASTM A 519-96	305
50 [345] Type 1	ASTM A 572/A 572M-00	71		SAE J404 APR94	31
	ASTM A 709/A 709M-00	71		ASTM A 29/A 29M-99	31
50 [345] Type 2	ASTM A 572/A 572M-00	71	5132	ASTM A 322-91 (1996)	31
	ASTM A 709/A 709M-00	71		ASTM A 519-96	305
50 [345] Type 3	ASTM A 572/A 572M-00	71		SAE J404 APR94	31
	ASTM A 656/A 656M-00	71		ASTM A 29/A 29M-99	31
	ASTM A 709/A 709M-00	71		ASTM A 322-91 (1996)	31
50 [345] Type 4	ASTM A 572/A 572M-00	71	5135	ASTM A 519-96	305
	ASTM A 709/A 709M-00	71		SAE J404 APR94	31
50 [345] Type 5	ASTM A 572/A 572M-00	71		ASTM A 29/A 29M-99	31
50 [345] Type 7	ASTM A 656/A 656M-00	71	5140	ASTM A 322-91 (1996)	31
50 CrMo 4	EN 10083-1:1991	34		ASTM A 519-96	305
	ISO 683-1:1987	34		SAE J404 APR94	32
50 CrV 4	DIN 17221:1988	482	5145	ASTM A 29/A 29M-99	32
50 CV 4	AFNOR	482		ASTM A 519-96	305
	NF A 35-571:1996		5147	ASTM A 29/A 29M-99	39
500 Nb Seamless	BSI BS 3602-1:1987	254, 261		ASTM A 519-96	305
5015	ASTM A 29/A 29M-99	39	5150	ASTM A 29/A 29M-99	39
	ASTM A 519-96	305		ASTM A 322-91 (1996)	39
5046	ASTM A 29/A 29M-99	39		ASTM A 519-96	305
	ASTM A 519-96	305		SAE J404 APR94	40
50B40	ASTM A 519-96	305	5155	ASTM A 29/A 29M-99	39
50B44	ASTM A 29/A 29M-99	37		ASTM A 322-91 (1996)	39
	ASTM A 322-91 (1996)	37		ASTM A 519-96	305
	ASTM A 519-96	305		ASTM A 689-97	482
50B46	ASTM A 29/A 29M-99	37	5160	ASTM A 29/A 29M-99	39
	ASTM A 322-91 (1996)	37		ASTM A 322-91 (1996)	39
	ASTM A 519-96	305		ASTM A 519-96	305
	SAE J404 APR94	37		ASTM A 689-97	482
50B50	ASTM A 29/A 29M-99	37		ASTM A 295-98	496
	ASTM A 322-91 (1996)	37		SAE J404 APR94	40
	ASTM A 519-96	305	5195	ASTM A 295-98	496
50B60	ASTM A 29/A 29M-99	37	51B60	ASTM A 29/A 29M-99	37
	ASTM A 322-91 (1996)	37		ASTM A 322-91 (1996)	37
	ASTM A 519-96	305		SAE J404 APR94	37
50B61	ASTM A 519-96	305	51CrV4	EN 10132-4:2000	494
50CrMo4	EN 10250-3:1999	325, 327		EN 10250-3:1999	359

610 Steel Grade/Name Index

Steel Grade/Name	Specification	Page No.	Steel Grade/Name	Specification	Page No.
52100	ASTM A 295-98	492	60-30	ASTM A 27/A 27M-95 (2000)	367, 371
525A58	BSI BS 970-2:1988 AMD 2:1992	494	60WCrV8	EN ISO 4957:2000	495
525A60	BSI BS 970-2:1988 AMD 2:1992	494	6118	ASTM A 29/A 29M-99 ASTM A 322-91 (1996) ASTM A 519-96	39 39 305
525A61	BSI BS 970-2:1988 AMD 2:1992	494	6120	ASTM A 519-96	305
525H60	BSI BS 970-2:1988 AMD 2:1992	494	6150	ASTM A 29/A 29M-99 ASTM A 322-91 (1996) ASTM A 519-96 ASTM A 689-97 SAE J404 APR94	38 38 305 482 38
54 SiCr 6	DIN 17221:1988	483	620	BSI BS 3604-2:1991 BSI BS 3606:1992	263, 267 217, 220
55	ASTM A 570/A 570M-98 ASTM A 984/A 984M-00	55, 66 299, 302	620-440 (1Cr-0.5Mo)	BSI BS 3604-1:1990 AMD 2: 1997	263, 267 217, 220
55 [380]	ASTM A 516/A 516M-90 (1996) ASTM A 572/A 572M-00 ASTM A 529/A 529M-96	143 69 55, 66	620-460	BSI BS 3059-2:1990	217, 220
55 [380] Type 1	ASTM A 572/A 572M-00	73	621	BSI BS 3604-2:1991 BSI BS 3606:1992	263, 267 217, 221
55 [380] Type 2	ASTM A 572/A 572M-00	73	621 (1.25Cr-0.5Mo)	BSI BS 3604-1:1990 AMD 2: 1997	263, 267 264, 268
55 [380] Type 3	ASTM A 572/A 572M-00	73	622	BSI BS 3606:1992	217, 221
55 [380] Type 4	ASTM A 572/A 572M-00	73	622 (2.25Cr-1Mo)	BSI BS 3604-1:1990 AMD 2: 1997	264, 268 217, 221
55 [380] Type 5	ASTM A 572/A 572M-00	73	622-490	BSI BS 3059-2:1990	217, 221
55 Cr 3	AFNOR NF A 35-571:1996 DIN 17221:1988 ISO 683-14:1992	482 482 482	625	BSI BS 3606:1992	217, 221
55 SiCr 63	ISO 683-14:1992	483	625 (5Cr-0.5Mo)	BSI BS 3604-1:1990 AMD 2: 1997	264, 268 218, 222
550 - Cat I	CSA Z245.1-98	294, 297	629-470	BSI BS 3059-2:1990	218, 222
550 - Cat II	CSA Z245.1-98	300, 304	629-470 (9Cr-1Mo)	BSI BS 3604-1:1990 AMD 2: 1997	264, 269 218, 222
550 - Cat III	CSA Z245.1-98	300, 304	629-590	BSI BS 3059-2:1990 BSI BS 3604-1:1990	308
550A (80A)	CSA G40.21:1998	89, 92	630	ASTM A 564/A 564M-99	464, 465
550AT (80AT)	CSA G40.21:1998	89, 92	631	ASTM A 564/A 564M-99	464, 466
55NiCrMoV7	EN ISO 4957:1999	490	632	ASTM A 564/A 564M-99	470
56Mn4	EN ISO 683-17:1999	496	634	ASTM A 564/A 564M-99	470
56Si7	EN 10132-4:2000	494	635	ASTM A 564/A 564M-99	470
58 [400]	ASTM A 573/A 573M-98	50	65	ASTM A 984/A 984M-00	300, 303
59 Si 7	ISO 683-14:1992	482	65 [450]	ASTM A 515/A 515M-97 ASTM A 516/A 516M-96 ASTM A 572/A 572M-00 ASTM A 573/A 573M-98 ASTM A 871/A 871M-97	101, 105 101, 105 70 54, 65 89
591	BSI BS 3604-1:1990	308	65 [450] Type 1	ASTM A 572/A 572M-00	74
6	ASTM A 333/A 333M-99 ASTM A 487/A 487M-93 (1998) ASTM A 1005/A 1005M-00 ASTM A 181/A 181M-00	288, 291 418 299, 303 320, 323	65 [450] Type 2	ASTM A 572/A 572M-00	74
60	ASTM A 515/A 515M-97 ASTM A 516/A 516M-90 (2001) ASTM A 572/A 572M-00 ASTM A 656/A 656M-00 ASTM A 871/A 871M-87	104 104 70 69 89	65 [450] Type 3	ASTM A 572/A 572M-00	74
60 [415]	ASTM A 572/A 572M-00 ASTM A 572/A 572M-00 ASTM A 656/A 656M-00	74 74 73	65 [450] Type 4	ASTM A 572/A 572M-00	74
60 [415] Type 1	ASTM A 572/A 572M-00	74	65 [450] Type 5	ASTM A 572/A 572M-00	74
60 [415] Type 2	ASTM A 572/A 572M-00	74	65-35	ASTM A 27/A 27M-95 (2000)	367, 371
60 [415] Type 3	ASTM A 572/A 572M-00	73, 74	660 (0.5Cr-0.5Mo-0.25V)	BSI BS 3604-1:1990 AMD 2: 1997	262, 266
60 [415] Type 4	ASTM A 572/A 572M-00	74	685A57	BSI BS 970-2:1988 AMD 2:1992	483
60 [415] Type 5	ASTM A 572/A 572M-00	74	685H57	BSI BS 970-2:1988 AMD 2:1992	483
60 [415] Type 7	ASTM A 656/A 656M-00	73			
60 CrB 3	ISO 683-14:1992	482			
60 CrMo 33	ISO 683-14:1992	483			
60 SiCr 7	DIN 17221-1988	494			

Steel Grade/Name	Specification	Page No.	Steel Grade/Name	Specification	Page No.
7	ASTM A 334/A 334M-99	241, 244	81B45	ASTM A 29/A 29M-99	39
	ASTM	418		ASTM A 322-91 (1996)	39
	A 487/A 487M-93 (1998)			ASTM A 519-96	305
70	ASTM	300, 304	8615	ASTM A 29/A 29M-99	39
	A 1005/A 1005M-00			ASTM A 322-91 (1996)	39
	ASTM A 181/A 181M-00	321, 323		ASTM A 519-96	305
70 [485]	ASTM A 515/A 515M-97	101, 106		SAE J404 APR94	40
	ASTM A 516/A 516M-96	101, 106	8617	ASTM A 29/A 29M-99	39
	ASTM A 573/A 573M-98	55, 66		ASTM A 322-91 (1996)	39
	ASTM A 656/A 656M-00	70		ASTM A 519-96	305
70, Type 3	ASTM A 656/A 656M-00	74		SAE J404 APR94	40
70, Type 7	ASTM A 656/A 656M-00	74	8620	ASTM A 29/A 29M-99	35
700Q (100Q)	CSA G40.21:1998	79, 83		ASTM A 322-91 (1996)	35
700QT (100QT)	CSA G40.21:1998	79, 83		ASTM A 513-00	305
70-36	ASTM	368, 372		ASTM A 519-96	305
	A 27/A 27M-95 (2000)			SAE J404 APR94	35
70-40	ASTM	368, 372	8622	ASTM A 29/A 29M-99	39
	A 27/A 27M-95 (2000)			ASTM A 322-91 (1996)	39
704A60	BSI BS 970-2:1988	494		ASTM A 519-96	305
	AMD 2:1992			SAE J404 APR94	40
704H60	BSI BS 970-2:1988	483	8625	ASTM A 29/A 29M-99	39
	AMD 2:1992			ASTM A 322-91 (1996)	39
705A60	BSI BS 970-2:1988	483		ASTM A 519-96	305
	AMD 2:1992		8627	ASTM A 29/A 29M-99	39
705H60	BSI BS 970-2:1988	483		ASTM A 322-91 (1996)	39
	AMD 2:1992			ASTM A 519-96	305
70Mn4	EN ISO 683-17:1999	496	8630	ASTM A 29/A 29M-99	39
70MnMoCr8	EN ISO 4957:2000	495		ASTM A 322-91 (1996)	39
735A51	BSI BS 970-2:1988	482		ASTM A 513-00	305
	AMD 2:1992			ASTM A 519-96	305
735A54	BSI BS 970-2:1988	494		SAE J404 APR94	40
	AMD 2:1992		8637	ASTM A 29/A 29M-99	39
735H51	BSI BS 970-2:1988	482		ASTM A 322-91 (1996)	39
	AMD 2:1992			ASTM A 519-96	305
75Ni8	EN 10132-4:2000	494	8640	ASTM A 29/A 29M-99	35
762	BSI BS 3059-2:1990	223, 224		ASTM A 322-91 (1996)	39
762 (12Cr-1Mo-V)	BSI BS 3604-1:1990	265, 269		ASTM A 519-96	305
	AMD 2: 1997			ASTM A 29/A 29M-99	35
8	ASTM A 333/A 333M-99	290, 292		ASTM A 322-91 (1996)	35
	ASTM A 334/A 334M-99	242, 245		ASTM A 519-96	305
8 CI A	ASTM	388, 389	8642	SAE J404 APR94	35
	A 487/A 487M-93 (1998)			ASTM A 29/A 29M-99	39
8 CI B	ASTM	388, 389		ASTM A 322-91 (1996)	39
	A 487/A 487M-93 (1998)			ASTM A 519-96	305
8 CI C	ASTM	388, 389	8645	ASTM A 29/A 29M-99	39
	A 487/A 487M-93 (1998)			ASTM A 322-91 (1996)	39
80	ASTM	300, 304		ASTM A 519-96	305
	A 1005/A 1005M-00			SAE J404 APR94	40
	ASTM A 656/A 656M-00	93	8650	ASTM A 29/A 29M-99	39
	ASTM A 984/A 984M-00	300, 304		ASTM A 519-96	305
800	ASTM A 240/A 240M-00	136, 140	8655	ASTM A 29/A 29M-99	39
800H	ASTM A 240/A 240M-00	136, 140		ASTM A 322-91 (1996)	39
80-40	ASTM	373		ASTM A 519-96	305
	A 148/A 148M-93 (1998)		8660	ASTM A 29/A 29M-99	39
80-50	ASTM	369		ASTM A 519-96	305
	A 148/A 148M-93 (1998)		86B45	ASTM A 519-96	305
805H60	BSI BS 970-2:1988	494	8720	ASTM A 29/A 29M-99	39
	AMD 2:1992			ASTM A 322-91 (1996)	39
80CrV2	EN 10132-4:2000	494		ASTM A 519-96	305
80MoCrV42-16	EN ISO 683-17:1999	496		SAE J404 APR94	40
8115	ASTM A 29/A 29M-99	39			
	ASTM A 519-96	305			

612 Steel Grade/Name Index

Steel Grade/Name	Specification	Page No.
8735	ASTM A 519-96	305
8740	ASTM A 29/A 29M-99	39
	ASTM A 322-91 (1996)	39
	ASTM A 519-96	305
8742	ASTM A 519-96	305
8822	ASTM A 29/A 29M-99	39
	ASTM A 322-91 (1996)	39
	ASTM A 519-96	305
	SAE J404 APR94	40
9	ASTM A 333/A 333M-99	308
	ASTM A 334/A 334M-99	308
	ASTM	418
	A 487/A 487M-93 (1998)	
9 S 20	ISO 683-9	479
9% Ni, 509 LT	BSI BS 3603:1991	242, 245
904L	ASTM A 240/A 240M-00	136, 140
90-60	ASTM	370, 373
	A 148/A 148M-93 (1998)	
90MnCrV8	EN ISO 4957:2000	495
91	BSI BS 3059-2:1990	218, 222
	BSI BS 3604-1:1990	308
9254	ASTM A 29/A 29M-99	39
9255	ASTM A 29/A 29M-99	39
	ASTM A 519-96	305
9259	ASTM A 29/A 29M-99	39
	ASTM A 322-91 (1996)	39
	SAE J404 APR94	40
925A60	BSI BS 970-2:1988	494
	AMD 2:1992	
9260	ASTM A 29/A 29M-99	39
	ASTM A 322-91 (1996)	39
	ASTM A 519-96	305
	ASTM A 689-97	482
	SAE J404 APR94	40
9262	ASTM A 519-96	305
94B15	ASTM A 519-96	305
94B17	ASTM A 29/A 29M-99	39
	ASTM A 322-91 (1996)	39
	ASTM A 519-96	305
94B30	ASTM A 29/A 29M-99	39
	ASTM A 322-91 (1996)	39
	ASTM A 519-96	305
94B40	ASTM A 519-96	305
95MnWCr5	EN ISO 4957:2000	495
9840	ASTM A 519-96	305
9850	ASTM A 519-96	305
A	ASTM A 106-99	10, 247, 256
	ASTM	379, 381
	A 128/A 128M-93 (1998)	
	ASTM A 135-97	247, 256
	ASTM A 139-00	247, 256
	ASTM	208, 212
	A 178/A 178M-95 (2000)	
	ASTM	143
	A 202/A 202M-93 (1999)	
	ASTM A 203/A 203M-97	124
	ASTM	112, 114
	A 204/A 204M-93 (1999)	
	ASTM A 283/A 283M-00	45, 62

Steel Grade/Name	Specification	Page No.
A (Continued)	ASTM	143
	A 285/A 285M-90 (1996)	
	ASTM A 302/A 302M-97	112, 114
	ASTM A 355-89 (2000)	3, 36
	ASTM A 500-99	157, 180
	ASTM A 514/A 514M-94	82
	ASTM	143
	A 517/A 517M-93 (1999)	
	ASTM A 588/A 588M-00	69, 73
	ASTM A 595-98	167, 187
	ASTM A 633/A 633M-00	68, 71
	ASTM A 662/A 662M-99	108, 110
	ASTM A 668/A 668M-96	314, 318
	ASTM A 678/A 678M-00	55, 66
	ASTM A 724/A 734 M-99	144
	ASTM	144
	A 734/A 734 M-87 (1997)	
	ASTM A 738/A 738M-00	102, 106
A, Cl. 1	ASTM A 841/A 841M-98	110
A, Cl. 2	ASTM A 841/A 841M-98	111
A, PSL 1 seamless	API 5L-2000	295
A, PSL 1 welded	API 5L-2000	295
A1	BSI BS 3100:1991	367, 371
	AMD 1:1992	
A-1	ASTM A 210/A 210M-96	210, 214
A10	ASTM A 681-94 (1999)	495
A1Q	ASTM A 757/A 757M-00	377, 378
A2	ASTM A 556/A 556M-96	208, 212
	BSI BS 3100:1991	368, 372
	AMD 1:1992	
	ASTM A 681-94 (1999)	489
	SAE J438-1970	489
A25, Cl I,	API 5L-2000	293, 295
PSL 1 seamless		
A25, Cl I, PSL 1 welded	API 5L-2000	295
A25, Cl II,	API 5L-2000	293, 295
PSL 1 seamless		
A25, Cl II, PSL 1 welded	API 5L-2000	295
A2Q	ASTM A 757/A 757M-00	377, 378
A3	ASTM A 681-94 (1999)	495
	BSI BS 3100:1991	368, 372
	AMD 1:1992	
A4	ASTM A 681-94 (1999)	495
	BSI BS 3100:1991 AMD	368, 372
	1:1992	
A5	ASTM A 681-94 (1999)	495
	BSI BS 3100:1991	370, 373
	AMD 1:1992	
A6	ASTM A 681-94 (1999)	495
	BSI BS 3100:1991	370, 374
	AMD 1:1992	
A7	ASTM A 681-94 (1999)	495
A8	ASTM A 681-94 (1999)	495
A9	ASTM A 681-94 (1999)	495
AL1	BSI BS 3100:1991	419
	AMD 1:1992	
AL2	BSI BS 3100:1991	419
	AMD 1:1992	
AL3	BSI BS 3100:1991	419
	AMD 1:1992	

Steel Grade/Name	Specification	Page No.	Steel Grade/Name	Specification	Page No.
AM1	BSI BS 3100:1991	419	B3, 100CrMnSi6-4	ASTM A 485-00	492
	AMD 1:1992			EN ISO 683-17:1999	492
AM2	BSI BS 3100:1991	419	B3N	ASTM A 757/A 757M-00	391, 392
	AMD 1:1992		B3Q	ASTM A 757/A 757M-00	391, 392
AW1	BSI BS 3100:1991	419	B4	BSI BS 3100:1991	419
	AMD 1:1992			AMD 1:1992	
AW2	BSI BS 3100:1991	419	B-4	ASTM	379, 381
	AMD 1:1992			A 128/A 128M-93 (1998)	
AW3	BSI BS 3100:1991	419	B4, 100CrMnSi6-6	ASTM A 485-00	492
	AMD 1:1992			EN ISO 683-17:1999	492
B	ASTM A 738/A 738M-00	103, 107	B4N	ASTM A 757/A 757M-00	418
	ASTM A 106-99	251, 259	B4Q	ASTM A 757/A 757M-00	418
	ASTM A 135-97	251, 258	B5	BSI BS 3100:1991	419
	ASTM A 139-00	251, 259		AMD 1:1992	
	ASTM	143	B5, 100CrMo7	ASTM A 485-00	492
	A 202/A 202M-93 (1999)			EN ISO 683-17:1999	492
	ASTM A 203/A 203M-97	124	B6	BSI BS 3100:1991	419
	ASTM	112, 114		AMD 1:1992	
	A 204/A 204M-93 (1999)		B6, 100CrMo7-3	ASTM A 485-00	492
	ASTM A 283/A 283M-00	47, 62		EN ISO 683-17:1999	492
	ASTM	143	B7	BSI BS 3100:1991	419
	A 285/A 285M-90 (1996)			AMD 1:1992	
	ASTM A 302/A 302M-97	113, 114	B7, 100CrMo7-4	ASTM A 485-00	492
	ASTM A 500-99	163, 184		EN ISO 683-17:1999	492
	ASTM A 514/A 514M-94	82	B8, 100CrMnMoSi8-4-6	ASTM A 485-00	492
	ASTM	143		EN ISO 683-17:1999	492
	A 517/A 517M-93 (1999)		BL2	BSI BS 3100:1991	419
	ASTM A 588/A 588M-00	69, 73		AMD 1:1992	
	ASTM A 595-98	168, 188	BT1	BSI BS 3100:1991	419
	ASTM A 662/A 662M-99	109, 110		AMD 1:1992	
	ASTM A 668/A 668M-96	314, 318	BT2	BSI BS 3100:1991	419
	ASTM A 678/A 678M-00	60, 67		AMD 1:1992	
	ASTM A 724/A 734 M-99	144	BT3	BSI BS 3100:1991	419
	ASTM	144		AMD 1:1992	
	A 734/A 734 M-87 (1997)		BW 10	BSI BS 3100:1991	379, 381
	ASTM A 737/A 737M-99	102, 106		AMD 1:1992	
B, Cl. 1	ASTM A 841/A 841M-98	109, 110	BW2	BSI BS 3100:1991	419
B, Cl. 2	ASTM A 841/A 841M-98	109, 111		AMD 1:1992	
B, PSL 1 seamless	API 5L-2000	295	BW3	BSI BS 3100:1991	419
B, PSL 1 welded	API 5L-2000	295		AMD 1:1992	
B, PSL 2 seamless	API 5L-2000	301	BW4	BSI BS 3100:1991	419
B, PSL 2 welded	API 5L-2000	301		AMD 1:1992	
B1	BSI BS 3100:1991	383, 384	C	ASTM A 738/A 738M-00	103, 107
	AMD 1:1992			ASTM A 106-99	253, 260
B-1	ASTM	379, 381		ASTM	379, 381
	A 128/A 128M-93 (1998)			A 128/A 128M-93 (1998)	
B1 100Cr6	EN ISO 683-17:1999	492		ASTM A 139-00	251, 259
B2	ASTM A 556/A 556M-96	210, 214,		ASTM	210, 214
	BSI BS 3100:1991	419		A 178/A 178M-95 (2000)	
	AMD 1:1992			ASTM	112, 114
B-2	ASTM	379, 381		A 204/A 204M-93 (1999)	
	A 128/A 128M-93 (1998)			ASTM A 210/A 210M-96	211, 215
B2, 100CrMnSi4-4	ASTM A 485-00	492		ASTM	143
	EN ISO 683-17:1999	492		A 225/A 225M-93 (1999)	
B2N	ASTM	391, 392		ASTM A 283/A 283M-00	50, 64
	A 757/A 757M-00			ASTM	143
B2Q	ASTM	391, 392		A 285/A 285M-90 (1996)	
	A 757/A 757M-00			ASTM A 302/A 302M-97	130
B3	BSI BS 3100:1991	419		ASTM A 500-99	165, 185
	AMD 1:1992			ASTM A 514/A 514M-94	78, 82
B-3	ASTM	379, 381		ASTM	143
	A 128/A 128M-93 (1998)			A 517/A 517M-93 (1999)	

614 Steel Grade/Name Index

Steel Grade/Name	Specification	Page No.	Steel Grade/Name	Specification	Page No.
C (Continued)	ASTM A 588/A 588M-00	69, 73	C12D	EN 10016-2:1994	19
	ASTM A 633/A 633M-00	69, 73	C12D2	EN 10016-4:1994	19
	ASTM A 662/A 662M-99	109, 110	C15D	EN 10016-2:1994	20
	ASTM A 668/A 668M-96	315, 318	C15D2	EN 10016-4:1994	20
	ASTM A 678/A 678M-00	61, 67	C15E	EN 10084:1998	20
	ASTM A 724/A 734 M-99	144	C15R	EN 10084:1998	20
	ASTM A 737/A 737M-99	103, 107	C16E	EN 10084:1998	20
C 10	ISO 683-1:1987	19	C16R	EN 10084:1998	20
C 15 E 4	ISO 683-1:1987	20	C18D	EN 10016-2:1994	20
C 15 M 2	ISO 683-1:1987	20	C18D2	EN 10016-4:1994	20
C 16 E 4	ISO 683-1:1987	20	C1Q	ASTM A 757/A 757M-00	418
C 16 M 2	ISO 683-1:1987	20	C2	ASTM A 556/A 556M-96	211, 215
C 22	DIN 17204:1990	165, 170, 185, 190	C20D	EN 10016-2:1994	21
C 25	ISO 683-1:1987	22	C20D2	EN 10016-4:1994	21
C 25 E 4	ISO 683-1:1987	22	C22	EN 10250-2:1999	314, 318
C 25 M 2	ISO 683-1:1987	22	C23	ASTM A 389/A 389M-93 (1998)	318
C 30	ISO 683-1:1987	22	C23-45A	ISO 4991:1995	375, 376
C 30 E 4	ISO 683-1:1987	22	C23-45B	ISO 4991:1995	375, 376
C 30 M 2	ISO 683-1:1987	22	C23-45BH	ISO 4991:1995	375, 376
C 35	DIN 17204:1990	171, 176, 191, 194	C23-45BL	ISO 4991:1994	377, 378
	ISO 2937:1974	172, 191	C23-45H	ISO 4991:1995	376
	ISO 683-1:1987	23	C24	ASTM A 389/A 389M-93 (1998)	388, 389
C 35 E 4	ISO 683-1:1987	23	C25	EN 10250-2:1999	315, 318
C 35 M 2	ISO 683-1:1987	23	C25E	EN 10250-2:1999	315, 318
C 40	ISO 683-1:1987	24	C26-52	ISO 4991:1994	375
C 40 E 4	ISO 683-1:1987	24		ISO 4991:1995	376
C 40 M 2	ISO 683-1:1987	24	C26-52H	ISO 4991:1994	375
C 45	DIN 17204:1990	175, 178, 194, 195		ISO 4991:1995	376
	ISO 683-1:1987	25	C26-52L	ISO 4991:1994	377, 378
C 45 E 4	ISO 683-1:1987	25	C26D	EN 10016-2:1994	22
C 45 M 2	ISO 683-1:1987	25	C26D2	EN 10016-4:1994	22
C 50	ISO 683-1:1987	26	C28H	ISO 4991:1994	388, 389
C 50 E 4	ISO 683-1:1987	26	C30	EN 10250-2:1999	315, 318
C 50 M 2	ISO 683-1:1987	26	C30E	EN 10083-1:1991	22
C 55	DIN 17204:1990	177, 195	C31L	ISO 4991:1994	420
	ISO 683-1:1987	27	C32D	EN 10016-2:1994	23
C 55 E 4	ISO 683-1:1987	27	C32D2	EN 10016-4:1994	22
C 55 M 2	ISO 683-1:1987	27	C32H	ISO 4991:1994	388, 389
C 60	DIN 17204:1990	178, 195	C33H	ISO 4991:1994	420
	ISO 683-1:1987	27	C34AH	ISO 4991:1994	388, 389
C 60 E 4	ISO 683-1:1987	27	C34BH	ISO 4991:1994	388, 389
C 60 M 2	ISO 683-1:1987	27	C34BL	ISO 4991:1994	420
C, Cl. 1	ASTM A 841/A 841M-98	109, 110	C35	EN 10250-2:1999	316, 318
C, Cl. 2	ASTM A 841/A 841M-98	109, 111	C35BH	ISO 4991:1994	388, 389
C100S	EN 10132-4:2000	481	C35E	EN 10250-2:1999	23, 316, 318
C105U	EN ISO 4957:1999	485	C36D2	EN 10016-4:1994	23
C10D	EN 10016-2:1994	19	C37H	ISO 4991:1994	388, 390
C10D2	EN 10016-4:1994	19	C38D	EN 10016-2:1994	23
C10E	EN 10084:1998	19	C38D2	EN 10016-4:1994	23
C10R	EN 10084:1998	19	C38H	ISO 4991:1994	388, 390
C12	ASTM A 217/A 217M-99	388, 390	C39CH	ISO 4991:1994	402, 403
C120U	EN ISO 4957:1999	485	C39CNiH	ISO 4991:1994	402, 403
C125S	EN 10132-4:2000	494	C39NiH	ISO 4991:1994	402, 403
C12A	ASTM A 217/A 217M-99	418	C39NiL	ISO 4991:1994	402, 403
			C3D2	EN 10016-4:1994	19
			C40	EN 10250-2:1999	316, 318

Steel Grade/Name	Specification	Page No.	Steel Grade/Name	Specification	Page No.
C40D2	EN 10016-4:1994	24	C70U	EN ISO 4957:1999	485
C40E	EN 10083-1:1991	24	C72D	EN 10016-2:1994	28
C40H	ISO 4991:1994	402, 403	C72D2	EN 10016-4:1994	28
C42D	EN 10016-2:1994	24	C75S	EN 10132-4:2000	481
C42D2	EN 10016-4:1994	24	C76D	EN 10016-2:1994	28
C43CL1	ISO 4991:1994	420	C76D2	EN 10016-4:1994	28
C43E2aL	ISO 4991:1994	391, 392	C78D	EN 10016-2:1994	28
C43E2bL	ISO 4991:1994	391, 392	C78D2	EN 10016-4:1994	28
C43L	ISO 4991:1994	391, 392	C7D	EN 10016-2:1994	19
C45	EN 10250-2:1999	316, 318	C80D	EN 10016-2:1994	28
C45E	EN 10250-2:1999	25, 316, 317, 318, 319	C80D2	EN 10016-4:1994	28
C46	ISO 4991:1994	404, 405	C80U	EN ISO 4957:1999	485
C46D2	EN 10016-4:1994	25	C82D	EN 10016-2:1994	28
C47	ISO 4991:1994	404, 405	C82D2	EN 10016-4:1994	28
C47H	ISO 4991:1994	420	C85S	EN 10132-4:2000	481
C47L	ISO 4991:1994	404, 405	C86D	EN 10016-2:1994	29
C48D	EN 10016-2:1994	25	C86D2	EN 10016-4:1994	29
C48D2	EN 10016-4:1994	25	C88D	EN 10016-2:1994	29
C4D	EN 10016-2:1994	19	C88D2	EN 10016-4:1994	29
C5	ASTM A 217/A 217M-99	388, 390	C8D2	EN 10016-4:1994	19
C50	EN 10250-2:1999	317, 319	C90S	EN 10132-4:2000	481
	ISO 4991:1994	404, 405	C90U	EN ISO 4957:1999	485
C50D	EN 10016-2:1994	26	C92D	EN 10016-2:1994	29
C50D2	EN 10016-4:1994	26	C92D2	EN 10016-4:1994	29
C52D	EN 10016-2:1994	26	C98D2	EN 10016-4:1994	29
C52D2	EN 10016-4:1994	26	C9D	EN 10016-2:1994	19
C50E	EN 10083-1:1991	26	CA15	ASTM A 217/A 217M-99	402, 403
C55	EN 10250-2:1999	317, 319		ASTM	402
C55E	EN 10250-2:1999	27, 317, 319		A 487/A 487M-93 (1998)	
C55S	EN 10132-4:2000	481	CA15M	ASTM A 743/A 743M-98	393, 394
C56D	EN 10016-2:1994	27		ASTM	418
C56D2	EN 10016-4:1994	27		A 487/A 487M-93 (1998)	
C56E2	EN ISO 683-17:1999	496	CA-28MWV	ASTM A 743/A 743M-98	393, 394
C57	ISO 4991:1994	404, 405	CA-40	ASTM A 743/A 743M-98	393, 394, 418
C58D	EN 10016-2:1994	27	CA-40F	ASTM A 743/A 743M-98	418
C58D2	EN 10016-4:1994	27	CA6N	ASTM A 743/A 743M-98	418
C5D2	EN 10016-4:1994	19	CA6NM	ASTM	402, 403
C60	ISO 4991:1994	58, 358, 404, 405		A 352/A 352M-93 (1998)	
C60D	EN 10016-2:1994	27		ASTM	402
C60D2	EN 10016-4:1994	27		A 487/A 487M-93 (1998)	
C60E	EN 10250-2:1999	27, 358	Carbon, 430 LT	ASTM A 743/A 743M-98	393, 395
C60H	ISO 4991:1994	420	CB-30	BSI BS 3603:1991	239, 240
C60Nb	ISO 4991:1994	404, 405	CB-6	ASTM A 743/A 743M-98	418
C60S	EN 10132-4:2000	405	CC-50	ASTM A 743/A 743M-98	418
C61	ISO 4991:1994	404, 405	CD3MWCuN	ASTM	418
C61LC	ISO 4991:1994	404		A 351/A 351M-94 (1999)	
C62D	EN 10016-2:1994	28	CD-4MCu	ASTM A 351/A 351M-00	404, 405
C62D2	EN 10016-4:1994	28	CE20N	ASTM	418
C66D	EN 10016-2:1994	28		A 351/A 351M-94 (1999)	
C66D2	EN 10016-4:1994	28	CE-30	ASTM A 743/A 743M-98	418
C67S	EN 10132-4:2000	481	CE8MN	ASTM	418
C68D	EN 10016-2:1994	28		A 351/A 351M-94 (1999)	
C68D2	EN 10016-4:1994	28	CEW 1	BSI BS 6323-6:1982	156, 160,
C70D	EN 10016-2:1994	28		AMD 2:1989	163, 179, 182, 184
C70D2	EN 10016-4:1994	28			

616 Steel Grade/Name Index

Steel Grade/Name	Specification	Page No.	Steel Grade/Name	Specification	Page No.
CEW 2	BSI BS 6323-6:1982 AMD 2:1989	157, 158, 161, 165, 180, 183, 185	CFS 4	BSI BS 6323-4:1982 AMD 2:1989	163, 164, 167, 171, 184, 187, 191
CEW 3	BSI BS 6323-6:1982 AMD 2:1989	158, 160, 163, 167, 181, 182, 184, 187	CFS 5	BSI BS 6323-4:1982 AMD 2:1989	169, 173, 175, 188, 192, 194
CEW 4	BSI BS 6323-6:1982 AMD 2:1989	163, 164, 167, 172, 184, 187, 191	CFS 6	BSI BS 6323-4:1982 AMD 2:1989	166, 167, 172, 174, 186, 187, 191, 193
CEW 5	BSI BS 6323-6:1982 AMD 2:1989	169, 173, 175, 188, 192, 194	CFS 7	BSI BS 6323-4:1982 AMD 2:1989	177, 178, 195
CEW C3	BSI BS 1717:1983	160, 167, 182, 187	CFS 8	BSI BS 6323-4:1982 AMD 2:1989	170, 172, 177, 178, 190, 191, 195
CF10	ASTM A 351/A 351M-94 (1999)	418	CFS 9	BSI BS 6323-4:1982 AMD 2:1989	196, 197
CF10M	ASTM A 351/A 351M-94 (1999)	418	CFS C3	BSI BS 1717:1983	160, 167, 182
CF10MC	ASTM A 351/A 351M-94 (1999)	418	CFS C4	BSI BS 1717:1983	164, 171, 185, 191
CF10SMnN	ASTM A 351/A 351M-94 (1999)	418	CFS C6	BSI BS 1717:1983	196, 197
CF16F	ASTM A 743/A 743M-98	418	CG-12	ASTM A 743/A 743M-98	418
CF16Fa	ASTM A 743/A 743M-98	418	CG3M	ASTM A 351/A 351M-00	418
CF-20	ASTM A 743/A 743M-98	396		ASTM A 743/A 743M-98	398, 401
CF-3	ASTM A 351/A 351M-00	404, 405		ASTM A 744/A 744M-00	398, 401
	ASTM A 743/A 743M-98	396, 399	CG6MMN	ASTM A 351/A 351M-94 (1999)	418
	ASTM A 744/A 744M-00	396, 399		ASTM A 743/A 743M-98	418
CF-3A	ASTM A 351/A 351M-00	404	CG8M	ASTM A 351/A 351M-00	418
CF-3M	ASTM A 351/A 351M-00	404, 405		ASTM A 743/A 743M-98	397, 400
	ASTM A 743/A 743M-98	397, 400		ASTM A 744/A 744M-00	397, 400
	ASTM A 744/A 744M-00	397, 400	CH10	ASTM A 351/A 351M-94 (1999)	418
CF-3MA	ASTM A 351/A 351M-00	404		ASTM A 743/A 743M-98	418
CF3-MN	ASTM A 351/A 351M-00	400, 418	CH-20	ASTM A 351/A 351M-00	418
	ASTM A 743/A 743M-98	397, 400, 418		ASTM A 743/A 743M-98	398, 401
CF-8	ASTM A 351/A 351M-00	404, 405	CH8	ASTM A 351/A 351M-94 (1999)	418
	ASTM A 743/A 743M-98	396	CK-20	ASTM A 351/A 351M-00	418
	ASTM A 744/A 744M-00	396, 399	Ck 22	DIN 17204:1990	165, 170, 185, 190
CF-8A	ASTM A 351/A 351M-00	404	Ck 35	DIN 17204:1990	171, 176, 191, 194
CF8C	ASTM A 351/A 351M-00	404, 405	Ck 45	DIN 17204:1990	175, 178, 194, 195
	ASTM A 743/A 743M-98	396, 399	Ck 55	DIN 17204:1990	177, 195
	ASTM A 744/A 744M-00	396, 399	Ck 60	DIN 17204:1990	178, 195
CF8M	ASTM A 351/A 351M-00	404, 405	CK-35MN	ASTM A 743/A 743M-98	418
	ASTM A 743/A 743M-98	397, 400	CK-3MCuN	ASTM A 351/A 351M-94 (1999)	418
	ASTM A 744/A 744M-00	397, 400		ASTM A 744/A 744M-00	398, 401
CFS 10	BSI BS 6323-4:1982 AMD 2:1989	196, 197		ASTM A 743/A 743M-98	398, 401
CFS 11	BSI BS 6323-4:1982 AMD 2:1989	196, 198	Cl. 1	ASTM A 782/A 782M-90 (1996)	144
CFS 3	BSI BS 6323-4:1982 AMD 2:1989	158, 160, 163, 167, 181, 182, 184, 187	Cl. 2	ASTM A 782/A 782M-90 (1996)	144
CFS 3A	BSI BS 6323-4:1982 AMD 2:1989	158, 160, 163, 167, 181, 182, 184, 187	Cl. 3	ASTM A 782/A 782M-90 (1996)	144
			Cm 22	DIN 17204:1990	165, 170, 185, 190

Steel Grade/Name	Specification	Page No.	Steel Grade/Name	Specification	Page No.
Cm 35	DIN 17204:1990	171, 176, 191, 194	E 235 D	ISO 630:1995	47, 62
Cm 45	DIN 17204:1990	175, 178, 194, 195	E 275 A	ISO 630:1995	52, 65
Cm 55	DIN 17204:1990	177, 195	E 275 B	ISO 630:1995	52, 65
Cm 60	DIN 17204:1990	178, 195	E 275 C	ISO 630:1995	52, 65
CN-3M	ASTM A 743/A 743M-98	398, 401	E 275 D	ISO 630:1995	52, 65
CN3MN	ASTM A 351/A 351M-94 (1999)	418	E 355 C	ISO 630:1995	56, 66
	ASTM A 743/A 743M-98	398, 401	E 355 D	ISO 630:1995	57, 66
	ASTM A 744/A 744M-00	398, 401	E 355 DD	ISO 4950-2:1995	75, 80
CN7M	ASTM A 351/A 351M-00	404, 405	E 355 E	ISO 4950-2:1995	75, 80
	ASTM A 743/A 743M-98	398, 401	E 460 DD	ISO 4950-3:1995	76, 80
	ASTM A 744/A 744M-00	398, 401	E 460 E	ISO 4950-3:1995	76, 80
CN7MS	ASTM A 743/A 743M-98	418	E Gr. A	ASTM A 53/A 53M-99	247, 256
	ASTM A 744/A 744M-98	418	E Gr. B	ASTM A 53/A 53M-99	251, 259
CT15C	ASTM A 351/A 351M-94 (1999)	418	E-1	ASTM A 128/A 128M-93 (1998)	379, 387
D	ASTM A 128/A 128M-93 (1998)	379, 381	E1Q	ASTM A 757/A 757M-00	418
	ASTM A 139-00	251, 259	E-2	ASTM A 128/A 128M-93 (1998)	380, 382
	ASTM A 178/A 178M-95 (2000)	211, 215	E295	EN 10025:1993	66
	ASTM A 203/A 203M-97	125, 126	E3310	ASTM A 519-96	305
	ASTM A 225/A 225M-93 (1999)	143	E335	EN 10025:1993	61, 67
	ASTM A 283/A 283M-00	52, 65	E360	EN 10025:1993	61, 67
	ASTM A 302/A 302M-97	131	E3N	ASTM A 757/A 757M-00	391, 392, 402, 403
	ASTM A 500-99	163, 184	E4337	ASTM A 519-96	305
	ASTM A 633/A 633M-00	69, 73	E4340	ASTM A 29/A 29M-99	35
	ASTM A 678/A 678M-00	93		ASTM A 322-91 (1996)	35
	ASTM A 668/A 668M-96	316, 318		ASTM A 519-96	305
D1N1	ASTM A 757/A 757M-00	418	E50100	SAE J404 APR94	35
D1N2	ASTM A 757/A 757M-00	418	E51100	ASTM A 519-96	305
D1N3	ASTM A 757/A 757M-00	418	E52100	ASTM A 519-96	305
D1Q1	ASTM A 757/A 757M-00	418	E7140	ASTM A 519-96	305
D1Q2	ASTM A 757/A 757M-00	418	E9310	ASTM A 29/A 29M-99	35
D1Q3	ASTM A 757/A 757M-00	418		ASTM A 519-96	305
D2	ASTM A 681-94 (1999)	489	ERW 1	BSI BS 6323-5:1982	156, 157, 179, 180
	SAE J438-1970	489	ERW 2	AMD 2:1989	157, 158, 159, 180
D3	ASTM A 681-94 (1999)	489	ERW 3	BSI BS 6323-5: 1982	158, 160, 163, 181, 182, 184
	SAE J438-1970	489		AMD 2:1989	167, 184, 187
D4	ASTM A 681-94 (1999)	495	ERW 4	BSI BS 6323-5: 1982	163, 164, 167, 184, 187
D5	ASTM A 681-94 (1999)	495		AMD 2:1989	169, 170, 188, 190
	SAE J438-1970	495	ERW 5	BSI BS 1717:1983	156, 157, 179, 180
D7	ASTM A 681-94 (1999)	495	ERW C1	BSI BS 1717:1983	157, 158, 180, 181
	SAE J438-1970	495	ERW C2	BSI BS 1717:1983	158, 160, 163, 181, 182, 184
E	ASTM A 139-00	253, 260	ERW C3	BSI BS 1717:1983	161, 165, 183, 186
	ASTM A 203/A 203M-97	125, 126		BSI BS 1717:1983	288, 291
	ASTM A 514/A 514M-94	78, 82	ERW C5	DIN 17178:1986	288, 291
	ASTM A 517/A 517M-93 (1999)	143		DIN 17179:1986	288, 291
	ASTM A 633/A 633M-00	70, 74	ERW C5	DIN 17178:1986	288, 291
	ASTM A 668/A 668M-96	316, 318		DIN 17179:1986	288, 291
E 185	ISO 630:1995	45, 62	ESiE 255		
E 235 A	ISO 630:1995	46, 62	ESiE 285		
E 235 B	ISO 630:1995	46, 62			
E 235 C	ISO 630:1995	46, 62			

618 Steel Grade/Name Index

Steel Grade/Name	Specification	Page No.	Steel Grade/Name	Specification	Page No.
ESiE 355	DIN 17178:1986	289, 291	F 317L	ASTM A 182/A 182M-00	349, 353
	DIN 17179:1986	289, 291	F 321	ASTM A 182/A 182M-00	349, 354
EstE 420	DIN 17178:1986	289, 291	F 321H	ASTM A 182/A 182M-00	349, 354
	DIN 17179:1986	289, 291	F 347	ASTM A 182/A 182M-00	354
ESiE 460	DIN 17178:1986	290, 292	F 347H	ASTM A 182/A 182M-00	349, 354
	DIN 17179:1986	290, 292	F 348	ASTM A 182/A 182M-00	361
F	ASTM	380, 382	F 348H	ASTM A 182/A 182M-00	361
	A 128/A 128M-93 (1998)		F 3V	ASTM A 182/A 182M-00	334, 335
	ASTM A 203/A 203M-97	125, 126		ASTM A 336/A 336M-99	334, 335
	ASTM A 514/A 514M-94	78, 82	F 3VCb	ASTM A 182/A 182M-98	360
	ASTM	143		ASTM A 336/A 336M-99	360
	A 517/A 517M-93 (1999)		F 429	ASTM A 182/A 182M-00	361
	ASTM A 668/A 668M-96	317, 319	F 44	ASTM A 182/A 182M-00	361
F 1	ASTM A 182/A 182M-00	328	F 45	ASTM A 182/A 182M-00	361
	ASTM A 336/A 336M-99	328	F 46	ASTM A 182/A 182M-00	361
	ASTM A 681-94 (1999)		F 47	ASTM A 182/A 182M-00	361
F 10	ASTM A 182/A 182M-00	361	F 48	ASTM A 182/A 182M-00	361
F 11, CI 1	ASTM A 182/A 182M-98	360	F 49	ASTM A 182/A 182M-00	361
	ASTM A 336/A 336M-99	360	F 5	ASTM A 182/A 182M-00	336
F 11, CI 2	ASTM A 182/A 182M-00	331		ASTM A 336/A 336M-99	336
	ASTM A 336/A 336M-99		F 50	ASTM A 182/A 182M-00	356, 357
F 11, CI 3	ASTM A 336/A 336M-99	331	F 51	ASTM A 182/A 182M-00	356, 357
F 12	ASTM A 336/A 336M-99	330	F 52	ASTM A 182/A 182M-00	361
F 12, CI 1	ASTM A 182/A 182M-98	360	F 53	ASTM A 182/A 182M-00	356, 357
F 12, CI 2	ASTM A 182/A 182M-00	330	F 54	ASTM A 182/A 182M-00	361
F 122	ASTM A 182/A 182M-00	361	F 55	ASTM A 182/A 182M-00	356, 357
F 2	ASTM A 182/A 182M-00	329	F 56	ASTM A 182/A 182M-00	361
	ASTM A 681-94 (1999)		F 57	ASTM A 182/A 182M-00	361
F 20	ASTM A 182/A 182M-00	361	F 58	ASTM A 182/A 182M-00	361
F 21	ASTM A 182/A 182M-00	334, 335	F 59	ASTM A 182/A 182M-00	356, 357
F 21, CI 1	ASTM A 336/A 336M-99	334, 335	F 5A	ASTM A 182/A 182M-00	336
F 21, CI 3	ASTM A 336/A 336M-99	334, 335		ASTM A 336/A 336M-99	336
F 22, CI 1	ASTM A 182/A 182M-00	332, 333	F 6	ASTM A 336/A 336M-99	360
	ASTM A 336/A 336M-99	332, 333	F 60	ASTM A 182/A 182M-00	356, 357
F 22, CI 3	ASTM A 182/A 182M-00	332, 333	F 61	ASTM A 182/A 182M-00	361
	ASTM A 336/A 336M-99	332, 333	F 62	ASTM A 182/A 182M-00	361
F 22V	ASTM A 182/A 182M-00	332, 333	F 6a CI 1	ASTM A 182/A 182M-00	344, 345
	ASTM A 336/A 336M-99	332, 333	F 6a CI 2	ASTM A 182/A 182M-00	344, 345
F 23	ASTM A 182/A 182M-98	360	F 6a CI 3	ASTM A 182/A 182M-00	344, 345
F 24	ASTM A 182/A 182M-98	360	F 6a CI 4	ASTM A 182/A 182M-00	344, 345
F 304	ASTM A 182/A 182M-00	347, 350	F 6b	ASTM A 182/A 182M-00	344, 345
F 304H	ASTM A 182/A 182M-00	347, 350	F 6NM	ASTM A 182/A 182M-00	344, 345
F 304L	ASTM A 182/A 182M-00	347, 350	F 9	ASTM A 182/A 182M-00	337
F 304LN	ASTM A 182/A 182M-00	351		ASTM A 336/A 336M-99	337
F 304N	ASTM A 182/A 182M-00	347, 351	F 91	ASTM A 182/A 182M-98	360
F 309H	ASTM A 182/A 182M-00	361		ASTM A 336/A 336M-99	360
F 310	ASTM A 182/A 182M-00	351	F 911	ASTM A 182/A 182M-98	360
F 310H	ASTM A 182/A 182M-00	347, 351		ASTM A 336/A 336M-99	360
F 310MoLN	ASTM A 182/A 182M-00	361	F 92	ASTM A 182/A 182M-98	360
F 316	ASTM A 182/A 182M-00	347, 348, 351	F Gr. A	ASTM A 53/A 53M-99	247, 256
F 316H	ASTM A 182/A 182M-00	347, 348, 353	F XM-11	ASTM A 182/A 182M-00	361
F 316L	ASTM A 182/A 182M-00	347, 348, 352	F XM-19	ASTM A 182/A 182M-00	361
F 316LN	ASTM A 182/A 182M-00	353	F XM-27Cb	ASTM A 182/A 182M-00	361
F 316N	ASTM A 182/A 182M-00	347, 348, 353	FR	ASTM A 182/A 182M-98	360
F 317	ASTM A 182/A 182M-00	349, 353	G (GH)	ASTM A 668/A 668M-96	359
			G10MnMoV6	AFNOR	419
				NF A 32-054:1994	

Steel Grade/Name	Specification	Page No.	Steel Grade/Name	Specification	Page No.
G12MoCrV5-2	EN 10213-2:1996	419	Gr. 100 [690] & 100W [690W] Type J	ASTM A 709/A 709M-00	83
G15CrMoV6	AFNOR	419	Gr. 100 [690] & 100W [690W] Type M	ASTM A 709/A 709M-00	83
G16Mn5	AFNOR	367, 371	Gr. 100 [690] & 100W [690W] Type P	ASTM A 709/A 709M-00	83
G17CrMo5-5	NF A 32-054:1994	388, 389	Gr. 100 [690] & 100W [690W] Type Q	ASTM A 709/A 709M-00	83
G17CrMo9-10	EN 10213-2:1996	388, 389	Gr. 11, Cl. 1	ASTM A 387/A 387M-99	117
G17CrMoV5-10	EN 10213-2:1996	388, 389	Gr. 11, Cl. 2	ASTM A 387/A 387M-99	117
G17Mn5	EN 10213-3:1996	377, 378	Gr. 12, Cl. 1	ASTM A 387/A 387M-99	116
G17NiCrMo13-6	EN 10213-3:1996	391, 392	Gr. 12, Cl. 2	ASTM A 387/A 387M-99	116
G18Mo5	EN 10213-3:1996	391, 392	Gr. 2, Cl. 1	ASTM A 387/A 387M-99	115
G20Mn5	EN 10213-3:1996	377, 378	Gr. 2, Cl. 2	ASTM A 387/A 387M-99	115
G20Mn6	AFNOR	368, 372	Gr. 21 L, Cl. 1	ASTM A 387/A 387M-99	118, 120
G20Mo5	NF A 32-054:1994	388, 389	Gr. 21, Cl. 1	ASTM A 387/A 387M-99	118, 120
G20NiCrMo12	EN 10213-2:1996	419	Gr. 21, Cl. 2	ASTM A 387/A 387M-99	118, 120
G25CrMo4	AFNOR	383, 384	Gr. 22 L, Cl. 1	ASTM A 387/A 387M-99	119
G30Mn6	NF A 32-054:1994	369, 370, 373	Gr. 22, Cl. 1	ASTM A 387/A 387M-99	119
G30NiCrMo14	AFNOR	419	Gr. 22, Cl. 2	ASTM A 387/A 387M-99	119
G30NiCrMo8	NF A 32-054:1994	383, 387	Gr. 36 Type 1	ASTM A 570/A 570M-98	49, 63
G35CrMo4	AFNOR	385	Gr. 36 Type 2	ASTM A 570/A 570M-98	50, 64
G35NiCrMo6	NF A 32-054:1994	419	Gr. 5, Cl. 1	ASTM A 387/A 387M-99	121
G42CrMo4	AFNOR	386	Gr. 5, Cl. 2	ASTM A 387/A 387M-99	121
G9Ni10	NF A 32-054:1994	391, 392	Gr. 60 Type I	ASTM A 871/A 871M-97	92
G9Ni14	EN 10213-3:1996	391, 392	Gr. 60 Type II	ASTM A 871/A 871M-97	92
G-CoCr 28	DIN 17465:1993	411, 417	Gr. 60 Type III	ASTM A 871/A 871M-97	92
GE 230	AFNOR	371	Gr. 60 Type IV	ASTM A 871/A 871M-97	92
GE 280	NF A 32-054:1994	372	Gr. 65 Type I	ASTM A 871/A 871M-97	92
GE320	AFNOR	369, 373	Gr. 65 Type II	ASTM A 871/A 871M-97	92
GE370	NF A 32-054:1994	370, 374	Gr. 65 Type III	ASTM A 871/A 871M-97	92
G-NiCr 26 W	AFNOR	370, 374	Gr. 65 Type IV	ASTM A 871/A 871M-97	92
GP240GH	NF A 32-054:1994	411, 417	Gr. 9, Cl. 1	ASTM A 387/A 387M-99	143
GP240GP	DIN 17465:1993	411, 417	Gr. 9, Cl. 2	ASTM A 387/A 387M-99	143
GP280GH	EN 10213-2:1996	375, 376	Gr. 91, Cl. 2	ASTM A 387/A 387M-99	143
Gr. 100 [690] & 100W [690W] Type A	EN 10213-2:1996	376	Gr. 911, Cl. 2	ASTM A 387/A 387M-99	143
Gr. 100 [690] & 100W [690W] Type B	EN 10213-2:1996	375, 376	Gr. A, Cl. 1	ASTM	144
Gr. 100 [690] & 100W [690W] Type C	ASTM A 709/A 709M-00	82	Gr. A, Cl. 2	A 736/A 736M-88 (1994)	144
Gr. 100 [690] & 100W [690W] Type E	ASTM A 709/A 709M-00	82	Gr. A, Cl. 3	A 736/A 736M-88 (1994)	144
Gr. 100 [690] & 100W [690W] Type F	ASTM A 709/A 709M-00	83	Gr. A Cl. 1	ASTM A 710/A 710M-95	77, 81
Gr. 100 [690] & 100W [690W] Type H	ASTM A 709/A 709M-00	83	Gr. A Cl. 2	ASTM A 710/A 710M-95	75, 80
			Gr. A Cl. 3	ASTM A 710/A 710M-95	76, 80
			Gr. A, Cl. 1, 2, 3, 4, 4a	ASTM A 542/A 542M-99	143
			Gr. B, Cl. 1, 2, 3	ASTM	143
			Gr. B, Cl. 1, 2, 3, 4, 4a	A 543/A 543M-93 (1999)	143
			Gr. C, Cl. 1, 3	ASTM A 542/A 542M-99	143
			Gr. C, Cl. 1, 2, 3	ASTM	144
			Gr. C, Cl. 1, 2, 3, 4, 4a	A 736/A 736M-88 (1994)	143
				ASTM	143
				A 543/A 543M-93 (1999)	143
				ASTM A 542/A 542M-99	143

620 Steel Grade/Name Index

Steel Grade/Name	Specification	Page No.	Steel Grade/Name	Specification	Page No.
Gr. D, Cl. 1, 2, 3, 4, 4a	ASTM A 542/A 542M-99	143	GX 8 CrNiMo 12 1	ISO 11972:1998	393, 394
Gr. D, Cl.1, 2, 3	ASTM A 533/A 533M-93 (1999)	143	GX100Mn13	ISO 13521:1999	397, 381
Gr. E, Cl. 4, 4a	ASTM A 542/A 542M-99	143	GX10NiCrNb31-20	ISO 11973:1999	420
Gr. Fe 235 W Quality B	ISO 4952:1981	84, 90	GX10NiCrNb50-50	ISO 11973:1999	410, 416
Gr. Fe 235 W Quality C	ISO 4952:1981	84, 90	GX110MnMo13-1	ISO 13521:1999	379, 381
Gr. Fe 235 W Quality D	ISO 4952:1981	84, 90	GX120Mn13	ISO 13521:1999	379, 381
Gr. Fe 355 W Quality 2B	ISO 4952:1981	86, 91	GX120Mn17	ISO 13521:1999	420
Gr. Fe 355 W Quality 2C	ISO 4952:1981	86, 91	GX120MnCr13-2	ISO 13521:1999	379, 381
Gr. Fe 355 W Quality 2D	ISO 4952:1981	86, 91	GX120MnCr7-2	ISO 13521:1999	380, 382
Gr. Fe 355 W Quality 1A	ISO 4952:1981	86, 91	GX120MnMo7-1	ISO 13521:1999	380, 382
Gr. Fe 355 W Quality 1D	ISO 4952:1981	86, 91	GX120MnNi13-3	ISO 13521:1999	379, 381
Gr. HSA 235W Class B	ISO 5952:1998	84, 90	GX12Cr12	EN 10283:1999	393, 394
Gr. HSA 235W Class D	ISO 5952:1998	84, 90	GX130CrSi29	DIN 17465:1993	406, 412
Gr. HSA 365W Class B	ISO 5952:1998	87, 91		ISO 11973:1999	406, 412
Gr. HSA 365W Class D	ISO 5952:1998	87, 91	GX15CrMo5	EN 10213-2:1996	388, 390
Grade 2	ASTM A 485-00	496	GX23CrMoV12-1	EN 10213-2:1996	402, 403
Grade 3	ASTM A 485-00	496	GX25CrNiSi18-9	DIN 17465:1993	407, 413
Grade 4	ASTM A 485-00	496		ISO 11973:1999	407, 413
GS-25 CrMo 4	DIN 17205:1992	383, 384	GX25CrNiSi20-14	DIN 17465:1993	407, 413
GS-25 CrNiMo 4	DIN 17205:1992	419		ISO 11973:1999	407, 413
GS-30 CrMoV 6 4	DIN 17205:1992	419	GX2CrNi19-11	EN 10283:1999	396, 399
GS-30 CrNiMo 8 5	DIN 17205:1992	419		EN 10213-4:1996	404, 405
GS-30 Mn 5	DIN 17205:1992	368, 372	GX2CrNiCuMoN25-6-3-3	EN 10213-4:1996	404, 405
GS-33 CrNiMo 7 4 4	DIN 17205:1992	383, 387	GX2CrNiMo19-11-2	EN 10213-4:1996	404, 405
GS-34 CrMo 4	DIN 17205:1992	383, 385		EN 10283	397, 400
GS-34 CrNiMo 6	DIN 17205:1992	419		EN 10283:1999	419
GS-35 CrMoV 10 4	DIN 17205:1992	419	GX2CrNiMoCuN20-18-6	EN 10283:1999	398, 401
GS-38	DIN 1681:1985	367, 371	GX2CrNiMoCuN25-6-3-3	EN 10283:1999	419
GS-42 CrMo 4	DIN 17205:1992	383, 386	GX2CrNiMoCuN29-25-5	EN 10283:1999	419
GS-45	DIN 1681:1985	367, 371	GX2CrNiMoN17-13-4	EN 10283:1999	397, 400
GS-52	DIN 1681:1985	368, 372	GX2CrNiMoN22-5-3	EN 10283:1999	419
GS-80	DIN 1681:1985	373	GX2CrNiMoN25-6-3	EN 10283:1999	419
GX 12 Cr 12	ISO 11972:1998	393, 394	GX2CrNiMoN25-7-3	EN 10283:1999	419
GX 2 CrNi 18 10	ISO 11972:1998	396, 399	GX2CrNiMoN26 5 3	EN 10213-4:1996	419
GX 2 CrNiCuMoN 26 5 3 3	ISO 11972:1998	398, 401	GX2CrNiMoN26-7-4	EN 10213-4:1996	419
GX 2 CrNiMo 19 11 2	ISO 11972:1998	397, 400		EN 10283:1999	419
GX 2 CrNiMo 19 11 3	ISO 11972:1998	398, 401	GX2NiCrMo28-20-2	EN 10213-4:1996	404, 405
GX 2 CrNiMoN 19 11 2	ISO 11972:1998	397, 400		EN 10283:1999	398, 401
GX 2 CrNiMoN 19 11 3	ISO 11972:1998	397, 400	GX2NiCrMoCu25-20-5	EN 10283:1999	419
GX 2 CrNiMoN 26 5 3	ISO 11972:1998	398, 401	GX2NiCrMoCuN25-20-6	EN 10283:1999	398, 401
GX 2 CrNiN 18 10	ISO 11972:1998	420	GX2NiCrMoN25-20-5	EN 10283:1999	398, 401
GX 4 CrNiMo 16 5 1	ISO 11972:1998	393, 395	GX30CoCr50-28	ISO 11973:1999	411, 417
GX 4CrNi 12 4	ISO 11972:1998	393, 394	GX30CrNiSiNb24-24	DIN 17465:1993	409, 415
GX 5 CrNi 19 9	ISO 11972:1998	396, 399	GX30CrSi5	DIN 17465:1993	406, 412
GX 5 CrNiMo 19 11 2	ISO 11972:1998	397, 400	GX30CrSi7	ISO 11973:1999	406, 412
GX 5 CrNiMo 19 11 3	ISO 11972:1998	397, 400	GX3CrNi13-4	EN 10213-3:1996	402, 403
GX 6 CrNiMoNb 19 11 2	ISO 11972:1998	397, 400	GX40CrNiSi22-10	ISO 11973:1999	407, 413
GX 6 CrNiNb 19 10	ISO 11972:1998	396, 399	GX40CrNiSi22-9	DIN 17465:1993	407, 413
			GX40CrNiSi25-12	DIN 17465:1993	414, 408
				ISO 11973:1999	414, 408
			GX40CrNiSi25-20	DIN 17465:1993	409, 415
				ISO 11973:1999	409, 415
			GX40CrNiSi27-4	DIN 17465:1993	406, 412
				ISO 11973:1999	406, 412
			GX40CrNiSiNb24-24	ISO 11973:1999	409, 415
			GX40CrSi13	DIN 17465:1993	406, 412
				ISO 11973:1999	406, 412

Steel Grade/Name	Specification	Page No.	Steel Grade/Name	Specification	Page No.
GX40CrSi17	DIN 17465:1993	406, 412	H21	ASTM A 681-94 (1999)	490
	ISO 11973:1999	406, 412		SAE J438-1970	490
GX40CrSi23	DIN 17465:1993	406, 412	H22	ASTM A 681-94 (1999)	495
GX40CrSi24	ISO 11973:1999	406, 412	H23	ASTM A 681-94 (1999)	495
GX40CrSi28	ISO 11973:1999	406, 412	H24	ASTM A 681-94 (1999)	495
GX40CrSi29	DIN 17465:1993	406, 412	H25	ASTM A 681-94 (1999)	495
GX40NiCrCo20-20-20	ISO 11973:1999	411, 417	H26	ASTM A 681-94 (1999)	495
GX40NiCrSi35-17	ISO 11973:1999	410, 416	H41	ASTM A 681-94 (1999)	495
GX40NiCrSi35-25	DIN 17465:1993	409, 415	H42	ASTM A 681-94 (1999)	495
GX40NiCrSi35-26	ISO 11973:1999	409, 415	H43	ASTM A 681-94 (1999)	495
GX40NiCrSi38-18	DIN 17465:1993	410, 416	HC	ASTM	406, 412
GX40NiCrSi38-19	ISO 11973:1999	410, 416		A 297/A 297M-97 (1998)	
GX40NiCrSiNb35-25	DIN 17465:1993	409, 415	HC30	ASTM A 608-91 (1998)	406, 412
GX40NiCrSiNb35-26	ISO 11973:1999	409, 415	HD	ASTM	406, 412
GX40NiCrSiNb38-18	DIN 17465:1993	410, 416		A 297/A 297M-97 (1998)	
GX40NiCrSiNb38-19	ISO 11973:1999	410, 416	HD50	ASTM A 608-91 (1998)	406, 412
GX45NiCrCoW35-25-15-5	ISO 11973:1999	420	HE	ASTM	407, 413
GX45NiCrWSi48-28-5	ISO 11973:1999	411, 417		A 297/A 297M-97 (1998)	
GX4CrNi13-4	AFNOR	393, 394	HE35	ASTM A 608-91 (1998)	407, 413
	NF A 32-054:1994		HF	ASTM	407, 413
	EN 10213-2:1996	402, 403		A 297/A 297M-97 (1998)	
	EN 10283:1999	393, 394	HF 30	ASTM A 608-91 (1998)	407, 413
GX4CrNi16-4	AFNOR	393, 395	HFS 3	BSI BS 6323-3:1982	160, 182
	NF A 32-054:1994			AMD 2:1989	
GX4CrNiMo16-5-1	EN 10213-2:1996	419	HFS 4	BSI BS 6323-3:1982	164, 185
	EN 10283:1999	393, 395		AMD 2:1989	
GX4CrNiMo16-5-2	EN 10283:1999	419	HFS 5	BSI BS 6323-3:1982	169, 189
GX4NiCrCuMo30-20-4	EN 10283:1999	398, 401		AMD 2:1989	
GX50NiCr52-19	ISO 11973:1999	420	HFS 8	BSI BS 1717:1983	172, 191
GX50NiCr65-15	ISO 11973:1999	411, 417	HFV 2	BSI BS 6323-2:1982	157, 180
GX5CrNi19-10	EN 10213-4:1996	404, 405		AMD 2:1989	
	EN 10283:1999	396, 399	HFV 3	BSI BS 6323-2:1982	160, 182
GX5CrNiCu16-4	EN 10283:1999	419	HFV 4	BSI BS 6323-3:1982	164, 185
GX5CrNiMo19-11-2	EN 10213-4:1996	404, 405		AMD 2:1989	
	EN 10283:1999	397, 400	HFV 5	BSI BS 6323-2:1982	169, 189
GX5CrNiMo19-11-3	EN 10283:1999	397, 400		AMD 2:1989	
GX5CrNiMoNb19-11-2	EN 10213-4:1996	404, 405	HH	ASTM	408, 414
	EN 10283:1999	397, 400		A 297/A 297M-97 (1998)	
GX5CrNiNb19-11	EN 10213-4:1996	404, 405	HH30	ASTM A 608-91 (1998)	408, 414
	EN 10283:1999	396, 399	HH33	ASTM A 608-91 (1998)	408, 414
GX6CrNiN26-7	EN 10283:1999	419	HI	ASTM	408, 414
GX7CrNiMo12-1	EN 10283:1999	393, 394		A 297/A 297M-97 (1998)	
GX8CrNi12	EN 10213-2:1996	402, 403	HI35	ASTM A 608-91 (1998)	408, 414
GX90MnMo14	ISO 13521:1999	380, 382	HK	ASTM	408, 414
H	ASTM A 514/A 514M-94	78, 82		A 297/A 297M-97 (1998)	
	ASTM	143	HK30	ASTM A 351/A 351M-00	408, 414
	A 517/A 517M-93 (1999)			ASTM A 608-91 (1998)	408, 414
H (HH)	ASTM A 668/A 668M-96	359	HK40	ASTM A 351/A 351M-00	409, 415
H10	ASTM A 681-94 (1999)	490		ASTM A 608-91 (1998)	409, 415
H11	ASTM A 681-94 (1999)	490	HL	ASTM	409, 415
	SAE J438-1970			A 297/A 297M-97 (1998)	
H12	ASTM A 681-94 (1999)	490	HL30	ASTM A 608-91 (1998)	409, 415
	SAE J438-1970		HL40	ASTM A 608-91 (1998)	409, 415
H13	ASTM A 681-94 (1999)	490	HN	ASTM	409, 415
	SAE J438-1970			A 297/A 297M-97 (1998)	
H14	ASTM A 681-94 (1999)	495	HN40	ASTM A 608-91 (1998)	409, 415
H19	ASTM A 681-94 (1999)	490	HP	ASTM	409, 415
				A 297/A 297M-97 (1998)	
			HPS 70W [HPS 485W]	ASTM A 709/A 709M-00	76, 80
			HS 18-0-1	EN ISO 4957:1999	486
			HS0-4-1	EN ISO 4957:2000	495

622 Steel Grade/Name Index

Steel Grade/Name	Specification	Page No.	Steel Grade/Name	Specification	Page No.
HS10-4-3-10	EN ISO 4957:1999	488	L245NB	EN 10208-2:1996	298, 301
HS1-4-2	EN ISO 4957:2000	495	seamless and welded	ISO 3183-2:1996	298, 301
HS1-8-1	EN ISO 4957:2000	495	L290 S/CE	ISO 3183-1:1996	295
HS2-9-1-8	EN ISO 4957:1999	487	L290 S/NE	ISO 3183-1:1996	295
HS2-9-2	EN ISO 4957:1999	487	L290 W/NE/CE	ISO 3183-1:1996	295
HS3-3-2	EN ISO 4957:2000	495	L290GA	EN 10208-1:1997	293
HS6-5-2	EN ISO 4957:1999	487	L290MB welded	EN 10208-2:1996	301
	EN ISO 4957:2000	495		ISO 3183-2:1996	301
HS6-5-2-5	EN ISO 4957:1999	488	L290NB	EN 10208-2:1996	298, 301
HS6-5-3	EN ISO 4957:1999	487	seamless and welded	ISO 3183-2:1996	298, 301
	EN ISO 4957:2000	495	L3	ASTM A 681-94 (1999)	495
HS6-5-3-8	EN ISO 4957:2000	495	L320 S/CE	ISO 3183-1:1996	296
HS6-5-4	EN ISO 4957:1999	487	L320 S/NE	ISO 3183-1:1996	296
HS6-6-2	EN ISO 4957:1999	487	L320 W/CE	ISO 3183-1:1996	296
HSA 245W-B	ISO 5952:1998	90	L320 W/NE	ISO 3183-1:1996	296
HSA 245W-D	ISO 5952:1998	90	L360 S/CE	ISO 3183-1:1996	296
HSA 355W1-A	ISO 5952:1998	92	L360 W/CE	ISO 3183-1:1996	296
HSA 355W1-D	ISO 5952:1998	92	L360 W/NE	ISO 3183-1:1996	296
HSA 355W2-C	ISO 5952:1998	92	L360GA	EN 10208-1:1997	293, 296
HSA 355W2-D	ISO 5952:1998	92	L360MB welded	EN 10208-2:1996	302
HT	ASTM	410, 416		ISO 3183-2:1996	302
	A 297/A 297M-97 (1998)		L360NB	EN 10208-2:1996	302
HT30	ASTM A 351/A 351M-00	410, 416	seamless and welded	ISO 3183-2:1996	302
HT50	ASTM A 608-91 (1998)	410, 416	L360QB seamless	EN 10208-2:1996	302
HU	ASTM	410, 416		ISO 3183-2:1996	302
	A 297/A 297M-97 (1998)		L390, S/NE/CE	ISO 3183-1:1996	296
HU50	ASTM A 608-91 (1998)	410, 416	L390, W/NE/CE	ISO 3183-1:1996	296
HX	ASTM	411, 417	L415 S/NE/CE	ISO 3183-1:1996	296
	A 297/A 297M-97 (1998)		L415 W/NE/CE	ISO 3183-1:1996	296
HX50	ASTM A 608-91 (1998)	411, 417	L415MB welded	EN 10208-2:1996	303
J	ASTM A 514/A 514M-94	78, 82		ISO 3183-2:1996	303
	ASTM	143	L415NB	EN 10208-2:1996	303
	A 517/A 517M-93 (1999)		seamless and welded	ISO 3183-2:1996	303
J (JH)	ASTM A 668/A 668M-96	359	L415QB seamless	EN 10208-2:1996	303
K	ASTM A 514/A 514M-94	78, 82		ISO 3183-2:1996	303
	ASTM	143	L450 S/NE/CE	ISO 3183-1:1996	296
	A 517/A 517M-93 (1999)		L450 W/NE/CE	ISO 3183-1:1996	296
	ASTM A 588/A 588M-00	69	L450MB welded	EN 10208-2:1996	303
K (KH)	ASTM A 668/A 668M-96	359		ISO 3183-2:1996	303
KC 30 Fe 20-M	AFNOR	411	L450QB seamless	EN 10208-2:1996	303
	NF A 32-057:1981			ISO 3183-2:1996	303
L (LH)	ASTM A 668/A 668M-96	359	L485 W/NE/CE	ISO 3183-1:1996	297
L175, CI I S/NE/CE	ISO 3183-1:1996	295	L485, S/NE/CE	ISO 3183-1:1996	297
L175, CI I W/EW/CW	ISO 3183-1:1996	295	L485MB welded	EN 10208-2:1996	304
L175, CI II S/NE/CE	ISO 3183-1:1996	295		ISO 3183-2:1996	304
L175, CI II W/EW/CW	ISO 3183-1:1996	295	L485QB seamless	EN 10208-2:1996	304
L2	ASTM A 681-94 (1999)	495		ISO 3183-2:1996	304
L210 S/NE/CE	ISO 3183-1:1996	295	L555 S/NE/CE	ISO 3183-1:1996	297
L210 W/NE/CE	ISO 3183-1:1996	295	L555 W/NE/CE	ISO 3183-1:1996	297
L210GA	EN 10208-1:1997	293, 295	L555MB welded	EN 10208-2:1996	304
L235GA	EN 10208-1:1998	310		ISO 3183-2:1996	304
L245 S/NE/CE	ISO 3183-1:1996	295	L555QB seamless	EN 10208-2:1996	304
L245 W/NE/CE	ISO 3183-1:1996	295		ISO 3183-2:1996	304
L245GA	EN 10208-1:1997	293, 295		ISO 3183-2:1996	304
L245MB welded	EN 10208-2:1996	301		ISO 3183-2:1996	304
	ISO 3183-2:1996	301			

Steel Grade/Name	Specification	Page No.	Steel Grade/Name	Specification	Page No.
L6	ASTM A 681-94 (1999)	491	M33	ASTM A 600-92 (1999)	495
	SAE J438-1970	491	M34	ASTM A 600-92 (1999)	495
LC1	ASTM	391, 392	M36	ASTM A 600-92 (1999)	487
	A 352/A 352M-93 (1998)		M4	ASTM A 600-92 (1999)	487
LC2	ASTM	391		SAE J438-1970	487, 495
	A 352/A 352M-93 (1998)		M41	ASTM A 600-92 (1999)	495
LC2-1	ASTM	391, 392	M42	ASTM A 600-92 (1999)	487
	A 352/A 352M-93 (1998)		M43	ASTM A 600-92 (1999)	495
LC3	ASTM	391, 392	M44	ASTM A 600-92 (1999)	495
	A 352/A 352M-93 (1998)		M46	ASTM A 600-92 (1999)	495
LC4	ASTM	418	M47	ASTM A 600-92 (1999)	495
	A 352/A 352M-93 (1998)		M48	ASTM A 600-92 (1999)	495
LC9	ASTM	418	M50	ASTM A 600-92 (1999)	495
	A 352/A 352M-93 (1998)		M52	ASTM A 600-92 (1999)	495
LCA	ASTM	377	M6	ASTM A 600-92 (1999)	495
	A 352/A 352M-93 (1998)		M62	ASTM A 600-92 (1999)	495
LCB	ASTM	377, 378	M7	ASTM A 600-92 (1999)	487
	A 352/A 352M-93 (1998)		MT 1010	ASTM A 512-96	156
LCC	ASTM	377, 378	MT 1015	ASTM A 512-96	156, 157, 179, 187
	A 352/A 352M-93 (1998)				167, 187
LF1	ASTM A 350/A 350M-00	323	MT 1017	ASTM A 512-96	159, 169, 181, 189
LF2	ASTM A 350/A 350M-00	323	MT 1020	ASTM A 512-96	161, 183
LF3	ASTM A 350/A 350M-00	339			166, 186
LF5	ASTM A 350/A 350M-00	360	MT 1025	ASTM A 512-96	306
LF6	ASTM A 350/A 350M-00	360	MT 1030	ASTM A 512-96	306
LF787	ASTM A 350/A 350M-00	360	MT 301	ASTM A 554-98	306
LF9	ASTM A 350/A 350M-00	360	MT 302	ASTM A 511-96	306
LW 12	BSI BS 6323-8:1982	199, 203		ASTM A 554-98	306
	AMD 2:1989		MT 303Se	ASTM A 511-96	306
LW 19	BSI BS 6323-8:1982	199, 203	MT 304	ASTM A 511-96	200, 204
	AMD 2:1989			ASTM A 554-98	200, 204
LW 20	BSI BS 6323-8:1982	200, 204	MT 304L	ASTM A 511-96	200, 204
	AMD 2:1989			ASTM A 554-98	200, 204
LW 21	BSI BS 6323-8:1982	200, 204	MT 305	ASTM A 511-96	306
	AMD 2:1989			ASTM A 554-98	306
LW 22	BSI BS 6323-8:1982	201, 206	MT 309S	ASTM A 511-96	306
	AMD 2:1989			ASTM A 554-98	306
LW 23	BSI BS 6323-8:1982	201, 205	MT 309S-Cb	ASTM A 554-98	306
	AMD 2:1989		MT 310S	ASTM A 511-96	306
LW 24	BSI BS 6323-8:1982	202, 207		ASTM A 554-98	306
	AMD 2:1989		MT 316	ASTM A 511-96	201, 205
LWCF 20	BSI BS 6323-8:1982	200, 204		ASTM A 554-98	201, 205
	AMD 2:1989		MT 316L	ASTM A 511-96	201, 206
LWCF 21	BSI BS 6323-8:1982	200, 204		ASTM A 554-98	201, 206
	AMD 2:1989		MT 317	ASTM A 511-96	306
LWCF 22	BSI BS 6323-8:1982	201, 206		ASTM A 554-98	306
	AMD 2:1989		MT 321	ASTM A 511-96	202, 207
LWCF 23	BSI BS 6323-8:1982	201, 205		ASTM A 554-98	202, 207
	AMD 2:1989		MT 330	ASTM A 554-98	306
LWCF 24	BSI BS 6323-8:1982	202, 207	MT 347	ASTM A 511-96	202, 207
	AMD 2:1989			ASTM A 554-98	202, 207
M	ASTM A 514/A 514M-94	82	MT 403	ASTM A 511-96	306
	ASTM	143	MT 405	ASTM A 511-96	199, 203
	A 517/A 517M-93 (1999)		MT 410	ASTM A 511-96	199, 203
M (MH)	ASTM A 668/A 668M-96	359	MT 414	ASTM A 511-96	306
M1	ASTM A 600-92 (1999)	495	MT 414Se	ASTM A 511-96	306
	SAE J438-1970	495	MT 429	ASTM A 511-96	306
M10	ASTM A 600-92 (1999)	495		ASTM A 554-98	306
M2	ASTM A 600-92 (1999)	487			
	SAE J438-1970	487, 495			
M3	SAE J438-1970	487, 495			
M3 Cl 1	ASTM A 600-92 (1999)	487			
M3 Cl 2	ASTM A 600-92 (1999)	487			
M30	ASTM A 600-92 (1999)	495			

624 Steel Grade/Name Index

Steel Grade/Name	Specification	Page No.	Steel Grade/Name	Specification	Page No.
MT 430	ASTMA 511-96	199, 203	P3	ASTM A 681-94 (1999)	495
	ASTM A 554-98	199, 203	P305GH	EN 10222-2:1999	321, 323
MT 430-Ti	ASTM A 554-98	306	P315	ISO 9328-2:1991	102, 106
MT 431	ASTM A 511-96	306	P315TN	ISO 9328-4:1991	100, 104
MT 440A	ASTM A 511-96	306	P317I	ASTM A 778-00	306
MT 443	ASTM A 511-96	306	P35	ISO 9327-4:1999	322, 323
MT 446-1	ASTM A 511-96	306	P355	ISO 9328-2:1991	145
MT 446-2	ASTM A 511-96	306	P355GH	EN 10028-2:1992	102
N (NH)	ASTM A 668/A 668M-96	359	P355M	EN 10028-5:1996	105
NC 50-M	AFNOR	410, 416	P355ML1	EN 10028-5:1996	101, 105
	NF A 32-057:1981		P355ML2	EN 10028-5:1996	101, 105
NiCr15Fe	EN 10095: 1999	469, 471	P355N	EN 10028-3:1992	109, 110
NiCr15Fe8	ISO 4955:1994	471	P355NH	EN 10028-3:1992	109, 110
NiCr20Ti	EN 10095: 1999	469, 471		EN 10222-4:1999	321, 323
	ISO 4955:1994	471	P355NL1	EN 10028-3:1992	109, 110
NiCr22Mo9Nb	EN 10095: 1999	469	P355NL2	EN 10028-3:1992	109, 110
	ISO 4955:1994	471	P355Q	EN 10028-6:1997	145
NiCr23Fe	EN 10095: 1999	469, 471	P355QH	EN 10028-6:1997	145
NiCr28FeSiCe	EN 10095: 1999	469, 471		EN 10222-4:1999	321, 323
O1	ASTM A 681-94 (1999)	495	P355QL1	EN 10028-6:1997	145
	SAE J438-1970	495	P355QL2	EN 10028-6:1997	145
O2	ASTM A 681-94 (1999)	495	P355TN	ISO 9328-4:1991	109, 110
	SAE J438-1970	495	P390 TN	ISO 9328-4:1991	145
O6	ASTM A 681-94 (1999)	495	P4	ASTM A 681-94 (1999)	495
	SAE J438-1970	495	P42	ISO 9327-4:1999	322, 324
O7	ASTM A 681-94 (1999)	495	P420M	EN 10028-5:1996	106
P	ASTM A 514/A 514M-94	78, 82	P420ML1	EN 10028-5:1996	102
	ASTM	143	P420ML2	EN 10028-5:1996	102
	A 517/A 517M-93 (1999)		P420NH	EN 10222-4:1999	322, 324
P1	ASTM A 335/A 335M-99	262, 266	P420QH	EN 10222-4:1999	322, 324
P11	ASTM A 335/A 335M-99	263, 267	P420TN	ISO 9328-4:1991	145
P12	ASTM A 335/A 335M-99	263, 267	P460M	EN 10028-5:1996	102, 106
P15	ASTM A 335/A 335M-99	308	P460ML	EN 10028-5:1996	106
P2	ASTM A 335/A 335M-99	262, 266	P460ML2	EN 10028-5:1996	102, 106
	ASTM A 681-94 (1999)	495	P460N	EN 10028-3:1993	145
P20	ASTM A 681-94 (1999)	495	P460NH	EN 10028-3:1993	145
P21	ASTM A 335/A 335M-99	495	P460NL1	EN 10028-3:1993	145
	ASTM A 681-94 (1999)	495	P460NL2	EN 10028-3:1993	145
P22	ASTM A 335/A 335M-99	264, 268	P460Q	EN 10028-6:1997	145
P235	ISO 9328-2:1991	99, 104	P460QH	EN 10028-6:1997	145
P235GH	EN 10028-2:1992	99, 104	P460QL1	EN 10028-6:1997	145
P245GH	EN 10222-2:1999	320	P460QL2	EN 10028-6:1997	145
P255TN	ISO 9328-4:1991	108, 110	P460TN	ISO 9328-4:1991	145
P265	ISO 9328-2:1991	100, 104	P460TQ	ISO 9328-4:1991	145
P265GH	EN 10028-2:1993	100, 104	P5	ASTM A 335/A 335M-99	264, 268
P275N	EN 10028-3:1992	108, 110		ASTM A 681-94 (1999)	495
P275NH	EN 10028-3:1992	108, 110	P500Q	EN 10028-6:1997	145
P275NL1	EN 10028-3:1992	108, 110	P500QH	EN 10028-6:1997	145
P275NL2	EN 10028-3:1992	108, 110	P500QL1	EN 10028-6:1997	145
P28	ISO 9327-4:1999	320, 323	P500QL2	EN 10028-6:1997	145
P280GH	EN 10222-2:1999	321, 323	P500TQ	ISO 9328-4:1991	145
P285NH	EN 10222-4:1999	320, 323	P550TQ	ISO 9328-4:1991	145
P285QH	EN 10222-4:1999	320, 323	P5b	ASTM A 335/A 335M-99	308
P285TN	ISO 9328-4:1991	108, 110			
P290	ISO 9328-2:1991	101, 105			
P295GH	EN 10028-2:1992	101, 105			

Steel Grade/Name	Specification	Page No.	Steel Grade/Name	Specification	Page No.
P5c	ASTM A 335/A 335M-99	308	PL 460 TQ	ISO 9328-4:1991	145
P6	ASTM A 681-94 (1999)	495	PL 500 TQ	ISO 9328-4:1991	145
P620TQ	ISO 9328-4:1991	145	PL 550 TQ	ISO 9328-4:1991	145
P690TQ	ISO 9328-4:1991	145	PL 620 TQ	ISO 9328-4:1991	145
P690Q	EN 10028-6:1997	145	PL 690 TQ	ISO 9328-4:1991	145
P690QH	EN 10028-6:1997	145	PLH 355 TN	ISO 9328-4:1991	109, 110
P690QL1	EN 10028-6:1997	145	PLH 390 TN	ISO 9328-4:1991	145
P690QL2	EN 10028-6:1997	145	PLH 420 TN	ISO 9328-4:1991	145
P9	ASTM A 335/A 335M-99	264, 269	PLH 460 TN	ISO 9328-4:1991	145
P91	ASTM A 335/A 335M-99	308	PLH 500 TQ	ISO 9328-4:1991	145
PH 235	ISO 9328-2:1991	99, 104	PLH 550 TQ	ISO 9328-4:1991	145
PH 255 TN	ISO 9328-4:1991	108, 110	PLH 620 TQ	ISO 9328-4:1991	145
PH 26	ISO 9327-2:1999	314, 318	PLH 690 TQ	ISO 9328-4:1991	145
PH 265	ISO 9328-2:1991	100, 104	Q	ASTM A 514/A 514M-94	82
PH 28	ISO 9327-4:1999	320, 323		ASTM	143
PH 285 TN	ISO 9328-4:1991	108, 110	R	A 517/A 517M-93 (1999)	
PH 29	ISO 9327-2:1999	315, 318		ASTM A 514/A 514M-94	82
PH 290	ISO 9328-2:1991	101, 105	R28	ISO 3304:1985	156, 160, 163, 179, 182, 184
PH 31	ISO 9327-2:1999	315, 318		ISO 3305:1985	156, 160, 163, 179, 182, 184
PH 315	ISO 9328-2:1991	102, 106		ISO 3306:1985	156, 157, 179, 180
PH 315 TN	ISO 9328-4:1991	100, 104	R33	ISO 3304:1985	157, 161, 165, 180, 183, 185
PH 35	ISO 9327-4:1999	322, 323		ISO 3305:1985	157, 161, 165, 180, 183, 185
PH 355	ISO 9328-2:1991	145		ISO 3306:1985	157, 158, 180
PH 355 TN	ISO 9328-4:1991	109, 110	R37	ISO 3304:1985	158, 160, 163, 167, 181, 182, 184, 187
PH 390 TN	ISO 9328-4:1991	145		ISO 3305:1985	158, 160, 163, 167, 181, 182, 184, 187
PH 42	ISO 9327-4:1999	322, 324		ISO 3306:1985	158, 160, 163, 181, 182, 184
PH 420 TN	ISO 9328-4:1991	145	R44	ISO 3304:1985	163, 165, 167, 171, 184, 187, 191
PH 460 TN	ISO 9328-4:1991	145		ISO 3305:1985	163, 165, 167, 171, 184, 187, 191
PH 460 TQ	ISO 9328-4:1991	145		ISO 3306:1985	163, 165, 184
PH 500 TQ	ISO 9328-4:1991	145	R50	ISO 3304:1985	168, 173, 175, 188, 192, 194
PH 550 TQ	ISO 9328-4:1991	145		ISO 3305:1985	168, 173, 175, 188, 192, 194
PH 620 TQ	ISO 9328-4:1991	145		ISO 3306:1985	168, 171, 188, 191
PH 690 TQ	ISO 9328-4:1991	145			
PL 21	ISO 9329-3:1997	238, 240			
	ISO 9330-3:1997	238, 240			
	ISO 9330-5:2000	238, 240			
PL 23	ISO 9329-3:1997	239, 240			
	ISO 9330-3:1997	239, 240			
	ISO 9330-5:2000	239, 240			
PL 25	ISO 9329-3:1997	238, 240			
	ISO 9330-3:1997	238, 240			
	ISO 9330-5:2000	238, 240			
PL 255 TN	ISO 9328-4:1991	108, 110			
PL 28	ISO 9327-4:1999	320, 323			
PL 285 TN	ISO 9328-4:1991	108, 110			
PL 315 TN	ISO 9328-4:1991	100, 104			
PL 35	ISO 9327-4:1999	322, 323			
PLH 35	ISO 9327-4:1999	322, 323			
PL 355 TN	ISO 9328-4:1991	109, 110			
PL 390 TN	ISO 9328-4:1991	145			
PL 42	ISO 9327-4:1999	322, 324			
PLH 42	ISO 9327-4:1999	322, 324			
PL 420 TN	ISO 9328-4:1991	145			
PL 460 TN	ISO 9328-4:1991	145			

626 Steel Grade/Name Index

Steel Grade/Name	Specification	Page No.	Steel Grade/Name	Specification	Page No.
RH 388	AFNOR	482	S235J2G4	EN 10025:1993	49, 63
RSt 34-2	NF A 35-571:1996		S235J2W	EN 10155:1993	84, 90
	DIN 2393-2:1994	157, 163, 164, 167, 180, 184, 187	S235JR	EN 10025:1993	48, 63
	DIN 2394-2:1994	157, 158, 180	S235JRG1	EN 10025:1993	48, 63
RSt 37-2	DIN 2393-2:1994	157, 158, 165, 166, 168, 180, 186, 188	S235JRG2	EN 10025:1993	48, 63
	DIN 2394-2:1994	157, 158, 162, 180, 183		EN 10250-2:1999	314, 318
S	ASTM A 514/A 514M-94	78, 82	S275J0	EN 10025:1993	53, 65
	ASTM	143	S275J2G3	EN 10025:1993	53, 65
	A 517/A 517M-93 (1999)		S275J2G4	EN 10025:1993	54, 65
S 09 CK	JIS G 4051:1979	19	S275JR	EN 10025:1993	53, 65
S 10 C	JIS G 4051:1979	19	S275M	EN 10113-3:1993	93
S 100	AFNOR NF A 49-310	161, 166, 170, 183, 186, 190	S275ML	EN 10113-3:1993	93
			S275N	EN 10113-2:1993	93
S 12 C	JIS G 4051:1979	19	S275NL	EN 10113-2:1993	93
S 15 C	JIS G 4051:1979	20	S355J0	EN 10025:1993	58, 67
S 15 CK	JIS G 4051:1979	20	S355J0W	EN 10155:1993	88, 92
S 17 C	JIS G 4051:1979	20	S355J0WP	EN 10155:1993	88, 92
S 20 C	JIS G 4051:1979	21	S355J2G1W	EN 10155:1993	88, 92
S 20 CK	JIS G 4051:1979	21	S355J2G2W	EN 10155:1993	88, 92
S 22 C	JIS G 4051:1979	21	S355J2G3	EN 10025:1993	58, 67, 358
S 25 C	JIS G 4051:1979	22	S355J2G4	EN 10025:1993	59, 67
S 28 C	JIS G 4051:1979	22	S355J2WP	EN 10155:1993	88, 92
S 30 C	JIS G 4051:1979	22	S355JR	EN 10025:1993	58, 67
S 33 C	JIS G 4051:1979	23	S355K2G1W	EN 10155:1993	88, 92
S 35 C	JIS G 4051:1979	23	S355K2G2W	EN 10155:1993	89, 92
S 38 C	JIS G 4051:1979	23	S355K2G3	EN 10025:1993	59, 67
S 40 C	JIS G 4051:1979	24	S355K2G4	EN 10025:1993	59, 67
S 43 C	JIS G 4051:1979	24	S355M	EN 10113-3:1993	68, 72
S 45 C	JIS G 4051:1979	25	S355ML	EN 10113-3:1993	68, 72
S 48 C	JIS G 4051:1979	25	S355N	EN 10113-2-93	69, 73
S 50 C	JIS G 4051:1979	26	S355NL	EN 10113-2-93	69, 73
S 53 C	JIS G 4051:1979	26	S4	ASTM A 681-94 (1999)	495
S 55 C	JIS G 4051:1979	27	S420M	EN 10113-3:1993	69, 73
S 58 C	JIS G 4051:1979	27	S420ML	EN 10113-3:1993	69, 73
S CM 415 TK	JIS G 3441:1988	306	S460Q	EN 10137-2:1995	76, 80
S Cr 420 TK	JIS G 3441:1988	306	S460QL	EN 10137-2:1995	76, 80
S Gr. A	ASTM A 53/A 53M-99	247, 256	S460QL1	EN 10137-2:1995	76, 80
S Gr. B	ASTM A 53/A 53M-99	251, 259	S5	ASTM A 681-94 (1999)	495
S1	ASTM A 681-94 (1999)	495		SAE J438-1970	495
	SAE J438-1970	495	S500A	EN 10137-3:1995	77, 81
S185	EN 10025:1993	45, 62	S500AL	EN 10137-3:1995	77, 81
S2	ASTM A 681-94 (1999)	495	S500Q	EN 10137-2:1995	76, 80
	SAE J438-1970	495	S500QL	EN 10137-2:1995	76, 80
S235J0	EN 10025:1993	48, 63	S500QL1	EN 10137-2:1995	76, 80
S235J0W	EN 10155:1993	84, 90	S50C-CSP	JIS 4802:1999	481
S235J2G3	EN 10025:1993	49, 63, 314, 318	S550A	EN 10137-3:1995	77, 81
S235J2G3	EN 10250-2:1999	49, 63, 314, 318	S550AL	EN 10137-3:1995	77, 81
			S550Q	EN 10137-2:1995	77, 81
			S550QL	EN 10137-2:1995	77, 81
			S550QL1	EN 10137-2:1995	77, 81
			S55C-CSP	JIS 4802:1999	481
			S6	ASTM A 681-94 (1999)	495
			S620A	EN 10137-3:1995	78, 82

Steel Grade/Name	Specification	Page No.	Steel Grade/Name	Specification	Page No.
S620AL	EN 10137-3:1995	78, 82	SC 4130 CI 105/85	ASTM A 958-00	385
S620Q	EN 10137-2:1995	78, 82	SC 4130 CI 115/95	ASTM A 958-00	385
S620QL	EN 10137-2:1995	78, 82	SC 4130 CI 130/115	ASTM A 958-00	385
S620QL1	EN 10137-2:1995	78, 82	SC 4130 CI 135/125	ASTM A 958-00	385
S65C-CSP	JIS 4802:1999	481	SC 4130 CI 150/135	ASTM A 958-00	385
S690A	EN 10137-3:1995	78, 83	SC 4140	ASTM A 958-00	383
S690AL	EN 10137-3:1995	78, 83	SC 4140 CI 65/35	ASTM A 958-00	386
S690Q	EN 10137-2:1995	78, 83	SC 4140 CI 70/36	ASTM A 958-00	386
S690QL	EN 10137-3:1995	78, 83	SC 4140 CI 80/40	ASTM A 958-00	386
S690QL1	EN 10137-3:1995	78, 83	SC 4140 CI 80/50	ASTM A 958-00	386
S7	ASTM A 681-94 (1999)	495	SC 4140 CI 90/60	ASTM A 958-00	386
S70C-CSP	JIS 4802:1999	481	SC 4140 CI 105/85	ASTM A 958-00	386
S890Q	EN 10137-2:1996	93	SC 4140 CI 115/95	ASTM A 958-00	386
S890QL	EN 10137-2:1996	93	SC 4140 CI 130/115	ASTM A 958-00	386
S890QL1	EN 10137-2:1996	93	SC 4140 CI 135/125	ASTM A 958-00	386
S960Q	EN 10137-2:1996	93	SC 4140 CI 150/135	ASTM A 958-00	386
S960QL	EN 10137-2:1996	93	SC 4140 CI 160/145	ASTM A 958-00	386
SACM 645	JIS G 4202:1979	36	SC 4140 CI 165/150	ASTM A 958-00	386
SAW 4	BSI BS 6323-7:1982	164, 185	SC 4330	ASTM A 958-00	383
	AMD 2:1989		SC 4140 CI 65/35	ASTM A 958-00	387
SAW 5	BSI BS 6323-7:1982	169, 189	SC 4140 CI 70/36	ASTM A 958-00	387
	AMD 2:1989		SC 4140 CI 80/40	ASTM A 958-00	387
SB 410	JIS G 3103:1987	100, 104	SC 4140 CI 80/50	ASTM A 958-00	387
SB 450	JIS G 3103:1987	101, 105	SC 4140 CI 90/60	ASTM A 958-00	387
SB 450 M	JIS G 3103:1987	112, 114	SC 4140 CI 105/85	ASTM A 958-00	387
SB 480	JIS G 3103:1987	101, 105	SC 4140 CI 115/95	ASTM A 958-00	387
SB 480 M	JIS G 3103:1987	112	SC 4140 CI 130/115	ASTM A 958-00	387
SBV 1 A	JIS G 3119:1987	112, 114	SC 4140 CI 135/125	ASTM A 958-00	387
SBV 1 B	JIS G 3119:1987	112, 114	SC 4140 CI 150/135	ASTM A 958-00	387
SBV 2	JIS G 3119:1987	130	SC 4140 CI 160/145	ASTM A 958-00	387
SBV 3	JIS G 3119:1987	131	SC 4140 CI 165/150	ASTM A 958-00	387
SC 1020 CI 65/35	ASTM A 958-00	367, 371	SC 4140 CI 210/180	ASTM A 958-00	387
SC 1020 CI 70/36	ASTM A 958-00	368, 372	SC 4340	ASTM A 958-00	419
SC 1025 CI 65/35	ASTM A 958-00	367, 371	SC 450	JIS G 5101:1991	367, 371
SC 1025 CI 70/36	ASTM A 958-00	368, 372	SC 480	JIS G 5101:1991	368, 372
SC 1030 CI 65/35	ASTM A 958-00	367, 371	SC 8620	ASTM A 958-00	419
SC 1030 CI 70/36	ASTM A 958-00	368, 372	SC 8625	ASTM A 958-00	419
SC 1030 CI 80/40	ASTM A 958-00	369, 373	SC 8630	ASTM A 958-00	419
SC 1030 CI 80/50	ASTM A 958-00	369, 373	SCC 3	JIS G 5111:1991	372, 373
SC 1040 CI 70/36	ASTM A 958-00	368, 372	SCC 5	JIS G 5111:1991	373, 374
SC 1040 CI 80/40	ASTM A 958-00	369, 373	SCCrM 1	JIS G 5111:1991	383
SC 1040 CI 80/50	ASTM A 958-00	369, 373	SCCrM 3	JIS G 5111:1991	383
SC 1040 CI 90/60	ASTM A 958-00	370, 373	SCH 1	JIS G 5122:1991	406, 412
SC 1045 CI 105/85	ASTM A 958-00	370, 374	SCH 11	JIS G 5122:1991	406, 412
SC 1045 CI 80/40	ASTM A 958-00	369, 373	SCH 12	JIS G 5122:1991	407, 413
SC 1045 CI 80/50	ASTM A 958-00	369, 373	SCH 13	JIS G 5122:1991	408, 414
SC 1045 CI 90/60	ASTM A 958-00	370, 373	SCH 13A	JIS G 5122:1991	408, 414
SC 360	JIS G 5101:1991	367, 371	SCH 15	JIS G 5122:1991	410, 416
SC 410	JIS G 5101:1991	367, 371	SCH 16	JIS G 5122:1991	410, 416
SC 4130	ASTM A 958-00	383	SCH 17	JIS G 5122:1991	407, 413
SC 4130 CI 65/35	ASTM A 958-00	385	SCH 18	JIS G 5122:1991	408, 414
SC 4130 CI 70/36	ASTM A 958-00	385	SCH 19	JIS G 5122:1991	409, 415
SC 4130 CI 80/40	ASTM A 958-00	385	SCH 2	JIS G 5122:1991	406, 412
SC 4130 CI 80/50	ASTM A 958-00	385	SCH 20	JIS G 5122:1991	410, 416
SC 4130 CI 90/60	ASTM A 958-00	385	SCH 21	JIS G 5122:1991	408, 414
			SCH 22	JIS G 5122:1991	409, 415
			SCH 23	JIS G 5122:1991	409, 415

628 Steel Grade/Name Index

Steel Grade/Name	Specification	Page No.	Steel Grade/Name	Specification	Page No.
SCH 24	JIS G 5122:1991	409, 415	SCPL 1	JIS G 5152:1991	377, 378
SCH 3	JIS G 5122:1991	406, 412	SCPL 11	JIS G 5152:1991	391, 392
SCM 415	JIS G 4105:1979	40	SCPL 21	JIS G 5152:1991	391, 392
SCM 418	JIS G 4105:1979	33	SCPL 31	JIS G 5152:1991	391, 392
SCM 418 TK	JIS G 3441:1988	196, 197	SCr 415	JIS G 4104:1979	31
SCM 420	JIS G 4105:1979	33	SCr 420	JIS G 4104:1979	31
SCM 420 TK	JIS G 3441:1988	196, 197	SCr 430	JIS G 4104:1979	31
SCM 421	JIS G 4105:1979	33	SCr 435	JIS G 4104:1979	31
SCM 430	JIS G 4105:1979	33	SCr 440	JIS G 4104:1979	32
SCM 430 TK	JIS G 3441:1988	196, 197	SCr 445	JIS G 4104:1979	32
SCM 432	JIS G 4105:1979	33	SCS 1	JIS G 5121:1991	393, 394
SCM 435	JIS G 4105:1979	34	SCS 10	JIS G 5121:1991	419
SCM 435 TK	JIS G 3441:1988	196, 197	SCS 11	JIS G 5121:1991	419
SCM 440	JIS G 4105:1979	34	SCS 12	JIS G 5121:1991	396, 399
SCM 440 TK	JIS G 3441:1988	196, 198	SCS 13	JIS G 5121:1991	396, 399
SCM 445	JIS G 4105:1979	34	SCS 13A	JIS G 5121:1991	396, 399
SCM 822	JIS G 4105:1979	33	SCS 14	JIS G 5121:1991	397, 400
SCMn 1	JIS G 5111:1991	372, 373	SCS 14A	JIS G 5121:1991	397, 400
SCMn 2	JIS G 5111:1991	373	SCS 15	JIS G 5121:1991	419
SCMn 3	JIS G 5111:1991	373, 374	SCS 16	JIS G 5121:1991	419
SCMn 5	JIS G 5111:1991	374	SCS 16 A	JIS G 5121:1991	397, 400
SCMnCr 2	JIS G 5111:1991	419	SCS 17	JIS G 5121:1991	398, 401
SCMnCr 3	JIS G 5111:1991	419	SCS 19	JIS G 5121:1991	396, 399
SCMnCr 4	JIS G 5111:1991	419	SCS 19A	JIS G 5121:1991	396, 399
SCMnCrM 2	JIS G 5111:1991	419	SCS 2	JIS G 5121:1991	393, 394
SCMnCrM 3	JIS G 5111:1991	419	SCS 20	JIS G 5121:1991	419
SCMnH 1	JIS G 5131:1991	379, 381	SCS 21	JIS G 5121:1991	396, 399
SCMnH 11	JIS G 5131:1991	379, 381	SCS 22	JIS G 5121:1991	397, 400
SCMnH 2	JIS G 5131:1991	379, 381	SCS 23	JIS G 5121:1991	398, 401
SCMnH 21	JIS G 5131:1991	419	SCS 24	JIS G 5121:1991	419
SCMnH 3	JIS G 5131:1991	379, 381	SCS 2A	JIS G 5121:1991	393, 394
SCMnM 3	JIS G 5111:1991	419	SCS 3	JIS G 5121:1991	393, 394
SCMQ4E	JIS G 4110:1993	145	SCS 4	JIS G 5121:1991	419
SCMQ4V	JIS G 4110:1993	145	SCS 5	JIS G 5121:1991	393, 394
SCMQ5V	JIS G 4110:1993	145	SCS 6	JIS G 5121:1991	393, 395
SCMV 1 Div. 1	JIS G 4109:1987	115	SCSiMn 2	JIS G 5111:1991	373
SCMV 1 Div. 2	JIS G 4109:1987	115	SCW 410	JIS G 5102:1991	367, 371
SCMV 2 Div 1	JIS G 4109:1987	116	SCW 450	JIS G 5102:1991	367, 371
SCMV 2 Div 2	JIS G 4109:1987	116	SCW 480	JIS G 5102:1991	368, 372
SCMV 3 Div 1	JIS G 4109:1987	117	SCW 550	JIS G 5102:1991	369, 373
SCMV 3 Div 2	JIS G 4109:1987	117	SCW 620	JIS G 5102:1991	370, 373
SCMV 4 Div 1	JIS G 4109:1987	118, 119	SEV 245	JIS G 3124:1987	102, 106
SCMV 4 Div 2	JIS G 4109:1987	118, 119	SEV 295	JIS G 3124:1987	112, 114
SCMV 5 Div 1	JIS G 4109:1987	120	SEV 345	JIS G 3124:1987	113, 114
SCMV 5 Div 2	JIS G 4109:1987	120	SF 340 A	JIS G 3201:1988	314, 318
SCMV 6 Div 1	JIS G 4109:1987	121		(1991)	
SCMV 6 Div 2	JIS G 4109:1987	121	SF 390 A	JIS G 3201:1988	314, 318
SCNCrM 2	JIS G 5111:1991	383		(1991)	
SCPH 1	JIS G 5151:1991	375, 376	SF 440 A	JIS G 3201:1988	315, 318
SCPH 11	JIS G 5151:1991	388, 389		(1991)	
SCPH 2	JIS G 5151:1991	375, 376	SF 490 A	JIS G 3201:1988	315, 318
SCPH 21	JIS G 5151:1991	388, 389		(1991)	
SCPH 22	JIS G 5151:1991	419	SF 540 A	JIS G 3201:1988	316, 318
SCPH 23	JIS G 5151:1991	388, 389		(1991)	
SCPH 32	JIS G 5151:1991	388, 389	SF 540 B	JIS G 3201:1988	316, 318
SCPH 61	JIS G 5151:1991	388, 389		(1991)	
			SF 590 A	JIS G 3201:1988	316, 318
				(1991)	

Steel Grade/Name	Specification	Page No.	Steel Grade/Name	Specification	Page No.
SF 590 B	JIS G 3201:1988 (1991)	316, 318	SFVQ 2A	JIS G 3204:1988 (1991)	341, 360
SF 640 B	JIS G 3201:1988 (1991)	317, 319	SFVQ 2A	JIS G 3204:1988	341, 360
SFCM 590 D	JIS G 3221:1988	359	SFVQ 2B	JIS G 3204:1988 (1991)	341, 360
SFCM 590 R	JIS G 3221:1988	359	SFVQ 2B	JIS G 3204:1988	341, 360
SFCM 590 S	JIS G 3221:1988	359	SFVQ 3	JIS G 3204:1988	343
SFCM 640 D	JIS G 3221:1988	359	SGP	JIS G 3452:1997	156, 179
SFCM 640 R	JIS G 3221:1988	359	SGV 410	JIS G 3118:1987	100, 104
SFCM 640 S	JIS G 3221:1988	359	SGV 450	JIS G 3118:1987	101, 105
SFCM 690 D	JIS G 3221:1988	359	SGV 480	JIS G 3118:1987	101, 105
SFCM 690 R	JIS G 3221:1988	359	SHY 685	JIS G 3128:1999	79, 83
SFCM 690 S	JIS G 3221:1988	359	SHY 685 N	JIS G 3128:1999	79, 83
SFCM 740 D	JIS G 3221:1988	359	SHY 685 NS	JIS G 3128:1999	79, 83
SFCM 740 R	JIS G 3221:1988	359	SK 1	JIS G 4401:1983	495
SFCM 740 S	JIS G 3221:1988	325	SK 2	JIS G 4401:1983	485
SFCM 780 D	JIS G 3221:1988	359	SK 3	JIS G 4401:1983	495
SFCM 780 R	JIS G 3221:1988	359	SK 4	JIS G 4401	485
SFCM 780 S	JIS G 3221:1988	325	SK 5	JIS G 4401:1983	485
SFCM 830 D	JIS G 3221:1988	359	SK 6	JIS G 4401:1983	485
SFCM 830 R	JIS G 3221:1988	359	SK 7	JIS G 4401:1983	485
SFCM 830 S	JIS G 3221:1988	359	SK4-CSP	JIS 4802:1999	481
SFCM 880 D	JIS G 3221:1988	359	SK5-CSP	JIS 4802:1999	481
SFCM 880 R	JIS G 3221:1988	359	SKD 1	JIS G 4404:1983	489
SFCM 880 S	JIS G 3221:1988	359	SKD 11	JIS G 4404:1983	489
SFCM 930 D	JIS G 3221:1988	359	SKD 12	JIS G 4404:1983	489
SFCM 930 R	JIS G 3221:1988	359	SKD 4	JIS G 4404:1983	495
SFCM 930 S	JIS G 3221:1988	359	SKD 5	JIS G 4404:1983	490
SFCM 980 D	JIS G 3221:1988	359	SKD 6	JIS G 4404:1983	490
SFCM 980 R	JIS G 3221:1988	359	SKD 61	JIS G 4404:1983	490
SFCM 980 S	JIS G 3221:1988	359	SKD 62	JIS G 4404:1983	490
SFL 1	JIS G 3205:1988	320, 323	SKD 7	JIS G 4404:1983	490
SFL 2	JIS G 3205:1988	321, 323	SKD 8	JIS G 4404:1983	490
SFL 3	JIS G 3205:1988	339	SKH 10	JIS G 4403:1983	486
SFVA F 1	JIS G 3203:1988	328	SKH 2	JIS G 4403:1983	486
SFVA F 11 A	JIS G 3203:1988	331	SKH 3	JIS G 4403:1983	486
SFVA F 11 B	JIS G 3203:1988	331	SKH 4	JIS G 4403:1983	486
SFVA F 12	JIS G 3203:1988	330	SKH 51	JIS G 4403:1983	487
SFVA F 2	JIS G 3203:1988	329	SKH 52	JIS G 4403:1983	487
SFVA F 21 A	JIS G 3203:1988	334, 335	SKH 53	JIS G 4403:1983	487
SFVA F 21 B	JIS G 3203:1988	334, 335	SKH 54	JIS G 4403:1983	487
SFVA F 22 A	JIS G 3203:1988	332, 333	SKH 55	JIS G 4403:1983	488
SFVA F 22 B	JIS G 3203:1988	332, 333	SKH 56	JIS G 4403:1983	487
SFVA F 5 A	JIS G 3203:1988	336	SKH 57	JIS G 4403:1983	488
SFVA F 5 B	JIS G 3203:1988	336	SKH 58	JIS G 4403:1983	487
SFVA F 5 C	JIS G 3203:1988	336	SKH 59	JIS G 4403:1983	487
SFVA F 5 D	JIS G 3203:1988	336	SKS 11	JIS G 4404:1983	491
SFVA F 9	JIS G 3203:1988	337	SKS 2	JIS G 4404:1983	495
SFVC 1	JIS G 3202:1988 (1991)	320, 323	SKS 21	JIS G 4404:1983	495
SFVC 2 A	JIS G 3202:1988 (1991)	321, 323	SKS 3	JIS G 4404:1983	495
SFVC 2 B	JIS G 3202:1988 (1991)	321, 323	SKS 31	JIS G 4404:1983	495
SFVCM F22B	JIS G 3206:1993	332, 333	SKS 4	JIS G 4401:1983	495
SFVCM F22V	JIS G 3206:1993	332, 333	SKS 41	JIS G 4404:1983	495
SFVCM F3V	JIS G 3206:1993	334, 335	SKS 43	JIS G 4404:1983	485, 489
SFVQ 1 A	JIS G 3204:1988	342	SKS 44	JIS G 4404	485
SFVQ 1 B	JIS G 3204:1988	342	SKS 5	JIS G 4404:1983	495
			SKS 51	JIS G 4404:1983	491

630 Steel Grade/Name Index

Steel Grade/Name	Specification	Page No.	Steel Grade/Name	Specification	Page No.
SKS 7	JIS G 4404:1983	495	SN400C	JIS G 3136:1994	51, 64
SKS 8	JIS G 4404:1983	495	SN490B	JIS G 3136:1994	56, 66
SKS 93	JIS G 4404:1983	495	SN490C	JIS G 3136:1994	56, 66
SKS 94	JIS G 4404:1983	495	SNCM 220	JIS G 4103:1979	35
SKS 95	JIS G 4404:1983	495	SNCM 240	JIS G 4103:1979	35
SKT 3	JIS G 4404:1983	495	SNCM 415	JIS G 4103:1979	35
SKT 4	JIS G 4404:1983	490	SNCM 420	JIS G 4103:1979	35
SL 2N 255	JIS G 3127:1990	124	SNCM 431	JIS G 4103:1979	40
SL 3N 255	JIS G 3127:1990	125, 126	SNCM 439	JIS G 4103:1979	35
SL 3N 275	JIS G 3127:1990	125, 126	SNCM 447	JIS G 4103:1979	40
SL 3N 440	JIS G 3127:1990	125, 126	SNCM 616	JIS G 4103:1979	40
SL 5N 590	JIS G 3127:1990	127	SNCM 625	JIS G 4103:1979	40
SL 9N 520	JIS G 3127:1990	128, 129	SNCM 630	JIS G 4103:1979	40
SL 9N 590	JIS G 3127:1990	128, 129	SNCM 815	JIS G 4103:1979	40
SLA 235 A	JIS G 3126:1990	108, 110	SPA-C	JIS G 3125:1987	86, 91
SLA 235 B	JIS G 3126:1990	108, 110	SPA-H	JIS G 3125:1987	86, 91
SLA 325 A	JIS G 3126:1990	108, 110	SPV 235	JIS G 3115:1990	100, 104
SLA 325 B	JIS G 3126:1990	108, 110	SPV 315	JIS G 3115:1990	102, 106
SLA 360	JIS G 3126:1990	109, 110		JIS G 3115-1:1990	145
SLA 410	JIS G 3126:1990	109, 111	SPV 355	JIS G 3115:1990	102, 106
SM400A	JIS G 3106:1999	50, 64		JIS G 3115-1:1995	102, 106
SM400B	JIS G 3106:1999	50, 64	SPV 410	JIS G 3115:1990	145
SM400C	JIS G 3106:1999	51, 64		JIS G 3115-1:1990	145
SM490A	JIS G 3106:1999	55, 66	SPV 450	JIS G 3115:1990	145
SM490B	JIS G 3106:1999	55, 66		JIS G 3115-1:1990	145
SM490C	JIS G 3106:1999	55, 66	SPV 490	JIS G 3115:1990	145
SM490YA	JIS G 3106:1999	56, 66		JIS G 3115-1:1990	145
SM490YB	JIS G 3106:1999	56, 66	SQV 1 A	JIS G 3120:1987	113
SM520B	JIS G 3106:1999	60, 67	SQV 1 B	JIS G 3120:1987	114
SM520C	JIS G 3106:1999	60, 67	SQV 2 A	JIS G 3120:1987	130
SM570	JIS G 3106:1999	61, 67	SQV 2 B	JIS G 3120:1987	130
SMA400AP	JIS G 3114:1998	85, 90	SQV 3 A	JIS G 3120:1987	131
SMA400AW	JIS G 3114:1998	85, 90	SQV 3 B	JIS G 3120:1987	131
SMA400BP	JIS G 3114:1998	85, 90	SS330	JIS G 3101:1995	46, 62
SMA400BW	JIS G 3114:1998	85, 90	SS400	JIS G 3101:1995	50, 64
SMA400CP	JIS G 3114:1998	85, 90	SS490	JIS G 3101:1995	55, 66
SMA400CW	JIS G 3114:1998	85, 90	SS540	JIS G 3101:1995	60, 67
SMA490AP	JIS G 3114:1998	87, 91	St 30 Al	DIN 2391-2:1994	156, 161, 165, 179, 183, 185
SMA490AW	JIS G 3114:1998	86, 91			
SMA490BP	JIS G 3114:1998	87, 91	St 30 Si	DIN 2391-2:1994	156, 161, 165, 179, 183, 185
SMA490BW	JIS G 3114:1998	87, 91			
SMA490CP	JIS G 3114:1998	87, 91	St 33	DIN 1615:1984	156, 179
SMA490CW	JIS G 3114:1998	87, 91	St 35	DIN 2391-2:1994	157, 158, 164, 165, 168, 180, 183, 185, 188, 191, 209, 213
SMA570P	JIS G 3114:1998	89, 92			
SMA570W	JIS G 3114:1998	89, 92			
SMn 420	JIS G 4106:1979	30	St 35.8	DIN 28180:1985	248, 257
SMn 433	JIS G 4106:1979	30		DIN 17175:1979	209, 213
SMn 438	JIS G 4106:1979	30	St 37.0	DIN 28180:1985	209, 213
SMn 443	JIS G 4106:1979	30		DIN 28181:1985	209, 213
SMnC 420	JIS G 4106:1979	30		DIN 1626:1984	248, 257
SMnC 443	JIS G 4106:1979	30		DIN 1629:1984	248, 257
SN400A	JIS G 3136:1994	51, 64			
SN400B	JIS G 3136:1994	51, 64			

Steel Grade/Name	Specification	Page No.	Steel Grade/Name	Specification	Page No.
St 37.4	DIN 1628:1984	248, 257	STC 370	JIS G 3473:1988	161, 183
	DIN 1630:1984	248, 257	STC 440	JIS G 3473:1988	166, 186
St 37.8	DIN 28181:1985	209, 213	STC 510A	JIS G 3473:1988	171, 190
	DIN 17177:1979	248, 257	STC 510B	JIS G 3473:1988	171, 190
St 42.8	DIN 17177:1979	250, 258	STC 540	JIS G 3473:1988	172, 191
St 44.0	DIN 1626:1984	251	STC 590A	JIS G 3473:1988	174, 193
	DIN 1629:1984	251	STC 590B	JIS G 3473:1988	174, 193
St 44-2	DIN 2393-2:1994	161, 164, 170, 171, 173, 183, 184, 185, 190, 192	StE 255	DIN 17178:1986	249, 257
				DIN 17179:1986	249, 257
	DIN 2394-2:1994	162, 164, 165, 183, 186	StE 285	DIN 17178:1986	249, 258
				DIN 17179:1986	249, 258
St 44.4	DIN 1628:1984	251	StE 355	DIN 17179:1986	253, 260
	DIN 1630:1984	251	StE 420	DIN 17178:1986	254, 261
St 45	DIN 2391-2:1994	162, 165, 171, 173, 186, 192		DIN 17179:1986	255, 261
St 45.8	DIN 17175:1979	250, 258	StE 460	DIN 17178:1986	309
St 52	DIN 2391-2:1994	169, 173, 176, 189, 192, 194	STF 410	JIS G 3467:1988	210, 214
St 52.0	DIN 1626:1984	254, 261	STF A 12	JIS G 3467:1988	216, 219
	DIN 1629:1984	254, 261	STF A 22	JIS G 3467:1988	217, 220
St 52-3	DIN 2393-2:1994	168, 169, 172, 174, 176, 188, 192, 194	STF A 23	JIS G 3467:1988	217, 221
			STF A 24	JIS G 3467:1988	217, 221
	DIN 2394-2:1994	168, 169, 172, 188, 191	STF A 25	JIS G 3467:1988	218, 221
St 52.4	DIN 1628:1984	254, 261	STF A 26	JIS G 3467:1988	218, 222
	DIN 1630:1984	254, 261	STK290	JIS G 3444:1994	156, 179
STAM 290 GA	JIS G 3472:1988	156, 179	STK400	JIS G 3444:1994	163, 184
STAM 290 GB	JIS G 3472:1988	156, 179	STK 490	JIS G 3444:1994	188
STAM 340 G	JIS G 3472:1988	158, 181	STK500	JIS G 3444:1994	170, 190
STAM 390 G	JIS G 3472:1988	162, 183	STK540	JIS G 3444:1994	172, 191
STAM 440 G	JIS G 3472:1988	166, 186	STKM 11 A	JIS G 3445:1988	156, 179
STAM 440 H	JIS G 3472:1988	166, 186	STKM 12 A	JIS G 3445:1988	158, 191
STAM 470 G	JIS G 3472:1988	168, 188	STKM 12 B	JIS G 3445:1988	162, 183
STAM 470 H	JIS G 3472:1988	168, 188	STKM 12 C	JIS G 3445:1988	168, 188
STAM 500 G	JIS G 3472:1988	170, 190	STKM 13 A	JIS G 3445:1988	161, 183
STAM 500 H	JIS G 3472:1988	170, 190	STKM 13 B	JIS G 3445:1988	166, 186
STAM 540 H	JIS G 3472:1988	172, 191	STKM 13 C	JIS G 3445:1988	171, 190
STB 340	JIS G 3461:1988	208, 212	STKM 14 A	JIS G 3445:1988	164, 185
STB 410	JIS G 3461:1988	210, 214	STKM 14 B	JIS G 3445:1988	170, 190
STB 510	JIS G 3461:1988	211, 215	STKM 14 C	JIS G 3445:1988	173, 192
STBA 12	JIS G 3462:1988	216, 219	STKM 15 A	JIS G 3445:1988	168, 188
STBA 13	JIS G 3462:1988	216, 219	STKM 15 C	JIS G 3445:1988	173, 192
STBA 20	JIS G 3462:1988	216, 220	STKM 16 A	JIS G 3445:1988	170, 190
STBA 22	JIS G 3462:1988	217, 220	STKM 16 C	JIS G 3445:1988	175, 194
STBA 23	JIS G 3462:1988	217, 221	STKM 17 A	JIS G 3445:1988	173, 192
STBA 24	JIS G 3462:1988	217, 221	STKM 17 C	JIS G 3445:1988	177, 195
STBA 25	JIS G 3462:1988	218, 221	STKM 18 A	JIS G 3445:1988	165, 186
STBA 26	JIS G 3462:1988	218, 222	STKM 18 B	JIS G 3445:1988	168, 188
STBL 380	JIS G 3464:1988	238, 240	STKM 18 C	JIS G 3445:1988	171, 190
STBL 450	JIS G 3464:1988	241, 244	STKM 19 A	JIS G 3445:1988	168, 188
STBL 690	JIS G 3464:1988	242, 245	STKM 19 C	JIS G 3445:1988	173, 192
			STKM 20 A	JIS G 3445:1988	172, 191
			STKT 540	JIS G 3474:1995	172, 191
			STKT 590	JIS G 3474:1995	174, 193
			STPA 12	JIS G 3458:1988	262, 267
			STPA 20	JIS G 3458:1988	262, 266
			STPA 22	JIS G 3458:1988	263, 267
			STPA 23	JIS G 3458:1988	263, 267
			STPA 24	JIS G 3458:1988	264, 268
			STPA 25	JIS G 3458:1988	264, 268

632 Steel Grade/Name Index

Steel Grade/Name	Specification	Page No.	Steel Grade/Name	Specification	Page No.
STPA 26	JIS G 3458:1988	264, 269	SUM 41	JIS G 4804	477
STPG 370	JIS G 3454:1988	249, 258	SUM 42	JIS G 4804	477
STPG 410	JIS G 3454:1988	250, 258	SUM 43	JIS G 4804	478
STPL 380	JIS G 3460:1988	288, 291	SUP 10	JIS G 4801:1984	482
STPL 450	JIS G 3460:1988	288, 291	SUP 11 A	JIS G 4801:1984	482
STPL 690	JIS G 3460:1988	290, 292	SUP 12	JIS G 4801:1984	483
STPT 370	JIS G 3456:1988	249, 258	SUP 13	JIS G 4801:1984	483
STPT 410	JIS G 3456:1988	250, 258	SUP 3	JIS G 4801:1984	481
STPT 480	JIS G 3456:1988	253, 260	SUP 6	JIS G 4801:1984	482
STPY 400	JIS G 3457:1988	250, 258	SUP 7	JIS G 4801:1984	482
STS 370	JIS G 3455:1988	249, 258	SUP 9	JIS G 4801:1984	482
STS 410	JIS G 3455:1988	250, 258	SUP 9 A	JIS G 4801:1984	482
STS 480	JIS G 3455:1988	253, 260	SUP10 CSP	JIS G 4802:1999	494
SUH1	JIS G 4311:1991	470	SUS 301-CSP	JIS G 4313:1996	484
SUH11	JIS G 4311:1991	470	SUS 304 TF	JIS G 3467:1988	225, 231
SUH21	JIS G 4312:1991	468	SUS 304-CSP	JIS G 4313:1996	494
SUH3	JIS G 4311:1991	470	SUS 304H TF	JIS G 3467:1988	225
SUH309	JIS G 4311:1991	456, 463	SUS 309 TF	JIS G 3467:1988	307
	JIS G 4312:1991	429, 437	SUS 310 TF	JIS G 3467:1988	226, 233
SUH31	JIS G 4311:1991	470	SUS 316	JIS G 3214:1991	348, 351
SUH310	JIS G 4312:1991	429, 438	SUS 316 TF	JIS G 3467:1988	227, 233
	JIS G 4311:1991	456, 463	SUS 316H	JIS G 3214:1991	348, 353
SUH330	JIS G 4312:1991	468	SUS 316H TF	JIS G 3467:1988	228, 234
	JIS G 4311:1991	470	SUS 317	JIS G 3214:1991	349, 353
SUH35	JIS G 4311:1991	470	SUS 317J1	JIS G 4303:1998	456, 462
SUH36	JIS G 4311:1991	470	SUS 321 TF	JIS G 3467:1988	228, 235
SUH37	JIS G 4311:1991	470	SUS 321H TF	JIS G 3467:1988	229, 236
SUH38	JIS G 4311:1991	470	SUS 329J3L	JIS G 4303:1998	467
SUH4	JIS G 4311:1991	470	SUS 347	JIS G 4304:1999	431, 442
SUH409	JIS G 4312:1991	468		JIS G 4305:1999	431, 442
SUH409L	JIS G 4312:1991	426, 427		JIS G 4312:1991	431, 442
SUH446	JIS G 4311:1991	451, 453, 470	SUS 347 TF	JIS G 3467:1988	229, 236
	JIS G 4312:1991	426, 427	SUS 347H TF	JIS G 3467:1988	229, 236
SUH600	JIS G 4311:1991	470	SUS 420 J 2-CSP	JIS G 4313:1996	484
SUH616	JIS G 4311:1991	470	SUS 631	JIS G 4304:1999	443
SUH660	JIS G 4311:1991	470		JIS G 4305:1999	443
	JIS G 4312:1991	468		JIS G 4312:1991	443
SUH661	JIS G 4311:1991	470	SUS 631-CSP	JIS G 4313:1996	484
	JIS G 4312:1991	468	SUS 632J1-CSP	JIS G 4313:1996	494
SUJ 1	JIS G 4805:1999	496	SUS F 304	JIS G 3214:1991	347, 350
SUJ 2	JIS G 4805:1999	492	SUS F 304H	JIS G 3214:1991	347, 350
SUJ 3	JIS G 4805:1999	492	SUS F 304L	JIS G 3214:1991	347, 350
SUJ 4	JIS G 4805:1999	496	SUS F 304LN	JIS G 3214:1991	347, 350
SUJ 5	JIS G 4805:1999	496	SUS F 304N	JIS G 3214:1991	351
SUM 11	JIS G 4804	476	SUS F 310	JIS G 3214:1991	347, 351
SUM 12	JIS G 4804	476	SUS F 316L	JIS G 3214:1991	348, 352
SUM 21	JIS G 4804	479	SUS F 316LN	JIS G 3214:1991	348, 353
SUM 22	JIS G 4804	479	SUS F 316N	JIS G 3214:1991	348, 353
SUM 22 L	JIS G 4804	479	SUS F 317L	JIS G 3214:1991	349, 353
SUM 23	JIS G 4804	479	SUS F 321	JIS G 3214:1991	349, 354
SUM 23 L	JIS G 4804	480	SUS F 321H	JIS G 3214:1991	349, 354
SUM 24 L	JIS G 4804	479	SUS F 347	JIS G 3214:1991	349, 354
SUM 25	JIS G 4804	480	SUS F 347H	JIS G 3214:1991	349, 354
SUM 31	JIS G 4804	476	SUS F 410-A	JIS G 3214:1991	344, 345
SUM 31 L	JIS G 4804	476	SUS F 410-B	JIS G 3214:1991	344, 345
SUM 32	JIS G 4804:1999	493	SUS F 410-C	JIS G 3214:1991	344, 345
			SUS F 410-D	JIS G 3214:1991	344, 345

Steel Grade/Name	Specification	Page No.	Steel Grade/Name	Specification	Page No.
SUS F 630	JIS G 3214:1991	355	SUS304N2 (Continued)	JIS G 4305:1991	468
SUS F 6B	JIS G 3214:1991	344, 345	SUS304TB	JIS G 3463:1994	225, 431
SUS F 6NM	JIS G 3214:1991	344, 345	SUS304TKA	JIS G 3446:1994	200, 204
SUS201	JIS G 4303:1998	454, 457	SUS304TKC	JIS G 3446:1994	200, 204
SUS202	JIS G 4303:1998	454, 457	SUS304TP	JIS G 3459:1997	270, 278
SUS217J3L	JIS G 4304:1999	468	SUS305	JIS G 4303:1998	455, 459
SUS301	JIS G 4303:1998	454, 457		JIS G 4304:1999	468
	JIS G 4304:1999	428, 433		JIS G 4305:1991	468
	JIS G 4305:1999	428, 433		JIS G 4318:1998	455, 459
SUS301J1	JIS G 4304:1999	428, 434	SUS305J1	JIS G 4318:1998	470
	JIS G 4305:1999	428, 434	SUS309S	JIS G 3468:1994	271, 280
SUS301L	JIS G 4304:1999	428, 434		JIS G 4303:1998	455, 460
	JIS G 4305:1999	428, 434		JIS G 4304:1999	429, 437
SUS302	JIS G 4303:1998	454, 457		JIS G 4305:1999	429, 437
	JIS G 4304:1999	428, 435		JIS G 4311:1991	455, 460
	JIS G 4305:1999	428, 435		JIS G 4312:1991	429, 437
	JIS G 4318:1998	454, 457		JIS G 4318:1998	455, 460
SUS302B	JIS G 4304:1999	428, 435	SUS309STB	JIS G 3463:1994	226, 232
	JIS G 4305:1999	428, 435	SUS309STP	JIS G 3459:1997	271, 280
	JIS G 4312:1991	428, 435	SUS309TB	JIS G 3463:1994	226, 232
SUS303	JIS G 4303:1998	454, 457	SUS309TP	JIS G 3459:1997	271, 280
	JIS G 4304:1999	468	SUS310S	JIS G 3468:1994	271, 280
	JIS G 4318:1998	454, 457		JIS G 4303:1998	455, 460
SUS303Cu	JIS G 4303:1998	470		JIS G 4304:1999	429, 438
	JIS G 4318:1998	470		JIS G 4305:1999	429, 438
SUS303Se	JIS G 4303:1998	454		JIS G 4311:1991	455, 460
	JIS G 4318:1998	454		JIS G 4312:1991	429, 438
SUS304	JIS G 3468:1994	270, 278		JIS G 4318:1998	455, 460
	JIS G 4303:1998	454, 458	SUS310STB	JIS G 3463:1994	226, 232
	JIS G 4304:1999	428, 436	SUS310STP	JIS G 3459:1997	271, 280
	JIS G 4305:1999	428, 436	SUS310TB	JIS G 3463:1994	226, 233
	JIS G 4311:1991	454, 458	SUS310TP	JIS G 3459:1997	308
	JIS G 4312:1991	428, 436	SUS315J1	JIS G 4304:1999	468
	JIS G 4318:1998	454, 458		JIS G 4305:1991	468
SUS304HTB	JIS G 3463:1994	225, 232	SUS315J2	JIS G 4304:1999	468
SUS304HTP	JIS G 3459:1997	271, 280		JIS G 4305:1991	468
SUS304J1	JIS G 4304:1999	468	SUS316	JIS G 3468:1994	272, 281
	JIS G 4305:1991	468		JIS G 4303:1998	455, 460
SUS304J2	JIS G 4304:1999	468		JIS G 4304:1999	429, 438
	JIS G 4305:1991	468		JIS G 4305:1999	429, 438
SUS304J3	JIS G 4303:1998	470		JIS G 4311:1991	455, 460
	JIS G 4318:1998	470		JIS G 4312:1991	429, 438
SUS304L	JIS G 3468:1994	270, 279		JIS G 4318:1998	455, 460
	JIS G 4303:1998	454, 458	SUS316F	JIS G 4303:1998	470
	JIS G 4304:1999	428, 436		JIS G 4318:1998	470
	JIS G 4305:1999	428, 436	SUS316HTB	JIS G 3463:1994	228, 234
	JIS G 4318:1998	454, 458	SUS316HTP	JIS G 3459:1997	274, 283
SUS304LN	JIS G 4303:1998	454, 459	SUS316J1	JIS G 4303:1998	470
	JIS G 4304:1999	429, 437		JIS G 4304:1999	468
	JIS G 4305:1999	429, 437		JIS G 4305:1991	468
SUS304LTB	JIS G 3463:1994	225, 231	SUS316J1L	JIS G 4303:1998	470
SUS304LTP	JIS G 3459:1997	270		JIS G 4304:1999	468
SUS304N1	JIS G 4303:1998	454, 459		JIS G 4305:1991	468
	JIS G 4304:1999	429, 437	SUS316L	JIS G 3468:1994	273, 282
	JIS G 4305:1999	429, 437		JIS G 4303:1998	4, 455, 461
SUS304N2	JIS G 4303:1998	454, 459		JIS G 4304:1999	429, 439
	JIS G 4304:1999	468		JIS G 4305:1999	429, 439

634 Steel Grade/Name Index

Steel Grade/Name	Specification	Page No.	Steel Grade/Name	Specification	Page No.
SUS316L (Continued)	JIS G 4318:1998	4, 455, 461	SUS321TKA	JIS G 3446:1994	202, 207
SUS316LN	JIS G 4303:1998	455, 461	SUS321TP	JIS G 3459:1997	275, 285
	JIS G 4304:1999	430, 440	SUS329J1	JIS G 3468:1994	308
	JIS G 4305:1999	430, 440		JIS G 4303:1998	470
SUS316LTB	JIS G 3463:1994	227, 234		JIS G 4305:1991	468
SUS316LTP	JIS G 3459:1997	273, 282	SUS329J1TB	JIS G 3463:1994	307
SUS316N	JIS G 4303:1998	455, 461	SUS329J3L	JIS G 4304:1999	445
	JIS G 4304:1999	430, 439		JIS G 4305:1999	445
	JIS G 4305:1999	430, 439	SUS329J3LTB	JIS G 3463:1994	229, 236
SUS316TB	JIS G 3463:1994	227, 233	SUS329J4L	JIS G 4303:1998	470
SUS316Ti	JIS G 4303:1998	455, 462		JIS G 4305:1991	468
	JIS G 4304:1999	430, 440	SUS329J4LTB	JIS G 3463:1994	229, 236
	JIS G 4305:1999	430, 440	SUS347	JIS G 3468:1994	276, 286
	JIS G 4311:1991	455, 462		JIS G 4303:1998	456, 463
	JIS G 4312:1991	430, 440		JIS G 4311:1991	456, 463
SUS316TiTB	JIS G 3463:1994	228, 235		JIS G 4318:1998	456, 463
SUS316TiTP	JIS G 3459:1997	274, 284	SUS347HTB	JIS G 3463:1994	229, 236
SUS316TKA	JIS G 3446:1994	201, 205	SUS347HTP	JIS G 3459:1997	276, 286
SUS316TKC	JIS G 3446:1994	201, 205	SUS347TB	JIS G 3463:1994	229, 236
SUS316TP	JIS G 3459:1997	272, 281	SUS347TKA	JIS G 3446:1994	202, 207
SUS317	JIS G 3468:1994	274, 284	SUS347TP	JIS G 3459:1997	276, 286
	JIS G 4303:1998	456, 462	SUS403	JIS G 4303:1998	446, 448
	JIS G 4304:1999	468		JIS G 4304:1999	424, 425
	JIS G 4305:1991	468		JIS G 4305:1999	424, 425
	JIS G 4311:1991	456, 462		JIS G 4311:1991	446, 448
	JIS G 4312:1991	468,		JIS G 4312:1991	424, 425
SUS317J1	JIS G 4304:1999	430, 440,		JIS G 4318:1998	446, 448
		468	SUS405	JIS G 4303:1998	451, 452
	JIS G 4305:1991	468		JIS G 4304:1999	426, 427
	JIS G 4305:1999	430, 440		JIS G 4305:1999	426, 427
SUS317J2	JIS G 4304:1999	468		JIS G 4311:1991	451, 452
	JIS G 4305:1991	468		JIS G 4312:1991	426, 427
SUS317J3L	JIS G 4305:1991	468	SUS405TB	JIS G 3463:1994	307
SUS317L	JIS G 3468:1994	274, 284	SUS405TO	JIS G 3459:1997	308
	JIS G 4303:1998	456, 462	SUS409LTB	JIS G 3463:1994	307
	JIS G 4304:1999	430, 440	SUS409LTP	JIS G 3459:1997	308
	JIS G 4305:1999	430, 440	SUS409TB	JIS G 3463:1994	223, 224
SUS317LN	JIS G 4303:1998	470	SUS410	JIS G 4303:1998	446, 448
	JIS G 4304:1999	430, 440		JIS G 4304:1999	424, 425,
	JIS G 4305:1999	430, 440			468
SUS317LTB	JIS G 3463:1994	228, 235		JIS G 4305:1991	424, 425,
SUS317LTP	JIS G 3459:1997	274, 284			468
SUS317TB	JIS G 3463:1994	228, 235		JIS G 4311:1991	446, 448
SUS317TP	JIS G 3459:1997	274, 284		JIS G 4312:1991	468
SUS321	JIS G 3468:1994	275, 285		JIS G 4318:1998	446, 448
	JIS G 4303:1998	456, 462	SUS410F2	JIS G 4303:1998	470
	JIS G 4304:1999	430, 441		JIS G 4318:1998	470
	JIS G 4305:1999	430, 441	SUS410J1	JIS G 4303:1998	470
	JIS G 4311:1991	456, 462		JIS G 4311:1991	470
	JIS G 4312:1991	430, 441	SUS410L	JIS G 4303:1998	470
	JIS G 4318:1998	456, 462		JIS G 4304:1999	468
SUS321HTB	JIS G 3463:1994	229, 236		JIS G 4305:1991	468
SUS321HTP	JIS G 3459:1997	275, 285		JIS G 4312:1991	468
SUS321J1TP	JIS G 3459:1997	308	SUS410S	JIS G 4304:1999	424, 425
SUS321J3LTP	JIS G 3459:1997	308		JIS G 4305:1991	468
SUS321J4LTP	JIS G 3459:1997	308		JIS G 4305:1999	424, 425
SUS321TB	JIS G 3463:1994	228, 235	SUS410TB	JIS G 3463:1994	223, 224
			SUS410TiTB	JIS G 3463:1994	307

Steel Grade/Name	Specification	Page No.	Steel Grade/Name	Specification	Page No.
SUS410TKA	JIS G 3446:1994	199, 203	SUS440A	JIS G 4303:1998	446, 449
SUS410TKC	JIS G 3446:1994	199, 203		JIS G 4304:1999	468
SUS416	JIS G 4303:1998	446, 448		JIS G 4305:1991	468
	JIS G 4318:1998	446, 448	SUS440B	JIS G 4303:1998	446, 450
SUS420F	JIS G 4303:1998	446, 449	SUS440C	JIS G 4303:1998	447, 450
	JIS G 4318:1998	446, 449		JIS G 4318:1998	447, 450
SUS420F2	JIS G 4303:1998	470	SUS440F	JIS G 4303:1998	470
	JIS G 4318:1998	470	SUS444	JIS G 4304:1999	426, 427
SUS420J1	JIS G 4303:1998	446, 449		JIS G 4305:1991	468
	JIS G 4304:1999	424, 425		JIS G 4305:1999	426, 427
	JIS G 4305:1991	424, 425	SUS444TB	JIS G 3463:1994	307
	JIS G 4305:1999	468	SUS444TP	JIS G 3459:1997	308
	JIS G 4318:1998	446, 449	SUS445J1	JIS G 4304:1999	468
SUS420J2	JIS G 4303:1998	446, 449		JIS G 4305:1991	468
	JIS G 4304:1999	424, 425	SUS445J2	JIS G 4304:1999	468
	JIS G 4305:1991	468		JIS G 4305:1991	468
	JIS G 4305:1999	424, 425	SUS447J1	JIS G 4303:1998	451, 452
	JIS G 4318:1998	446, 449, 470		JIS G 4304:1999	468
	JIS G 4318:1998	446, 449, 470		JIS G 4305:1991	468
SUS429	JIS G 4304:1999	468	SUS630	JIS G 4303:1998	464, 465
	JIS G 4305:1991	468		JIS G 4304:1999	443
SUS429J1	JIS G 4304:1999	468		JIS G 4305:1999	443
	JIS G 4305:1991	468		JIS G 4311:1991	464, 466
SUS430	JIS G 4303:1998	451, 452		JIS G 4312:1991	443, 444
	JIS G 4304:1999	426, 427	SUS631	JIS G 4303:1998	464, 466
	JIS G 4305:1999	426, 427		JIS G 4311:1991	464, 466
	JIS G 4311:1991	451, 452	SUS836L	JIS G 4303:1998	456, 462
	JIS G 4312:1991	426, 427		JIS G 4304:1999	430, 441
	JIS G 4318:1998	451, 452		JIS G 4305:1999	430, 441
SUS430F	JIS G 4303:1998	451, 452	SUS836LTB	JIS G 3463:1994	230, 237
	JIS G 4318:1998	451, 452	SUS836LTP	JIS G 3459:1997	308
SUS430J1L	JIS G 4304:1999	468	SUS890L	JIS G 4303:1998	456, 462
	JIS G 4305:1991	468		JIS G 4304:1999	430, 441
	JIS G 4312:1991	468		JIS G 4305:1999	430, 441
SUS430J1LTB	JIS G 3463:1994	307	SUS890LTB	JIS G 3463:1994	230, 237
SUS430J1LTP	JIS G 3459:1997	308	SUS890LTP	JIS G 3459:1997	277, 287
SUS430LX	JIS G 4304:1999	426, 427	SUSXM151J1	JIS G 4312:1991	468
	JIS G 4305:1999	426, 427	SUSXM15J1	JIS G 4303:1998	470
SUS430LXTB	JIS G 3463:1994	223, 224		JIS G 4304:1999	468
SUS430LXTP	JIS G 3459:1997	308		JIS G 4305:1991	468
SUS430TB	JIS G 3463:1994	223, 224		JIS G 4311:1991	470
SUS430TKA	JIS G 3446:1994	199, 203	SUSXM15J1TB	JIS G 3463:1994	307
SUS430TKC	JIS G 3446:1994	199, 203	SUSXM27	JIS G 4303:1998	451, 452
SUS430TP	JIS G 3459:1997	308		JIS G 4304:1999	468
SUS431	JIS G 4303:1998	446, 449		JIS G 4305:1991	468
	JIS G 4311:1991	446, 449	SUSXM27TB	JIS G 3463:1994	229, 237
SUS434	JIS G 4303:1998	451, 452	SUSXM7	JIS G 4303:1998	470
	JIS G 4304:1999	426, 427		JIS G 4304:1999	468
	JIS G 4305:1999	426, 427		JIS G 4305:1991	468
SUS436J1L	JIS G 4304:1999	468	SUSXM8TB	JIS G 3463:1994	307
	JIS G 4305:1991	468	T	ASTM A 514/A 514M-94	78, 82
	JIS G 4312:1991	468		ASTM	143
SUS436L	JIS G 4304:1999	468		A 517/A 517M-93 (1999)	
	JIS G 4305:1991	468	T1	ASTM A 209/A 209M-98	216, 219
SUS436LTB	JIS G 3463:1994	307		ASTM A 250/A 250M-99	216, 219
SUS436LTP	JIS G 3459:1997	308		ASTM A 600-92 (1999)	486
				SAE J438-1970	486

636 Steel Grade/Name Index

Steel Grade/Name	Specification	Page No.	Steel Grade/Name	Specification	Page No.
T11	ASTM A 213/A 213M-99	217, 221	TP304H	ASTM A 249/A 249M-98	225, 232
	ASTM A 250/A 250M-99	217, 221		ASTM A 312/A 312M-00	271, 280
T12	ASTM A 213/A 213M-99	217, 220		ASTM A 376/A 376M-98	271, 280
	ASTM A 250/A 250M-99	217, 220	TP304L	ASTM A 249/A 249M-98	225, 231
T122	ASTM A 213/A 213M-99	307		ASTM A 269-01	200, 204
T15	ASTM A 600-92 (1999)	486		ASTM A 312/A 312M-00	270
T17	ASTM A 213/A 213M-99	307		ASTM A 409/A 409M-95	270, 279
T1a	ASTM A 209/A 209M-98	216, 219		ASTM A 688/A 688M-00	225, 231
	ASTM A 250/A 250M-99	216, 219		ASTM A 851-96	225, 231
T1b	ASTM A 209/A 209M-98	216, 219	TP304LN	ASTM A 249/A 249M-98	226, 232
	ASTM A 250/A 250M-99	216, 219		ASTM A 269-01	200, 205
T2	ASTM A 213/A 213M-99	216, 220		ASTM A 312/A 312M-00	308
	ASTM A 250/A 250M-99	216, 220		ASTM A 376/A 376M-98	271, 279
	SAE J438-1970	495		ASTM A 688/A 688M-00	226, 232
T21	ASTM A 213/A 213M-99	307	TP304N	ASTM A 249/A 249M-98	226, 232
T22	ASTM A 213/A 213M-99	217, 221		ASTM A 312/A 312M-00	308
	ASTM A 250/A 250M-99	217, 221		ASTM A 688/A 688M-00	226, 232
T23	ASTM A 213/A 213M-99	307	TP305	ASTM A 249/A 249M-98	307
T4	ASTM A 600-92 (1999)	486	TP309Cb	ASTM A 249/A 249M-98	307
	SAE J438-1970	486		ASTM A 312/A 312M-00	308
T5	ASTM A 213/A 213M-99	218, 221		ASTM A 409/A 409M-95	308
	ASTM A 600-92 (1999)	486	TP309H	ASTM A 249/A 249M-98	226, 232
	SAE J438-1970	486		ASTM A 312/A 312M-00	308
T5b	ASTM A 213/A 213M-99	218, 221	TP309HCb	ASTM A 249/A 249M-98	307
T5c	ASTM A 213/A 213M-99	307		ASTM A 312/A 312M-00	308
T6	ASTM A 600-92 (1999)	495	TP309S	ASTM A 249/A 249M-98	226, 232
T8	ASTM A 600-92 (1999)	495		ASTM A 312/A 312M-00	271, 280
	SAE J438-1970	495		ASTM A 409/A 409M-95	308
T9	ASTM A 213/A 213M-99	218	TP310Cb	ASTM A 249/A 249M-98	307
T91	ASTM A 213/A 213M-99	218, 222		ASTM A 312/A 312M-00	308
T92	ASTM A 213/A 213M-99	307		ASTM A 409/A 409M-95	308
TP 304	ASTM A 632-98	200, 204	TP310H	ASTM A 249/A 249M-98	307
TP 304L	ASTM A 632-98	200, 204		ASTM A 312/A 312M-00	308
	ASTM A 778-98	200, 204	TP310HCb	ASTM A 249/A 249M-98	307
TP 310	ASTM A 632-98	306		ASTM A 312/A 312M-00	308
TP 316	ASTM A 632-98	201, 205	TP310S	ASTM A 249/A 249M-98	226, 232
TP 316L	ASTM A 632-98	201, 206		ASTM A 312/A 312M-00	271, 280
	ASTM A 778-98	201, 206		ASTM A 409/A 409M-95	308
TP 316N	ASTM A 688/A 688M-00	307	TP316	ASTM A 249/A 249M-98	227, 233
TP 317	ASTM A 632-98	306		ASTM A 269-01	201, 205
TP 321	ASTM A 632-98	202, 207		ASTM A 312/A 312M-00	272, 281
	ASTM A 778-98	202, 207		ASTM A 376/A 376M-98	272, 281
TP 347	ASTM A 632-98	202, 207		ASTM A 409/A 409M-95	272, 281
	ASTM A 778-98	202, 207		ASTM A 688/A 688M-00	227, 233
TP 348	ASTM A 632-98	306	TP316H	ASTM A 249/A 249M-98	228, 234
TP XM-27	ASTM A 803/A 803M-01	229, 237		ASTM A 312/A 312M-00	274, 283
TP XM-29	ASTM A 688/A 688M-00	307		ASTM A 376/A 376M-98	274, 283
TP XM-33	ASTM A 803/A 803M-98	307	TP316L	ASTM A 249/A 249M-98	227, 234
TP201	ASTM A 249/A 249M-98	307		ASTM A 269-01	201, 206
TP202	ASTM A 249/A 249M-98	307		ASTM A 312/A 312M-00	273, 282
TP304	ASTM A 249/A 249M-98	225, 231		ASTM A 409/A 409M-95	273, 282
	ASTM A 269-01	200, 204		ASTM A 688/A 688M-00	227, 234
	ASTM A 312/A 312M-00	270, 278	TP316LN	ASTM A 249/A 249M-98	228, 234
	ASTM A 376/A 376M-98	270, 278		ASTM A 269-01	201, 206
	ASTM A 409/A 409M-95	270, 278		ASTM A 312/A 312M-00	308
	ASTM A 688/A 688M-00	225, 231		ASTM A 376/A 376M-98	273, 283
	ASTM A 851-96	225, 231		ASTM A 688/A 688M-00	228, 234

Steel Grade/Name	Specification	Page No.	Steel Grade/Name	Specification	Page No.
TP316N	ASTM A 249/A 249M-98	307	TS 1	ISO 2604-II:1975	208, 212
	ASTM A 312/A 312M-00	308		ISO 2937:1974	158, 180
TP317	ASTM A 249/A 249M-98	228, 235	TS 10	ISO 2604-II:1975	210, 214
	ASTM A 269-01	305	TS 10 CD 9-10	AFNOR	264, 268
	ASTM A 312/A 312M-00	274, 284		NF A 49-253:1982	
	ASTM A 409/A 409M-95	274, 284	TS 10 N 9	AFNOR	241, 244
TP317L	ASTM A 249/A 249M-98	228, 235		NF A 49-245:1986	
	ASTM A 312/A 312M-00	274, 284	TS 13	ISO 2604-II:1975	211, 215
TP321	ASTM A 249/A 249M-98	228, 235	TS 14	ISO 2604-II:1975	211, 215
	ASTM A 269-01	202, 207	TS 15	ISO 2604-II:1975	211, 215
	ASTM A 312/A 312M-00	275, 285	TS 15 CD 2 05	AFNOR	262, 266
	ASTM A 376/A 376M-98	275, 285		NF A 49-243:1985	
	ASTM A 409/A 409M-95	275, 285		AFNOR	215, 220
TP321H	ASTM A 249/A 249M-98	229, 236		NF A 49-245:1986	
	ASTM A 312/A 312M-00	275, 285		AFNOR	262, 266
	ASTM A 376/A 376M-98	275, 285	TS 15 CD 4 05	NF A 49-253:1982	263, 267
TP347	ASTM A 249/A 249M-98	229, 236		AFNOR	
	ASTM A 269-01	202, 207		NF A 49-243:1985	217, 220
	ASTM A 312/A 312M-00	276, 286	TS 15 D 3	NF A 49-245:1986	
	ASTM A 376/A 376M-98	276, 286		AFNOR	216, 219
	ASTM A 409/A 409M-95	276, 286		NF A 49-245:1986	
TP347H	ASTM A 249/A 249M-98	229, 236		AFNOR	262, 266
	ASTM A 312/A 312M-00	276, 286	TS 17 N 2	NF A 49-253:1982	
	ASTM A 376/A 376M-98	276, 286		AFNOR	241
TP347LN	ASTM A 312/A 312M-00	308	TS 18	NF A 49-245:1986	
TP348	ASTM A 249/A 249M-98	307		ISO 2604-II:1975	211, 215
	ASTM A 269-01	305		ISO 2937:1974	169, 189
	ASTM A 312/A 312M-00	308	TS 18 M 5	AFNOR	170, 190
	ASTM A 409/A 409M-95	308		NF A 49-343:1980	
TP348H	ASTM A 249/A 249M-98	307	TS 18 MAD 5	AFNOR	194
	ASTM A 312/A 312M-00	308		NF A 49-343: 1980	
TP403Ti	ASTM A 268/A 268M-00	305	TS 18 MDV 5	AFNOR	175
TP405	ASTM 268/A 268M-00	199, 203		NF A 49-343:1980	
TP409	ASTM A 268/A 268M-00	199, 203	TS 2	ISO 2604-II:1975	208
	ASTM A 803/A 803M-01	223, 224	TS 26	ISO 2604-II:1975	216, 219
TP410	ASTM A 268/A 268M-00	199, 203	TS 30-0	AFNOR	157, 160,
TP429	ASTM A 268/A 268M-00	305		NF A 49-341: 1975	180, 182
TP430	ASTM A 268/A 268M-00	199, 203	TS 30-a	AFNOR	157, 160,
TP439	ASTM A 268/A 268M-00	199, 203		NF A 49-341: 1975	161, 180,
	ASTM A 803/A 803M-01	223, 224	TS 32		182, 183
TP443	ASTM A 268/A 268M-00	305		ISO 2604-II:1975	217, 220
TP446-1	ASTM A 268/A 268M-00	305	TS 33	ISO 2604-II:1975	216, 220
TP446-2	ASTM A 268/A 268M-00	305	TS 34	ISO 2604-II:1975	217, 221
TPXM-10	ASTM A 269-01	305	TS 34 a	AFNOR	158, 161,
	ASTM A 312/A 312M-00	308		NF A 49-341	163, 180,
TPXM-11	ASTM A 269-01	305	TS 34 BT		183, 184
	ASTM A 312/A 312M-00	308		AFNOR	238, 240
TPXM-15	ASTM A 269-01	305	TS 34 c	NF A 49-245:1986	
	ASTM A 312/A 312M-00	308		AFNOR	208, 212
TPXM-19	ASTM A 249/A 249M-98	307	TS 37	NF A 49-245:1986	
	ASTM A 269-01	305		ISO 2604-II :1975	218, 221
	ASTM A 312/A 312M-00	308	TS 37 a	AFNOR	161, 164,
	ASTM A 269-01	305		NF A 49-341:1975	167, 187
	ASTM A 312/A 312M-00	308		AFNOR	161
	ASTM A 249/A 249M-98	307	TS 37 a (NE)	NF A 49-141:1978	
	ASTM A 269-01	305		AFNOR	182, 183,
	ASTM A 312/A 312M-00	308	TS 37 b	NF A 49-141:1978	185
TPXM-27	ASTM A 268/A 268M-00	305		AFNOR	161, 183
TPXM-29	ASTM A 249/A 249M-98	307	TS 37 c	NF A 49-343:1980	
	ASTM A 269-01	305		AFNOR	249, 257
	ASTM A 312/A 312M-00	308		NF A 49-242:1985	
TPXM-33	ASTM A 268/A 268M-00	305		AFNOR	209, 213
				NF A 49-245:1986	

638 Steel Grade/Name Index

Steel Grade/Name	Specification	Page No.	Steel Grade/Name	Specification	Page No.
TS 37 c (Continued)	AFNOR	249, 257	TS 9	ISO 2937:1974	164, 185
TS 37 CP	NF A 49-243:1985			ISO 2604-II:1975	210, 214
	AFNOR	248, 257	TS 9H	ISO 2604-II:1975	210, 214
	NF A 49-252:1982		TS E 185 A	AFNOR	247, 256
	AFNOR	248, 257		NF A 49-142:1987	
TS 38	NF A 49-253:1982		TS E 235 A	AFNOR	249, 257
TS 39	ISO 2604-II:1975	218, 222		NF A 49-142:1987	
TS 4	ISO 2604-II:1975	223, 224	TS E 24 a	AFNOR	161, 182
	ISO 2937:1974	160, 182		NF A 49-250	
	ISO 2604-II:1975	209, 213	TS E 24 W 3	AFNOR	309
TS 40	ISO 2604-II:1975	223, 224		NF A 49-242:1985	
TS 42 a	AFNOR	165, 168,		AFNOR	307
	NF A 49-341:1975	170, 186,		NF A 49-245:1986	
		188, 190	TS E 250 A	AFNOR	250, 257
TS 42 BT	AFNOR	239, 240		NF A 49-142:1987	
	NF A 49-245:1986		TS E 26-b	AFNOR	164, 185
TS 42 C	AFNOR	250, 258		NF A 49-250:1979	
	NF A 49-242:1985		TS E 275 A	AFNOR	253, 260
	AFNOR	250, 258		NF A 49-142:1987	
	NF A 49-243:1985		TS E 36 WB3	AFNOR	307
	AFNOR	210, 214		NF A 49-245:1986	
	NF A 49-245:1986			AFNOR	309
TS 42 CP	AFNOR	250, 258		NF A 49-242:1985	
	NF A 49-252:1982		TS Z 10 CD 5-05	AFNOR	264, 268
	AFNOR	250, 258		NF A 49-253:1982	
	NF A 49-253:1982		TS Z 12 CN 17-07	AFNOR	306
TS 43	ISO 2604-II:1975	307		NF A 49-647:1979	
TS 45	ISO 2604-II:1975	307	TS Z 2 CN 18-10	AFNOR	225, 231
TS 46	ISO 2604-II:1975	225, 231		NF A 49-247:1981	
TS 47	ISO 2604-II:1975	225, 231		AFNOR	200, 204
TS 47 a	AFNOR	168, 171,	TS Z 2 CND 17-12	AFNOR	227, 234
	NF A 49-341: 1975	173, 188,		NF A 49-247:1981	
		190, 192	TS Z 2 CND 19-15	AFNOR	228, 235,
TS 48	ISO 2604-II:1975	225, 232		NF A 49-247:1981	307
TS 48 C	AFNOR	253, 260	TS Z 6 C 13	AFNOR	223, 224
	NF A 49-243:1985			NF A 49-245:1986	
	AFNOR	211, 215	TS Z 6 CN 18-09	AFNOR	225, 231
	NF A 49-245:1986			NF A 49-247:1981	
TS 48 CP	AFNOR	253, 260		AFNOR	200, 204
	NF A 49-252:1982			NF A 49-647:1979	
	AFNOR	253, 260	TS Z 6 CND 17-11	AFNOR	201, 205
	NF A 49-253:1982			NF A 49-647:1979	
TS 5	ISO 2604-II:1975	209, 213		AFNOR	227, 233
TS 50	ISO 2604-II:1975	229, 236		NF A 49-247:1981	
TS 52 C	AFNOR	254, 261	TS Z 6 CNT 18-10	AFNOR	228, 235
	NF A 49-243:1985			NF A 49-247:1981	
TS 52 CP	AFNOR	254, 261	TS Z 6 CT 12	AFNOR	223, 224
	NF A 49-252:1982			NF A 49-245:1986	
	AFNOR	254, 261	TS Z 8 C 17	AFNOR	223, 224
	NF A 49-253:1982			NF A 49-245:1986	
TS 53	ISO 2604-II:1975	228, 235		AFNOR	199, 203
TS 54	ISO 2604-II:1975	229, 236		NF A 49-647:1979	
TS 56	ISO 2604-II:1975	229, 236	TS Z 8 CT 17	AFNOR	223, 224
TS 57	ISO 2604-II:1975	227, 234		NF A 49-245:1986	
TS 58	ISO 2604-II:1975	227, 234	TStE 255	DIN 17178:1986	288, 291
TS 6	ISO 2604-II:1975	209, 213		DIN 17179:1986	288, 291
TS 60	ISO 2604-II:1975	227, 233	TStE 285	DIN 17178:1986	288, 291
TS 61	ISO 2604-II:1975	227, 233		DIN 17179:1986	288, 291
TS 63	ISO 2604-II:1975	228, 234	TStE 355	DIN 17178:1986	260, 289,
TS 67	ISO 2604-II:1975	307			291
TS 68	ISO 2604-II:1975	226, 233		DIN 17179:1986	289, 291
TS 69	ISO 2604-II:1975	307	TStE 420	DIN 17178:1986	289, 291
				DIN 17179:1986	289, 291
			TStE 460	DIN 17178:1986	290, 292

Steel Grade/Name	Specification	Page No.	Steel Grade/Name	Specification	Page No.
TStE 460 (Continued)	DIN 17179:1986	290, 292	TU 37 F	AFNOR	248, 257
TTSt 35 N	DIN 28181:1985	208		NF A 49-219:1990	
	DIN 28180:1985	208, 209, 212, 213	TU 42 BT	AFNOR	239, 240
	DIN 17173:1985	238, 240		NF A 49-215:1981	
	DIN 17174:1985	238, 240	TU 42 C	AFNOR	250, 258
TTSt 35 V	DIN 17173:1985	238, 240		NF A 49-213:1990	
	DIN 17174:1985	238, 240		AFNOR	210, 214
TU 10 CD 5-05	AFNOR	263, 267		NF A 49-215:1981	
	NF A 49-213:1990			AFNOR	250, 258
	AFNOR	217, 221	TU 42 CR	NF A 49-220:1990	
	NF A 49-215:1981			AFNOR	250, 251, 258, 259
	AFNOR	263, 267	TU 42 F	NF A 49-213:1990	
	NF A 49-219:1990			AFNOR	250, 258
	AFNOR	263, 267	TU 48 C	NF A 49-219:1990	
	NF A 49-220:1990			AFNOR	253
TU 10 CD 9-10	AFNOR	264, 268		NF A 49-213:1990	
	NF A 49-213:1990			AFNOR	211, 215
	AFNOR	221		NF A 49-215:1981	
	NF A 49-215:1981			AFNOR	253
	AFNOR	217, 264, 268	TU 48 CR	NF A 49-220:1990	
	NF A 49-219:1990			AFNOR	253, 260
	AFNOR	264, 268	TU 52 b	NF A 49-213:1990	
	NF A 49-220:1990			AFNOR	168, 170, 173, 175, 177, 188, 190, 192, 194, 195
TU 10 N 14	AFNOR	241, 244		NF A 49-310:1994	
	NF A 49-215:1981			AFNOR	170, 190
TU 10 N 9	AFNOR	241, 244		NF A 49-311:1994	
	NF A 49-215:1981		TU 52 C	AFNOR	254, 261
TU 13 CD 4-04	AFNOR	263, 267		NF A 49-213:1990	
	NF A 49-213:1990			AFNOR	254, 261
	AFNOR	263, 267		NF A 49-220:1990	
	NF A 49-219:1990			AFNOR NF A 49-311	173, 192
TU 13 CD 4-04 (1)	AFNOR	263, 267	TU 56-b	AFNOR	248, 257
	NF A 49-220:1990		TU E 220 A	NF A 49-112:1987	
TU 15 CD 2 05	AFNOR	262, 266		AFNOR	250, 258
	NF A 49-213:1990		TU E 235 A	NF A 49-112:1987	
	AFNOR	216, 220		AFNOR NF A 49-311	172, 191
	NF A 49-215:1981		TU XC 35	AFNOR	229, 237
	AFNOR	262, 266	TU Z 1 CND 25 22 AZ	NF A 49-217:1987	
	NF A 49-220:1990			AFNOR	230, 237
TU 15 D 3	AFNOR	262, 266	TU Z 1 CNDU 20 18 06 AZ	NF A 49-217:1987	
	NF A 49-213:1990			AFNOR	230, 237
	AFNOR	216, 219	TU Z 1 CNS 18 15	NF A 49-217:1987	
	NF A 49-215:1981			AFNOR	307
	AFNOR	262, 266	TU Z 1 NCDU 25 20 04	NF A 49-217:1987	
	NF A 49-220:1990			AFNOR	307
TU 17 N 2	AFNOR	241, 243	TU Z 1 NCDU 31 27 03	NF A 49-217:1987	
	NF A 49-215:1981			AFNOR	223, 224
TU 20 MV 6	AFNOR	171, 173, 175, 177, 178, 191, 192, 194, 195	TU Z 10 C 17	NF A 49-217:1987	
	NF A 49-310:1994			AFNOR	264, 269
			TU Z 10 CD 09	NF A 49-213:1990	
TU 37 a	AFNOR			AFNOR	264, 269
	NF A 49-111			NF A 49-219:1990	
TU 37 b	AFNOR	158, 161, 162, 165, 166, 180, 183, 186	TU Z 10 CD 5 05	AFNOR	218, 221
	NF A 49-310:1994	160, 182		NF A 49-215:1981	
			TU Z 10 CD 9	AFNOR	218, 222
	AFNOR			NF A 49-215:1981	
	NF A 49-311		TU Z 10 CDNbV 09-02	AFNOR	309
	AFNOR	248, 257		NF A 49-213:1990	
	NF A 49-213:1990		TU Z 10 CDVNB 09-01	AFNOR	309
TU 37 C	AFNOR	209, 213		NF A 49-213:1990	
	AFNOR	248, 257		AFNOR	309
	NF A 49-215:1981			NF A 49-219:1990	
	AFNOR		TU Z 12 C 13	AFNOR	223, 224
	NF A 49-220:1990			NF A 49-217:1987	

640 Steel Grade/Name Index

Steel Grade/Name	Specification	Page No.	Steel Grade/Name	Specification	Page No.
TU Z 12 CD 05-05	AFNOR NF A 49-213:1990	264, 268	Type B, Cl. 1	ASTM A 533/A 533M-93	130
	AFNOR	264, 268	Type B, Cl. 2	ASTM A 533/A 533M-93	130
	NF A 49-219:1990		Type B, Cl. 3	ASTM A 533/A 533M-93	130
TU Z 2 CN 18 10	AFNOR	225, 231	Type C, Cl. 1	ASTM A 533/A 533M-93	131
	NF A 49-217:1987		Type C, Cl. 2	ASTM A 533/A 533M-93	131
	AFNOR	200, 204	Type C, Cl. 3	ASTM A 533/A 533M-93	131
	NF A 49-317:1980		Type I	ASTM A 553/A 553M-95	128, 129
TU Z 2 CN 18 10 AZ	AFNOR	226, 232	Type I	ASTM	408
	NF A 49-217:1987			A 447/A 447M-93 (1998)	
TU Z 2 CN Nb 25 20	AFNOR	307	Type II	ASTM A 553/A 553M-95	128, 129
	NF A 49-217:1987		Type II	ASTM	414
TU Z 2 CND 17 12	AFNOR	227, 234		A 447/A 447M-93 (1998)	
	NF A 49-217:1987			ASTM	367, 371
	AFNOR	201, 206		A 27/A 27M-95 (2000)	
	NF A 49-317:1980		U-60-30	DIN 1626:1984	248, 257
TU Z 2 CND 17 12 AZ	AFNOR	228, 234	USt 37.0	SAE J438-1970	485
	NF A 49-217:1987		W108	SAE J438-1970	485
TU Z 2 CND 18 05 03	AFNOR	307	W109	SAE J438-1970	485
	NF A 49-217:1987		W110	SAE J438-1970	485
TU Z 2 CND 18 14	AFNOR	227, 234	W112	SAE J438-1970	485
	NF A 49-217:1987		W1-A-10	ASTM A 686-92 (1999)	485
TU Z 2 CND 22 05 03	AFNOR	229, 236	W1-A-11½	ASTM A 686-92 (1999)	485
	NF A 49-217:1987		W1-A-8	ASTM A 686-92 (1999)	485
TU Z 2 CND 25 07 03	AFNOR	229, 236	W1-A-8½	ASTM A 686-92 (1999)	485
	NF A 49-217:1987		W1-A-9	ASTM A 686-92 (1999)	485
TU Z 2 CNDU 17 16	AFNOR	307	W1-C	ASTM A 686-92 (1999)	495
	NF A 49-217:1987		W209	SAE J438-1970	495
TU Z 5 CNDU 21 08 02	AFNOR	307	W210	SAE J438-1970	495
	NF A 49-217:1987		W2-A-8½	ASTM A 686-92 (1999)	485
TU Z 6 CN 18 09	AFNOR	225, 231	W2-A-9½	ASTM A 686-92 (1999)	485
	NF A 49-217:1987		W2-C	ASTM A 686-92 (1999)	495
TU Z 6 CND 17 11	AFNOR	227, 233	W310	SAE J438-1970	495
	NF A 49-217:1987		W5	ASTM A 686-92 (1999)	495
TU Z 6 CNT 18 10	AFNOR	228, 235	WC1	ASTM A 217/A 217M-99	388, 389
	NF A 49-217:1987		WC11	ASTM A 217/A 217M-99	418
TU Z 6 N 9	AFNOR	242, 245	WC4	ASTM A 217/A 217M-99	418
	NF A 49-215:1981		WC5	ASTM A 217/A 217M-99	418
TW 1	ISO 2604-III:1975	208, 212	WC6	ASTM A 217/A 217M-99	388, 389
TW 10	ISO 2604-III:197	210, 214	WC9	ASTM A 217/A 217M-99	388, 389
TW 13	ISO 2604-III:1975	211, 215	WCA	ASTM	375, 376
TW 14	ISO 2604-III:1975	211, 215		A 216/A 216M-93 (1998)	
TW 15	ISO 2604-III:1975	211, 215	WCB	ASTM	375, 376
TW 2	ISO 2604-III:1975	208, 212		A 216/A 216M-93 (1998)	
TW 26	ISO 2604-III:1975	216, 219	WCC	ASTM	375, 376
TW 32	ISO 2604-III:1975	217, 220		A 216/A 216M-93 (1998)	
TW 4	ISO 2604-III:1975	209, 213	WStE 255	DIN 17178:1986	257
TW 46	ISO 2604-V:1978	225, 231		DIN 17179:1986	257
TW 47	ISO 2604-V:1978	225, 231	WStE 285	DIN 17178:1986	258
TW 5	ISO 2604-III:1975	209, 213		DIN 17179:1986	258
TW 50	ISO 2604-V:1978	229, 236	WStE 355	DIN 17178:1986	260
TW 53	ISO 2604-V:1978	228, 235		DIN 17179:1986	260
TW 57	ISO 2604-V:1978	227, 234	WStE 420	DIN 17178:1986	261
TW 58	ISO 2604-V:1978	227, 234		DIN 17179:1986	261
TW 6	ISO 2604-III:1975	209, 213	WStE 460	DIN 17178:1986	309
TW 60	ISO 2604-V:1978	227, 233	X 10 Ni 9	ISO 9329-3:1997	242, 245
TW 61	ISO 2604-V:1978	227, 233		ISO 9330-5:2000	242, 245
TW 69	ISO 2604-V:1975	307	X 12 CrNi 17 7	DIN 17224:1982	484
TW 9	ISO 2604-III:1975	210, 214	X 12 Ni 5	ISO 9329-3:1997	241, 245
TW 9H	ISO 2604-III:197	210, 214		ISO 9330-3:1997	241, 245
Type A, Cl. 1	ASTM A 533/A 533M-93	113, 114			
Type A, Cl. 2	ASTM A 533/A 533M-93	113, 114			
Type A, Cl. 3	ASTM A 533/A 533M-93	113, 114			

Steel Grade/Name	Specification	Page No.	Steel Grade/Name	Specification	Page No.
X 12 Ni 5 (Continued)	ISO 9330-5:2000	241, 245	X 6 CrNiMoTi 17 12 2	ISO 9328-5:1991	136, 140
X 2 CrNi 18 10	ISO 9328-5:1991	134, 137	(Continued)	DIN 17457:1985	285
X 2 CrNi 19 11	DIN 17457:1985	270, 279		DIN 17458:1985	285
	DIN 17458:1985	270, 279		DIN 28180:1985	228, 235
X 2 CrNiMo 17 12	ISO 9328-5:1991	135, 138		DIN 28181:1985	228, 235
X 2 CrNiMo 17 13	ISO 9328-5:1991	135, 138		ISO 9328-5:1991	136, 140
X 2 CrNiMo 17 13 2	DIN 17457:1985	273, 282	X 7 CrNi 18 9	ISO 9328-5:1991	134, 137
	DIN 17458:1985	273, 282	X 7 CrNiAl 17 7	DIN 17224:1982	484
X 2 CrNiMo 18 14 3	DIN 17457:1985	273, 282	X 7 CrNiMo 17 12	ISO 9328-5:1991	135, 138
	DIN 17458:1985	273, 282	X 7 CrNiMoB 17 12	ISO 9328-5:1991	146
X 2 CrNiMoN 17 12	ISO 9328-5:1991	135, 139	X 7 CrNiNb 18 10	ISO 9328-5:1991	136, 140
X 2 CrNiMoN 17 13 3	DIN 17457:1985	273, 283	X 7 CrNiTi 18 10	ISO 9328-5:1991	136, 140
	DIN 17458:1985	273, 283	X 7 NiCrAlTi 32 21 TQ1	ISO 9328-5:1991	136, 140
X 2 CrNiMoN 17 13 5	ISO 9328-5:1991	136, 139	X 7 NiCrAlTi 32 21 TQ2	ISO 9328-5:1991	136, 140
	DIN 17457:1985	276, 287	X 8 CrNiMoNb 16 16	DIN 17459:1992	309
	DIN 17458:1985	276, 287	X 8 CrNiMoVNb 16 13	DIN 17459:1992	309
X 2 CrNiN 18 10	ISO 9328-5:1991	134, 137	X 8 CrNiNb 16 13	DIN 17459:1992	276, 286
	DIN 17457:1985	271, 279	X 8 CrNiTi 18 10	DIN 17459:1992	309
	DIN 17458:1985	271, 279	X 8 Ni 9	DIN 17173:1985	242, 245
X 2 NiCrMoCu 25 20 5	ISO 9328-5:1991	136, 140		DIN 17174:1985	242, 245
X 20 CrMoV 12 1	DIN 17175:1979	265, 269		ISO 9328-3:1991	128, 129
X 3 CrNiMo 18 16 4	ISO 9328-5:1991	135, 139	X 8 NiCrAlTi 32 21	DIN 17459:1992	277, 287
X 3 CrNiMoN 17 13	DIN 17459:1992	274, 283	X 8 NiCrAlTi 32 21 TQ1	ISO 9328-5:1991	136, 140
X 3 CrNiN 18 11	DIN 17459:1992	309	X 8 NiCrAlTi 32 21 TQ2	ISO 9328-5:1991	136, 140
X 42, PSL 1 seamless	API 5L-2000	295	X100CrMoV5	EN ISO 4957:1999	489
X 42, PSL 1 welded	API 5L-2000	295	X105CrMo17	EN 10088-3:1995	447, 450
X 42, PSL 2 seamless	API 5L-2000	301	X106CrMo17	EN ISO 683-17:1999	496
X 42, PSL 2 welded	API 5L-2000	301	X10CrAlSi13	EN 10095: 1999	469, 471
X 5 CrNi 18 10	DIN 17457:1985	270, 278		ISO 4955:1994	471
	DIN 17458:1985	270, 278	X10CrAlSi18	EN 10095: 1999	469, 471
	DIN 28180:1985	225, 231		ISO 4955:1994	471
	DIN 28181:1985	225, 231	X10CrAlSi25	EN 10095: 1999	469, 471
X 5 CrNi 18 9	ISO 9328-5:1991	134, 137		ISO 4955:1994	471
X 5 CrNiMo 17 12	ISO 9328-5:1991	134, 138	X10CrAlSi7	EN 10095: 1999	469, 471
X 5 CrNiMo 17 12 2	DIN 17457:1985	272, 281	X10CrMoVNb9-1	EN 10222-2:1999	337
	DIN 17458:1985	272, 281	X10CrNi18-8	EN 10088-2:1995	428, 433
	DIN 28180:1985	227, 233		EN 10088-3:1995	454, 457
	DIN 28181:1985	227, 233	X10NiCrAlTi32-21	EN 10095: 1999	469, 471
X 5 CrNiMo 17 13	ISO 9328-5:1991	134, 138	X10NiCrSi35-19	EN 10095: 1999	469, 471
X 5 CrNiMo17 13 3	DIN 17457:1985	272, 281	X10NiCrSiNb35-22	EN 10095: 1999	469, 471
	DIN 17458:1985	272, 281	X12Cr13	DIN 17456:1999	199, 203
X 5 CrNiMo 18 10	DIN 17224:1982	494		EN 10088-2:1995	468
X 5 NiCrAlTi 31 20	DIN 17459:1992	272, 287		EN 10088-3:1995	446, 448
X 6 CrNi 18 11	DIN 17459:1992	271, 280		EN 10250-4:1999	344, 345
X 6 CrNiMo 17 13	DIN 17459:1992	274, 283	X12CrMnNiN17-7-5	EN 10088-2:1995	428, 432
X 6 CrNiMoNb 17 12	ISO 9328-5:1991	135, 139	X12CrMnNiN18-9-5	EN 10088-2:1995	428, 433
X 6 CrNiMoNb 17 12 2	DIN 17458:1985	284	X12CrMo5-1	ISO 9327-2:1999	336
X 6 CrNiMoTi 17 12	ISO 9328-5:1991	135, 139	X12CrNi23-13	EN 10095:1999	429, 437,
X 6 CrNiMoTi 17 12 2	DIN 17457:1985	284			456, 463
	DIN 17458:1985	135, 139	X12CrS13	EN 10088-3:1995	446, 448,
	DIN 28180:1985	228, 235			478
	DIN 28181:1985	228, 235	X12Ni5	EN 10222-3:1999	339
	DIN 17457:1985	275, 276,	X12NiCrSi35-16	EN 10095: 1999	469, 471
		286		ISO 4955:1994	471
	DIN 17458:1985	275, 276,	X14CrMoS17	EN 10088-3:1995	471
		286	X153CrMoV12	EN ISO 4957:2000	495

642 Steel Grade/Name Index

Steel Grade/Name	Specification	Page No.	Steel Grade/Name	Specification	Page No.
X15CrN26	ISO 4955:1994	426, 427, 451, 453	X2CrNi12	EN 10028-7:2000	132, 133
X15CrNi24-13	AFNOR NF A 49-244:1993	271		EN 10088-2:1995	468
X15CrNiSi20-12	EN 10095: 1999	469, 471		EN 10088-3:1995	471
X15CrNiSi201-2	ISO 4955:1994	471	X2CrNi18-10	ISO 9327-5:1999	347, 350
X15CrNiSi25-21	EN 10095:1999	456, 463	X2CrNi18-9	EN 10250-4:1999	347, 350
	ISO 4955:1994	429, 438, 456, 463		EN 10222-5:1999	347, 350
X15CrNiSi25-4	EN 10095: 1999	469, 471		EN 10088-2:1995	428, 436
X16CrMo5-1	EN 10222-2:1999	336		EN 10088-3:1995	454, 458
X17CrNi16-2	EN 10088-3:1995	446, 449	X2CrNi19-11	DIN 17455:1999	200, 204
	EN 10250-4:1999	361		DIN 17456:1999	200, 204
X1CrNi25-20	AFNOR NF A 49-244:1993	271, 280		EN 10028-7:2000	134, 137
X1CrNi25-21	EN 10028-7:2000	146		EN 10088-2:1995	468
	EN 10088-2:1995	468		EN 10088-3:1995	471
X1CrNiMoCuN20-18-7	EN 10028-7:2000	146		EN 10250-4:1999	347, 350
	EN 10088-3:1995	471	X2CrNiCu19-10	EN 10222-5:1999	361
	EN 10250-4:1999	361	X2CrNiMo17-12	ISO 9327-5:1999	348, 352
X1CrNiMoCuN25-25-5	EN 10028-7:2000	146	X2CrNiMo17-12-2	DIN 17455:1999	201, 206
	EN 10088-2:1995	468		DIN 17456:1999	201, 206
	EN 10088-3:1995	471		EN 10028-7:2000	135, 138
X1CrNiMoN25-22-2	EN 10028-7:2000	146		EN 10088-2:1995	429, 439
X1CrNiMoNCu20-18-7	EN 10088-2:1995	468		EN 10088-3:1995	455, 461
X1CrNiSi18-15-4	EN 10088-2:1995	468		EN 10222-5:1999	348, 352
	EN 10088-3:1995	471		EN 10250-4:1999	348, 352
X1NiCrMoCu25-20-5	EN 10028-7:2000	136, 140	X2CrNiMo17-12-3	EN 10028-7:2000	135, 138
	EN 10088-2:1995	430, 441		EN 10088-2:1995	429, 439
	EN 10088-3:1995	456, 462, 471		EN 10088-3:1995	455, 461
	EN 10250-4:1999	349, 354, 361		EN 10222-5:1999	348, 352
X1NiCrMoCu31-27-4	EN 10028-7:2000	146	X2CrNiMo17-13	ISO 9327-5:1999	348, 352
	EN 10088-2:1995	468	X2CrNiMo17-13-3	EN 10222-5:1999	348, 353
	EN 10088-3:1995	471		EN 10250-4:1999	348, 353
	EN 10250-4:1999	361	X2CrNiMo18-14-3	DIN 17455:1999	201, 206
X1NiCrMoCuN25-20-7	EN 10028-7:2000	136, 140		DIN 17456:1999	201, 206
	EN 10088-3:1995	471		EN 10028-7:2000	135, 138
X1NiMoCuN25-20-7	EN 10250-4:1999	361		EN 10088-2:1995	429, 439
X20Cr13	EN 10088-2:1995	424, 425		EN 10088-3:1995	455, 461, 471
	EN 10088-3:1995	446, 449		EN 10222-5:1999	348, 352
	EN 10250-4:1999	361		EN 10250-4:1999	348, 352
X20CrMoV11-1	EN 10222-2:1999	338	X2CrNiMo18-15-4	EN 10028-7:2000	135, 139
X20CrMoV12-1	ISO 9327-2:1999	338		EN 10088-3:1995	456, 462
X210Cr12	EN ISO 4957:1999	489	X2CrNiMoCuN	EN 10088-2:1995	468
X210CrW12	EN ISO 4957:2000	495	X2CrNiMoCuN25-6-3	EN 10028-7:2000	141, 142
X25CrMnNiN25-9-7	EN 10095: 1999	469, 471		EN 10088-3:1995	471
X29CrS13	EN 10088-3:1995	446, 449		EN 10250-4:1999	356, 357
X2CrAlTi18-2	EN 10088-2:1995	468	X2CrNiMoCuWN25-7-4	EN 10028-7:2000	141, 142
X2CrMnNiN17-7-5	EN 10088-2:1995	428, 432		EN 10088-2:1995	468
X2CrMoTi17-1	EN 10088-2:1995	468		EN 10088-3:1995	471
X2CrMoTi18-2	EN 10028-7:2000	132, 133		EN 10222-5:1999	348, 353
	EN 10088-2:1995	426, 427	X2CrNiMoN17-11-2	EN 10028-7:2000	135, 139
X2CrMoTi29-4	EN 10088-2:1995	468		EN 10088-2:1995	430, 440
X2CrMoTiS18-2	EN 10088-3:1995	451, 452		EN 10088-3:1995	455, 461
X2CrNbZr17	EN 10088-2:1995	468		EN 10222-5:1999	348, 353
				EN 10250-4:1999	348, 353
			X2CrNiMoN17-12	ISO 9327-5:1999	348, 353
			X2CrNiMoN17-13	ISO 9327-5:1999	348, 353
			X2CrNiMoN17-13-3	DIN 17455:1999	201, 206
				DIN 17456:1999	201, 206

Steel Grade/Name	Specification	Page No.	Steel Grade/Name	Specification	Page No.
X2CrNiMoN17-13-3	EN 10028-7:2000	135, 139	X38CrMo16	EN ISO 4957:2000	495
(Continued)	EN 10088-2:1995	430, 440	X38CrMoV5-3	EN ISO 4957:2000	495
	EN 10088-3:1995	455, 461	X39Cr13	EN 10088-2:1995	468
X2CrNiMoN17-13-5	DIN 17455:1999	202, 207		EN 10088-3:1995	471
	DIN 17456:1999	202, 207	X39CrMo17-1	EN 10088-2:1995	468
	EN 10028-7:2000	136, 139		EN 10088-3:1995	471
	EN 10088-2:1995	430, 440, 468	X3CrAlTi18-2	EN 10095: 1999	469, 471
	EN 10088-3:1995	456, 462	X3CrNb17	EN 10088-2:1995	426, 427
X2CrNiMoN18-12-4	EN 10028-7:2000	135, 139	X3CrNi18-10	AFNOR	270
	EN 10088-2:1995	430, 440		NF A 49-244:1993	
X2CrNiMoN22-5-3	EN 10028-7:2000	141, 142	X3CrNiCu18-9-4	EN 10088-3:1995	471
	EN 10088-2:1995	445	X3CrNiCu19-9-2	EN 10088-3:1995	471
	EN 10088-3:1995	467	X3CrNiCuMo17-11-3-2	EN 10088-3:1995	471
	EN 10222-5:1999	356, 357	X3CrNiMo13-4	EN 10028-7:2000	132, 133
	EN 10250-4:1999	356, 357		EN 10088-2:1995	468
	ISO 9327-5:1999	356, 357		EN 10088-3:1995	471
X2CrNiMoN25-7-4	EN 10028-7:2000	141, 142		EN 10222-5:1999	344, 345
	EN 10088-2:1995	468		EN 10250-4:1999	344, 345
	EN 10088-3:1995	471	X3CrNiMo17-11-2	AFNOR	273, 282
	EN 10222-5:1999	356, 357		NF A 49-244:1993	
	EN 10250-4:1999	356, 357	X3CrNiMo17-12-3	AFNOR	273, 282
X2CrNiN18-10	DIN 17455:1999	200, 205		NF A 49-244:1993	
	DIN 17456:1999	200, 205	X3CrNiMo17-13-3	DIN 17455:1999	201, 205
	EN 10028-7:2000	134, 137		DIN 17456:1999	201, 205
	EN 10088-2:1995	429, 437		EN 10028-7:2000	134, 138
	EN 10088-3:1995	454, 459		EN 10088-2:1995	429, 438
	EN 10222-5:1999	347, 351		EN 10088-3:1995	455,
	EN 10250-4:1999	347, 351		EN 10222-5:1999	348, 351
	ISO 9327-5:1999	347, 351		EN 10250-4:1999	348, 351
X2CrNiN18-7	EN 10028-7:2000	134	X3CrNiMo18-12-3	AFNOR	273, 282
	EN 10088-2:1995	428, 434		NF A 49-244:1993	
X2CrNiN18-9	EN 10028-7:2000	134, 137		EN 10222-5:1999	361
X2CrNiN23-4	EN 10028-7:2000	141, 142	X3CrNiMo19-15-4	AFNOR	274, 284
	EN 10088-2:1995	468		NF A 49-244:1993	
	EN 10088-3:1995	471	X3CrNiMoBN17-13-3	EN 10028-7:2000	146
	EN 10250-4:1999	356, 357	X3CrNiMoCu22-7	AFNOR	307
	ISO 9327-5:1999	356, 357		NF A 49-244:1993	
X2CrNiTi12	EN 10088-2:1995	468	X3CrNiMoCuN25-6	AFNOR	307
X2CrTi12	DIN 17455:1999	199, 203		NF A 49-244:1993	
	DIN 17456:1999	199, 203	X3CrNiMoCuN25-7	AFNOR	307
	EN 10088-2:1995	426, 427		NF A 49-244:1993	
X2CrTi17	EN 10028-7:2000	146	X3CrNiMoN17-11	AFNOR	273, 283
	EN 10088-2:1995	426, 427		NF A 49-244:1993	
X2CrTiNb18	EN 10028-7:2000	132, 133	X3CrNiMoN17-12	AFNOR	273, 283
	EN 10088-2:1995	468		NF A 49-244:1993	
X2NiCrMo18-15-4	EN 10088-2:1995	430, 440	X3CrNiMoN17-13-3	EN 10222-5:1999	361
X2NiCrMoCu25-20	AFNOR	277, 287	X3CrNiMoN18-14-5	AFNOR	276, 287
	NF A 49-244:1993			NF A 49-244:1993	
X2NiCrMoCu25-20-5	ISO 9327-5:1999	349, 354, 361	X3CrNiMoN19-14	AFNOR	307
				NF A 49-244:1993	
X30Cr13	EN 10088-2:1995	424, 425	X3CrNiMoN22-5	AFNOR	307
	EN 10088-3:1995	446, 449		NF A 49-244:1993	
	EN 10250-4:1999	361	X3CrNiMoN25-6	AFNOR	307
X30WCrV9-3	EN ISO 4957:1999	490		NF A 49-244:1993	
X35CrWMoV5	EN ISO 4957:1999	490	X3CrNiMoN25-7	AFNOR	307
X37CrMoV5-1	EN ISO 4957:1999	490		NF A 49-244:1993	
			X3CrNiMoN27-5-2	EN 10088-3:1995	471
				EN 10250-4:1999	356, 357
			X3CrNiN18-10	AFNOR	271, 279
				NF A 49-244:1993	
			X3CrNiN23-4	AFNOR	307
				NF A 49-244:1993	

644 Steel Grade/Name Index

Steel Grade/Name	Specification	Page No.	Steel Grade/Name	Specification	Page No.
X3CrTi17	DIN 17455:1999	199, 203	X60, PSL 2 welded	API 5L-2000	303
	DIN 17456:1999	199, 203	X65, PSL 1 seamless	API 5L-2000	296
	EN 10028-7:2000	132	X65, PSL 1 welded	API 5L-2000	296
	EN 10088-2:1995	426, 427	X65, PSL 2 seamless	API 5L-2000	303
X40Cr14	EN ISO 4957:2000	495	X65, PSL 2 welded	API 5L-2000	303
X40CrMoV5-1	EN ISO 4957:1999	490	X65Cr14	EN ISO 683-17:1999	496
X46, PSL 1 seamless	API 5L-2000	296	X6Cr13	EN 10088-2:1995	424, 425
X46, PSL 1 welded	API 5L-2000	296		EN 10088-3:1995	451, 452
X46, PSL 2 seamless	API 5L-2000	301		ISO 4955:1994	424, 425, 451, 452
X46, PSL 2 welded	API 5L-2000	301			
X46Cr13	EN 10088-2:1995	468	X6Cr17	DIN 17455:1999	199, 203
	EN 10088-3:1995	471		DIN 17456:1999	199, 203
X47Cr14	EN ISO 683-17:1999	496		EN 10088-2:1995	426, 427
X4CrNi18-12	EN 10088-2:1995	468		EN 10088-3:1995	451, 452
	EN 10088-3:1995	455, 459		EN 10250-4:1999	346
X4CrNiMo16-5-1	EN 10028-7:2000	146	X6CrAl13	DIN 17456:1999	199, 203
	EN 10088-2:1995	468		EN 10088-2:1995	426, 427
	EN 10088-3:1995	471		EN 10250-4:1999	361
	EN 10250-4:1999	361	X6CrMo17-1	EN 10088-2:1995	426, 427
X50CrMoV15	EN 10088-2:1995	468		EN 10088-3:1995	451, 452
	EN 10088-3:1995	471	X6CrMoNb17-1	EN 10088-2:1995	468
X52, PSL 1 seamless	API 5L-2000	296	X6CrMoS17	EN 10088-3:1995	451, 452
X52, PSL 1 welded	API 5L-2000	296	X6CrNi17-1	EN 10088-2:1995	468
X52, PSL 2 seamless	API 5L-2000	302	X6CrNi18-10	EN 10222-5:1999	347, 350
X52, PSL 2 welded	API 5L-2000	302		EN 10028-7:2000	134, 137
X56, PSL 1 seamless	API 5L-2000	296	X6CrNi23-13	EN 10028-7:2000	134, 138
X56, PSL 1 welded	API 5L-2000	296	X6CrNi23-14	ISO 4955:1994	429, 437, 455, 460
X56, PSL 2 seamless	API 5L-2000	302			
X56, PSL 2 welded	API 5L-2000	302	X6CrNi25-20	EN 10028-7:2000	134, 138
X5CrNi18-10	DIN 17455:1999	200, 204	X6CrNi25-21	ISO 9327-5:1999	347, 351
	DIN 17456:1999	200, 204	X6CrNiMo17-11-2	AFNOR	274, 284
	EN 10028-7:2000	134, 137		NF A 49-244:1993	
	EN 10088-2:1995	428, 436	X6CrNiMoNb17-12-2	EN 10028-7:2000	135, 139
	EN 10088-3:1995	454, 458		EN 10088-2:1995	468
	EN 10222-5:1999	347		EN 10088-3:1995	471
	EN 10250-4:1999	347	X6CrNiMoTi17-12	ISO 9327-5:1999	349, 353
X5CrNi18-9	ISO 9327-5:1999	347, 350	X6CrNiMoTi17-12-2	EN 10028-7:2000	135, 139
X5CrNiCuNb16-4	EN 10088-2:1995	443, 444		EN 10088-2:1995	430
	EN 10088-3:1995	464, 466		EN 10088-3:1995	440, 455, 462
	EN 10250-4:1999	355,		EN 10250-4:1999	349, 353
X5CrNiMo17-12	ISO 9327-5:1999	348, 351	X6CrNi19-9	AFNOR	271, 279
X5CrNiMo17-12-2	DIN 17455:1999	201, 205		NF A 49-244:1993	
	DIN 17456:1999	201, 205	X6CrNiNb18-10	DIN 17455:1999	202, 207
	EN 10028-7:2000	134, 138		DIN 17456:1999	202, 207
	EN 10088-2:1995	429, 438		EN 10028-7:2000	136
	EN 10088-3:1995	455, 460		EN 10088-3:1995	431
	EN 10222-5:1999	348, 351		EN 10222-5:1999	349, 354
	EN 10250-4:1999	348, 351		EN 10250-4:1999	361
X5CrNiMo17-13	ISO 9327-5:1999	348, 351		ISO 9327-5:1999	349, 354
X5CrNiMoCuNb14-5	EN 10088-3:1995	471	X6CrNiSiNCe19-10	EN 10095: 1999	469, 471
X5CrNi19-9	EN 10028-7:2000	134, 137	X6CrNiTi12	EN 10028-7:2000	132, 133
X5NiCr32-21	AFNOR	277, 287	X6CrNiTi18-10	AFNOR	275, 285
	NF A 49-244:1993			NF A 49-244:1993	
X5NiCrAlTi31-20 (+RA)	EN 10028-7:2000	146		DIN 17455:1999	202, 207
X60, PSL 1 seamless	API 5L-2000	296		DIN 17456:1999	202, 207
X60, PSL 1 welded	API 5L-2000	296		EN 10028-7:2000	136, 140
X60, PSL 2 seamless	API 5L-2000	303		EN 10088-2:1995	430, 441

Steel Grade/Name	Specification	Page No.	Steel Grade/Name	Specification	Page No.
X6CrNiTi18-10	EN 10088-3:1995	456	XM-12	ASTM A 564/A 564M-99	470
(Continued)	EN 10222-5:1999	349, 354	XM-13	ASTM A 564/A 564M-99	470
	EN 10250-4:1999	349, 354	XM-14	ASTM A 666-00	468
	ISO 9327-5:1999	349, 354	XM-15	ASTM A 240/A 240M-00	146
X6CrNiTiB18-10	EN 10028-7:2000	136, 140		ASTM A 249/A 249M-98	307
	EN 10222-5:1999	361	XM-16	ASTM A 564/A 564M-99	470
X6CrTi12	ISO 4955:1994	471	XM-17	ASTM A 240/A 240M-00	146
X6NiCrCuS18-9-2	EN 10088-3:1995	471	XM-18	ASTM A 240/A 240M-00	146
X6NiCrNbCe32-27	EN 10095: 1999	469, 471	XM-19	ASTM A 240/A 240M-00	146
X6NiCrSi36-19	ISO 4955:1994	471		ASTM A 276-00	470
X6NiCrSiNCE35-25	EN 10095: 1999	469, 471		ASTM A 358/A 358M-98	308
X70, PSL 1 seamless	API 5L-2000	297	XM-2	ASTM 582/A 582M-95	470
X70, PSL 1 welded	API 5L-2000	297	XM-21	ASTM A 240/A 240M-00	146
X70, PSL 2 seamless	API 5L-2000	304	XM-21	ASTM A 276-00	454, 459
X70, PSL 2 welded	API 5L-2000	304	XM-25	ASTM A 564/A 564M-99	470
X70CrMo15	EN 10088-3:1995	446, 449	XM-26	ASTM A 276-00	470
X75WCrV18-4-1	EN ISO 683-17:1999	496,	XM-27	ASTM A 240/A 240M-00	146
X7CrNi18-9	AFNOR	270, 278,		ASTM A 276-00	451
	NF A 49-244:1993		XM-28	ASTM A 276-00	470
	ISO 4955:1994	428, 436	XM-29	ASTM A 240/A 240M-00	146
	ISO 9327-5:1999	347, 350		ASTM A 358/A 358M-98	308
X7CrNiAl17-7	EN 10088-2:1995	443, 444,	XM-29	ASTM A 276-00	470
	EN 10088-3:1995	464, 466	XM-30	ASTM A 276-00	470
X7CrNiMo17-11-2	AFNOR	272, 281	XM-31	ASTM A 240/A 240M-00	146
	NF A 49-244:1993		XM-33	ASTM A 240/A 240M-00	146, 307
X7CrNiMo17-12	ISO 9327-5:1999	348, 353	XM-34	ASTM 582/A 582M-95	470
X7CrNiNb18-10	EN 10222-5:1999	349, 354	XM-5	ASTM 582/A 582M-95	470
	ISO 9327-5:1999	349, 354	XM-6	ASTM 582/A 582M-95	470
	ISO 4955:1994	431, 442,	Z 10 CNWT 17-13 B	AFNOR	309
		456, 463		NF A 49-214:1978	
X7CrNiSiNCE21-11	ISO 4955:1994	471	Z 25C13-M	AFNOR	406, 412
X7CrNiTi18-10	ISO 9327-5:1999	349, 354		NF A 32-057:1981	
	ISO 4955:1994	430, 441	Z 25CN20.10-M	AFNOR	407, 413
X7Ni9	EN 10028-4:1994	128, 129		NF A 32-057:1981	
X80, PSL 2 seamless	API 5L-2000	304	Z 30CN26.05-M	AFNOR	406, 412
X80, PSL 2 welded	API 5L-2000	304		NF A 32-057:1981	
X82WMoCrV6-5-4	EN ISO 683-17:1999	496	Z 3CN13.4-M	AFNOR	393, 394
X89CrMoV18-1	EN ISO 683-17:1999	496		NF A 32-053:1992	
X8CrNi25-20	AFNOR	307	Z 40C28-M	AFNOR	406, 412
	NF A 49-244:1993			NF A 32-057:1981	
X8CrNi25-21	EN 10095: 1999	469, 471	Z 40CN25.12-M	AFNOR	408, 414
X8CrNiNb16-13	EN 10028-7:2000	136, 140		NF A 32-057:1981	
X8CrNiS18-9	EN 10088-3:1995	454, 457,	Z 40CN25.20-M	AFNOR	409, 415
		478		NF A 32-057:1981	
	EN 10088-2:1995	468,	Z 40CN30.20-M	AFNOR	409, 415
X8CrNiTi18-10	EN 10095: 1999	469		NF A 32-057:1981	
X8CrNoMoAl15-7-2	EN 10088-2:1995	468	Z 40CNK20.20.20-M	AFNOR	411, 417
X8Ni9	EN 10028-4:1994	129		NF A 32-057:1981	
	EN 10222-3:1999	339	Z 40NC35.15-M	AFNOR	410, 416
	ISO 9327-3:1999	339		NF A 32-057:1981	
X8NiCrAlTi32-21	EN 10028-7:2000	136, 140	Z 45NCW45.25-M	AFNOR	411, 417
	ISO 4955:1994	471		NF A 32-057:1981	
X90CrMoV18	EN 10088-3:1995	471	Z 50NC60.15-M	AFNOR	411, 417
X9CrNiSiNCE21-11-1	EN 10095: 1999	469, 471		NF A 32-057:1981	
XM-1	ASTM 582/A 582M-95	470	Z 5CN19.10-M	AFNOR	396, 399
XM-10	ASTM A 276-00	470		NF A 32-053:1992	
XM-11	ASTM A 276-00	470	Z 6 CN 19-10	AFNOR NF A 49-	271, 280
	ASTM A 666-00	468		214:1978	
			Z 6 CN Nb 18-12 B	AFNOR NF A 49-	276, 286
				214:1978	

646 Steel Grade/Name Index

Steel Grade/Name	Specification	Page No.
Z 6 CND 17-12 B	AFNOR NF A 49-214:1978	274, 283
Z 6 CNT 18-12 B	AFNOR NF A 49-214:1978	275, 285
Z 8 CNDT 17-13 B	AFNOR NF A 49-214:1978	274, 284
Z100MD8 1-M	AFNOR NF A 32-058:1984	380, 382
Z100MN13 4-M	AFNOR NF A 32-058:1984	379
Z110MD12 1-M	AFNOR NF A 32-058:1984	379, 381
Z120M12-M	AFNOR NF A 32-058:1984	379, 381
Z120MC12-M	AFNOR NF A 32-058:1984	379, 381
Z120MC17 2-M	AFNOR NF A 32-058:1984	380, 382

UNS NUMBER INDEX

648 UNS Number Index

UNS Number	Page No.
G10050	19
G10060	19
G10080	19, 39, 156, 158, 161, 164, 179, 180, 183, 185
G10100	19, 156, 157, 159, 161, 164, 165, 179, 180, 183, 185, 186
G10110	39, 166, 186
G10120	19, 39
G10130	39
G10150	20, 156, 157, 158, 161, 164, 166, 167, 179, 180, 183, 185, 187
G10160	20, 167, 187
G10170	20, 167, 187
G10180	20, 167, 187
G10190	20
G10200	20, 158, 159, 160, 161, 164, 166, 168, 169, 180, 181, 180, 183, 185, 186, 188, 189
G10210	21, 159, 161, 165, 167, 169, 181, 183, 185, 187, 189
G10220	21
G10230	21
G10250	22, 161, 166
G10260	22, 164, 165, 168, 171, 173, 185, 188, 190, 192
G10290	22
G10300	22, 164, 165, 166, 168, 173, 174, 185, 186, 188, 192, 494
G10340	23
G10350	23, 164, 166, 167, 171, 173, 174, 175, 185, 186, 187, 190, 192, 194, 494
G10370	23
G10380	23
G10390	24
G10400	13, 24, 166, 167, 174, 175, 186, 187, 192, 194, 494
G10420	24
G10430	24
G10440	25
G10450	25, 166, 167, 173, 175, 186, 190, 192, 194, 494
G10460	25
G10490	26
G10500	26, 167, 172, 173, 187, 191, 192, 481
G10530	26
G10550	27, 481
G10590	27
G10600	27, 481
G10640	28, 481
G10650	28, 481
G10690	28
G10700	28, 481
G10710	28
G10740	28, 481
G10750	28
G10780	28, 481
G10800	29
G10840	29
G10850	481
G10860	29, 481
G10900	29
G10950	29, 481
G11080	493

UNS Number	Page No.
G11090	476
G11094	476
G11100	165, 186, 476
G11160	493
G11174	476
G11180	493
G11190	493
G11260	493
G11320	493
G11370	477
G11374	477
G11380	493
G11390	493
G11400	493
G11410	477
G11414	477
G11440	478
G11444	478
G11450	493
G11460	478
G11464	478
G11510	493
G11700	476
G12110	493
G12120	479
G12130	479
G12134	479
G12144	479
G12150	479
G12154	480
G13300	39, 305
G13350	39, 40, 305
G13400	39, 40, 305
G13450	39, 305
G15180	39
G15220	30
G15240	39, 167, 174, 175, 187, 192, 194
G15250	39
G15260	39
G15270	39
G15300	39
G15360	30
G15410	30
G15470	39
G15480	39
G15510	39
G15520	39
G15610	39
G15660	39
G15720	39
G31400	305
G33106	305
G40120	39, 305
G40230	39, 40, 305
G40240	39, 305
G40270	39, 40, 305
G40280	39, 196, 197

UNS Number	Page No.
G40370	39, 40, 305
G40420	39, 305
G40470	39, 40, 305
G40630	305
G41180	33, 196, 197
G41200	33
G41210	33
G41300	33, 196, 197
G41350	39, 196, 197
G41370	34, 196, 197
G41400	34, 196, 198
G41420	39, 40, 196, 198, 305
G41450	34, 196
G41470	39, 305
G41500	34, 305
G41610	483
G41670	39
G43200	35, 305
G43320	39
G43370	305
G43376	305
G43400	35, 305
G43406	35, 305
G44190	39
G44220	39, 305
G44270	39, 305
G45200	305
G46150	39, 305
G46170	305
G46200	39, 40, 305
G46210	39, 305
G46260	39
G47150	39
G47180	39, 305
G47200	39, 305
G48150	39, 305
G48170	39, 305
G48200	39, 40, 305
G50150	39, 305
G50401	305
G50441	37, 305
G50460	39, 305
G50461	37, 305
G50501	37, 305
G50601	37, 305
G50611	305
G51150	39, 305
G51170	39
G51200	31, 305
G51300	31, 305
G51320	31, 305
G51350	31, 305
G51400	32, 305
G51450	305
G51470	39, 305
G51500	39, 40, 305
G51550	39, 305, 482

UNS Number	Page No.
G51600	39, 40, 305, 482, 496
G51601	37, 482
G51950	496
G51986	305
G52986	305
G61180	39, 305
G61200	305
G61500	38, 305, 482
G81150	39, 305
G81451	39, 305
G86150	39, 40, 305
G86170	39, 40, 305
G86200	35, 305
G86220	39, 40, 305
G86250	39, 305
G86270	39, 305
G86300	39, 40, 305
G86370	39, 305
G86400	35, 305
G86420	39, 305
G86450	39, 40, 305
G86451	305
G86500	39, 305
G86550	39, 305
G86600	39, 305
G87200	39, 40, 305
G87350	305
G87400	39, 305
G87420	305
G88200	39, 40
G88220	305
G92540	39
G92550	39, 305
G92590	39, 40
G92600	39, 40, 305, 482
G92620	305
G93106	35
G94151	305
G94171	39, 305
G94301	39, 305
G94401	305
G98400	305
G98500	305
J02500	367, 371
J02501	368, 372
J02502	375, 376
J02503	375, 376, 377, 378
J02504	377, 378
J02505	377, 378
J03000	367, 371
J03001	367, 371
J03002	375, 376, 377, 378
J03003	377, 378
J03501	368, 372
J11872	418
J12072	388, 389
J12082	418

650 UNS Number Index

UNS Number	Page No.	UNS Number	Page No.
J12084	418	J92615	418
J12092	388, 389	J92701	418
J12522	391, 392	J92710	396, 399, 404, 405
J12524	388, 389	J92800	397, 400, 404, 405
J12582	418	J92803	407, 413
J13002	418	J92900	397, 400, 404, 405
J13005	418	J92901	418
J13047	418	J92971	418
J13080	418	J92972	418
J13345	418	J92999	398, 401, 418
J13855	418	J93000	397, 400, 418
J15580	418	J93001	418
J21890	388, 389	J93005	406, 412
J22000	418	J93015	406, 412
J22091	388, 389	J93254	398, 401, 418
J22092	418	J93303	408, 414
J22500	391, 392	J93370	404, 405
J22501	391, 392	J93400	418
J23015	418	J93401	418
J31200	418	J93402	398, 401, 418
J31300	418	J93402	398, 401, 418
J31500	391, 392	J93403	407, 413
J31550	391, 392	J93413	407, 413
J31575	370, 374	J93423	418
J41500	418	J93503	408, 414
J41501	418	J93513	408, 414
J42045	388, 390	J93603	407, 413
J42065	391, 392	J93633	408, 414
J42215	391, 392	J94003	408, 414
J42220	418	J94013	408, 414
J82090	388, 390	J94202	418
J84090	418	J94204	409, 415
J91109	379, 381	J94213	409, 415
J91119	379, 381	J94214	409, 415
J91129	379, 381	J94224	408, 414
J91139	379, 381	J94650	418
J91149	379, 381	J94651	398, 401, 418
J91150	393, 394, 402, 403	J94652	398, 401
J91151	393, 394, 418	K01200	208, 212
J91153	393, 394, 418	K01201	208, 212
J91154	418	K01600	55, 66
J91171	402, 403	K01700	143
J91249	379, 381	K01701	108, 110
J91309	379, 381	K01800	143
J91339	380, 382	K01802	68
J91340	380, 382	K01807	208, 212
J91422	418	K02002	60, 67
J91459	379, 381	K02004	167, 187
J91540	393, 395, 402, 403	K02005	168, 188
J91550	402, 403	K02007	109, 110
J91803	418	K02100	100, 104
J91804	418	K02200	143
J92500	396, 399	K02203	109, 110
J92590	418	K02204	61, 67
J92600	396, 399, 404, 405	K02301	50, 64
J92605	406, 412	K02401	50, 64, 100, 104
J92613	406, 412	K02403	101, 105

UNS Number	Page No.
K02404	54, 65
K02501	247, 256
K02502	46, 48, 49, 50, 62, 63, 64
K02504	247, 256
K02507	52, 54, 55, 65, 66
K02595	50, 64
K02596	50, 64
K02597	50, 64
K02598	50, 64
K02599	50, 64
K02700	101, 106
K02701	55, 66
K02702	52, 65
K02703	55, 66
K02705	165, 185
K02707	210, 214
K02800	101, 105
K02801	143
K02803	143
K02900	103, 107
K03000	157, 163, 180, 184
K03003	251, 259
K03004	251, 259
K03005	251, 259
K03006	211, 215, 239, 240, 251, 259, 288, 291
K03008	238, 240, 288, 291
K03009	320, 323
K03010	251, 259
K03011	321, 323
K03012	253, 260
K03017	321, 323
K03101	101, 106
K03300	143
K03501	211, 215, 253, 260
K03502	320, 321, 323
K03503	210, 214
K03504	321, 323
K03506	321, 323
K05001	358
K10623	144
K11224	143
K11267	308
K11422	216, 219
K11430	69, 73
K11510	69, 73
K11511	82, 143
K11522	216, 219, 262, 266
K11538	69, 73
K11547	216, 220, 262
K11562	217, 220, 263
K11564	330
K11572	331
K11576	82, 143
K11578	308
K11597	217, 221, 263, 267, 360
K11625	82, 143
K11630	82, 143

UNS Number	Page No.
K11646	82, 143
K11683	82, 143
K11720	144
K11742	143
K11757	116
K11789	117
K11820	112, 114
K11831	144
K11856	82, 143
K12000	69, 73
K12001	102, 103, 106, 107
K12020	112, 114
K12021	112, 114
K12022	113, 114
K12023	216, 219
K12031	144
K12037	69, 73, 144
K12039	130
K12042	342
K12043	69, 73, 77
K12045	342
K12047	307
K12054	131
K12122	329
K12143	115
K12202	70, 74, 93
K12320	112, 114
K12437	102, 103, 106, 107
K12447	102, 106
K12520	328
K12521	113, 114
K12524	143
K12529	143
K12539	130
K12542	143
K12554	131
K12765	341
K12766	341
K12822	328
K13050	360
K13502	321, 323
K19195	496
K19526	496
K19667	492
K19965	496
K19990	496
K20747	75, 76, 77, 80, 81, 144
K21205	144
K21390	332, 333
K21590	118, 119, 143, 217, 221, 264, 268, 332, 333
K21604	82, 143
K21650	82, 143
K21703	124
K21903	241, 244, 308
K22035	308, 360
K22036	360
K22103	124

652 UNS Number Index

UNS Number	Page No.	UNS Number	Page No.
K24065	36, 305	S20103	146, 428, 432
K31545	120, 307, 308, 334, 335	S20153	146, 428, 432
K31718	125, 126	S20160	470
K31830	143, 144, 334, 335	S20161	146
K31835	332, 333, 360	S20200	146, 307, 428, 433, 454, 457
K31918	241, 244, 288, 291	S20300	470
K32018	125, 126	S20400	146, 468
K32025	339	S20500	468, 470
K41245	307, 308	S20910	146, 305, 307, 308, 361, 470
K41545	121, 218, 221, 264, 268, 336	S21400	146
K41545	121, 218, 221, 264, 268	S21460	468
K41583	144	S21600	146
K41650	360	S21603	146
K42339	143	S21800	146, 470
K42544	336	S21900	305, 308, 470
K51545	218, 221, 308	S21904	305, 308, 361, 468, 470
K71340	128, 129	S24000	146, 305, 307, 308, 470
K81340	128, 129, 242, 245, 290, 292	S24100	470
K90941	337	S24565	305, 307, 308
K91560	308	S28300	308
K92460	307	S30100	146, 306, 428, 433
K92930	361	S30153	134, 137, 428, 434
N06006	411, 417	S30200	146, 306, 428, 435, 454, 457
N08004	410, 416	S30215	428, 435, 470
N08005	410, 416	S30300	454, 457, 478
N08006	411, 417	S30310	470
N08007	398, 401, 404, 405	S30323	454, 458, 493
N08020	146, 308, 361	S30345	470
N08031	422, 468, 470	S30400	134, 137, 200, 204, 225, 231, 270, 278, 347, 350, 428, 436, 454, 458
N08050	410, 416	S30403	134, 137, 200, 204, 225, 231, 270, 279, 347, 350, 428, 436, 454, 458
N08151	418	S30409	134, 225, 232, 271, 280, 347, 350
N08366	422, 430, 441, 470	S30415	146, 307, 308
N08367	146, 230, 237, 305, 308, 361, 422, 430, 441, 456, 462, 470	S30451	134, 137, 226, 232, 308, 347, 351, 429, 437, 454, 459
N08603	410, 416	S30452	146, 454, 459
N08604	409, 415	S30453	134, 137, 200, 205, 226, 232, 308, 347, 351, 429, 437, 454, 459
N08605	410, 416	S30454	470
N08613	409, 415	S30500	146, 306, 307, 455, 459
N08614	409, 415	S30600	146, 305, 308, 361
N08705	409, 415	S30601	146
N08800	136, 140, 308	S30615	146, 230, 237, 308
N08810	136, 140, 308	S30800	468, 470
N08811	136, 140	S30815	146, 307, 308, 361, 470
N08904	136, 140, 230, 237, 277, 287, 305, 308, 422, 430, 441, 456, 462, 468, 470	S30900	429, 437, 456, 463
N08925	422, 468, 470	S30908	146, 226, 232, 271, 280, 306, 308, 455, 460
N08926	136, 140, 230, 237, 305, 308, 422, 468, 470	S30909	134, 138, 226, 232, 308, 361
N08932	422, 468	S30940	146, 306, 307, 308, 470
R20033	422, 468, 470	S30941	146, 307, 308
S13800	470	S31000	306, 347, 351, 429, 438, 456, 463
S15500	470	S31008	146, 226, 232, 271, 280, 306, 308, 455, 460
S15700	470	S31009	134, 138, 307, 308, 347, 351
S17400	464, 465	S31040	146, 307, 308, 470
S17600	470	S31041	146, 307, 308
S17700	464, 466	S31050	146, 229, 237, 308, 361
S18200	470	S31100	470
S18235	451, 452		
S20100	146, 307, 428, 432, 454, 457		

UNS Number	Page No.
S31200	146, 356, 357
S31254	146, 230, 237, 305, 308, 361, 470
S31260	146
S31266	146, 308, 361
S31400	470
S31600	134, 138, 201, 205, 227, 233, 272, 281, 348, 351, 429, 438, 455, 460
S31603	135, 138, 201, 206, 227, 234, 273, 282, 348, 352, 429, 439, 455, 461
S31609	135, 228, 234, 274, 283, 348, 353
S31635	135, 139, 455, 462
S31640	135, 139, 470
S31651	146, 307, 308, 348, 353, 430, 439, 455, 461
S31653	135, 139, 201, 206, 228, 234, 308, 348, 353, 455, 461
S31654	470
S31700	146, 228, 235, 274, 284, 305, 306, 349, 353, 456, 462
S31703	135, 139, 228, 235, 274, 284, 306, 349, 353
S31725	146, 202, 207, 276, 287, 307, 308, 361, 470
S31726	136, 139, 305, 307, 308, 361, 470
S31751	308
S31753	135, 139
S31803	146, 356, 357, 467
S32001	146
S32050	146, 308
S32100	136, 140, 202, 207, 228, 235, 275, 285, 349, 354, 456, 462
S32109	136, 140, 229, 236, 275, 285, 349, 354
S32205	141, 142, 356, 357, 467
S32304	141, 142, 470
S32520	141, 142, 356, 357
S32550	146, 361, 470
S32615	146, 308
S32654	146, 305, 307, 308, 470
S32750	141, 142, 356, 357
S32760	141, 142, 356, 357
S32803	146, 305
S32900	146
S32950	146, 361
S33100	361
S33228	146, 307, 308, 361
S33400	146
S34565	146, 308, 361, 470
S34700	136, 140, 202, 207, 229, 236, 276, 286, 349, 354, 456, 463
S34709	136, 140, 229, 236, 276, 286, 349, 354
S34800	146, 305, 306, 307, 308, 361, 470
S34809	146, 307, 308, 361
S35045	146
S35135	146
S35315	146, 308
S35500	470
S38100	146, 305, 307, 308
S39274	361
S39277	361
S40300	306, 424, 425, 446, 448
S40500	132, 133, 199, 203, 451, 452
S40800	305

UNS Number	Page No.
S40900	199, 203, 223, 224
S40910	146
S40920	146
S40930	146
S40945	146
S40975	132, 133
S40976	470
S40977	146
S41000	146, 199, 203, 344, 345, 360, 446, 448
S41003	146
S41008	146
S41026	344, 345
S41040	470
S41045	146
S41050	146
S41400	306, 470
S41425	470
S41500	132, 133, 305, 344, 345, 470
S41600	446, 448, 478
S41603	470
S41610	470
S41623	306, 470, 493
S42000	424, 425
S42010	470
S42020	446, 449, 493
S42023	470, 493
S42035	146
S42200	468
S42900	146, 305, 306, 361, 470
S43000	146, 199, 203, 346, 451, 452
S43020	451, 452, 493
S43023	470, 493
S43035	132, 133, 199, 203, 223, 224
S43036	305, 306
S43100	306, 446, 449, 468
S43400	146
S43600	146
S43932	132, 133
S43940	132, 133
S44002	306, 446, 449
S44003	446, 450
S44004	447, 450
S44200	468
S44300	305, 306
S44400	132, 133, 305, 307, 470
S44500	146
S44600	305, 306, 426, 427, 451, 453
S44626	146, 305, 307
S44627	146, 229, 237, 305, 361, 451, 452
S44635	146, 305, 307
S44660	146, 305, 307
S44700	146, 305, 306, 307, 451, 452
S44735	146, 305, 307
S44800	146, 305, 306, 307, 470
S45000	470
S45500	470
S45503	470

654 UNS Number Index

UNS Number	Page No.	UNS Number	Page No.
S46800	146	T30405	495
S50100	121	T30407	495
S50200	121	T31501	495
S50400	143, 218, 222, 264, 269	T31502	495
T11301	487, 495	T31506	495
T11302	495	T31507	495
T11304	487	T41901	495
T11306	495	T41902	495
T11307	487	T41904	495
T11313	487, 495	T41905	495
T11323	487	T41906	495
T11330	495	T41907	495
T11333	495	T51602	495
T11334	495	T51603	495
T11336	487	T51604	495
T11341	495	T51605	495
T11342	487	T51606	495
T11343	495	T51620	495
T11344	495	T51621	495
T11346	495	T60601	495
T11347	495	T60602	491
T11350	495	T61202	495
T11352	495	T61203	495
T12001	486	T61206	491
T12002	495	T72301	485, 495
T12004	486	T72302	495
T12005	486		
T12006	495		
T12008	495		
T12015	486		
T20810	490		
T20811	490		
T20812	490		
T20813	490		
T20814	495		
T20819	490		
T20821	490		
T20822	495		
T20823	495		
T20824	495		
T20825	495		
T20826	495		
T20841	495		
T20842	495		
T20843	495		
T30102	489		
T30103	495		
T30104	495		
T30105	495		
T30106	495		
T30107	495		
T30108	495		
T30109	495		
T30110	495		
T30402	489		
T30403	489		
T30404	495		

STEEL NUMBER INDEX

656 Steel Number Index

Steel Number	Page No.	Steel Number	Page No.
1.0034	157, 180, 184, 187	1.0463	288, 291
1.0035	45, 62, 156, 179	1.0473	102, 106
1.0036	48, 63	1.0477	323
1.0037	48, 63	1.0478	323
1.0038	157, 180, 183, 186, 188	1.0481	253, 260
1.0044	161, 162, 164, 171, 173, 183, 184, 185, 186	1.0482	254, 261
1.0045	58, 67	1.0483	293, 295
1.0050	56, 66	1.0484	298, 301
1.0060	61, 67	1.0486	108, 110, 249, 258
1.0070	61, 67	1.0487	108, 249, 258
1.0114	48, 63	1.0488	108, 110, 288, 291
1.0116	49, 63, 314, 318	1.0490	93
1.0117	49, 63	1.0491	93
1.0143	53, 65	1.0498	250, 258
1.0144	53, 65	1.0499	293, 296
1.0145	54, 65	1.0501	171, 176, 191, 194
1.0211	156, 161, 165, 179, 183, 185	1.0503	175, 178, 194, 195
1.0212	156, 161, 165, 179, 183, 185	1.0511	316, 318
1.0253	248, 257	1.0516	23
1.0254	209, 213, 248, 257	1.0517	25
1.0255	248, 257	1.0518	27
1.0256	251, 259	1.0528	315, 318
1.0257	251, 259	1.0530	23
1.0300	19	1.0535	177, 195, 317, 319
1.0304	19	1.0540	317, 319
1.0305	209, 213, 248, 257	1.0541	24
1.0306	213	1.0545	69, 73
1.0308	157, 158, 164, 165, 168, 180, 183, 185, 188, 191	1.0546	69, 73
1.0310	19	1.0552	368
1.0311	19	1.0553	58, 67
1.0313	19	1.0558	370
1.0315	209, 213, 248, 257	1.0561	306
1.0319	293, 295	1.0562	109, 110, 253, 260
1.0345	99, 104	1.0565	109, 110, 253, 260, 323
1.0352	323	1.0566	109, 110, 260, 289, 291
1.0356	208, 212, 238, 240	1.0570	168, 169, 174, 188, 191, 358
1.0402	21, 165, 170, 185, 190	1.0571	323
1.0405	250, 258	1.0577	59, 60, 67
1.0406	315, 318	1.0578	299, 302
1.0408	162, 165, 171, 173	1.0580	169, 173, 176
1.0413	20	1.0581	254, 261
1.0414	21	1.0582	299, 302
1.0415	22	1.0586	26
1.0416	20	1.0588	26
1.0418	298, 301	1.0595	59, 67
1.0420	367	1.0596	59, 67
1.0421	254, 261	1.0601	178, 195, 358
1.0425	100, 104	1.0609	27
1.0426	323	1.0610	27
1.0429	298, 301	1.0611	28
1.0436	323	1.0612	28
1.0446	367	1.0613	28
1.0457	298, 301	1.0614	28
1.0458	310	1.0615	28
1.0459	293, 295	1.0616	29
1.0461	294, 257	1.0617	28
1.0462	249, 257	1.0618	29

Steel Number	Page No.
1.0619	375, 376
1.0620	28
1.0621	375, 376
1.0622	28
1.0625	375, 376
1.0626	28
1.0628	29
1.0715	479
1.0718	479
1.0721	476
1.0722	476
1.0725	476
1.0726	493
1.0727	478
1.0736	480
1.0737	480
1.0756	493
1.0757	478
1.0760	477
1.0761	477
1.0762	478
1.0763	478
1.0764	477
1.0765	477
1.1103	288, 291
1.1104	108, 110, 288, 291
1.1106	109, 110, 289, 291
1.1110	19
1.1111	19
1.1113	19
1.1114	19
1.1121	19
1.1124	19
1.1126	20
1.1129	20
1.1131	377, 378
1.1133	359
1.1137	21
1.1139	22
1.1140	20
1.1141	20
1.1143	22
1.1145	23
1.1148	20
1.1149	165, 170, 185, 190
1.1150	23
1.1151	165, 170, 185, 190
1.1153	24
1.1154	24
1.1158	315, 318
1.1162	25
1.1164	25
1.1165	368, 372
1.1167	306
1.1170	306, 359
1.1171	26
1.1178	22

Steel Number	Page No.
1.1179	22
1.1180	23, 171, 176, 191, 194
1.1181	23, 171, 176, 191, 194, 316, 318
1.1186	24
1.1189	24
1.1191	25, 175, 178, 194, 195, 316, 317, 318, 319
1.1201	25, 175, 178, 194, 195
1.1202	26
1.1203	27, 177, 195
1.1204	481
1.1206	26
1.1207	19
1.1208	20
1.1209	27, 177, 195
1.1211	481
1.1212	27, 479
1.1217	481
1.1220	27
1.1221	27, 178, 195, 358
1.1222	28
1.1223	27, 178, 195
1.1228	27
1.1231	481
1.1232	28
1.1236	28
1.1241	26
1.1242	28
1.1248	481
1.1251	28
1.1252	28
1.1253	28
1.1255	28
1.1262	28
1.1265	29
1.1269	481
1.1272	29
1.1274	481
1.1282	29
1.1283	29
1.4000	424, 425, 451, 452
1.4002	199, 203, 361, 426, 427
1.4003	132, 133, 468, 471
1.4005	446, 448, 478
1.4006	199, 203, 468
1.4008	393, 394
1.4011	393, 394
1.4016	199, 203, 346
1.4017	468
1.4021	361
1.4028	361
1.4029	446, 449
1.4031	468, 471
1.4034	468, 471
1.4057	361
1.4104	471
1.4105	451, 452
1.4107	402, 403

658 Steel Number Index

Steel Number	Page No.	Steel Number	Page No.
1.4109	446, 449	1.4509	132, 133, 468
1.4112	471	1.4510	132, 133, 199, 203, 426, 427
1.4113	426, 427, 451, 452	1.4511	426, 427
1.4116	468, 471	1.4512	199, 203, 426, 427
1.4122	468, 471	1.4513	468
1.4125	447, 450	1.4516	132, 133, 468
1.4301	134, 137, 200, 204, 225, 231, 270, 278, 347, 350, 428, 436, 454, 458	1.4517	404, 405, 419
1.4303	455, 459, 468	1.4520	146, 426, 427
1.4305	468	1.4521	132, 133, 426, 427
1.4306	134, 137, 200, 204, 270, 279, 347, 350, 468, 471	1.4523	451, 452
1.4307	134, 137, 347, 350, 428, 436, 454, 458, 533	1.4525	419
1.4308	396, 399, 404, 405	1.4526	468
1.4309	396, 399, 404, 405	1.4527	398, 401
1.4310	428, 433, 454, 457, 484	1.4529	361, 468, 471
1.4311	134, 137, 200, 205, 271, 279, 347, 351, 429, 437, 454, 459	1.4532	468
1.4313	468, 471	1.4537	146
1.4315	134, 137	1.4539	361, 471
1.4317	393, 394, 402, 403	1.4541	136, 140, 202, 207, 228, 235, 275, 285, 349, 354, 430, 441, 46, 462
1.4318	134, 137, 428, 434	1.4542	355, 443, 444, 464, 466
1.4335	468	1.4547	146, 361, 471
1.4347	419	1.4550	136, 140, 202, 207, 276, 286, 349, 354, 361, 431, 442, 456, 463, 471
1.4361	468, 471	1.4552	396, 399, 404, 405
1.4362	468, 471	1.4563	146, 361, 468, 471
1.4371	428, 432	1.4567	471
1.4372	428, 432	1.4568	443, 444, 464, 466, 484
1.4373	428, 433	1.4570	471
1.4401	201, 205, 227, 233, 272, 281, 494	1.4571	228, 235, 274, 284
1.4404	201, 206, 273, 282	1.4578	471
1.4405	393, 395, 419	1.4580	309, 468, 471
1.4406	135, 139, 348, 353, 430, 440, 455, 461,	1.4581	397, 400, 404, 405
1.4408	397, 400, 404, 405	1.4584	419
1.4409	397, 400, 404, 405, 419	1.4587	419
1.4410	468, 471	1.4588	398, 401
1.4411	419	1.4590	468
1.4412	397, 400	1.4592	468
1.4416	398, 401	1.4593	398, 401
1.4417	419	1.4594	471
1.4418	146, 361, 468, 471	1.4605	468
1.4429	201, 206, 273	1.4650	361
1.4432	135, 138, 348, 352, 429, 439, 455, 461	1.4710	406, 412
1.4434	135, 139, 430, 440	1.4713	469, 471
1.4435	201, 206, 273, 282, 471	1.4724	469, 471
1.4436	201, 205, 272, 281	1.4729	406, 412
1.4438	135, 139, 430, 440, 456, 462	1.4736	469, 471
1.4439	202, 207, 276, 468	1.4740	406, 412
1.4446	397, 400	1.4742	469, 471
1.4449	361	1.4745	406, 412
1.4458	398, 401, 404, 405	1.4776	406, 412
1.4460	471	1.4777	406, 412
1.4462	141, 142, 356, 357, 445, 467	1.4818	469, 471
1.4466	146, 468	1.4821	469, 471
1.4468	419	1.4823	406, 412
1.4469	419	1.4825	407, 413
1.4470	419	1.4826	407, 413
1.4501	468, 471	1.4828	469, 471
1.4507	468, 471	1.4832	407, 413

Steel Number	Page No.
1.4833	429, 437, 456, 463
1.4835	469, 471
1.4837	408, 414
1.4841	456, 463
1.4845	469, 471
1.4848	409, 415
1.4849	410, 416
1.4852	409, 415
1.4854	469, 471
1.4855	409, 415
1.4857	409, 415
1.4864	469, 471
1.4865	410, 416
1.4872	469, 471
1.4876	469, 471
1.4877	469, 471
1.4878	469, 471
1.4886	469, 471
1.4887	469, 471
1.4903	337
1.4910	146, 274, 283, 361
1.4912	349, 354
1.4919	274, 283
1.4922	265, 269, 338
1.4931	402, 403
1.4941	136, 140, 309, 361
1.4948	134, 137, 271, 280, 347, 350
1.4950	134, 138
1.4958	277, 287
1.4958 RK	287
1.4958 (+RA)	146
1.4959	136, 140, 277, 287
1.4961	136, 140, 276, 286
1.5402	360
1.5415	145, 216, 219, 262, 266, 328
1.5419	388, 389
1.5422	391, 392
1.5636	391, 392
1.5637	241, 244
1.5638	391, 392
1.5662	242, 245
1.5663	128, 129
1.5680	241, 245, 339
1.5714	40
1.5715	40
1.5752	40
1.5805	40
1.5810	40
1.5918	40
1.6212	122, 241, 243
1.6217	122, 241, 243, 340
1.6220	377, 378
1.6228	123
1.6308	360
1.6311	359
1.6511	306, 359
1.6515	419

Steel Number	Page No.
1.6523	35
1.6526	35
1.6566	40
1.6569	40
1.6570	419
1.6571	35
1.6580	306, 359
1.6582	306, 359, 419
1.6657	40
1.6773	359
1.6781	391, 392
1.6920	360
1.6932	359
1.6956	359
1.6982	402, 403
1.7003	359
1.7006	359
1.7014	31
1.7016	31
1.7030	31
1.7033	359
1.7034	359
1.7035	306, 359
1.7036	31
1.7131	40
1.7139	40
1.7147	40
1.7149	40
1.7182	37
1.7185	37
1.7189	37
1.7218	196
1.7219	242, 246
1.7220	196, 197, 325, 327, 383, 385
1.7225	196, 198, 325, 326, 383, 386
1.7228	325, 327
1.7243	33, 359
1.7244	33
1.7319	33
1.7320	33
1.7321	33
1.7323	33
1.7333	33
1.7335	217, 220, 263, 267
1.7357	388, 389
1.7361	359
1.7365	388, 390
1.7366	336
1.7379	388, 389
1.7380	118, 119, 264, 268
1.7383	118, 119, 332, 333
1.7706	388, 389
1.7707	306, 359
1.7715	262, 266, 360
1.7720	419
1.7725	419
1.7755	419

660 Steel Number Index

Steel Number	Page No.	Steel Number	Page No.
1.8159	359, 494	1.8945	88, 92
1.8507	36	1.8946	88, 92
1.8523	359	1.8947	299, 303
1.8818	93	1.8948	299, 302
1.8819	93	1.8952	300, 303
1.8821	101, 105	1.8955	300, 304
1.8823	68, 72	1.8957	300, 304
1.8824	102, 106	1.8958	84, 90
1.8825	69, 73	1.8959	88, 92
1.8826	102, 106	1.8961	84, 90
1.8828	102, 106	1.8963	88, 92
1.8831	102, 106	1.8965	88, 92
1.8832	101, 105	1.8966	88, 92
1.8833	101, 105	1.8967	89, 92
1.8834	68, 72	1.8972	299, 303
1.8835	102	1.8973	299, 303
1.8836	69, 73	1.8973	299, 303
1.8837	102	1.8975	300, 303
1.8864	145	1.8977	300, 304
1.8865	145	1.8978	300, 304
1.8866	145	1.8980	77, 81
1.8867	145	1.8983	93
1.8868	145	1.8984	76, 80
1.8869	145	1.8986	77, 81
1.8870	145	1.8987	78, 82
1.8871	145	1.8988	78, 83
1.8872	145	1.8990	77, 81
1.8873	145	1.8991	77, 81
1.8874	145	1.8992	77, 81
1.8875	145	1.8993	78, 82
1.8879	145	1.8994	78, 82
1.8880	145	1.8995	78, 83
1.8881	145	1.8996	78, 83
1.8888	145	2.4778	411, 417
1.8902	254, 255, 261	2.4816	469, 471
1.8904	77, 81	2.4851	469, 471
1.8905	145, 309	2.4856	469, 471
1.8906	76, 80	2.4879	411
1.8908	76, 80	2.4889	469, 471
1.8909	76, 80	2.4951	469, 471
1.8912	289, 291		
1.8913	289, 291		
1.8914	78, 82		
1.8915	145, 290, 292		
1.8918	145, 290, 292		
1.8924	76, 80		
1.8925	93		
1.8926	77, 81		
1.8927	78, 82		
1.8928	78, 83		
1.8931	78, 83		
1.8932	254, 255, 261		
1.8933	93		
1.8935	145, 309		
1.8936	322, 324		
1.8940	93		
1.8941	93		