



7320 Madison Street
Paramount, CA 90723
(800)353-FINE • (562)408-0500
Fax: (562)408-0235

PIPE - FITTING SPECIFICATIONS

A 105 / SA 105

Standard Specification for Carbon Steel Forgings for Piping Applications

Overview

1.1 This specification covers forged carbon steel piping components for ambient- and higher-temperature service in pressure systems. Included are flanges, fittings, valves, and similar parts ordered either to dimensions specified by the purchaser or to dimensional standards such as the ANSI and API specifications. Forgings made to this specification are limited to a maximum weight of 10,000 lb [4540 kg]. Larger forgings may be ordered to other specifications. Tubesheets and hollow cylindrical forgings for pressure vessel shells are not included within the limits of this specification. Although this specification covers some piping components machined from rolled bar and seamless tubular products, it does not cover raw material produced in these product forms.

1.2 Supplementary requirements are provided for use when additional testing or inspection is required. These shall apply only when specified individually by the purchaser in the order.

1.3 Specification A 266/A 266M covers other steel forgings and Specifications A 675, A 695, A 696 cover other steel bars.

1.4 This specification is expressed in both inch-pound units and SI units. However, unless the order specifies the applicable "M" specification designation (SI units), the material shall be furnished to inch-pound units.

1.5 The values stated in either inch-pound units or SI are to be regarded separately as standard. (A combination of values from the two systems may result in nonconformance with the specification.)

A 182 / SA 182

Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service

Overview

1.1 This specification covers forged low alloy and stainless steel piping components for use in pressure systems. Included are flanges, fittings, valves, and similar parts to specified dimensions or to dimensional standards such as the ASME specifications.



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A 182 / SA 182 (Cont.)

1.2 For bars and products machined directly from bar, refer to Specifications A 479/A 479M and A 739, for the similar grades available in those specifications. Products made to this specification are limited to a maximum weight of 10 000 lb [4250 kg]. For larger products and products for other applications, refer to Specification A 336 for the similar grades available in that specification.

1.3 Several grades of low alloy steels and ferritic, martensitic, austenitic, and ferritic-austenitic stainless steels are included. Selection will depend upon design and service requirements.

1.4 Supplementary requirements are provided for use when additional testing or inspection is desired. These shall apply only when specified individually by the purchaser in the order.

1.5 This specification is expressed in both inch-pound units and SI units. However, unless the order specifies the applicable "M" specification designation (SI units), the material shall be furnished to inch-pound units.

1.6 The values stated in either inch-pound units or SI units are to be regarded separately as the standard. (A combination of values from the two systems may result in nonconformance with the specification.)

A 210 / SA 210

Standard Specification for Seamless Medium-Carbon Steel Boiler and Superheater Tubes

Overview

1.1 This specification covers minimum-wall-thickness, seamless medium-carbon steel, boiler tubes and boiler flues, including safe ends, arch and stay tubes, and superheater tubes.

1.2 The tubing sizes and thicknesses usually furnished to this specification are 1/8 in. to 5 in. [12.7 mm to 127 mm] in outside diameter and 0.035 to 0.500 in. [0.9 to 12.7 mm], inclusive, in minimum wall thickness. Tubing having other dimensions may be furnished, provided such tubes comply with all other requirements of this specification.

1.3 Mechanical property requirements do not apply to tubing smaller than 1/8 in. [3.2 mm] in inside diameter or 0.015 in. [0.4 mm] in thickness.

1.4 When these products are to be used in applications conforming to ISO Recommendations for Boiler Construction, the requirements of Specification A 520, shall supplement and supersede the requirements of this specification.

1.5 The values stated in either inch-pound units or SI units are to be regarded separately as standard. (A combination of values from the two systems may result in nonconformance with the specification.) The inch-pound units shall apply unless the "M" designation of the specification is specified in the order.



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A 213 / SA 213

Standard Specification for Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater, and Heat-Exchanger Tubes

Overview

1.1 This specification covers minimum-wall-thickness, seamless ferritic and austenitic steel, boiler and superheater tubes and austenitic steel heat-exchanger tubes, designated Grades T5, TP304, etc. These steels are listed in the specification (Tables 1-3).

1.2 Grades TP304H, TP309H, TP309HCb, TP310H, TP310HCb, TP310HCbN, TP316H, TP321H, TP347H, TP347HFG (fine grained) and TP348H are modifications of Grades TP304, TP309S, TP309Cb, TP310S, TP310Cb, TP316, TP321, TP347, and TP348, and are intended for high-temperature service, such as for superheaters and reheaters.

1.3 The tubing sizes and thicknesses usually furnished to this specification are 1/8 in. [3.2 mm] in inside diameter to 5 in. [127 mm] in outside diameter and 0.015 to 0.500 in. [0.4 to 12.7 mm], inclusive, in minimum wall thickness. Tubing having other dimensions may be furnished, provided such tubes comply with all other requirements of this specification.

1.4 Mechanical property requirements do not apply to tubing smaller than 1/8 in. [3.2 mm] in inside diameter or 0.015 in. [0.4 mm] in thickness.

1.5 Optional supplementary requirements are provided and, when desired, shall be so stated in the order.

1.6 The values stated in either inch-pound units or SI units are to be regarded separately as standard. (A combination of values from the two systems may result in nonconformance with the specification.) The inch-pound units shall apply unless the "M" designation of this specification is specified in the order.

A 249 / SA 249

Standard Specification for Welded Austenitic Steel Boiler, Superheater, Heat-Exchanger, and Condenser Tubes

Overview

1.1 This specification covers nominal-wall-thickness welded tubes made from the austenitic steels listed in Table 1, with various grades intended for such use as boiler, superheater, heat exchanger, or condenser tubes.

1.2 Grades TP304H, TP309H, TP309HCb, TP310H, TP310HCb, TP316H, TP321H, TP347H, and TP348H are modifications of Grades TP304, TP309S, TP309Cb, TP310S, TP310Cb, TP316, TP321, TP347, and TP348, and are intended for high-temperature service such as for superheaters and reheaters.



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A 249 / SA 249 (Cont.)

1.3 The tubing sizes and thicknesses usually furnished to this specification are 1/8 in. [3.2 mm] in inside diameter to 5 in. [127 mm] in outside diameter and 0.015 to 0.320 in. [0.4 to 8.1 mm], inclusive, in wall thickness. Tubing having other dimensions may be furnished, provided such tubes comply with all other requirements of this specification.

1.4 Mechanical property requirements do not apply to tubing smaller than 1/8 in. [3.2 mm] in inside diameter or 0.015 in. [0.4 mm] in thickness.

1.5 Optional supplementary requirements are provided and, when one or more of these are desired, each shall be so stated in the order.

1.6 The values stated in either inch-pound units or SI units are to be regarded separately as standard. (A combination of values from the two systems may result in nonconformance with the specification.) The inch-pound units shall apply unless the "M" designation of this specification is specified in the order.

A 268 / SA 268

Standard Specification for Seamless and Welded Ferritic and Martensitic Stainless Steel Tubing for General Service

Overview

1.1 This specification covers a number of grades of nominal-wall-thickness, stainless steel tubing for general corrosion-resisting and high-temperature service. Most of these grades are commonly known as the "straight-chromium" types and are characterized by being ferromagnetic. Two of these grades, TP410 and UNS S 41500 in the specification (Table 1), are amenable to hardening by heat treatment, and the high-chromium, ferritic alloys are sensitive to notch-brittleness on slow cooling to ordinary temperatures. These features should be recognized in the use of these materials. Grade TP439 is used primarily for hot-water tank service and does not require post-weld heat treatment to prevent attack of the heat affected zone.

1.2 An optional supplementary requirement is provided, and when desired, shall be so stated in the order.

1.3 The values stated in either inch-pound units or SI units are to be regarded separately as standard. (A combination of values from the two systems may result in nonconformance with the specification.) The inch-pound units shall apply unless the "M" designation of this specification is specified in the order.

A 269

Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service

Overview

1.1 This specification covers grades of nominal-wall-thickness, stainless steel tubing for general corrosion-resisting and low- or high-temperature service.



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A 269 (Cont)

1.2 The tubing sizes and thicknesses usually furnished to this specification are 0.252 in. (6.4 mm) in inside diameter and larger and 0.020 in. (0.51 mm) in nominal wall-thickness and heavier.

1.3 Mechanical property requirements do not apply to tubing smaller than 1/8 in. (3.2 mm) in inside diameter or 0.015 in. (0.38 mm) in thickness.

1.4 Optional supplementary requirements are provided and, when one or more of these are desired, each shall be so stated in the order.

1.5 The values stated in inch-pound units are to be regarded as the standard

A 270 / BPE

Standard Specification for Seamless and Welded Austenitic Stainless Steel Sanitary Tubing

Overview

1.1 This specification covers grades of seamless and welded austenitic stainless steel sanitary tubing intended for use in the dairy and food industry and having special surface finishes. Pharmaceutical quality and finishes may be requested, as a supplementary requirement.

1.2 This specification covers tubes in sizes up to and including 4 in. (101.6 mm) in outside diameter.

1.3 The values stated in inch-pound units are to be regarded as the standard.

1.4 Optional supplementary requirements are provided, and when one or more of these are desired, each shall be so stated in the order.

A 312 / SA 312

Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipes

Overview

1.1 This specification covers seamless and straight-seam welded austenitic steel pipe intended for high-temperature and general corrosive service.

1.2 Grades TP304H, TP309H, TP309HCb, TP310H, TP310HCb, TP316H, TP321H, TP347H, and TP348H are modifications of Grades TP304, TP309Cb, TP309S, TP310Cb, TP310S, TP316, TP321, TP347, and TP348, and are intended for high-temperature service.



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A 312 / SA 312 (Cont)_

1.3 Optional supplementary requirements are provided for pipe where a greater degree of testing is desired. These supplementary requirements call for additional tests to be made and, when desired, one or more of these may be specified in the order.

1.4 The ASTM table lists the dimensions of welded and seamless stainless steel pipe as shown in ANSI B36.19. Pipe having other dimensions may be furnished provided such pipe complies with all other requirements of this specification.

1.5 Grades TP321 and TP321H have lower strength requirements for pipe manufactured by the seamless process in nominal wall thicknesses greater than 3/8 in. [9.5 mm].

1.6 The values stated in either inch-pound units or SI units are to be regarded separately as the standard. (A combination of values from the two systems may result in nonconformance with the specification.) The inch-pound units shall apply unless the "M" designation of this specification is specified in the order.

A351/A351M-06

A351/A351M-06 Standard Specification for Castings, Austenitic, for Pressure-Containing Parts

1.1 This specification covers austenitic steel castings for valves, flanges, fittings, and other pressure-containing parts (Note 0). Note 0 Carbon steel castings for pressure-containing parts are covered by Specification A 216/A 216M, low-alloy steel castings by Specification A 217/A 217M, and duplex stainless steel castings by Specification A 995/A 995M.

1.2 A number of grades of austenitic steel castings are included in this specification. Since these grades possess varying degrees of suitability for service at high temperatures or in corrosive environments, it is the responsibility of the purchaser to determine which grade shall be furnished. Selection will depend on design and service conditions, mechanical properties, and high-temperature or corrosion-resistant characteristics, or both.

1.2.1 Because of thermal instability, Grades CE20N, CF3A, CF3MA, and CF8A are not recommended for service at temperatures above 800F [425C].

1.2.2 Because of embrittlement phases, Grade CD4MCu is not recommended for service at temperatures above 600F [316C].

1.3 Supplementary requirements of an optional nature are provided for use at the option of the purchaser. The Supplementary requirements shall apply only when specified individually by the purchaser in the purchase order or contract.



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A351/A351M-06 (Cont.)

1.4 This specification is expressed in both inch-pound units and in SI units; however, unless the purchase order or contract specifies the applicable M specification designation (SI units), the inch-pound units shall apply. The values stated in either inch-pound units or SI units are to be regarded separately as standard. Within the text, the SI units are shown in brackets. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the standard.

A 403 / SA 403

Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings

Overview

1.1 This specification covers wrought stainless steel fittings for pressure piping applications.

1.2 Several grades of austenitic stainless steel alloys are included in this specification. Grades are designated with a WP or CR based on the applicable ANSI or MSS dimensional and rating standards, respectively.

1.3 For each of the WP stainless grades, several classes of fittings are covered, to indicate whether seamless or welded construction was used. Class designations are also used to indicate the nondestructive test method and extent of nondestructive examination (NDE). A table gives the general summary of the fitting classes applicable to all WP grades of stainless steel covered by this specification. There are no classes for the CR grades. Specific requirements are covered under another specification.

1.4 This specification is expressed in both inch-pound units and in SI units. However, unless the order specifies the applicable "M" specification designation (SI units), the material shall be furnished to inch-pound units.

1.5 The values stated in either inch-pound units or SI units are to be regarded separately as the standard. (A combination of values from the two systems may result in nonconformance with the specification.)

1.6 This specification does not apply to cast steel fittings. Austenitic stainless steel castings are covered in Specifications A 351/A 351M, A 743/A 743M, and A 744/A 744M.

A 554

Standard Specification For Welded Stainless Steel Mechanical Tubing

Overview

1.1 This specification covers welded stainless steel tubing for mechanical applications where appearance, mechanical properties, or corrosion resistance is needed.

1.2 This specification covers as-welded or cold-reduced mechanical tubing in sizes to 16 in. (406.4 mm) outside diameter, inclusive (for round tubing) and in wall thicknesses 0.020 in. (0.51 mm) and over.



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A 554 (Cont)

1.3 Tubes shall be furnished in one of the following shapes as specified by the purchaser: round, square, rectangular, or special.

1.4 Supplementary requirements of an optional nature are provided and when desired shall be so stated in the order.

1.5 Values stated in inch-pound units, in accordance with the specifications, are to be regarded as the standard.

A774/A774M-06

A774/A774M-06 Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures

1.1 This specification covers five grades of as-welded, wrought austenitic stainless steel fittings for low-pressure piping and intended for low and moderate temperatures and general corrosive service. Users should note that certain corrosive conditions may restrict the use of one or more grades. For applications requiring a product that requires heat treatment or full pressure rating, refer to Specification A 403/A 403M. The term "fittings" applies to butt and socket welding parts such as 45 and 90 elbows, tees, reducers, wyes, laterals, crosses, and stub ends.

1.2 This specification covers as-welded fittings 3 through 48 in. [75 through 1225 mm] in outside diameter and in nominal wall thicknesses 0.062 through 0.500 in. [1.6 through 12.7 mm]. and list the common diameters and nominal thicknesses of fittings in this specification.

1.3 This specification does not apply to cast fittings. Cast austenitic steel fittings are covered by Specification A 351/A 351M.

1.4 Optional supplementary requirements are provided for fittings where a greater degree of examination is desired. These supplementary requirements call for additional tests. When desired, one or more of these may be specified in the order.

1.5 This specification is expressed in both inch-pound units and in SI units. However, unless the order specifies the applicable "M" specification designation (SI units), the material shall be furnished to inch-pound units.

1.6 The values stated in either inch-pound units or SI units are to be regarded separately as standard. Within the text, the SI units are shown in brackets. The values stated in each system are not exact equivalents; therefore, each system must be used independently of the other. Combining values from the two systems may result in nonconformance with the specification.



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A 778

STANDARD SPECIFICATION FOR WELDED, UNANNEALED AUSTENITIC STAINLESS STEEL TUBULAR PRODUCTS

Overview

1.1 This specification covers straight seam and spiral butt seam welded unannealed austenitic stainless steel tubular products intended for low and moderate temperatures and corrosive service where heat treatment is not necessary for corrosion resistance. The user of this specification should be aware that a minimum amount of testing and examination is required of the basic product. The user requiring additional testing or examination is referred to the supplemental requirements or Ordering Information, or both. Users requiring a tubular product with post-weld heat treatment or with radiographic examination are referred to Specifications A 312, A 358, or A 409 as applicable.

1.2 This specification covers welded unannealed tubular products 3 in. (75 mm) through 48 in. (1200 mm) in outside diameter and in nominal wall thicknesses of 0.062 in. (1.5 mm) through 0.500 in. (12.5 mm) produced to this specification. Tubular products having other diameters, or wall thickness, or both may be furnished provided it complies with all other requirements of this specification.

1.3 The values stated in inch-pound units are to be regarded as the standard.

A 815 / SA 815

Standard Specification For Wrought Ferritic, Ferritic/Austenitic, and Martensitic Stainless Steel Piping Fittings

Overview

1.1 This specification covers two general classes, WP and CR, of wrought ferritic, ferritic/austenitic, and martensitic stainless steel fittings of seamless and welded construction covered by the latest revision of ANSI B16.9, ANSI B16.11, ANSI B16.28, MSS Standard Practice SP-79, and MSS Standard Practice SP-43. Fittings differing from these standards may be furnished in accordance with Supplementary Requirement S8.

1.1.1 Class WP fittings are subdivided into four subclasses: Classes WP-S, WP-W, WP-WX, and WP-WU. They are manufactured to the requirements of ANSI B16.9, B16.11, B16.28, or MSS Standard Practice SP-79, and they shall have pressure ratings compatible with 12.2. Class WP-S fittings are those manufactured from seamless product by a seamless method of manufacture (marked with class symbol WP-S); Class WP-W fittings are those which contain welds where the fitting fabrication or construction welds have been radiographed (marked with class symbol WP-W); and Class WP-WX fittings are those which contain welds where all welds have been radiographed (marked with class symbol WP-WX); and Class WP-WU fittings are those which contain welds where all weld have been ultrasonically tested (marked with class symbol WP-WU).

1.1.2 Class CR fittings are those manufactured to the requirements of MSS SP-43, and they shall have pressure ratings compatible with 112.3.

1.2 This specification does not apply to cast fittings.



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A 815 / SA 815 (Cont)

1.3 Optional supplementary requirements are provided. When desired, one or more of these may be specified in the order.

1.4 This specification is expressed in both inch-pound units and in SI units. However, unless the order specifies the applicable "M" specification designation [SI units], the material shall be furnished to inch-pound units.

1.5 The values stated in either inch-pound units or SI units are to be regarded separately as the standard. (A combination of values from the two systems may result in nonconformance with the specification.)



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INDUSTRIAL REGULATORY GROUPS

- ASTM** - The American Society for Testing and Materials
- ASME** - The American Society of Mechanical Engineers
- MSS** - Manufacturers Standardization Society
- API** - American Petroleum Institute
- AWWA** - The American Water Works Association
- NACE** - National Association of Corrosion Engineers
- UNS** - Unified Numbering System
- ANSI** - American National Standards Institute

SPECIAL ALLOYS

Alloy 20 Chemical Composition %

C	Cb	Cr	Cu	Mn	Mo	Ni	P	S	Si	Ta
Max	8 times			Max			Max	Max	Max	8 times
0.07	Carbon-1.00	19.0-21.0	3.0-4.0	2.0	2.0-3.0	32.0-38.0	0.045	0.035	1.0	Carbon-1.00

SPECIFICATIONS

ASTM

B729, B464, B366, B473, B462

ASME

SB729, SB464, SB366, SB473, SB462

DESCRIPTION

Alloy 20 is one of the so-called "Super" stainless steels that was designed for maximum resistance to acid attack. It's nickel, chromium, molybdenum and copper content contribute to its overall resistance to chloride stress corrosion cracking and general pitting attack. The alloy is stabilized with columbium to minimize carbide precipitation during welding. It has good mechanical properties and can be fabricated with comparative ease. Although the alloy was designed for use in sulfuric acid related industries, it finds wide usage throughout the chemical processing industry. It also is used for processing pharmaceuticals, food, gasoline, solvents, plastics, explosives, synthetic fibers and many other products.

DESIGN FEATURES

- Superior resistance to stress-corrosion cracking in boiling 20 to 40% sulfuric acid.
- Excellent general corrosion resistance to sulfuric acid.
- Excellent resistance to chloride stress corrosion cracking.
- Excellent mechanical properties and fabricability.
- Minimal carbide precipitation during welding.

TYPICAL APPLICATIONS

Chemical and allied industries

Food and dye production

Heat exchangers

SO₂ scrubbers and other severe environments

Tanks

Pickling racks

Valves



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TENSILE REQUIREMENTS

Tensile Strength (KSI) 80
 Yield Strength (KSI) 35KSI can be converted to MPA (Megapascals) by multiplying by 6.895.

2205 Chemical Composition %

C	Cr	Fe	Mn	Mo	N	Ni	P	S	Si
Max			Max				Max	Max	Max
0.030	21.0-23.0	Bal	2.0	2.50-3.50	0.08-0.20	4.50-6.50	0.03	0.02	1.0

SPECIFICATIONS

ASTM
 A790, A815, A182
 ASME
 SA790, SA815, SA182

DESCRIPTION

Avesta Sheffield 2205 is a ferritic-austenitic stainless steel which combines many of the beneficial properties of both ferritic and austenitic steels. As a result of high chromium and molybdenum contents, the steel has very good pitting and uniform corrosion resistance to stress corrosion cracking as well as high mechanical strength.

2205 has good weldability and can be welded using most of the welding techniques for stainless steels. Due to the balanced composition, when welded correctly, the heat affected zone contains sufficient austenite to avoid the risk of localized corrosion. The chemical composition of 2205 is balanced to give a microstructure containing roughly equal amounts of ferrite and austenite.

DESIGN FEATURES

- High strength.
- Low thermal expansion and higher heat conductivity than austenitic steels.
- High resistance to stress corrosion cracking, corrosion fatigue and erosion.
- High uniform corrosion resistance.
- High pitting and crevice corrosion resistance.
- Good sulfide stress corrosion cracking resistance.



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TYPICAL APPLICATIONS

- Heat exchangers, tubes and pipe for production and handling of gas and oil
- Heat exchangers and pipes in desalination plants
- Pressure vessels, pipes, tanks and heat exchangers for processing and transport of various chemicals
- Pressure vessels, tanks and pipes in process industries handling chlorides
- Rotors, fans, shafts and press rolls where the high corrosion fatigue strength can be utilized
- Cargo tanks, piping and welding consumables for chemical tankers

TENSILE REQUIREMENTS

Tensile Strength (KSI) 65

Yield Strength (KSI) 90KSI can be converted to MPA (Megapascals) by multiplying by 6.895.

Alloy C-276 Chemical Composition %

C	Co	Cr	Fe	Mn	Mo	Ni	P	S	Si	V	W
Max	Max			Max			Max	Max	Max	Max	
0.01	2.5	14.5-16.5	4.0-7.0	1.0	15.0-17.0	Bal	0.04	0.03	0.08	0.35	3.0-4.5

SPECIFICATIONS

ASTM

B619, B366, B564, B574

ASME

SB619, SB366, SB564, SB574

DESCRIPTION

Alloy C-276 is an improved wrought version of Alloy C and has the same excellent corrosion resistance as that material but has greatly improved fabricability. It can be hot worked and cold formed by conventional procedures. It can be joined by all of the common welding methods and resists the formation of grain boundary precipitates in the weld-affected zone, thus making it suitable for most chemical process applications in the aswelded condition. It resists pitting and stress-corrosion cracking and is resistant to oxidation at temperatures up to 1900 deg.F.

DESIGN FEATURES

- Outstanding corrosion resistance and oxidizing environments.
- Excellent resistance to pitting and stress-corrosion cracking.
- Maintains corrosion resistance in welded joints.

TYPICAL APPLICATIONS

Chemical processing Pollution control Pulp and paper Other severe environments and/or conditions.



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TENSILE REQUIREMENTS

Tensile Strength (KSI) 100

Yield Strength (KSI) 41KSI can be converted to MPA (Megapascals) by multiplying by 6.895.

AL-6XN

Typical Composition (Weight %)

C	Mn	P	S	Si	Cr	Ni	Mo	N	Cu	Fe
0.02	0.40	0.025	0.002	0.40	20.5	24.0	6.3	0.22	0.1	Balance

GENERAL PROPERTIES

The AL-6XN alloy is a superaustenitic stainless steel which was developed by Allegheny Ludlum Corporation. It exhibits far greater resistance to chloride pitting, crevice corrosion and stress-corrosion cracking than exhibited by the standard 300 series stainless steels, and is less costly than the traditional nickel-base corrosion resistant alloys.

The AL-6XN alloy has exhibited good performance in variety of highly corrosive environments. The AL-6XN alloy is available in a wide range of product forms including plate, strip, sheet, bar, billet, tubing, pipe, and castings. Its various product forms are covered by ASME and ASTM specifications. The use of wrought AL-6XN products in the ASME Boiler and Pressure Vessel is covered by Code Case 1997 (latest revision) for Section VIII construction and by Code Case N-438 (latest revision) for Section III construction. The use of AL-6XN castings is covered by Code Case 2106 (latest revision)

for Section VIII and Code Case 497 (latest revision) for Section III construction. The alloy is approved for both welded and unwelded construction under ANSI/ASME B31.1 Code Case 155. Use of AL-6XN alloy in contact with hydrogen sulfide-containing petroleum and natural gas is covered by NACE MR0175-92.

PRODUCT FORM	ASME	ASTM
Plate, Sheet and Strip	SB-688	B 688
Rod, Bar and Wire	SB691	B 691
Welded Pipe	SB675	B 675
Welded Tube	SB-676	B 676
Seamless Pipe & Tube	SB-690	B 690
Billets and Bars for Reforging	-	B 472
Forged Pipe Flanges, Fittings and Valves	SB-462	B 462
Wrought Welded Fittings	SB-366	B 366
Forging	SB-564	B 564
Pipe Welded With Filler	-	B 804
Casting (CN-3MN)	-	A 743
		A 744

PRODUCT FORMS & SPECIFICATIONS

304/304L
Chemical Composition %

C	Cr	Mn	NI	P	S	Si
Max		Max		Max	Max	Max
0.035	18.0-20.0	2.0	8.0-13.0	0.040	0.030	0.75

SPECIFICATIONS

ASTM
 A312, A376, A358, A269, A249, A403, A182, A351
 ASME
 SA312, 5A376, SA358, SA269, SA249, SA403, SA182, SA351

DESCRIPTION

304 stainless is a low carbon (0.08% max) version of basic 18-8 also known as 302. Type 302 has 18% chromium and 8% nickel. Type 304 has slightly lower strength than 302 due to its lower carbon content. Type 304 finds extensive use in welding applications because the low carbon permits some exposure in the carbide precipitation range of 800 0 F - 1500 OF without the need for post-annealing operations. However, the severity of corrosive environments may necessitate annealing after welding or the use of 304L. Type 304L has a carbon content of 0.03% or less. This alloy can be used in the as-welded condition without becoming susceptible to intergranular corrosion.

DESIGN FEATURES

Oxidation resistance up to 1650 0 F for continuous service and up to 1 1500 deg.F where cyclic heating is involved.
 General purpose corrosion resistance.
 Non-hardenable except by cold working.
 Non-magnetic except when cold worked.
 May be susceptible to chloride stress corrosion cracking.
 Used where field working is employed.

TYPICAL APPLICATIONS

Sanitary
 Dairy and Food processing
 Heat exchangers, evaporators
 Feedwater heaters

TENSILE REQUIREMENTS

Tensile Strength (KSI) 70
 Yield Strength (KSI) 25

KSI can be converted to MPA (Megapascals) by multiplying by 6.895.

316/316L
Chemical Composition %

C	Cr	Mn	Mo	Ni	P	S	Si
Max		Max			Max	Max	Max
0.035	16.0-20.0	2.00	2.0-3.0	10.0-15.0	0.040	0.030	0.75

SPECIFICATIONS

ASTM

A312, A376, A358, A269 A249, A403, A182, A351 A479, A276

ASME

SA312, SA376, SA358, SA269, SA249, SA182, SA276, SA403, SA479, SA351

DESCRIPTION

Type 316 is a molybdenum steel possessing improved resistance to pitting by solutions containing chlorides and other halides. In addition, it provides excellent elevated temperature tensile, creep and stress - rupture strengths.

DESIGN FEATURES

- Type 316 is more resistant to atmospheric and other mild environments than Type 304. It is resistant to dilute solutions (i.e. 1-5%) of sulfuric acid up to 120 deg.F. However, in certain oxidizing acids, Type 316 is less resistant than Type 304.
- 316 is susceptible to carbide precipitation when exposed in the temperature range of 800 deg. - 1500 deg.F. and therefore is susceptible to intergranular corrosion in the as-welded condition.
- Annealing after welding will restore corrosion resistance.
- Type 316L has the same composition as Type 316 except the carbon content is held below 0.03%. Not unexpectedly, its general corrosion resistance and other properties closely correspond to those of Type 316. However, it does provide immunity to intergranular attack in the as-welded condition or with short periods of exposure in the temperature range of 800 deg. - 1500 deg.F. The use of 316L is recommended when exposure in the carbide precipitation range is unavoidable and where annealing after welding is not practical. However, prolonged exposure in this range may embrittle the material and make it susceptible to intergranular attack.
- The maximum temperature for scaling resistance in continuous service is about 1650 deg. F. and 1500 deg.F. for intermittent service.
- May be susceptible to chloride stress corrosion cracking.
- Non-hardenable; non-magnetic in the annealed condition, and slightly magnetic when cold worked.
- Improved corrosion resistance to chlorides.

TYPICAL APPLICATIONS

Nuclear, chemical processing, Rubber, plastics, pulp/paper, pharmaceutical and textile industries, heat exchangers, condensers and evaporators

TENSILE REQUIREMENTS

Tensile Strength (KSI) 70

Yield Strength (KSI) 25

KSI can be converted to MPA (Megapascals) by multiplying by 6.895.