

SPECIFICATION FOR COMMON REQUIREMENTS FOR STEEL FLANGES, FORGED FITTINGS, VALVES, AND PARTS FOR PIPING APPLICATIONS



SA-961/SA-961M



(23)

(Identical with ASTM Specification A961/A961M-21.)

Specification for Common Requirements for Steel Flanges, Forged Fittings, Valves, and Parts for Piping Applications

1. Scope

1.1 This specification covers a group of common requirements that shall apply to steel flanges, forged fittings, valves, and parts for piping applications under any of the following individual product specifications:

Title of Specification	ASTM Designation
Forgings, Carbon Steel, for Piping Components	A105/A105M
Forgings, Carbon Steel, for General-Purpose Piping	A181/A181M
Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High Temperature Service	A182/A182M
Forgings, Carbon and Low Alloy Steel, Requiring Notch Toughness Testing for Piping Components	A350/A350M
Forged or Rolled 8 and 9 % Nickel Alloy Steel Flanges, Fittings, Valves, and Parts for Low-Temperature Service	A522/A522M
Forgings, Carbon and Alloy Steel, for Pipe Flanges, Fittings, Valves, and Parts for High-Pressure Transmission Service	A694/A694M
Flanges, Forged, Carbon and Alloy Steel for Low Temperature Service	A707/A707M
Forgings, Carbon Steel, for Piping Components with Inherent Notch Toughness	A727/A727M
Forgings, Titanium-Stabilized Carbon Steel, for Glass-Lined Piping and Pressure Vessel Service	A836/A836M

1.2 In case of conflict between a requirement of the individual product specification and a requirement of this general requirement specification, the requirements of the individual product specification shall prevail over those of this specification.

1.3 By mutual agreement between the purchaser and the supplier, additional requirements may be specified (see Section 4.1.2). The acceptance of any such additional requirements shall be dependent on negotiations with the supplier and must be included in the order as agreed upon between the purchaser and supplier.

1.4 The values stated in either SI units or inch-pound units are to be regarded separately as standard. Within the text and

the tables, 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 non-conformance with the standard. The inch-pound units shall apply, unless the “M” designation (SI) of the product specification is specified in the order.

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:

- A105/A105M Specification for Carbon Steel Forgings for Piping Applications
- A181/A181M Specification for Carbon Steel Forgings, for General-Purpose Piping
- A182/A182M Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
- A275/A275M Practice for Magnetic Particle Examination of Steel Forgings
- A350/A350M Specification for Carbon and Low-Alloy Steel Forgings, Requiring Notch Toughness Testing for Piping Components
- A370 Test Methods and Definitions for Mechanical Testing of Steel Products
- A522/A522M Specification for Forged or Rolled 8 and 9% Nickel Alloy Steel Flanges, Fittings, Valves, and Parts for Low-Temperature Service
- A694/A694M Specification for Carbon and Alloy Steel Forgings for Pipe Flanges, Fittings, Valves, and Parts for High-Pressure Transmission Service
- A700 Guide for Packaging, Marking, and Loading Methods

for Steel Products for Shipment
 A707/A707M Specification for Forged Carbon and Alloy Steel Flanges for Low-Temperature Service
 A727/A727M Specification for Carbon Steel Forgings for Piping Components with Inherent Notch Toughness
 A751 Test Methods and Practices for Chemical Analysis of Steel Products
 A836/A836M Specification for Titanium-Stabilized Carbon Steel Forgings for Glass-Lined Piping and Pressure Vessel Service
 A941 Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys
 A967/A967M Specification for Chemical Passivation Treatments for Stainless Steel Parts
 A991/A991M Test Method for Conducting Temperature Uniformity Surveys of Furnaces Used to Heat Treat Steel Products
 A1058 Test Methods for Mechanical Testing of Steel Products—Metric
 B880 Specification for General Requirements for Chemical Check Analysis Limits for Nickel, Nickel Alloys and Cobalt Alloys
 E165/E165M Practice for Liquid Penetrant Testing for General Industry
 E381 Method of Macroetch Testing Steel Bars, Billets, Blooms, and Forgings
 E709 Guide for Magnetic Particle Testing
 E1916 Guide for Identification of Mixed Lots of Metals
 2.2 *ASME Standard:*
 ASME Boiler and Pressure Vessel Code—Section IX
 2.3 *Manufacturer's Standardization Society Standard:*
 SP 25 Standard Marking System of Valves, Fittings, Flanges and Unions

3. Terminology

3.1 *Definitions*—For definitions of other terms used in this specification, refer to Terminology A941.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *bar, n*—a solid rolled or forged section that is long in relationship to its cross sectional dimensions, with a relatively constant cross section throughout its length and a wrought microstructure.

3.2.2 *certifying organization, n*—the company or association responsible for the conformance of, the marking of, and the certification of the product to the specification requirements.

3.2.3 *fitting, n*—a component for non-bolted joints in piping systems.

3.2.4 *flange, n*—a component for bolted joints used in piping systems.

3.2.5 *forging, n*—the product of a substantially compressive hot or cold plastic working operation that consolidates the material and produces the required shape.

3.2.5.1 *Discussion*—The plastic working must be performed by a forging machine, such as a hammer, press, or ring rolling machine, and must deform the material to produce a wrought structure throughout the material cross section.

3.2.6 *seamless tubing, n*—a tubular product made without a welded seam.

3.2.6.1 *Discussion*—It is manufactured usually by hot working the material, and if necessary, by subsequently cold finishing the hot worked tubular product to produce the desired shape, dimensions and properties.

4. Ordering Information

4.1 It is the purchaser's responsibility to specify in the purchase order all ordering information necessary to purchase the needed material. Examples of such information include, but are not limited to, the following:

4.1.1 Quantity,

4.1.2 Size and pressure class or dimensions, (tolerances and surface finishes should be included),

4.1.3 Specification number with grade or class, or both, as applicable, and year/date,

4.1.4 Choice of testing track from the options listed in Test Methods A1058 when material is ordered to an M suffix (SI units) product standard. If the choice of test track is not specified in the order, then the default ASTM track shall be used as noted in Test Methods A1058,

4.1.5 Supplementary requirements, and

4.1.6 Additional requirements.

5. Melting Process

5.1 Unless otherwise specified in the individual Product Specification, the steel shall be fully killed.

5.2 If a specific type of melting is required by the purchaser, it shall be stated on the purchase order.

5.3 The primary melting may incorporate separate degassing or refining and may be followed by secondary melting, such as electroslag remelting or vacuum remelting. If secondary melting is employed, the heat shall be defined as all of the ingot remelted from a single primary heat.

5.4 Steel may be cast in ingots or may be strand cast. When steel of different grades is sequentially strand cast, identification of the resultant transition material is required. The steel producer shall remove the transition material by an established procedure that positively separates the grades.

5.5 A sufficient discard shall be made from the source material to secure freedom from injurious porosity and shrinkage, and undue segregation.

6. Manufacture

6.1 The finished part shall be manufactured from a forging that is as close as practicable to the finished size or shape. Alternative starting materials may be used, but with the following exceptions and requirements.

6.1.1 *Bar*—Flanges, elbows, return bends, tees, and header tees shall not be machined directly from bar. Other cylindrical shaped parts up to, and including, NPS 4 can be machined from bar provided that the axial length of the part is approximately parallel to the metal flow lines of the starting stock.

6.1.2 *Wrought Seamless Pipe and Tubing*—Flanges shall not be machined directly from seamless pipe or tubing. Other hollow cylindrical shaped parts can be machined from seamless pipe and tubing provided that the axial length of the part is approximately parallel to the metal flow lines of the starting stock.

7. Heat Treatment

7.1 Material requiring heat treatment shall be treated as specified in the individual product specification using the following procedures that are defined in more detail in Terminology A941.

7.1.1 *Annealing*—Material shall be uniformly reheated to a temperature above the transformation range and, after holding for a sufficient time at this temperature, cooled slowly to a temperature below the transformation range.

7.1.2 *Solution Annealing (or Solution Treat or Treatment)*—Material shall be heated to a temperature that causes the chromium carbides to go into solution, and then, quenched in water or rapidly cooled by other means to prevent reprecipitation.

7.1.3 *Isothermal Annealing*—Isothermal annealing shall consist of austenitizing a ferrous alloy, and then, cooling to and holding within the range of temperature at which the austenite transforms to a relatively soft ferrite-carbide aggregate.

7.1.4 *Normalizing*—Material shall be uniformly reheated to a temperature above the transformation range, and subsequently, cooled in air at room temperature.

7.1.5 *Tempering and Post-Weld Heat Treatment*—Material shall be reheated to the prescribed temperature below the transformation range, held at temperature for the greater of 30 min or 1 h/in. [25.4 mm] of thickness at the thickest section and cooled in still air.

7.1.6 *Stress Relieving*—Material shall be uniformly heated to the selected stress relieving temperature, held long enough to reduce stresses and then cooled at a rate that will result in the properties required for the material grade and minimize the development of new residual stresses. The temperature shall not vary from the selected temperature by more than ± 25 °F [± 14 °C].

7.1.7 *Quench and Temper*—Material shall be fully austenitized and quenched immediately in a suitable liquid medium. The quenched material shall be reheated to a minimum temperature of 1100 °F [590 °C] and cooled in still air.

7.1.8 *Same Heat Treat Cycle*—Heat treat loads at the same temperature, equivalent soak times as appropriate for the maximum section size on the respective load and equivalent cooling methods.

8. Chemical Requirements

8.1 *Chemical Analysis*—Samples for chemical analysis and methods of analysis shall be in accordance with Test Methods, Practices, and Terminology A751.

8.2 *Heat Analysis*—An analysis of each heat of steel shall be made by the steel manufacturer to determine the percentages of those elements specified in the individual product specification. If secondary melting processes are employed, the heat analysis shall be obtained from one remelted ingot, or the product of one remelted ingot, from each primary melt. The chemical analysis thus determined shall conform to the requirements of the individual product specification. Note that the product analysis (check analysis) tolerances are not to be applied to the Heat Analysis requirements.

8.3 *Product Analysis*—If a product analysis is performed it shall be in accordance with Test Methods, Practices, and Terminology A751. Samples for analysis shall be taken from midway between center and surface of solid parts, midway between inner and outer surfaces of hollow parts, midway between center and surface of full-size prolongations or from broken mechanical test specimens. The chemical composition thus determined shall conform to the limits of the product specification, within the permissible variations of Table 1 of this specification.

8.3.1 Limits on formula calculations involving elemental contents shall apply only to the heat analysis, unless agreed upon between supplier and purchaser. Where limits on formula calculations involving elemental contents apply to product analysis by such agreement, permissible variations in the formula calculation results beyond the limits for the heat analysis shall also be agreed upon between supplier and purchaser. Examples of such formula calculations include, but are not limited to, the following: carbon equivalent $CE = C + Mn / 6 + (Cr + Mo + V) / 5 + (Ni + Cu) / 15$; J factor = $(Mn + Si) \times (P + Sn) \times 10^4$; or requirements for specific elemental balance or sufficiency, typically related to Ti, Nb, or Al and interstitials C and N, such as $Nb = 5 \times C$ minimum.

9. Mechanical Requirements

9.1 *Method of Mechanical Tests*—All tests shall be conducted in accordance with Test Methods and Definitions A370 if the inch-pound units are specified or Test Methods A1058 if the M suffix (SI units) is specified.

9.2 For the purpose of determining conformance to the product specification requirements, specimens shall be obtained from the production forgings, or from separately forged test blanks prepared from the stock used to make the finished product. In either case, mechanical test specimens shall not be removed until after all heat treatment is complete. If repair welding is performed, test specimens shall not be removed until after post-weld heat treatment is complete, unless permitted by the product specification. The locations from which test specimens are removed shall be in accordance with the Product Specification.

9.3 If separately forged test blanks are used, they shall be of the same heat of steel, be subjected to substantially the same reduction and working as the production forging they represent, be heat treated in the same furnace charge except as provided for in the reduced testing provisions of the product specification, under the same conditions as the production forging, and be of the same nominal thickness as the maximum heat treated thickness of the production forging.

TABLE 1 Product Analysis Tolerances^A

Element	Limit or Maximum of Specified Range, Wt %	Tolerance Over the Maximum Limit or Under the Minimum Limit
Carbon	to 0.010, incl.	0.002
	over 0.010 to 0.030, incl.	0.005
	over 0.030 to 0.20 incl.	0.01
Manganese	over 0.20 to 0.80, incl.	0.02
	to 1.00 incl.	0.03
	over 1.00 to 3.00 incl.	0.04
Phosphorous	over 3.00 to 6.00, incl.	0.05
	over 6.00 to 10.00, incl.	0.06
	to 0.040, incl.	0.005
Sulfur	over 0.040 to 0.20, incl.	0.010
	to 0.040 incl.	0.005
Silicon	over 0.040 to 0.20, incl.	0.010
	over 0.20 to 0.50, incl.	0.020
	to 1.00, incl.	0.05
Chromium	over 1.00 to 3.00 incl.	0.10
	over 3.00 to 7.00, incl.	0.15
	0.90 and under	0.03
Nickel	over 0.90 to 2.10, incl.	0.05
	over 2.10 to 4.00, incl.	0.07
	over 4.00 to 10.00 incl.	0.10
	over 10.00 to 15.00 incl.	0.15
	over 15.00 to 20.00 incl.	0.20
	over 20.00 to 30.00 incl.	0.25
Molybdenum	to 1.00 incl.	0.03
	over 1.00 to 5.00 incl.	0.07
	over 5.00 to 10.00 incl.	0.10
Titanium	over 10.00 to 20.00 incl.	0.15
	over 20.00 to 30.00 incl.	0.20
	over 30.00 to 40.00, incl.	0.25
Niobium (Columbium)	to 0.20 incl.	0.01
	over 0.20 to 0.60 incl.	0.03
	over 0.60 to 2.00 incl.	0.05
Tantalum	over 2.00 to 7.00 incl.	0.10
	to 1.15, incl.	0.05
	to 0.14, incl.	0.02
Copper	over 0.14 to 5.50	0.05
	to 0.10 incl.	0.02
	to 0.50, incl.	0.03
Cobalt	over 0.50 to 1.00, incl.	0.05
	over 1.00 to 5.00, incl.	0.10
	0.05 to 0.25, incl.	0.01 ^B
Nitrogen	0.25 to 5.00, incl.	0.07
	to 0.02, incl.	0.005
	over 0.02 to 0.19 incl.	0.01
Aluminum	over 0.19 to 0.25	0.02
	over 0.25 to 0.35	0.03
	over 0.35 to 0.45	0.04
	over 0.45	0.05
	to 0.15, incl.	-0.005
	over 0.15 to 0.50, incl.	+0.01
Vanadium	over 0.50 to 0.80, incl.	0.05
	to 0.10 incl.	0.01
	over 0.10 to 0.25 incl.	0.02
Cerium	over 0.25 to 0.50, incl.	0.03
	minimum value specified, under minimum limit only	0.01
	to 0.20, incl.	0.01
Selenium	to 0.35, incl.	0.001
	to 0.50, incl.	0.02
Tungsten	over 0.50 to 1.00, incl.	0.03
	over 1.00 to 2.00, incl.	0.05
	over 2.00 to 4.00, incl.	0.06
Lead	to 0.35, incl.	0.03
	to 0.01, incl.	0.005
Zirconium	to 0.015, incl.	0.0005
	to 0.010, incl.	c
Boron	to 0.010, incl.	c
Tin	to 0.010, incl.	c
Arsenic	to 0.010, incl.	c
Antimony	to 0.003, incl.	c

^A This table does not apply to heat analysis.

^B Product analysis limits for cobalt under 0.05 % have not been established and the producer should be consulted for those limits.

^C No over tolerance allowed.

9.4 When parts are machined from bar or seamless tubing, as permitted in 6.1.1 and 6.1.2, the mechanical properties may be determined for the parts from the starting material, if the parts have not been subjected to any subsequent thermal processing since the time of mechanical test.

10. Hardness Requirements

10.1 The part shall conform to the hardness requirements prescribed in the product specification.

10.2 Sampling for hardness testing shall conform to the product specification.

11. Tensile Requirements

11.1 Sampling for tensile testing shall conform to the Product Specification.

11.2 When the dimensions of the material to be tested will permit, the tension test specimens shall be machined to standard round 2-in. gauge length tension test specimen described in Test Methods and Definitions A370 if inch-pound units are specified or the standard gauge length tension test specimens described in the applicable track of Test Methods A1058 if SI units are specified.

11.3 In the case of small sections, which will not permit taking of the standard test specimen described in 11.2, the subsize round specimen shall be machined. The tension test specimen shall be as large as feasible.

11.4 The results of the tensile tests shall conform to the tensile property requirements prescribed in the product specification.

11.5 If the results of tension tests do not conform to the requirements specified in the product specification, a retest shall be permitted on twice the number of test specimens as originally tested as outlined in the test methods specified herein. When any retest specimen does not conform to the product specification requirements for the characteristic in question, the lot represented by that specimen shall be rejected or reheated treated in accordance with Section 7.

11.5.1 If the results of any tension test specimen are less than specified because a flaw becomes evident in the test specimen during testing, a replacement test specimen shall be allowed provided that the defect is not attributable to ruptures, cracks, or flakes in the steel.

12. Impact Requirements

12.1 The part shall conform to the impact requirements prescribed in the product specification.

12.2 Sampling for impact testing shall conform to the Product Specification.

12.3 Notched-bar impact specimens shall be simple-beam, Charpy-type A with a V-notch in accordance with Test Methods and Definitions A370 if the inch-pound units are specified or Test Methods A1058 if the M suffix (SI Units) standard is specified. Standard specimens 10 by 10 mm in cross section shall be used unless the material to be tested is of insufficient thickness, in which case the largest obtainable standard subsize impact specimens shall be used. When the size or shape of the

finished part is insufficient to permit obtaining the smallest standard subsize impact specimens, an impact test by the part manufacturer will not be required.

12.4 If the average impact energy value meets the product specification requirements, but the energy value for one specimen is below the specified minimum value for individual specimens, a retest is permitted. This shall consist of two impact specimens from a location adjacent to, and on either side of, the specimen that failed. Each of the retested specimens must exhibit an energy value equal to or greater than the minimum average value required by the product specification.

13. Hydrostatic Test Requirements

13.1 Parts manufactured under this specification shall be capable of passing a hydrostatic test compatible with the rating of the finished part. Such tests shall be conducted by the supplier only when the hydrostatic test supplementary requirement in the product specification is invoked by the purchaser.

14. Rework

14.1 When one or more representative test specimens or retest specimens do not conform to the requirements specified in the product specification for the tested characteristic, the product may be reworked according to the following requirements:

14.1.1 If previously tested in the unheat treated condition, the product may be reworked by heat treatment, and subsequently retested, in accordance with the product specification.

14.1.2 If previously tested in the heat treated condition, the product may be reworked by reheat treatment, and subsequently retested, in accordance with the product specification.

15. Surface Finish, Appearance, and Corrosion Protection

15.1 The parts shall conform to the dimensions, tolerances, and finish as specified on the purchaser's drawing or order and the individual ASTM product specification.

15.2 The finished parts shall be cleaned to remove all scale and processing compounds prior to the final surface examination. The cleaning process shall not injure the surface finish, material properties, or the metallurgical structure.

15.2.1 The surface finish shall allow the detection of imperfections that can be disclosed by visual inspection.

15.2.2 The cleaned parts shall be protected to prevent recontamination.

15.2.2.1 Exterior and interior surfaces of carbon, low and intermediate alloy steel fittings shall have a corrosion protective coating. Unless otherwise specified by the purchaser, the type of surface protection shall be at the option of the manufacturer.

15.2.2.2 Stainless steel and nickel alloy fittings need not be coated. Unmachined surfaces of stainless steel fittings shall be passivated by exposure to an acid bath, or electropolished.

15.2.3 Protective coatings on parts subsequently subjected to socket welds or butt welds shall be suitable for welding without removal of the coating. Threaded fittings shall be capable of installation without the removal of the coating.

15.2.4 When specified in the purchase order, parts may be furnished in the as-formed or as-forged condition.

15.3 The parts shall be free of injurious imperfections as defined below. At the discretion of the inspector representing the purchaser, finished parts shall be subject to rejection if surface imperfections acceptable under 15.5 are not scattered, but appear over a large area.

15.4 *Depth of Injurious Imperfections*—Selected typical linear and other typical surface imperfections shall be explored for depth. When the depth encroaches on the minimum specified wall thickness of the finished part, such imperfections shall be considered injurious.

15.5 *Imperfections Not Classified as Injurious*—Surface imperfections not classified as injurious shall be treated as follows:

15.5.1 Seams, laps, tears, or slivers not deeper than 5 % of the actual wall thickness at the point of interest or $\frac{1}{16}$ in. [1.6 mm], whichever is less, are acceptable. If deeper, these imperfections require removal, and shall be removed by machining or grinding.

15.5.2 Mechanical marks or abrasions and pits shall be acceptable without grinding or machining provided the depth does not exceed $\frac{1}{16}$ in. [1.6 mm]. If such imperfections are deeper than $\frac{1}{16}$ in. [1.6 mm] but do not encroach on the minimum wall thickness of the forging they shall be removed by machining or grinding to sound metal.

15.5.3 The wall thickness at the point of grinding, or at imperfections not required to be removed, shall be determined by deducting the amount removed by grinding, from the nominal finished wall thickness of the part. In any case, the wall thickness shall not be less than the specified minimum value.

16. Repair by Welding

16.1 The purchaser may require the supplier to submit proposed weld repairs for approval by invoking the appropriate supplementary requirement from the applicable product specification in the purchase order. If the purchaser does not require prior approval of proposed weld repairs, these repairs shall be permitted at the discretion of the supplier. All weld repairs shall be performed in accordance with the following limitations and requirements.

16.1.1 The welding procedure and welders shall be qualified in accordance with Section IX of the ASME Boiler and Pressure Vessel Code.

16.1.2 Defects shall be completely removed prior to welding by chipping or grinding to sound metal. Removal of these defects shall be verified by magnetic particle inspection in accordance with Test Method A275/A275M or Guide E709 for the ferritic, martensitic, or ferritic/austenitic grades, or by liquid penetrant inspection in accordance with Test Method E165/E165M for ferritic, martensitic, or austenitic grades.

16.1.3 After repair welding, the welded area shall be ground smooth to the original contour and shall be completely free of defects as verified by magnetic particle or liquid penetrant inspection, as applicable.

16.1.4 Repair by welding shall not exceed 10 % of the surface area of the part, or 33 $\frac{1}{3}$ % of the wall thickness of the finished product, or $\frac{3}{8}$ in. [10 mm] deep at the location of the repair.

16.2 The weld repair shall conform to 9.2 and to the additional requirements, if any, invoked in the Product Specification.

17. Inspection

17.1 The supplier shall afford the purchaser's inspector all reasonable facilities necessary to satisfy him that the material is being produced and furnished in accordance with the general specification and the applicable product specification. Site inspection by the purchaser shall not interfere unnecessarily with the supplier's operations.

18. Rejection and Rehearing

18.1 Samples representing material rejected by the purchaser shall be preserved until disposition of the claim has been agreed upon between the manufacturer and the purchaser.

18.2 Material that shows injurious defects subsequent to its acceptance at the manufacturer's works will be rejected, and the manufacturer shall be notified.

19. Certification

19.1 A test report and a certificate of compliance are required.

19.2 Test reports shall include the product specification number and year/date of issue, the results of all tests required by this specification, and the purchaser order, and shall be traceable to the part represented.

19.3 A single document, containing the test report information and certificate of compliance information may be used.

19.4 A certificate printed from or used in electronic data interchange (EDI) transmission shall be regarded as having the same validity as a counterpoint printed in the certifier's facility.

The content of the EDI transmitted document shall conform to any existing EDI agreement between the purchaser and supplier.

19.5 Notwithstanding the absence of a signature, the organization submitting either a printed certificate or an EDI transmitted certificate is responsible for the content of the report.

20. Marking

20.1 Each piece shall be legibly marked in a position as not to injure the usefulness of the forgings with the product specification number, grade or marking symbol, class, certifying organization's name or symbol, the heat number or heat identification, size, and service rating, if applicable. Dual or multiple marking with the product specification number, grade or marking symbol, and class is acceptable provided the material meets all the requirements with which it is marked. It is not required to mark the product with the specification year and date of issue. When size or shape does not permit the inclusion of all the required marking as described, see 20.2. Manufacturer can also choose the use of tags, box labels, etc. for identification when per piece marking is not practical due to size or shape.

20.2 The Standard Marking System of Valves, Fittings, Flanges and Unions MSS SP 25 shall be followed except the word "steel" shall not be substituted for the specification grade.

20.3 Product marking shall conform to the additional requirements, if any, invoked in the product specification or purchase order.

21. Packaging, Marking and Loading for Shipment

21.1 Packaging, marking, and loading for shipment shall be in accordance with Practices A700.

22. Keywords

22.1 alloy steel; carbon steel; fittings; flanges; forgings; general requirement; piping applications; pressure containing parts; stainless steel; temperature service applications—elevated; temperature service applications—high; valves

SUPPLEMENTARY REQUIREMENTS

These requirements shall not be considered unless specified in the order, in which event, the supplementary requirements specified shall be made at the place of manufacture, unless otherwise agreed upon, at the purchaser's expense. The test specified shall be witnessed by the purchaser's inspector before shipment of material, if so specified in the order. The rationale for beginning the section numbering with S50 is to eliminate the possibility of confusion with supplementary requirements existing in individual product specifications.

S50. Macroetch Test

S50.1 A sample forging shall be sectioned and etched to show flow lines and internal imperfections. The test shall be conducted according to Method E381.

S50.2 Acceptance limits shall be as agreed upon between the certifying organization and the purchaser.

S51. Heat Analysis

S51.1 When secondary melting processes are employed, a heat analysis shall be obtained from each remelted ingot, or the product of each remelted ingot, from each primary melt. The chemical analysis thus determined shall conform to the requirements of the individual product specification. Note that the

product analysis (check analysis) tolerances are not to be applied to the heat analysis requirements.

S52. Product Analysis

S52.1 A product analysis shall be made from one randomly selected forging representing each heat. The results shall comply with the product analysis limits listed in the applicable product specification. For Specification A182/A182M grades of F20 and F58, results shall comply with the product analysis limits listed in Specification B880.

S52.2 If the analysis fails to comply, each forging shall be checked or the lot rejected. All results shall be reported to the purchaser.

S53. Tension Tests

S53.1 In addition to the requirements of Section 9, one tension specimen shall be obtained from a representative forging from each heat at a location agreed upon between the certifying organization and the purchaser. The results of the test shall comply with the tensile property requirements listed in the applicable product specification and shall be reported to the purchaser.

S54. Impact Tests

S54.1 In addition to the requirements of Section 9, three CVN impact energy specimens shall be obtained from a representative forging from each heat at a location agreed upon between the certifying organization and the purchaser.

S54.2 The purchaser shall supply the impact test temperature and the required minimum requirements for the test, including the lowest single absorbed energy for a single specimen if an average absorbed energy value is required. The lateral expansion values and the fracture appearance of the specimens as percentage ductile fracture shall be reported for information if these parameters are not part of the acceptance requirements.

S55. Magnetic Particle Examination

S55.1 All accessible surfaces of the finished forging shall be examined by a magnetic particle method. The method shall be in accordance with Test Method A275/A275M. Acceptance limits shall be as agreed upon between the certifying organization and the purchaser.

S56. Liquid Penetrant Examination

S56.1 All accessible surfaces shall be examined by a liquid penetrant method in accordance with Test Method E165/E165M. Acceptance limits shall be as agreed upon between the certifying organization and the purchaser.

S57. Hydrostatic Testing

S57.1 A hydrostatic test at a pressure agreed upon between the certifying organization and the purchaser shall be applied by the certifying organization.

S58. Repair Welding

S58.1 No repair welding shall be permitted without prior approval of the purchaser. If permitted, the restrictions of Section 16 shall apply.

S59. Electropolished Austenitic and Ferritic–Austenitic Grades

S59.1 All electropolished austenitic and ferritic–austenitic products shall be of a cleanliness in accordance with Specification A967/A967M.

S59.2 Details concerning which test method of Specification A967/A967M are to be a matter of agreement between the manufacturer and the purchaser.

S60. Positive Material Identification Examination

S60.1 Forgings shall receive positive material identification to ensure that the purchaser is receiving forgings of the correct material grade prior to shipment of the forgings. This examination is a method to ensure that no material grade mix-up has occurred during the manufacturing and marking of the forgings.

S60.2 Forgings shall receive a positive material identification examination in accordance with Guide E1916.

S60.3 The quantity examined shall be 100 % of the forgings.

S60.4 All forgings that are not of the correct material grade shall be rejected.

S60.5 The method of forging marking after examination shall be agreed upon between the manufacturer and the purchaser.

S61. Heat Treatment in the Working Zone of a Surveyed Furnace

S61.1 Material shall be heat treated in the working zone of a furnace that has been surveyed in accordance with Test Method A991/A991M, provided that such working zone was established using a variation of 25 °F [14 °C] or less from the furnace set point.

S61.2 The test report shall indicate that S61 applies.

S62. Requirements for Carbon Steel Products for Concentrated Hydrofluoric Acid Service

S62.1 The maximum carbon equivalent based on heat analysis shall be as follows:

Maximum section thickness less than or equal to 1 in.	CE maximum = 0.43
Maximum section thickness greater than 1 in.	CE maximum = 0.45

S62.2 Determine the carbon equivalent (CE) as follows:

$$CE = C + Mn/6 + (Cr + Mo + V)/5 + (Ni + Cu)/15 \quad (1)$$

S62.3 Vanadium and Niobium maximum content based on heat analysis shall be:

Maximum Vanadium = 0.02 wt %
Maximum Niobium ^A = 0.02 wt %
Maximum Vanadium plus Niobium ^A = 0.03 wt %

^ANiobium = Columbium

S62.4 The maximum composition based on heat analysis of Ni + Cu shall be 0.15 wt %.

S62.5 The minimum C content based on heat analysis shall be 0.18 wt %. The maximum C content shall be as specified in the appropriate material specification.

S62.6 Repair welds shall not be made with E60XX electrodes. Use of E70XX electrodes is recommended, and the resulting weld chemistry should meet the same chemistry criteria as the base metal as listed above.

S62.7 In addition to the requirements of product marking of the specification, a “HF” stamp or marking shall be provided on each component to identify that component complies with this supplementary requirement.

S63 Pressure Equipment Directive—Mechanical Testing

S63.1 Charpy impact testing shall be done at the lowest scheduled operating temperature but not higher than 68 °F [20 °C].

S63.2 The frequency of impact testing shall be the same as that specified in the product specification for the tension test, with three individual Charpy test specimens for each required tension test.

S63.3 The minimum impact absorption energy for the Charpy test specimen shall be at least 20 ft/lb [27 J].

S63.4 The minimum elongation in the tension test shall be measured on a gauge length of five times the diameter of the test specimen, and it shall not be less than 14 %.

S63.5 Impact and tension test results shall be included in the product certification.

ANNEXES

(Mandatory Information)

A1. REQUIREMENTS FOR THE INTRODUCTION OF NEW MATERIALS

A1.1 New materials may be proposed for inclusion in specifications referencing this specification of general requirements subject to the following conditions:

A1.1.1 Application for the addition of a new grade to a specification shall be made to the chair of the subcommittee that has jurisdiction over that specification.

A1.1.2 The application shall be accompanied by a statement from at least one user indicating that there is a need for the new grade to be included in the applicable specification.

A1.1.3 The application shall be accompanied by test data as required by the applicable specification. Test data from a minimum of three test lots, as defined by the specification, each from a different heat, shall be furnished.

A1.1.4 The application shall provide recommendations for all requirements appearing in the applicable specification.

A1.1.5 The application shall state whether or not the new grade is covered by patent.

A2. REQUIREMENTS FOR THE INTRODUCTION OF MATERIALS FROM OTHER A01 OR B02.07 SPECIFICATIONS

A2.1 Wrought materials that are already covered by another A01 or B02.07 specification may be proposed for inclusion in specifications referencing this specification of general requirements subject to the following conditions:

A2.1.1 Application for the addition of a grade that is already covered in another A01 or B02.07 specification shall be made to the chair of the subcommittee that has jurisdiction over that specification.

A2.1.2 The chemical requirements, the specified mechanical properties, and the heat treatment requirements of the grade being added shall be the same as those for the grade in the A01 or B02.07 specification in which the grade is presently covered.

A2.1.3 The application shall provide the recommendations for all requirements appearing in the applicable specification.

A2.1.4 The application shall state whether or not the grade is covered by patent.

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