



Standard Specification for Common Requirements for Steel Flanges, Forged Fittings, Valves, and Parts for Piping Applications¹

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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	A 105/A 105M
Forgings, Carbon Steel, for General-Purpose Piping	A 181/A 181M
Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High Temperature Service	A 182/A 182M
Forgings, Carbon and Low Alloy Steel, Requiring Notch Toughness Testing for Piping Components	A 350/A 350M
Forged or Rolled 8 and 9 % Nickel Alloy Steel Flanges, Fittings, Valves, and Parts for Low-Temperature Service	A 522/A 522M
Forgings, Carbon and Alloy Steel, for Pipe Flanges, Fittings, Valves, and Parts for High-Pressure Transmission Service	A 694/A 694M
Flanges, Forged, Carbon and Alloy Steel for Low Temperature Service	A 707/A 707M
Forgings, Carbon Steel, for Piping Components with Inherent Notch Toughness	A 727/A 727M
Forgings, Titanium-Stabilized Carbon Steel, for Glass-Lined Piping and Pressure Vessel Service	A 836/A 836M

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 inch-pound units or SI units (metric) 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 are not exact equivalents; therefore each system must be used independently of the other.

¹ This specification is under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel, and Related Alloys and is the direct responsibility of Subcommittee A01.22 on Steel Forgings and Wrought Fittings for Piping Applications and Bolting Materials for Piping and Special Purpose Applications.

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Combining values from the two systems may result in nonconformance with the specification. The inch-pound units shall apply unless the “M” designation (SI) of the product specification is specified in the order.

2. Referenced Documents

2.1 ASTM Standards:

- A 105/A 105M Specification for Carbon Steel Forgings for Piping Applications²
- A 181/A 181M Specification for Carbon Steel Forgings for General-Purpose Piping²
- A 182/A 182M Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service²
- A 275/A 275M Test Method for Magnetic Particle Examination of Steel Forgings³
- A 350/A 350M Specification for Carbon and Low-Alloy Steel Forgings, Requiring Notch Toughness Testing for Piping Components²
- A 370 Test Methods and Definitions for Mechanical Testing of Steel Products⁴
- A 522/A 522M Specification for Forged or Rolled 8 and 9 % Nickel Alloy Steel Flanges, Fittings, Valves, and Parts for Low-Temperature Service²
- A 694/A 694M Specification for Carbon and Alloy Steel Forgings for Pipe Flanges, Fittings, Valves, and Parts for High-Pressure Transmission Service²
- A 700 Practices for Packaging, Marking, and Loading Methods for Steel Products for Domestic Shipment³
- A 707/A 707M Specification for Forged Carbon and Alloy Steel Flanges for Low-Temperature Service²
- A 727/A 727M Specification for Carbon Steel Forgings, for Piping Components with Inherent Notch Toughness²
- A 751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products⁴
- A 836/A 836M Specification for Titanium-Stabilized Carbon Steel Forgings for Glass-Lined Piping and Pressure Vessel Service²
- A 941 Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys²

² Annual Book of ASTM Standards, Vol 01.01.

³ Annual Book of ASTM Standards, Vol 01.05.

⁴ Annual Book of ASTM Standards, Vol 01.03.

A 967 Specification for Chemical Passivation Treatments for Stainless Steel Parts⁴

A 991/A 991M Test Method for Conducting Temperature Uniformity Surveys of Furnaces Used to Heat Treat Steel Products⁴

E 165 Test Method for Liquid Penetrant Examination⁵

E 381 Method of Macroetch Testing Steel Bars, Billets, Blooms, and Forgings⁶

E 709 Guide for Magnetic Particle Examination⁵

E 1916 Guide for Identification and/or Mixed Lots of Metals⁷

2.2 *ASME Standard*:⁸

ASME Boiler and Pressure Vessel Code—Section IX

2.3 *Military Standard*:⁹

MIL-STD-163 Steel Mill Products, Preparation for Shipment and Storage

2.4 *Manufacturer's Standardization Society Standard*:¹⁰

SP 25 Standard Marking System of Valves, Fittings, Flanges and Unions

3. Terminology

3.1 *Definitions of Terms Specific to This Standard and Related Individual Product Specifications*:

3.1.1 *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. A wrought microstructure is required.

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

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

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

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

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

⁵ *Annual Book of ASTM Standards*, Vol 03.03.

⁶ *Annual Book of ASTM Standards*, Vol 03.01.

⁷ *Annual Book of ASTM Standards*, Vol 03.06.

⁸ Available from the American Society of Mechanical Engineers, Three Park Avenue, New York, NY 10016-5990.

⁹ Available from Standardization Documents Order Desk, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

¹⁰ Available from the Manufacturer's Standardization Society of the Valve and Fittings Industry, 1815 N. Fort Myer Dr., Arlington, VA 22209.

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 Supplementary requirements.

4.1.5 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 hollow 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 *Seamless Tubing*—Flanges shall not be machined directly from seamless tubing. Other hollow cylindrical shaped parts up to, and including, NPS 4 can be machined from seamless 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 A 941.

7.1.1 *Full 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*—Material shall be heated to a temperature that causes the chrome 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. The temperature shall not vary from the selected temperature by more than $\pm 25^{\circ}\text{F}$ [$\pm 14^{\circ}\text{C}$].

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

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 A 751.

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 A 751. 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 or Table 2 of this specification, as appropriate for the grade being supplied.

9. Mechanical Requirements

9.1 *Method of Mechanical Tests*—All tests shall be conducted in accordance with Test Methods and Definitions A 370.

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 permit-

TABLE 1 Product Analysis Tolerances for Higher Alloy and Stainless Steels^A

Element	Limit or Maximum of Specified Range, Wt %	Tolerance Over the Maximum Limit or Under the Minimum Limit
Carbon	0.030, incl	0.005
	over 0.030 to 0.20 incl.	0.01
Manganese	to 1.00 incl.	0.03
	over 1.00 to 3.00 incl.	0.04
	over 3.00 to 6.00	0.05
	over 6.00 to 10.00	0.06
Phosphorous	to 0.040, incl.	0.005
Sulfur	to 0.030, incl.	0.005
Silicon	to 1.00, incl.	0.05
	over 1.00 to 5.00, incl.	0.10
Chromium	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 27.50 incl.	0.25
Nickel	to 1.00 incl.	0.03
	over 1.00 to 5.00 incl.	0.07
Molybdenum	over 5.00 to 10.00 incl.	0.10
	over 10.00 to 20.00 incl.	0.15
	over 20.00 to 22.00 incl.	0.20
	to 0.20 incl.	0.01
Titanium	over 0.20 to 0.60 incl.	0.03
	over 0.60 to 2.00 incl.	0.05
Columbium (Niobium) + Tantalum	over 2.00 to 7.00 incl.	0.10
	all ranges	0.05
Columbium (Niobium)	all ranges	0.05
	0.05 to 0.20, incl.	0.01
Tantalum	to 0.10 incl.	0.02
Cobalt	0.05 to 0.20, incl.	0.01 ^B
	to 0.19 incl	0.01
Nitrogen	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 to 0.60	0.05
Aluminum	to 0.05 incl.	0.01
Vanadium	to 0.10 incl.	0.01
	over 0.10 to 0.25 incl.	0.02
Cerium	0.03 to 0.08	-0.005
		+0.01

^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.

ted 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.

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.

TABLE 2 Product Analysis Tolerances for Low Alloy Steels^A

Element	Limit or Maximum of Specified Range, Wt %	Tolerance Over Maximum Limit or Under Minimum Limit for Size Ranges Shown, Wt % ^B			
		100 in. ² (6.45 × 10 ⁴ mm ²), or less	Over 100 to 200 in. ² (1.290 × 10 ⁵ mm ²), incl	Over 200 to 400 in. ² (2.581 × 10 ⁵ mm ²), incl	Over 400 in. ²
Mn	to 0.90 incl	0.03	0.04	0.05	0.06
	over 0.90 to 1.00 incl	0.04	0.05	0.06	0.07
P	to 0.045, incl	0.005	0.010	0.010	0.010
S	to 0.045, incl	0.005	0.010	0.010	0.010
Si	to 0.40 incl	0.02	0.02	0.03	0.04
	over 0.40 to 1.00 incl	0.05	0.06	0.06	0.07
Cr	to 0.90, incl	0.03	0.04	0.04	0.05
	over 0.90 to 2.10, incl	0.05	0.06	0.06	0.07
	over 2.10 to 3.99 incl	0.10	0.10	0.12	0.14
Ni	to 0.50	0.03	0.03	0.03	0.03
Mo	to 0.20 incl	0.01	0.01	0.02	0.03
	over 0.20 to 0.40 incl	0.02	0.03	0.03	0.04
	over 0.40 to 1.15	0.03	0.04	0.05	0.06
Cu	to 1.00 incl	0.03	0.03	0.03	0.03
	over 1.00 to 2.00 incl	0.05	0.05	0.05	0.05
Ti	to 0.10	0.01	0.01	0.01	0.01
V	to 0.10 incl	0.01	0.01	0.01	0.01
	over 0.10 to 0.25 incl	0.02	0.02	0.02	0.02
	over 0.25 to 0.50 incl	0.03	0.03	0.03	0.03

^A Product Analysis for C, B, Cb and Ca shall conform to the Product Specification.

^B Cross-sectional area.

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. [50-mm] gage length tension test specimens described in Test Methods and Definitions A 370.

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 as described in Test Methods and Definitions A 370. 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, retests are permitted as outlined in Test Methods and Definitions A 370. If the results of any tension test specimen are less than specified because a flaw becomes evident in the test specimen during testing, a retest 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 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. Finish and Appearance

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

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. The cleaned parts shall be protected to prevent recontamination. Protective coatings on parts subsequently subjected to socket welds or butt welds shall be suitable for welding without removal of the coating. 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 A 275 or Practice E 709 for the ferritic, martensitic, or ferritic/austenitic grades, or by liquid penetrant inspection in accordance with Practice E 165 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 Unless otherwise specified, any rejection based on product analyses made by the purchaser in accordance with this specification shall be reported to the manufacturer within two days from date of test.

18.2 Samples that represent material rejected for failure to comply to product analysis specified in S52 shall be preserved for two weeks from the date of the test report. In case of dissatisfaction with the results of the test, the manufacturer may make claim for a rehearing within that time.

18.3 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 Marking of the ASTM specification number and manufacturer's name or trademark on the parts, and printing of the same on test reports, when required, shall be certification that the parts have been furnished in accordance with the requirements of the specification.

19.2 Test reports shall be traceable to the heat identification on the parts. They shall contain the information specified by the Product Specification and the purchaser order. They shall include the specification number and year/date of issue.

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

19.4 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 with the ASTM specification number, grade and class, certifying organization's name or symbol, the heat number or heat identification, size, and service rating, if applicable. It is not required to mark the product with the specification year and date of issue. The Standard Marking System of Valves, Fittings, Flanges and Unions (SP 25) may be followed except the word "steel" shall not be substituted for the ASTM designation.

20.2 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 Practice A 700.

21.2 When specified in the contract or order, and or direct procurement by or direct shipment to the government, when Level A is specified, preservation, packaging, and packing shall be in accordance with Level A requirements of MIL-STD-163.

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 E 381.

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.

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. The results of the test shall comply with the CVN impact energy

requirements listed in the applicable product specification and shall be reported to the purchaser.

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 A 275. 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 E 165. 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 A 967.

S59.2 Details concerning which test method of Specification A 967 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 E 1916.

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 A 991/A 991M, provided that such working zone was established using a variation of 25°F (15°C) or less from the furnace set point.

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

ANNEX

(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 chairman of the subcommittee, which 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.

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