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An American National Stardard

Standard Specification for Forged Carbon and Alloy Steel Flanges for Low-Temperature Service[1]

This standard is issued under the fixed designation A 707/A 707M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers forged carbon and alloy steel flanges intended primarily for petroleum and gas pipelines in areas subject to low ambient temperatures. Included are flanges to specified dimensions or to dimensional standards such as those MSS, ASME, and API specifications that are referenced in Section 2.

1.2 Supplementary requirements are provided for use when additional requirements are desired. These shall apply only when specified individually by the purchaser in the order.

1.3 Eight grades, four yield-strength classes, and three different notch toughness levels are included.

1.4 The availability of a particular size of flange of a specific grade and class is limited only by the capability of the composition to meet the specified mechanical property requirements. However, current practice normally limits the following:

(*a*) Grade L1 to Classes 1 and 2,
(*b*) Grade L2 to Classes 1, 2, and 3,
(*c*) Grade L3 to Classes 1, 2, and 3,
(*d*) Grade L4 to Classes 1, 2, and 3,
(*e*) Grade L7 to Classes 1 and 2, and
(*f*) Grades L5, L6, and L8 are generally available in any class.

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.

2. Referenced Documents

2.1 In addition to those reference documents listed in Specification A 961, the following list of standards apply to this specification:

2.2 *ASTM Standards:*
A 388/A 388M Practice for Ultrasonic Examination of Heavy Steel Forgings[2]
A 788 Specification for Steel Forgings, General Requirements[2]
A 961 Specification for Common Requirements for Steel Flanges, Forged Fittings, Valves, and Parts for Piping Applications[3]
2.3 *MSS Standards:*
SP 25 Standard Marking System for Valves, Fittings, Flanges and Unions[4]
SP 44 Steel Pipeline Flanges[4]
2.4 *API Standard:*
605 Large Diameter Carbon Steel Flanges[5]
2.5 *ASME Boiler and Pressure Vessel Code:*
Section IX, Welding Qualifications[6]
B 16.5 Dimensional Standards for Steel Pipe Flanges and Flanged Fittings[6]
2.6 *AWS Standards:*
A 5.1 Mild Steel Covered Electrodes[7]
A 5.5 Low-Alloy Steel Covered Arc-Welding Electrodes[7]

3. Terminology

3.1 *Definitions:*

3.1.1 *flakes*—short discontinuous internal fissures attributed to stresses produced by localized transformation and decreased solubility of hydrogen during cooling after hot working.

3.1.2 *linear surface imperfection (or indication)*—an imperfection or indication with a length at least three times its width.

4. Ordering Information

4.1 It is the purchaser's responsibility to specify in the purchase order all ordering information necessary to purchase

[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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[2] *Annual Book of ASTM Standards*, Vol 01.05.
[3] *Annual Book of ASTM Standards*, Vol 01.01.
[4] Available from the Manufacturers' Standardization Society of the Valve and Fittings Industry, 127 Park St., Northeast, Vienna, VA 22180.
[5] Available from American Petroleum Institute, 2101 L St., N.W., Washington, DC 20037.
[6] Available from American Society of Mechanical Engineers, Three Park Avenue, New York, NY 10016-5990.
[7] Available from American Welding Society, 550 LeJeune Rd., P.O. Box 351040, Miami, FL 33135.

the needed material. In addition to the ordering information guide lines in Specification A 961, orders should include the following information:

4.1.1 Additional requirements (see Table 1 footnotes, 9.2.2, 9.3, 11.5, 17.1, 21.1, and 21.2).

5. General Requirements

5.1 Material furnished to this specification shall conform to the applicable requirements of the current edition of Specification A 961 unless otherwise provided herein.

6. Manufacture

6.1 The steel shall meet the melting practice of Specification A 961.

6.2 The finished product shall be a forging as defined by 3 (only) of Specification A 788.

7. Heat Treatment

7.1 After forging and before reheating for heat treatment, the forging shall be allowed to cool substantially below the transformation range. The method of cooling shall be such as to ensure against the development of cracks, flakes, etc.

7.2 All material shall be heat treated by annealing, normalizing, precipitation hardening, quenching-and-tempering, normalizing-and-tempering, normalizing-and-precipitation hardening, or quenching-and-precipitation hardening.

7.2.1 The procedures for the various heat treatments are as follows:

7.2.1.1 *Annealing*—Consists of heating to a temperature between 1550 and 1700°F [843 and 927°C], and then cooling uniformly in the furnace.

7.2.1.2 *Normalizing*—Consists of heating to a temperature between 1550 and 1700°F [843 and 927°C], removing from the furnace, and cooling in air.

7.2.1.3 *Quenching*—Consists of heating to a temperature between 1475 and 1700°F [800 and 927°C], and then quenching in a liquid medium to a temperature below 300°F [149°C]. Quench facilities shall be equipped with mechanical agitation, recirculating pumps, or controlled overflow, or a combination thereof. Quench baths shall be equipped with temperature control devices to maintain a water temperature of 90°F [32°C] maximum or an oil temperature of 120 to 160°F [49 to 71°C], or such oil temperature range as recommended by the oil manufacturer, during the quenching operation. Baths shall be of adequate type and size to rapidly absorb the heat rejected by the most massive part to be quenched.

7.2.1.4 *Tempering or Post-Weld Heat Treatment*—Consists of heating to a temperature between 1100°F [593°C] and the

TABLE 1 Chemical Requirements

Element	Grade							
	L1[A]	L2[A]	L3	L4	L5	L6	L7[B]	L8
Carbon, max, %								
Heat analysis	0.20	0.30	0.22	0.18	0.07	0.07	0.20	0.20
Product analysis	0.23	0.33	0.25	0.20	0.09	0.09	0.22	0.22
Manganese, %								
Heat analysis	0.60-1.50	0.60-1.35	1.15–1.50	0.45–0.65	0.40–0.70	1.85–2.20	0.90 max	0.20–0.40
Product analysis	0.55-1.60	0.55-1.45	1.05–1.60	0.40–0.70	0.35–0.75	1.75–2.30	1.00 max	0.15–0.45
Phosphorus, max, %								
Heat analysis	0.030	0.030	0.025	0.025	0.025	0.025	0.025	0.020
Product analysis	0.035	0.035	0.030	0.030	0.030	0.030	0.030	0.025
Sulfur, max, %								
Heat analysis	0.030	0.030	0.025	0.025	0.025	0.025	0.025	0.020
Product analysis	0.040	0.040	0.035	0.035	0.035	0.035	0.035	0.025
Silicon, max, %								
Heat analysis	0.35	0.35	0.30	0.35	0.35	0.15	0.35	0.35
Product analysis	0.37	0.37	0.32	0.37	0.37	0.17	0.37	0.37
Chromium, %								
Heat analysis	0.30 max	0.30 max	0.30 max	0.30 max	0.60–0.90	0.30 max	0.30 max	1.50–2.00
Product analysis	0.34 max	0.34 max	0.34 max	0.34 max	0.56–0.94	0.34 max	0.34 max	1.44–2.06
Nickel, %								
Heat analysis	0.40 max	0.40 max	0.40 max	1.65–2.00	0.70–1.00	0.40 max	3.2–3.7	2.8–3.9
Product analysis	0.43 max	0.43 max	0.43 max	1.60–2.05	0.67–1.03	0.43 max	3.18–3.82	2.68–3.97
Molybdenum, %								
Heat analysis	0.12 max	0.12 max	0.12 max	0.20–0.30	0.15–0.25	0.25–0.35	0.12 max	0.40–0.60
Product analysis	0.13 max	0.13 max	0.13 max	0.19–0.33	0.14–0.28	0.22–0.38	0.13 max	0.35–0.65
Vanadium, %								
Heat analysis	0.05 max	0.05 max	0.04–0.11	0.05 max	0.05 max	0.05 max	0.05 max	0.05 max
Product analysis	0.06 max	0.06 max	0.03–0.13	0.06 max	0.06 max	0.06 max	0.06 max	0.06 max
Nitrogen, %								
Heat analysis	...	...	0.010–0.030	...	...	...	...	...
Product analysis	...	...	0.005–0.035	...	...	...	...	...
Copper, %								
Heat analysis	0.40 max	0.40 max	0.20 min[C]	0.40 max	1.00–1.30	0.40 max	0.40 max	0.40 max
Product analysis	0.43 max	0.43 max	0.18 min[C]	0.43 max	0.95–1.35	0.43 max	0.43 max	0.43 max
Columbium, %								
Heat analysis	0.02 max	0.02 max	0.02 max	0.02 max	0.03 min	0.06–0.10	0.02 max	0.02 max
Product analysis	0.03 max	0.03 max	0.03 max	0.03 max	0.02 min	0.05–0.11	0.03 max	0.03 max

[A] The sum of copper, nickel, chromium, and molybdenum shall not exceed 1.00 % on heat analysis.
[B] The sum of chromium, molybdenum and vanadium shall not exceed 0.32 % on heat analysis.
[C] When specified.