Designation: ~~A707/A707M – 14~~ A707/A707M – 19

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

This standard is issued under the fixed designation A707/A707M; 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.

1.7 *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 In addition to those reference documents listed in Specification A961/A961M, the following list of standards apply to this specification:

2.2 *ASTM Standards:*[2]

A388/A388M Practice for Ultrasonic Examination of Steel Forgings
A788/A788M Specification for Steel Forgings, General Requirements
A961/A961M Specification for Common Requirements for Steel Flanges, Forged Fittings, Valves, and Parts for Piping Applications

[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] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

***A Summary of Changes section appears at the end of this standard**

2.3 *MSS Standards:*
SP 44 Steel Pipeline Flanges[3]
2.4 *API Standard:*
605 Large Diameter Carbon Steel Flanges[4]
2.5 *ASME Boiler and Pressure Vessel Code:*
Section VIII Division I, Part UG-84[5]
Section IX[5]
2.6 *ASME Standard:*
B 16.5 Dimensional Standards for Steel Pipe Flanges and Flanged Fittings[5]
2.7 *AWS Standards:*
A 5.5 Low-Alloy Steel Covered Arc-Welding Electrodes[6]

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 the needed material. In addition to the ordering information guide lines in Specification A961/A961M, orders should include the following information:

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

5. General Requirements

5.1 Product furnished to this specification shall conform to the requirements of Specification A961/A961M, including any supplementary requirements that are indicated in the purchase order. Failure to comply with the general requirements of Specification A961/A961M constitutes nonconformance with this specification. In case of conflict between the requirements of this specification and Specification A961/A961M, this specification shall prevail.

6. Manufacture

6.1 The steel shall meet the melting practice of Specification A961/A961M.

6.2 The finished product shall be a forging as defined by 3 (only) of Specification A788/A788M.

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 given in Specification A961/A961M except as defined in the following:

7.2.1.1 *Precipitation Hardening*—Consists of heating to a temperature between 1000 and 1250°F [538 and 677°C], holding at temperature for not less than ½ h, and then cooling at any convenient rate.

8. Chemical Composition

8.1 A chemical heat analysis in accordance with Specification A961/A961M shall be made and conform to the requirements as to chemical composition prescribed in Table 1. Leaded steels shall not be permitted.

9. Mechanical Requirements

9.1 The material in the weld neck shall conform to the mechanical property requirements prescribed in Table 2.

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[3] Available from Manufacturers Standardization Society of the Valve and Fittings Industry (MSS), 127 Park St., NE, Vienna, VA 22180-4602, http://www.mss-hq.com.

[4] Available from American Petroleum Institute (API), 1220 L. St., NW, Washington, DC 20005-4070, http://api-ec.api.org.

[5] Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Two Park Ave., New York, NY 10016-5990, http://www.asme.org.

[6] Available from American Welding Society (AWS), 550 NW LeJeune Rd., Miami, FL 33126, http://www.aws.org.

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, %~~								
Niobium, %[D]								
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.
[D] Columbium and Niobium are alternate names for element 41 in the Periodic Table of the Elements.

TABLE 2 Mechanical Requirements

Property	Class 1	Class 2	Class 3	Class 4
Yield strength[A] min, ksi [MPa]	42 [290]	52 [360]	60 [415]	75 [515]
Tensile strength, min, ksi [MPa]	60 [415]	66 [455]	75 [515]	90 [620]
Elongation in 2 in. or 50 mm, min, %	22	22	20	20
Reduction of area, min, %	40	40	40	40
Hardness, HBW	149–207	149–217	156–235	179–265
Cv energy absorption,[B,C] min, avg, ft·lbf [J]	30 [41]	40 [54]	50 [68]	50 [68]
C_v energy absorption,[B,D] min, ft·lbf [J]	24 [33]	32 [43]	40 [54]	40 [54]

[A] 0.2 % offset.
[B] For a set of three full-size [10 by 10 mm] Charpy V-notch specimens. Acceptance values for sub-size specimens are reduced in proportion to the reduction in width of the specimen.
[C] These requirements are intended to minimize fracture initiation. They are not intended to give assurance against fracture propagation. If minimization of fracture propagation is of interest, consideration should be given to specifying Supplementary Requirement ~~S7~~S4 at the operating temperature.
[D] Minimum impact energy permitted for one specimen only of a set of three specimens.