



ASTM A694/A694M-08

Standard Specification for Carbon and Alloy Steel Forgings

For Pipe Flanges, Fittings, Valves, and Parts for High-Pressure

Transmission Service¹

1. Scope :-

- 1.1 This specification covers forged or rolled steel pipe flange, forged fittings, valves, and parts suitable for use with high-strength transmission-service pipe. Included are flanges, fittings, and similar parts ordered either to dimensions specified by the purchaser or to ASME or MSS dimensional standards referenced in section 2.
- 1.2 Several grades of material, based on minimum yield strength requirements, are covered, as indicated in Table 1.
- 1.3 Supplementary Requirements are provided. Supplementary Requirements S 1 is provided for use when purchaser approval is required for repair welding.
- 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 SI units or inch-pound 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 order. Combining values from the two systems may result in non-conformance with the standard.

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 Standard :

- A53/A53M specification for pipe, steel, black and hot-dipped, zinc-coated, welded and seamless
- A106/A106M specification for seamless carbon steel pipe for high-temperature service
- A381 specification for metal-arc-welded steel pipe for use with high-pressure transmission system
- A707/A707M specification for forged carbon and alloy steel flanges for low-temperature service
- A788/A788M specification for steel forgings, General requirements
- A961/A961M specification for common requirements for steel flange, forged fittings, valves, and parts for piping applications

2.3 ASME Standards :-

- ASME B16.5 steel pipe flanges and flanged fittings
- ASME B16.9 steel butt-welding fittings
- ASME B16.10 Face-to-face and End-to-End dimensions of ferrous valves
- ASME B 16.11 Forged steel fittings, socket welding and threaded
- ASME B16.28 wrought steel butt-welding short radius Elbows
- ASME B16.47 large diameter steel flanges



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2.4 MSS Standards :-

- MSS SP-44 Standard for steel pipe line flanges
- MSS SP-75 specification for high-test welding fittings
- MSS SP-95 swage (d) nipples and bull plugs
- MSS SP-97 integrally reinforced forged branch outlet fittings

2.5 API Standards :-

- 5L specification for line pipe

TABLE 1 Tensile Requirements

Grade	Yield Strength (0.2% Offset), min, ksi [MPa]	Tensile Strength, min, ksi [MPa]	Elongation in 2 in. Or 50 mm, min %
F42	42[290]	60[415]	20
F46	46[315]	60[415]	20
F48	48[330]	62[425]	20
F50	50[345]	64[440]	20
F52	52[360]	66[455]	20
F56	56[385]	68[470]	20
F60	60[415]	75[515]	20
F65	65[450]	77[530]	20
F70	70[485]	82[565]	18

3. Ordering Information :-

- 3.1 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 guidelines in specification A961/A961M, orders should include the following information:
- 3.1.1 Additional requirements (see 8.1 and 10.1).

4. General Requirements :-

- 4.1 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 non-conformance with this specification. In case of conflict between the requirements of this specification and specification A961/A961M, this specification shall prevail.

5. Manufacture :-

5.1 Melting Process :

- 5.1.1 The steel shall be made by any of the following processes: open hearth, electric furnace, or basic oxygen. The steel shall be fully deoxidized.
- 5.1.2 The steel shall be carbon steel, high-strength low-alloy steel, or alloy steel, as agreed upon between the manufacturer and purchaser. Analysis of the steel used, including all alloying elements, shall be reported by the manufacturer to the purchaser. The steel shall be suitable for field welding (as established by the purchaser) to other fittings, valve materials and flanges, and to pipe manufactured under the following ASTM specification: Specification A53/A53M,



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Specification A106/A106M, Specification A381, and API Standard 5L pipe, as well as to fittings manufactured under MSS SP-75.

5.2 Manufacturing Practice:

- 5.2.1 Material for forgings shall consist of ingots or blooms, billets, slabs, or bars of forged or rolled form and cut to the required length by a suitable process.
- 5.2.2 The finished product shall be a forging as defined in the terminology section of specification A788/A788M.
- 5.2.3 Hot working shall be sufficient to develop a wrought structure throughout the part.
- 5.2.4 Flanges shall not be machined directly from plate nor from solid bar stock.

5.3 Heat treatment:

- 5.3.1 All items shall be heat treated. Heat treatment of carbon steel and high-strength low-alloy steel may consist of normalizing, normalizing-and-tempering, or quenching-and-tempering. Heat treatment of alloy steel may consist of normalizing and precipitation heat treatment or quenching and precipitation heat treatment.
- 5.3.2 The tempering temperature shall be at least 1000 °F [540 °C]. The precipitation heat treatment of the alloy steel shall be in the range from 1000 to 1225 °F [540 to 665 °C].

6. Chemical Composition :-

- 6.1 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 2.
- 6.2 High-strength low-alloy steels shall be of specified alloy element composition, with the elements covered in 6.1 restricted within the limits prescribed there in as may be necessary to ensure weld ability and specified minimum tensile properties. When high-strength low-alloy steel is furnished, appropriate procedures are required for field welding.
- 6.3 Alloy steel shall conform to the requirements for grade L5 of specification A707/A707M.

7. Tensile Requirements :-

- 7.1 The material shall conform to the requirements as to tensile properties prescribed in Table 1, when tested in accordance with the mechanical testing requirements of specification A961/A961M.
- 7.2 The tensile test specimen shall be obtained from a production forging, or from an integral prolongation representative of the hub location of a flange, or the heaviest cross section of a fitting, valve, or other part within the scope of this specification. Alternatively, the test specimen may be taken from a separately forged test block which has been taken from the same heat of steel as the production forgings, and which has been reduced by forging in a manner similar to that for the forgings it represents.
 - 7.2.1 The test specimen shall represent all forgings from the same heat and heat treatment load whose maximum thicknesses do not exceed the thickness of the test forging or blank by more than ¼ in.[6 mm].
- 7.3 The axis of the tension test sample shall be located in the test forging, or prolongation so as to represent mid-wall of the flange hub, or mid-wall of the thickness cross section of the valve, fitting, or other part.

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- 7.4 The axis of the tension test specimen shall be oriented parallel to the direction of maximum forging work for fittings, valves, and other parts, except for flanges when the specimen shall be oriented in the tangential direction.
- 7.5 One tension test shall be taken from each heat in each heat treatment load, and shall be representative of the largest flange hub, or valve or fitting wall thickness in the load.
- 7.6 When heat treatment is done either continuous or batch type furnaces in which the working zones are controlled to within ± 25 °F [± 14 °C] of the required heat treatment temperature, and when the furnace is equipped with functioning recording pyrometers such that complete heat treatment records are available, then one tension test from each heat shall be required instead of from each heat in each heat treatment load. However, this provision is limited to forgings with heat treated weights not exceeding 10000 lbs [4540 kg], and the test forging must accompany a production charge.

TABLE 2 Chemical Requirements

Composition, %		
	Heat Analysis	Product Analysis
Carbon, max	0.26	0.265
Manganese, max	1.60	1.64
Phosphorus, max	0.025	0.030
Sulfur, max	0.025	0.030
Silicon	0.15-0.35	0.10-0.40

8. Workmanship, Finish, and Appearance

9. Retests

10. Rejection and Rehearing

11. Certification :-

- 11.1 Certification shall comply with specification A961/A961M. However, if high-strength low-alloy steel is used, the analysis and the heat number or manufacturer's heat identification shall be reported to the purchaser.

12. Product Marking

13. Keywords :-

- 13.1 High strength low alloy steel; pipe fittings, steel; piping application; pressure containing parts; steel flanges; steel forgings, alloy; steel forgings, carbon; steel valves

Supplementary Requirements :-

S1. Special Flanges :-

- S1.2 Flanges shall meet the requirements of MSS SP-44, except the chemical requirements shall conform to Table 2.