



## Standard Specification for Heat-Treated Carbon Steel Fittings for Low-Temperature and Corrosive Service<sup>1</sup>

This standard is issued under the fixed designation A 858/A 858M; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 1. Scope

1.1 This specification covers heat-treated wrought carbon steel piping fittings with lowered carbon content of seamless and electric fusion-welded construction covered by the latest revisions in ANSI B 16.9, ANSI B 16.11, ANSI B 16.28, MSS-SP-75, and MSS-SP-79. Fittings differing from these ~~ANSI ASME~~ and MSS standards shall be furnished in accordance with Supplementary Requirement S58 of Specification A 960. These fittings are for use in pressure components where inherent notch toughness and optimum sulfide-cracking resistance are required, such as oil and gas industry piping and distribution systems.

1.2 Optional supplementary requirements are provided for fittings when a greater degree of examination is desired. One or more of the supplementary requirements may be specified in the order.

1.3 This specification does not cover cast-welding fittings or fittings machined from castings.

1.4 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. Combining values from the two systems may result in nonconformance with this specification. The values stated in each system are not exact equivalents; therefore, each system must be used independently of the other. Unless the other specifies the applicable “M” specification designation (SI units), the material shall be furnished to inch-pound units.

### 2. Referenced Documents

2.1 In addition to those reference documents listed in Specification A 960, the following list of standards apply to this specification.

2.2 ASTM Standards:

A 370 Test Methods and Definitions 530/A 530M Specification for Mechanical Testing of General Requirements for

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee A-1 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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Specialized Carbon and Alloy Steel Products Pipe<sup>2</sup>

~~A 530/A 530M Specification 960 Specification for General Common Requirements for Specialized Carbon and Alloy Wrought Steel Pipe~~

~~A 751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products~~<sup>2</sup>

~~E 165 Test Method for Liquid Penetrant Examination~~<sup>3</sup>

~~E 709 Practice for Magnetic Particle Examination~~<sup>3</sup>

~~2.2 ANSI Standards:~~<sup>4</sup>

~~B 16.9 Steel Butt-Welding Fittings~~

~~B 16.11 Forged Steel Fittings, Socket-Weld and Threaded~~

~~B 16.28 Wrought Steel Butt-Welding Short Radius Elbows and Returns Fittings~~<sup>2</sup>

~~2.3 ASME Boiler and Pressure Vessel Code:~~

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<sup>2</sup> Annual Book of ASTM Standards, Vol 01.01.

Section V Nondestructive Examination<sup>3</sup>

Section VIII Division 1, Pressure Vessels

~~Section IX Welding Qualifications<sup>5</sup>~~

~~2.4 ASNT Standards:~~

~~SNT-TC-1A(1984) Recommended Practice for Nondestructive Testing Personnel Qualification and Certification<sup>4</sup>~~

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*Annual Book*

<sup>3</sup> Available from American Society of ~~ASTM Standards, Vol 03.03~~, Mechanical Engineers, Three Park Avenue, New York, NY 10016-5990.

~~2.5—MSS Standards:<sup>4</sup>~~

- ~~MSS-SP-25 Standard Marking System for Valves, Fittings, Flanges and Unions  
MSS-SP-75 Specification for High Test Wrought Butt-Welding Fittings  
MSS-SP-79 Socket Welding Reducer Inserts<sup>3</sup>~~

**3. Ordering Information**

3.1 Orders for material under this specification shall include

3.1 In addition to the following information:

- 3.1.1 Quantity and number requirements of fittings of each kind;
- 3.1.2 Description of fitting and nominal dimensions (standard or special);
- 3.1.3 Construction, seamless or welded (unless seamless or welded construction is specified by Specification A 960, the purchaser, either may be furnished at the option of the supplier);
- 3.1.4 Supplementary requirements, if any;
- 3.1.5 Specification designation and year of issue;
- 3.1.6 Additional requirements, if any (See 18.5), and
- 3.1.7 Requirements following ordering information applies: requirements for certification of the test report.

**4. General Requirements**

4.1 Products furnished to this specification shall conform to the requirements of Specification A 960, including any supplementary requirements that are indicated in the purchase order. Failure to comply with the general requirements of Specification A 960 constitutes nonconformance with this specification. In case of conflict between the requirements of this specification and Specification A 960, this specification shall prevail.

**5. Materials**

5.1 The material for fittings shall be fully killed fine-grain material made by a melting process that is intended to produce rounded, well dispersed, fine sulfide inclusions, that promote good notch toughness, assists in the resistance to hydrogen induced cracking, and for weldability suitable for field-welding.

5.2 Starting materials shall consist of plate, sheet, forgings, forging quality bar and seamless or fusion welded tubular products with filler metal added. The chemical composition shall conform to Table 1.

5.3 A starting material that specifically requires the addition of any element beyond those listed in Table 1 is not permitted. This does not preclude the use of deoxidizers.

5.4 Starting materials shall not require a preheat for field welding provided that the restrictions of *ASME Boiler and Pressure Vessel Code*, Section VIII, Paragraph UW-30 are complied with.

**56. Manufacture**

56.1 Forging or shaping operations may be performed by hammering, pressing, piercing, extruding, upsetting, rolling, bending, fusion welding, machining, or by a combination of these operations. ~~Fittings machined from bar shall be restricted to NPS-4 or smaller. Elbows, return bends, and tees and header tees, shall not be machined directly from bar stock.~~

5.2 All operations.

6.2 All welds including welds in tubular products from which the fittings are made shall be:

56.2.1 Made by welders, welding operators, and welding procedures qualified under the provisions of *ASME Boiler and Pressure Vessel Code*, Section IX,

56.2.2 Heat treated in accordance with Section ~~6~~ 7 of this specification, and

**TABLE 1 Chemical Requirements**

	Composition %		
	Heat Analysis	Product Analysis	
Carbon	0.20	0.22	All values are maximum unless a range is shown
Manganese	0.90–1.35	1.45	
Phosphorus	0.030	0.030	
Sulfur	0.010	0.010	
Silicon	0.15–0.40 <sup>A</sup>	0.10–0.40	
Nickel	0.50 <sup>B</sup>	0.60	
Chromium	0.30 <sup>B</sup>	0.30	
Molybdenum	0.20 <sup>B</sup>	0.20	
Copper	0.35 <sup>B</sup>	0.35	

<sup>A</sup> When vacuum carbon deoxidation is used, the silicon shall be 0.10 % maximum, and on product analysis shall not exceed 0.12 %.

<sup>B</sup> The combined total of nickel, chromium, molybdenum, and copper shall not exceed 1.0 %.

56.2.3 Radiographically examined throughout the entire length of each weld in accordance with Articles 1 and 2 of *ASME Boiler and Pressure Vessel Code*, Section V with the acceptance limits in accordance with Paragraph UW-51 in Section VIII of that same code.

56.3 The welded joints of the fittings shall be furnished in accordance with the requirements of Paragraph UW-35(a) of *ASME Boiler and Pressure Vessel Code*, Section VIII.

56.4 All butt-weld tees manufactured by cold-forming methods shall be liquid-penetrant or magnetic-particle examined by one of the methods specified in ~~Supplementary Requirements S3 or S4~~. Specification A 960. This examination shall be performed in accordance with a written procedure and shall be performed after final heat treatment. Only the side wall area of the tees need be examined. This area is defined by a circle that covers the area from the weld bevel of the branch outlet to the center line of the body or run. Internal and external surfaces shall be examined when size permits accessibility. No cracks shall be permitted. Other imperfections shall be treated in accordance with Section ~~13~~ 14 on finish. After the removal of any crack, the tees shall be re-examined by the original method. Acceptable tees shall be marked with the symbol PT or MT, as applicable, to indicate compliance. NDE personnel shall be qualified in accordance with SNT-TC-1A.

56.5 All caps machined from bar stock shall be examined by liquid penetrant or magnetic particle in accordance with ~~Supplementary Requirement S3~~ S69 or ~~S4~~ S70 with personnel qualifications, acceptance criteria and marking as in 5.4.

## 6. Heat Treatment

6.1 All fittings shall be furnished in the heat-treated condition. Fittings formed above the transformation temperature or upon which welding is performed, shall be cooled to below the lower criteria temperature prior to heat treatment. Fittings shall subsequently be heat treated by one or more of the following procedures:

6.1.1 *Normalizing*—Fittings shall be uniformly heated to a selected temperature above the transformation range and held at that temperature for a minimum of 30 min. Each fitting shall be uniformly cooled in air.

6.1.2 *Quenching and Tempering*:

6.1.2.1 *Quenching*—Fittings shall be uniformly heated to a selected temperature above the transformation range for at least 30 min and subsequently quenched in a liquid medium to a temperature below 300°F [150°C]. Quench facilities shall be equipped with suitable agitation systems such as mechanical agitation, recirculation pumps, sprays, or controlled overflow, or a combination thereof. The temperature of the water quenchants shall be restricted to a maximum of 120°F [49°C] at the end of the quench. The temperature of oil quenchants shall be maintained between 120°F and 160°F [49 and 71°C] using the maximum temperature suggested by the manufacturer. Polymer quenchants shall be controlled to a maximum temperature recommended by the quenchant manufacturer. Baths shall be of adequate type and size to rapidly absorb the heat rejected by the most massive part to be quenched. Quenched fittings shall subsequently be tempered.

6.1.2.2 *Tempering*—Fittings shall be uniformly heated to a selected temperature between 1150°F [620°C] and the lower critical temperature for at least 1 h and subsequently cooled at any convenient rate.

6.1.3 *Stress Relieving*—The fitting shall be uniformly heated to a selected temperature below the transformation range, but not less than 1150°F [620°C], held at temperature for at least 1 h and subsequently cooled at any convenient rate.

## 7. Chemical Composition Requirements

7.1 The chemical composition of the steel ~~Heat Treatment~~

7.1 All fittings shall conform to the requirements prescribed be furnished in ~~Table 1~~.

7.2 The steel shall not contain any unspecified elements for the ordered grade to heat-treated condition. Fittings formed above the extent that it conforms to the requirements of another grade for transformation temperature or upon which that element welding is a specified element having a required minimum content.

7.3 An analysis of each heat of steel performed, shall be made from a sample taken preferably during the pouring of the heat. The results shall conform cooled to Table 1 for either heat or product analysis limits as applicable.

7.4 The fittings manufacturer shall make a product analysis per heat from either below the starting material or from a fitting. The chemical composition thus determined shall conform lower criteria temperature prior to Table 1. The product analysis shall be the basis for rejection. For referee purposes, Methods, Practices, and Definitions A 751 shall apply.

7.5 Weld metal used in the construction of the fittings shall conform to the tensile and impact requirements of 8.4 and 10.1 after heat treatment in accordance with Section 6. A chemical analysis treatment. Fittings shall subsequently be performed on deposited weld metal for each heat of filler metal or, for submerged arc welding, each heat of filler metal treated by normalizing, quenching, and batch of flux. The weld metal shall be deposited tempering or stress-relieving in accordance with the qualified weld procedure.

7.6 Only the carbon content of the deposited weld-metal composition need comply with the requirements of Table 1. The total nickel content of the deposited weld metal shall not exceed 1.0%—Specification A 960.

## 8. Chemical Composition Requirements

8.1 The chemical composition of the steel shall conform to the requirements prescribed in Table 1.

8.2 The steel shall not contain any unspecified elements for the ordered grade to the extent that it conforms to the requirements of another grade for which that element is a specified element having a required minimum content.

8.3 An analysis of each heat of steel shall be made from a sample taken preferably during the pouring of the heat. The results shall conform to Table 1.

8.4 The fittings manufacturer shall make a product analysis per heat from either the starting material or from a fitting in accordance with Specification A 960.

8.5 Weld metal used in the construction of the fittings shall conform to the tensile and impact requirements of 9.4 and 11.1 after heat treatment in accordance with Section 7. A chemical analysis shall be performed on deposited weld metal for each heat of filler metal or, for submerged arc welding, each heat of filler metal and batch of flux. The weld metal shall be deposited in accordance with the qualified weld procedure.

8.6 Only the carbon content of the deposited weld-metal composition need comply with the requirements of Table 1. The total nickel content of the deposited weld metal shall not exceed 1.0 %.

## 9. Tensile Requirements

89.1 The tensile properties of the fitting material shall conform to the requirements listed in Table 2. ~~The testing shall be performed in accordance with Test Methods and Definitions A 370.~~

### 8.2 Tension

9.2 Tension test specimens shall be taken from a fitting after final heat treatment or from a test piece of the same heat and nominal thickness that was heat-treated in a charge with the fittings it represents.

89.3 One tensile test is required for each heat of fittings of the same section thickness and heat treated in either a continuous- or batch-type furnace, controlled within a range of 50°F [28°C] and equipped with recording pyrometers.

89.4 In addition, fittings containing welds shall have one center-weld tension test made with the axis transverse to the weld seam for each heat of filler metal, or each heat of filler metal and batch of flux for submerged arc welds, for fittings of the same section thickness and heat treated in either a continuous or batch-type furnace controlled within a range of 50°F [28°C] and equipped with recording pyrometers. Only the ultimate tensile strength need meet the minimum requirements of Table 2.

**TABLE 2 Mechanical Requirements**

Yield strength, min, 0.2 % offset, ksi [MPa]	36 [250]
Tensile strength, min, ksi [MPa]	70 [485]-95 [485]
<i>Elongation:</i>	
Standard round specimen, or small-size proportional specimen, min, % in 4D	22
Rectangular specimen, for section thickness 5/16 in. [7.94 mm] and over, and for small sizes tested in full section; min, % in 2 in. [50 mm]	30
Rectangular specimen, for section thickness 5/16 in. [7.94 mm] and over, and for small sizes tested in full section; min, % in 2 in. [50 mm]	30
Rectangular specimen for section thickness less than 5/16 in. [7.94 mm]; min, % in 2 in. [50 mm]. Width of specimen 1 1/2 in. [40 mm]	<sup>A</sup>
Rectangular specimen for section thickness less than 5/16 in. [7.94 mm]; min, % in 2 in. [50 mm]. Width of specimen 1 1/2 in. [40 mm]	<sup>A</sup>
Reduction of area (round specimen only); min, %.	40
<i>Toughness:</i>	
$C_v$ energy absorption <sup>B</sup> ; measured at -50°F [-46°C]:	
Specimen size, mm	Average/min, ft-lbs [J]
10 × 10	20/16 [27/22]
10 × 7.5	17/13 [23/18]
10 × 5	13/11 [18/15]

<sup>A</sup> For each 1/32 in. [0.79 mm] decrease in section thickness below 5/16 in. [7.94 mm] a deduction 1.5 % from the 30 % shown above is permitted. Where the section thickness lies between two values defined above, the minimum elongation value is determined by the following equation:

$$E = 48t + 15.00$$

where:

$E$  = elongation in 2 in. [50 mm], and

$t$  = actual thickness of specimen, in.

<sup>B</sup> These requirements are intended to minimize fracture initiation. The requirements are not intended to give assurance against fracture propagation.

## 9. Hardness Requirements

9.1 Fittings shall have a maximum hardness of 22 HRC (235 HB).

## 10. Notch Toughness Properties

10.1 The notch toughness properties of the fittings ~~Hardness Requirements~~

~~10.1 Fittings shall conform to the requirements listed in Table 2. The testing shall be performed in accordance with Methods and Definitions A 370. Full-size Charpy, V-notch, Type A specimens shall be used whenever possible. Small size specimens shall be used only when the material thickness does not permit full size specimens. The impact specimens shall not be flattened after heat treatment. All base metal specimens shall be removed with the axis of the specimens longitudinal to the direction of primary metal flow. Weld metal specimens shall have the axis transverse to the weld seam.~~

~~10.2 One set a maximum hardness of impact tests (three specimens) shall be made to represent the base metal and one set of impact tests (three specimens) shall be made to represent the weld metal on the same frequency as the tension tests.~~

~~10.3 The test temperature shall be  $-50^{\circ}\text{F}$  [ $-46^{\circ}\text{C}$ ]-22 HRC (235 HB).~~

## 11. Dimensions

~~11.1 Dimensional requirements for NPS 14 and smaller fittings are provided by ANSI B 16.9, B 16.11, B 16.28, or MSS-SP-79.~~

~~11.2 Dimensional requirements for fittings larger than NPS 14 up through NPS 48 are provided in MSS-SP-75, except as modified by 11.3~~

~~11.3 Fittings Notch Toughness Properties~~

~~11.1 The notch toughness properties of a size or shape differing from the standards in 11.1 and 11.2 but meeting all fittings shall conform to the other requirements of this specification, may listed in Table 2. The testing shall be furnished performed in accordance with Methods and Definitions A 370. Full-size Charpy, V-notch, Type A specimens shall be used whenever possible. Small size specimens shall be used only when the material thickness does not permit full size specimens. The impact specimens shall not be flattened after heat treatment. All base metal specimens shall be removed with the axis of the specimens longitudinal to the direction of primary metal flow. Weld metal specimens shall have the axis transverse to the weld seam.~~

~~11.2 One set of impact tests (three specimens) shall be made to represent the base metal and one set of impact tests (three specimens) shall be made to represent the weld metal on the same frequency as the tension tests.~~

~~11.3 The test temperature shall be  $-50^{\circ}\text{F}$  [ $-46^{\circ}\text{C}$ ].~~

## 12. Finish Dimensions

~~12.1 Dimensional requirements for NPS 14 and Appearance~~

~~12.1 Fittings supplied under this specification shall be examined visually. Selected typical surface discontinuities shall be explored smaller fittings are provided by ANSI B 16.9, B 16.11, B 16.28, or MSS-SP-79.~~

~~12.2 Dimensional requirements for depth. The fittings shall be free of surface discontinuities that penetrate more larger than 5 % of the specified nominal wall thickness, NPS 14 up through NPS 48 are provided in MSS-SP-75, except as defined in 12.3 and 12.4, and shall have a workmanlike finish.~~

~~12.2 Surface discontinuities deeper than 5 % modified by 12.3~~

~~12.3 Fittings of a size or shape differing from the specified nominal wall thickness, except as defined standards in 12.31 and 12.4, shall be removed by the manufacturer by machining or grinding to sound metal, and the repaired areas shall be well faired. The wall thickness at 12.2 but meeting all points shall be at least 87½ % of the specified nominal wall thickness, and the diameters at all points shall be within the specified limits.~~

~~12.3 Surface checks (fish scale) deeper than 1/64 in. [0.4 mm] shall be removed.~~

~~12.4 Mechanical marks deeper than 1/16 in. [1.6 mm] shall be removed.~~

~~12.5 When the removal other requirements of a surface discontinuity reduces the wall thickness below 87½ % of the specified nominal wall thickness at any point, the fitting shall this specification, may be subject to rejection or to repair as provided furnished in accordance with Supplementary Requirement S58 of Specification 13 A 960.~~

## 13. Repair by Welding (Base Metal)

13.1 Repair welding, by the manufacturer, is permissible.

13.1.1 The welding procedure Finish and the welder shall be qualified in accordance with Section IX of *ASME Boiler and Pressure Vessel Code*.

13.1.2 The deposited weld metal shall conform to the requirements of 7.5 and 7.6. Electrodes Appearance

13.1 See Specification A 960 for the shielded metal-arc process shall be of the low-hydrogen type.

13.1.3 Surface discontinuities shall be completely removed by chipping or grinding to sound metal and verified by magnetic particle or liquid-penetrant inspection.

13.1.4 After repair welding, the area welded shall be ground smooth to the original contour and shall be completely free of surface discontinuities as verified by magnetic particle or liquid-penetrant inspection. Sections thicker than 1 in. [25 mm] shall also be radiographed in accordance with 5.2.

13.1.5 All fittings repaired by welding shall be thermally treated after repair by either complete reheat treatment or post-weld

~~heat treatment at least 50°F [28°C] below the tempering temperature if tempering has been performed.~~

~~13.1.6 Repair by welding shall not exceed 10 % of the surface area of the fitting nor 33⅓ % of the nominal wall thickness.~~

~~13.1.7 Indications discovered by nondestructive examination shall, after heat treatment, be again examined by the same NDE method as used in the original determination.~~

~~13.1.8 Personnel performing NDE examinations shall be qualified in accordance with SNT-TC-1A, specific requirements.~~

#### **14. Repair by Welding (Base Metal)**

14.1 Repair welding, by the manufacturer, is permissible in accordance with Specification A 960 and the following:

14.1.1 The deposited weld metal shall conform to the requirements of 8.5 and 8.6. Electrodes for the shielded metal-arc process shall be of the low-hydrogen type.

14.1.2 Sections thicker than 1 in. [25 mm] shall also be radiographed after repair welding in accordance with 6.2.

14.1.3 All fittings repaired by welding shall be thermally treated after repair by either complete reheat treatment or post-weld heat treatment at least 50°F [28°C] below the tempering temperature if tempering has been performed.

14.1.4 Indications discovered by nondestructive examination shall, after heat treatment, be again examined by the same NDE method as used in the original determination.

14.1.5 Personnel performing NDE examinations shall be qualified in accordance with SNT-TC-1A.

#### **15. Hydrostatic Test**

145.1 Hydrostatic testing is not required by this specification.

145.2 Every fitting shall be capable of withstanding without failure, leakage, or impairment of serviceability, a hydrostatic test pressure of 1½ times its pressure rating or 1½ times the piping design pressure.

#### **15. Inspection**

~~15.1 The manufacturer shall afford the purchaser's inspector all reasonable facilities necessary to satisfy him that the material is being furnished in accordance with this specification. Inspection by the purchaser shall not interfere unnecessarily with the manufacturer.~~

#### **16. Rejection and Rehearing**

16.1 Material that fails to conform to the requirements of this specification may be rejected. Rejection shall be reported to the producer or supplier promptly in writing. In case of dissatisfaction with the results of the tests, the producer or supplier may make claim for a rehearing.

#### **17. Certification**

17.1 When requested by the purchaser, the manufacturer shall provide a certificate of compliance to this specification (including year date). In addition, if requested to provide test reports, the manufacturer shall also provide the following, where applicable:

17.1.1 Chemical analysis results, (Section ~~7~~ 8 and Table 1), base metal only, and

17.1.2 Tensile property results, (Section ~~8~~ 9 and Table 2), including the yield strength and tensile strength in ksi, and elongation and reduction of area in percent for the base metal. Transverse-weld tensile strength shall be reported in ksi.

17.1.3 Impact test results, (Section ~~10~~ 11 and Table 2), base metal and weld metal, report specimen size and test temperature, and

17.1.4 Type heat treatment, (Section ~~6~~ 7),

17.1.5 Radiographic examination results, and

17.1.6 Any supplemental testing required by the purchase order.

#### **18. Product Marking**

18.1 Identification marking shall consist of the manufacturer's symbol or name (Note 1), specification number (year date not needed), size, and nominal wall thickness or schedule, and heat code identity. In addition, quenched and tempered fittings shall be marked with the symbol QT, and cold-formed tees shall be marked as prescribed in ~~5~~ 6.4.

NOTE 1—For purposes of identification marking, the manufacturer is considered the organization that certifies the piping component complies with this specification.

18.2 Fittings that have been repaired by welding shall be marked with the letter W following the designation number.

18.3 Marking shall be by low-stress die stamps or interrupted dot stamps and shall be in accordance with MSS-SP-25.

18.4 If the impact test temperature is other than -50°F [-46°C], the impact test temperature shall be marked on the fitting.

18.5 *Bar Coding*—In addition to the requirements in 18.1, 18.2, 18.3, and 18.4, bar coding is acceptable as a supplemental identification method. The purchaser may specify in the order a specific bar coding system to be used. The bar coding system, if applied at the discretion of the supplier, should be consistent with one of the published industry standards for bar coding. If used on small fittings, the bar code may be applied to the box or a substantially applied tag.

#### **19. Keywords**

19.1 corrosive service applications; pipe fittings—steel; piping applications; pressure containing parts; temperature service applications—low



## **SUPPLEMENTARY REQUIREMENTS**

These requirements shall not be considered unless specified in the order, in which event, the supplementary requirements 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.

### **S1. Repair Welding**

S1.1 No repair welding shall be permitted without the prior approval of the purchaser.

### **S2. Special Notch Toughness**

S2.1 The impact test temperature or acceptance values, or both, shall be as agreed upon, but only with respect to lower temperatures or higher energy values.

### **S3. Liquid Penetrant Examination**

S3.1 All surfaces shall be liquid penetrant examined in accordance with Practice E 165. Acceptance limits shall be specified by the purchaser. Personnel performing NDE examinations shall be qualified in accordance with SNT-TC-1A.

### **S4. Magnetic Particle Examination**

S4.1 All accessible surfaces shall be magnetic particle examined in accordance with Practice E 709. Acceptance limits shall be specified by the purchaser. Personnel performing NDE examinations shall be qualified in accordance with SNT-TC-1A.

### **S5. Bar Stock Fittings**

S5.1 Bar stock fittings shall not be permitted.

### **S6. Special Heat Treatment**

S6.1 A special heat treatment shall be applied as agreed upon between the manufacturer and the purchaser (Section 6).

### **S7. Hardness Test**

S7.1 If actual hardness testing of the fittings is required, the frequency and the method used shall be as agreed upon between the manufacturer and the purchaser.

### **S8. Special Fittings**

S8.1 Partial compliance fittings of size or shape not conforming to the dimensional requirements of ANSI B 16.9, B 16.11, B 16.28, MSS-SP-75 and MSS-SP-79 shall meet all other requirements of this specification. In addition to the marking required by Section 18, the grade designation symbol shall be followed by the symbol S8.

### **S9. Ultrasonic Examination**

S9.1 Each fitting shall be ultrasonically examined as agreed upon between the purchaser and the manufacturer.

S9.2 Personnel performing NDE examinations shall be qualified in accordance with SNT-TC-1A.

### **S10. Weld Metal Analysis**

S10.1 Analysis of weld metal shall be reported.

### **S11. Welding Procedure Test Record**

S11.1 Welding Procedure Test Record shall be furnished.

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