



## ASTM A860/A860M-09

# Standard Specification for Wrought High – Strength

## Ferritic Steel Butt – Welding Fittings

### 1. Scope :-

- 1.1 This specification covers wrought high – strength ferritic steel butt-welding fitting of seamless and electric and fusion-welded construction covered by the latest revision of ASME B16.9 and MSS-SP-75 . Butt-welding fittings differing from these ASME and MSS standards shall be furnished in accordance with Supplementary Requirements S58 of specification A960/A960M . These fittings are for use in high – pressure gas and oil transmission and distribution system .
- 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 fitting or fittings machined from castings .
- 1.4 The values states in either SI units or inch – pounds units are to be regarded separately as standard . Within the text , the SI units are shown in brackets . The values states in each system may not be exact equivalents , therefore , each system shall be used independently of the other . Combining values from the two system may result in – conformance with the standard . unless the order specifies the applicable “M” specification designation (SI units ) , the material shall be furnished to inch – pound units .

### 2. Reference Documents :-

#### 2.1 ASTM Standards :-

- A370 Test Methods and Definitions for Mechanical testing of Steel Products
- A751 Tests method , practices , and terminology for chemical Analysis of Steel Products
- A960/A960M specification for common Requirements for Wrought steel Piping fittings

#### 2.2 ASME standards :-

- B16.9 Steel Butt-Welding Fitting

#### 2.3 ASME Boiler and Pressure Vessel Code

- Section V Nondestructive Examination
- Section VIII Division 1 , Pressure Vessels
- Section IX Welding and Brazing qualification

#### 2.4 MSS Standards :-

- MSS-SP-25 The standard Marking system of valves , fittings , flange and unions
- MSS-SP-75 Specification for high test wrought butt-welding fittings

#### 2.5 American society of Nondestructive testing :-



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SNT-TC-1A Recommended Practice for Nondestructive Testing Personnel  
Qualification and Certification

### 3. General Information :-

3.1 Product furnished to this specification shall conform to the requirements of specification A960/A960M , including any supplementary requirements that are indicated in the purchase order . failure to comply with the general requirements of specification A690/A960M constitutes non-conformance with this specification . In case of conflict between the requirements of this specification and Specification A960/A960M , this specification shall prevail .

### 4. Materials and Manufacture :-

- 4.1 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 sulphide inclusions , that promote good notch toughness , assists in the resistance to hydrogen induced cracking , and for weldability suitable for field welding .
- 4.2 Starting materials shall consist of plate , sheet , forgings , forging quality bar , and seamless or fusion – welded tubular product with filler metal added . The chemical composition shall conform to Table 1 .
- 4.3 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 .
- 4.4 Starting material 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 .
- 4.5 Forging or shaping operation may be performed by hammering , pressing , piercing , extruding , upsetting , rolling , bending , fusion , welding , machining , or by a combination of these operations .
- 4.6 All welds including welds in tubular product from which the fitting are welding are made shall be :
- 4.6.1 Made by welders , welding operators , and welding procedures qualified under the provision of ASME Boiler and Pressure Vessel Code , Section IX .
  - 4.6.2 Heat treatment in accordance with section 6 of this specification , and
  - 4.6.3 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 acceptance limits in accordance with Paragraph UW-51 of ASME Boiler and Pressure Vessel Code , section VIII .
- 4.7 The welded joint of the fitting shall be furnished in accordance with the requirement of paragraph UW-35(a) of ASME Boiler and Pressure Vessel Code , section VIII .

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- 4.8 All butt – weld tees manufactured by cold – forming methods shall be liquid penetrant or magnetic particle examined by one of the specified in supplementary Requirements S69 or S70 of Specification a960/A960M . 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 tes needs be examined . this area is defined by a circle that covers area from the weld bevel of the branch outlet to the center line of the body or run . Internal and external surface shall be examined when size permits permits accessibility . No cracks shall be permitted . other imperfections shall be treated in accordance with 12.1 on finish . After the removal of any cracks , the tees shall be re-examined by the removal of any Acceptable tees shall be marked with the symbol PT or MT , as applicable , to indicate compliance . NDE personal shall be qualified in accordance with SNT-TC-1A .
- 4.9 All caps machined from bar stock shall be examined by liquid penetrant or magnetic particle in accordance with supplementary Requirements S69 or S70 of specification A960/A960M , and with personal qualification , acceptance criteria and marking as in 4.8 .

**TABLE 1 Chemical Requirements**

Composition %		
Heat Analysis		
Carbon	0.20 <sup>A</sup>	All values are Maximum unless A range is stated
Manganese	1.00-1.45	
Phosphorus	0.030	
Sulfur	0.010	
Silicon	0.15-0.40 <sup>B</sup>	
Nickel	0.50	
Chromium	0.30	
Molybdenum	0.25	
Copper	0.35	
Titanium	0.05	
Vanadium	0.10	
Columbium	0.04	
Vanadium plus Columbium	0.12	
Aluminium	0.06	

### 5. Heat Treatment :-

- 5.1 All fittings shall be furnished in the heat-treated condition . fittings formed above the transformation temperature or upon which welding is performed ,



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shall be cooled to below the lower critical temperature prior to heat treatment .  
Fittings shall subsequently be heat treated by normalizing , quenching , and tempering or stress relieving in accordance with specification A960/A960M .

### 6. Chemical Composition :-

- 6.1 The chemical composition of the steel shall conformed to the requirements prescribed in Table 1 .
- 6.2 The steel shall not contain any unspecified elements for the ordered grade to the extent that it conformed to the requirements of another grade for which that element is a specified element having a required minimum content .
- 6.3 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 for either heat or specification A960/A960M for product analysis limits as applicable .
- 6.4 The fittings manufacturer shall make a product analysis per heat from either the starting material or from a fitting . The chemical composition thus determined shall conform to Table 1. The product analysis shall be the basis for rejection . for referee purposes , Test Method , Practices , and Terminology A751 shall Apply .
- 6.5 The carbon equivalent of the base metal , as terminology A751 shall apply .  
$$CN=C+mn/6+(Cr+Mo+V)/5+(Ni+Cu)/15$$
- 6.6 weld metal used in the construction of the fittings shall conform to the tensile and impact requirements of 9.4 and 8.1 after heat treatment in accordance with Section 6 .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 .
- 6.7 Only the carbon content of the deposited weld-metal composition need comply with the requirements of table 1 .The nickel content of the deposited weld metal shall not exceed 1.0 % .

### 7. Notch Toughness properties :-

- 7.1 The notch toughness properties of the fittings shall conform to the requirements listed in table 2 . The testing shall be performed in accordance with Test method and Definitions A370 . Full size Charpy , V-notch specimens shall be used whenever possible . small size specimens shall be used 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 be specimens with the axis transverse to the weld seam .



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

7.3 The test temperature shall be -50 °F [-46° C]

### 8. Tensile Requirements :-

8.1 The tensile properties of the fitting material shall conform to the requirements listed in Table 2.

8.2 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 furnace charge with the fitting they represent .

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

8.4 In addition , fittings 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 arrange of 50 F [28 C] and equipped with recording pyrometers . Only the ultimate strength need meet the minimum requirements of Table 2 .

### 9. Hardness requirements :-

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

### 10. Dimensions :-

10.1 Dimensional requirements for NPS 14 and smaller butt-welding fittings are provided in ASME B16.9 .

10.2 Dimensional requirements for butt-welding fittings large than NPS 14 through NPS 48 are provided by MSS-SP-75 .

10.3 Fittings of a size or shape differing from the standard in 11.1 and 11.2 , but meeting all the other requirements of this specification , may be furnished in accordance with supplementary requirements S58 of Specification A960/A960M.

10.4 fittings that do not have a thickness or yield strength , or both , that are equal to the matting pipe , are acceptable provided the welding end preparations comply with MSS-SP-75 , Figs . 3(a) , and (c) and the fitting welding –end thickness is at least equal to the pipe wall thickness times the ratio of the specified minimum yield strength of the pipe and the minimum tested yield strength of the fitting



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TABLE 2 Mechanical Requirements

Property	Grade					
	WPHY 42	WPHY 46	WPHY 52	WPHY 60	WPHY 65	WPHY 70
Yield Strength , Min <sup>A</sup> 0.2 % offset, Ksi[MPa]	42[290]	46[315]	52[360]	60[415]	65[450]	70[485]
Elongation:	60[415]	63[435]	66[455]	75[515]	77[530]	80[550]
Standard Round Specimen, Or small Size Proportional Specimen , Min,% in 4D	-85[585]	-88 [605]	-91[625]	-100 [690]	-102 [705]	-105 [725]
Rectangular specimen, For section thickness 5/16 in. [7.94 mm] And over, And for all Sizes tested In full Section;min, % in 2 in . [50 mm]	25	25	25	20	20	20
Rectangular Specimen For Thickness Less than 5/16 in. [7.94 mm]; Min % 2 in. [50 mm]. Width of Specimen 1.50 in . [40 mm]	32	32	32	28	28	28
Rectangular Specimen, For Thickness Less than 5/16 in . [7.94 mm]; Min, % 2 in . [50 mm]. Width of specimen 1.50 in . [40 mm]	B	B	B	B	B	B
Toughness:						
C <sub>v</sub> energy absorption <sup>c</sup> Measured ; at-50 °F [-46 °C] .						



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Size ,mm	Average/min, ft. lbs [J]	Lateral Expansion min, MLS [mm]
10X10	30/25 [40/34]	25 [0.64]
10X7.5	25/21 [34/28]	21 [0.53]
10X 5	20/17 [27/23]	13[0.33]

### 10.Certification :-

10.1 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 , when application :

10.1.1 Chemical analysis results , when (Section 7 and Table 1) , base metal only , and

10.1.2 Tensile property results , (Section 9 and Table 2) , the yield strength and ultimate strength in ksi , and elongation in percent for the base metal .  
Transverse – weld tensile strength shall be reported in ksi .

10.1.3 Impact test results , (Section 8 and table 2) , base metal and weld metal , specimens size , and test temperature ,

10.1.4 Type heat treatment , (Section 6) ,

10.1.5 Radiographic examination results , and

10.1.6 Any supplemental testing required by the purchase order .

### 11. Keywords :-

11.1 high – strength low – alloy steel ; pipe fittings ; piping application ; pressure – containing parts .