ASTM A860 WPHY 65 Pipe Fittings Elbow Tee Reducer Caps Specification

ASTM A860 WPHY 65 covers **high-strength wrought carbon steel butt-weld pipe fittings** used in **high-pressure transmission pipelines**, especially for oil, gas, and petrochemical applications.
WPHY refers to **Wrought Pipe High Yield**, and Grade **65** indicates a **minimum yield strength of 65,000 psi (450 MPa)**.

The pipe fittings are typically made from seamless or welded steel pipes such as API 5L X65, X65M, X65Q, among others, which are commonly utilized for oil and gas transmission.

Dimensions Standard:

This grade is commonly supplied as **elbows, tees, reducers, caps, and crosses** manufactured according to **ASME B16.9** or **MSS SP-75**.

Butt-welding fittings with NPS 14 or smaller must adhere to the ASME B16.9 standard.

For fittings larger than NPS 14 (up to NPS 48), compliance with the MSS-SP-75 standard is required. These standards specify the dimensions, tolerances, materials, and testing requirements for the fittings to ensure their quality and suitability for use in various industries. The use of standardized fittings ensures compatibility and interchangeability between different manufacturers and suppliers.

Materials and Manufacturing

The material used for the fittings must be fine-grained and completely killed, produced through a melting process that results in well-dispersed, round sulfide inclusions. This unique composition helps to improve the fittings' notch toughness, making them more resistant to hydrogen-induced cracking. Additionally, the fittings possess excellent weldability, making them ideal for field soldering application

Product Scope

ASTM A860 WPHY 65 covers **high-yield carbon steel butt-weld fittings**, including:

- 45° / 90° Elbows
- Long Radius (LR) and Short Radius (SR) Elbows
- Equal and Reducing Tees
- Concentric & Eccentric Reducers
- Caps
- Crosses

Manufactured via **seamless or welded** construction.

Manufacturing Standards

- **ASTM A860 / A860M**
- **MSS SP-75** (main dimensional standard)
- **ASME B16.9** (Butt-weld fittings dimension)
- **ASME B31.3 / B31.4 / B31.8** (Pipeline codes)

ASTM A860 WPHY 65 Data Sheet

Chemical Composition

Element	Composition % (Heat Analysis)
Carbon	0.20[4]
Manganese	1.00 – 1.45
Phosphorus	0.03
Sulfur	0.01
Silicon	0.15 – 0.40[B]
Nickel	0.50[c]
Chromium	0.30[c]

Molybdenum	0.25[C]
Copper	0.35[C]
Titanium	0.05
Vanadium	0.1
Niobium[D]	0.04
Vanadium plus Niobium	0.12
Aluminum	0.06

Notes on Chemical Composition Specifications

1. [4] **Carbon Content & Carbon Equivalent (CE) Requirement**: The maximum carbon (C) content is 0.20%. The carbon equivalent shall comply with CE ≤ 0.42%, calculated by the formula:CE = C + Mn/6 + (Cr+Mo+V)/5 + (Ni+Cu)/15(Where C, Mn, Cr, Mo, V, Ni, Cu represent the mass percentage of each element in the steel. This formula is in line with the international welding society (IIW) standard and is used to evaluate the weldability of steel materials.)
2. [B] **Silicon (Si) Content Exception for Vacuum Carbon Deoxidation (VCD)**: The standard silicon content range is 0.15–0.40%. If vacuum carbon deoxidation process is adopted, the silicon content shall be ≤ 0.10% (based on heat analysis) and ≤ 0.12% (based on product analysis). This limitation optimizes the deoxidation effect and reduces oxygen content in the steel.
3. [C] **Sum Limit for Alloying Elements**: The maximum content of nickel (Ni) is 0.50%, chromium (Cr) 0.30%, molybdenum (Mo) 0.25%, and copper (Cu) 0.35% respectively. The total sum of Ni + Cr + Mo + Cu shall not exceed 1.0% to ensure the structural stability and processability of the steel.
4. [D] **Interchangeability of Niobium and Columbium**: Niobium (Nb) and columbium are interchangeable names for the same chemical element. Both designations are acceptable in ASTM Subcommittee A01.22 specifications. The maximum niobium content is 0.04%, and the combined content of vanadium (V) + niobium (Nb) shall not exceed 0.12%.
5. **General Specification**: Unless a specific range is specified for an element, all listed values represent the maximum allowable content (mass percentage) in heat analysis, in line with relevant ASTM standard requirements for structural steel.

Mechanical Properties

Part 1: Strength and Elongation Properties	
Property	Grade WPHY 65
Yield strength, min[4] 0.2% offset, ksi [MPa]	65 [450]
Tensile strength, ksi [MPa]	77 [530]
-	-102 [705]
Elongation: Standard round/small proportional specimen, min, % in 4D	20
Elongation: Rectangular specimen (≥7.94 mm thickness), min, % in 2 in. [50 mm]	28
Elongation: Rectangular specimen (<7.94 mm thickness), min, % in 2 in. [50 mm]	B
Part 2: Toughness Properties	
Size, mm	Average/min, ft-lbs[J]
10×10	30/25 [40/34]
10×7.5	25/21 [34/28]
10×5	20/17 [27/23]

Heat Treatment

ASTM A860 WPHY65, 42, 46, 52, 56, 60, and 70 all fittings shall be heat treated. Fittings that are formed above transformation temperature or made by welding, shall be cooled down to critical temperature before heat treatment. The methods include normalizing, quenching, tempering or stress relieving under the specification of ASTM A960/960M.

ASTM A860 WPHY 65 fittings shall be:

- **Normalizing**, or
- **Quenching and Tempering**,

Post-weld heat treatment applies for welded fittings depending on code requirements.

Hydrostatic Test

Hydrostatic testing is not required by this specification.

All fitting shall be capable of withstanding, after installation, without failure, leakage, or impairment of serviceability, a hydrostatic test pressure of 100% based on minimum yield strength of the material grade, wall thickness, and outside diameter ordered. The hydrostatic pressure shall be calculated in accordance with below equation:

P=2S x t/D

P = Hydrostatic pressure

S = Specific yield strength, min,

t = Nominal wall thickness, and

D = Outside diameter.

Available Sizes

- **½" to 48"** (DN15 – DN1200)
- **Schedules:** SCH 20, SCH 40, SCH 80, XS, XXS
- Also available in **API line pipe thicknesses**.

Typical Application

ASTM A860 WPHY 65 fittings are widely used in:

- Oil & gas transmission pipelines
- High-pressure natural gas systems
- Petrochemical industries
- Offshore platforms
- Refineries

- High-temperature and high-pressure piping
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Related Grades

- ASTM A860 **WPHY 42**
- ASTM A860 WPHY **52**
- ASTM A860 WPHY **60**
- ASTM A860 WPHY **70**