ASME B16.49, ASME B16.49 Specification, ASME B16.49 Butt Welding Bends, ASME B16.49 Production Standards, ASME B16.49 BW Pipe Bend, ASME B16.49 Stainless Steel Pipe Bend, ASME B16.49 Nickel Alloy Pipe Bend, ASME B16.49 Carbon Steel Pipe Bend.

ASME B16.49 Specification covers factory-made wrought steel pipe bends, including elbows, for high-pressure transmission and distribution systems.

1. ASME B16.49 Specification Size Range

- Nominal Pipe Size (NPS): The **ASME B16.49 Butt Welding Bends** standard typically covers nominal pipe sizes ranging from NPS 2 to NPS 60.
- Bend Radius: The specification requires that bends and elbows have a minimum radius, typically 3 times the nominal pipe size (3D) or greater, depending on the application and specific system requirements.

2. ASME B16.49 Tolerance

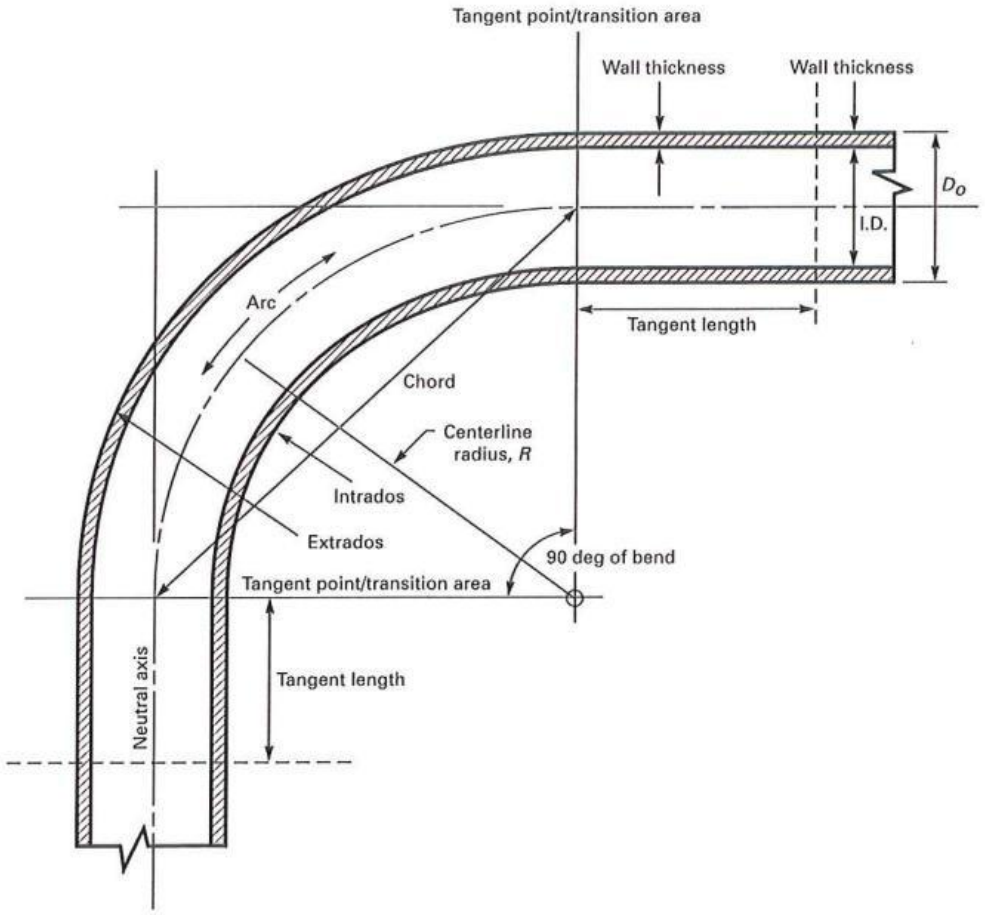
The **ASME B16.49 Production Standard** defines the permissible tolerances for dimensions of pipe elbows, including:

- Wall Thickness:
  - The minimum wall thickness shall be as specified for the pipe material or elbow size.
  - Tolerances must ensure the **ASME B16.49 BW Pipe Bend** does not fall below the specified thickness.
- Length and Radius:
  - Bend radius tolerance is typically limited to ±1% of the specified radius.
  - Angular tolerance for the bend angle must be within ±1 degree.
  - Ovality (out-of-roundness) should be controlled to prevent excessive distortion during bending and ensure consistent internal pressure ratings.
- End Preparation: Tolerances for the **ASME B16.49 Stainless Steel Pipe Bends** are specified to ensure proper fit-up for welding.

3. Manufacture Process

Induction bends manufactured to ASME B16.49 can be either made from seamless or welded pipes with or without tangent length by cold- or heat-forming process. Generally, **ASME B16.49 Nickel Alloy Pipe Bend** heat-forming process is applied which utilizes the mid-frequency induction-bending machine. This process utilizes induction heating to heat a narrow band 360 deg around a pipe or cylinder at the point of bending as the pipe or cylinder is being pushed through the inductor coil at a constant velocity. After the material passes through the coil, it may be cooled by forced air or water spray, or it may be allowed to cool in still air. Bends in any producible wall thickness and diameter are covered.

Fig. 1 Bend Dimensional Terms



ASME B16.49-2007

Table 1 Tensile Properties

Grade and Symbol	Tensile Properties			Hardness	
	Minimum Yield Strength, MPa (ksi)	Minimum Tensile Strength, MPa (ksi)	Minimum Elongation, %	Maximum HB [Note (1)]	Maximum HRC [Note (2)]
P241 (X241)	241 (35)	414 (60)	20	238	22
P290 (X290)	290 (42)	414 (60)	20	238	22
P317 (X317)	317 (46)	434 (63)	20	238	22
P359 (X359)	359 (52)	455 (66)	20	238	22
P386 (X386)	386 (56)	490 (71)	20	238	22
P414 (X414)	414 (60)	517 (75)	20	238	22
P448 (X448)	448 (65)	531 (77)	18	238	22
P483 (X483)	483 (70)	565 (82)	16	247	24
P552 (X552)	552 (80)	621 (90)	16	247	24

GENERAL NOTE: Intermediate grades may be purchased subject to agreement between the purchaser and manufacturer.

NOTES:

(1) HB (Hardness Brinell) is the primary number.

(2) HRC (Hardness Rockwell C) is an approximation based on ASTM E 140 hardness conversion.

4. ASME B16.49 Material Requirements

ASME B16.49 Carbon Steel Pipe Bend Grades

- ASTM A234 WPB
- ASTM A420 WPL3 WPL6 (low-temperature service)

- Applications: Suitable for general service conditions, including oil, gas, and water pipelines, where toughness and strength are required.

ASME B16.49 Alloy Steel Pipe Bend Grades

- ASTM A234 WP11, WP22, WP9 WP91
- ASTM A860 WPHY 42, WPHY 46, WPHY 52, WPHY 60, WPHY 65, WPHY 70 (High-yield strength materials)
- Applications: Used in high-temperature and high-pressure environments, such as power plants, refineries, and chemical plants.

ASME B16.49 Stainless Steel Pipe Bend Grades

- ASTM A403 WP304, WP304L, WP316, WP316L, WP321, WP347
- Applications: Ideal for corrosive environments, including food processing, pharmaceuticals, and chemical industries.

ASME B16.49 Duplex Stainless Steel Pipe Bend Grades

- ASTM A815 UNS S31803 (Duplex 2205)
- ASTM A815 UNS S32750 (Super Duplex 2507)
- Applications: Provides higher strength and corrosion resistance, used in oil and gas, marine, and chemical processing industries.

ASME B16.49 Nickel Alloy Pipe Bend Grades

- ASTM B366 UNS N06600 (Inconel 600), UNS N06625 (Inconel 625), UNS N08825 (Incoloy 825)
- ASTM B366 UNS N10276 (Hastelloy C276)
- ASTM B366 UNS N04400 (Monel 400)
- ASTM B366 UNS N06022 (Hastelloy C22)
- Applications: Used in applications requiring specific resistance to certain chemicals or environments, such as sulfuric acid plants, chemical processing, and pollution control equipment.

Table 2 Maximum Limits of Chemical Elements That May Be Used

Element	Symbol	Maximum, %
Carbon	C	0.30
Manganese	Mn	1.60 [Note (1)]
Phosphorus	P	0.025
Sulfur	S	0.015
Silicon	Si	0.50
Chromium	Cr	0.30
Molybdenum	Mo	0.25
Vanadium	V	0.10
Copper	Cu	0.50
Nickel	Ni	1.00
Niobium	Nb (Cb)	0.10

GENERAL NOTE: The chemical requirements of this Table are not intended to represent the composition of any heat of steel, but to record the maximum permissible amounts of individual elements.

NOTE:

(1) For Grades P483 (X483) and higher for each reduction of 0.01% below the specified maximum carbon content, an increase of 0.05% above the maximum manganese content is permissible, up to a maximum of 2.00%.

5. ASME B16.49 Pressure Rating

- Pressure-Temperature Ratings: Pipe elbows must withstand the pressure ratings specified by the connected piping system, ensuring that the elbow's pressure rating matches the same rating as the pipe.

- **ASME B16.49 Pressure Ratings** are based on the class of pipe, material, and wall thickness.

- Wall Thickness and Pressure Relationship: For a given NPS, the elbow's wall thickness must meet the design pressure requirements at the specified operating temperature.

6. ASME B16.49 Specification Marking

- The marking requirements ensure traceability and compliance with the standard:
  - Manufacturer's Identification: Includes the manufacturer's name or trademark.
  - Material Grade: Denotes the steel grade or material type.
  - Pipe Size and Radius: Includes the nominal pipe size, bend radius, and wall thickness.
  - Pressure Rating: Specifies the pressure class or schedule of the pipe elbow.
  - Heat Number: Provides traceability to the material's production batch.

- **ASME B16.49 Standard** Designation: Marking the part as per ASME B16.49, ensuring compliance with the specification.

7. Heat Treatment & Testing Requirements

Each induction bends shall be heat-treated after bending by one or more of the following methods:

Stress Relieve or Temper. Uniformly, heat between 480°C (900°F) and 675°C (1,250°F) and hold at temperature for at least 30 min per 25 mm (1 in.) of thickness at temperature, but no less than 30 min.

ASME B16.49 Pipe Bend Normalizing. Heat above the transformation temperature range and hold at temperature for a minimum of 20 min per 25 mm (1 in.) of thickness, but not less than 20 min, and allow to cool in still air.

Quench and Temper. Heat above the transformation temperature range and hold at temperature for a minimum of 20 min per 25 mm (1 in.)of thickness and direct quench in either water, oil, or a synthetic quenchant. Reheat to temper as defined above. Quench facilities shall be of sufficient size and shall be equipped to ensure proper and uniform cooling.

ASME B16.49 Pipe elbows must undergo various testing procedures to verify their compliance with the standard:

- Non-Destructive Testing (NDT): Includes methods such as:
  - **ASME B16.49 SS Pipe Bned** Ultrasonic Testing (UT) or Radiographic Testing (RT) to detect internal flaws.
  - Magnetic Particle Inspection (MPI) or Dye Penetrant Testing (DPT) to detect surface cracks or imperfections.
- Hydrostatic Testing: A pressure test is performed to ensure the elbow can withstand specified internal pressures without failure or leaks. The test pressure is usually 1.5 times the design pressure of the system.
- **ASME B16.49 CS Pipe Bned** Dimensional Inspection: A detailed dimensional inspection is performed to verify that the bend radius, wall thickness, and end dimensions meet the tolerance requirements.

Conclusion

ASME B16.49 governs the manufacturing, testing, and quality assurance of factory-made wrought steel pipe elbows for high-pressure systems. The **ASME B16.49 Pipe Bned Specification** ensures that pipe elbows maintain appropriate tolerances, material strength, pressure ratings, and undergo thorough testing to guarantee integrity in service. This helps to provide consistent performance in high-pressure environments like oil and gas pipelines, chemical processing, and other critical industries.