

# ASTM A335 P91 Alloy Steel Pipe Specification

ASTM A335 P91 is a ferritic alloy steel seamless pipe used in high-temperature and high-pressure applications such as power plants, refineries, and petrochemical facilities. It is part of the ASTM A335 / ASME SA335 standard specification for seamless ferritic alloy-steel pipe for high-temperature service.

P91 is a chromium-molybdenum alloy with a chromium content ranging from 8.00 to 9.50%.

## ASTM A335 P91 Chemical Composition (% by weight)

Grade	Composition, %							
	Carbon	Manganese	Phosphorus	Sulfur	Silicon	Chromium	Molybdenum	Others
P91 Type 1	0.08 - 0.12	0.30 - 0.60	0.020, max	0.010, max	0.20 - 0.50	8.00 - 9.50	0.85 - 1.05	V: 0.18 - 0.25 N: 0.030 - 0.070 Ni: 0.40 max Al: 0.02 max Nb: 0.06 - 0.10 Ti: 0.01 max Zr: 0.01 max
P91 Type 2 (Heat Analysis)	0.08 - 0.12	0.30 - 0.50	0.020, max	0.005, max	0.20 - 0.40	8.00 - 9.50	0.85 - 1.05	V: 0.18 - 0.25 Ni: 0.20 max Al: 0.020 max N: 0.035 - 0.070 N/Al ratio ≥ 4.0 Nb: 0.06 - 0.10 Ti: 0.01 max Zr: 0.01 max Sn: 0.010 max Sb: 0.003 max As: 0.010 max B: 0.001 max W: 0.05 max Cu: 0.10 max
P91 Type 2 (Product Analysis)	0.07 - 0.13	0.30 - 0.50	0.020, max	0.005, max	0.20 - 0.40	8.00 - 9.50	0.80 - 1.05	V: 0.16 - 0.27 Ni: 0.20 max Al: 0.020 max N: 0.035 - 0.070 N/Al ratio ≥ 4.0 Nb: 0.05 - 0.11 Ti: 0.01 max Zr: 0.01 max Sn: 0.010 max Sb: 0.003 max As: 0.010 max B: 0.001 max W: 0.05 max Cu: 0.10 max

## ASTM A335 P91 Pipe Tensile Requirement

- **Tensile Requirement**

Grade	ASTM A335 P91 Type 1 and Type 2	
Tensile strength, min, ksi [MPa]	85 [585]	
Yield strength, min, ksi [MPa]	60 [415]	
Elongation in 2 in. or 50 mm, (or 4D), min, %	Longitudinal	Transverse
Basic minimum elongation for wall 5/16 in [8 mm] and over in thickness, strip tests, and for all small sizes tested in full section	20	—
When standard round 2 in or 50 mm gage length or proportionally smaller size specimen with the gage length equal to 4D (4 times the diameter) is used	20	13
For strip tests a deduction for each 1/32 in [0.8 mm] decrease in wall thickness below in. [8 mm] from the basic minimum elongation of the following percentage points shall be made	1.00	—

## Heat Treatment

Grade	P91 Type 1, P91 Type 2	Heat Treat Type	Normalizing Temperature, min or range °F [°C]	Cooling Media	Subcritical Annealing or Tempering Temperature, min or range °F [°C]
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normalize  
and  
temper B

1650 [900]

—

1100 [595]

normalize  
and  
temper

1900 - 1975  
[1040 - 1080]

—

1350 - 1470 [730 -  
800] C

quench  
and  
temper

1900 - 1975  
[1040 - 1080]

## Hardness Requirement

Grade	P91 Type 1 and Type 2
Brinell	190 - 250 HBW
Vickers	196 - 265 HV
Rockwell	91HRBW - 25 HRC

## Size Range

<b>Outside Diameter (OD)</b>	<b>½" to 24" NPS (or custom)</b>
<b>Wall Thickness (WT)</b>	Sch. 40 to Sch. XXH / Custom
<b>Length</b>	Random, Fixed, Double Random (6m/12m)

## Standards & Markings

- **Standard:** ASTM A335 / ASME SA335
- **Marking Includes:**
  - Manufacturer's name or logo
  - ASTM A335 / P91
  - Heat number
  - Size & Schedule
  - Lot or batch number

## Applications

- High-pressure boilers and superheaters
- Thermal power plants (especially ultra-supercritical boilers)
- Refinery piping
- Petrochemical processing
- Steam pipelines and headers

## Testing & Inspection

- Hydrostatic testing
- Ultrasonic / NDT testing
- Hardness testing
- Flattening, flaring, and bending tests
- PMI (Positive Material Identification)
- EN 10204 3.1 or 3.2 certification