

# ASTM A105 / ASME SA105

## SPECIFICATION FOR CARBON STEEL FORGINGS, FOR PIPING APPLICATIONS

This specification covers forged carbon steel piping components for ambient- and higher-temperature service in pressure systems.

### A. General Requirements :-

1. Product furnished to this specification shall conform to the requirements of Specification A 961.
2. In case of a conflict between the requirements of this specification and Specification A 961, this specification shall prevail.

### B. Heat Treatment :-

1. Heat treatment is not a mandatory requirement of this specification except for the following piping components:
  - i. Flanges above Class 300,<sup>1</sup>
  - ii. Flanges of special design where the design pressure at the design temperature exceeds the pressure temperature ratings of Class 300, Group 1.1,
  - iii. Flanges of special design where the design pressure or design temperature are not known,
  - iv. Piping components other than flanges which meet both of the following criteria: (1) over NPS 4 and (2) above Class 300, and
  - v. Piping components of Special Class<sup>2</sup> other than flanges which meet both of the following criteria: (1) over NPS 4 and (2) when the working pressure at the operating temperature exceeds the tabulated values for Special Class
  - vi. 300, Group 1.1.
2. Heat treatment, when required by point B.1 shall be annealing, normalizing, or normalizing and tempering or quenching and tempering in accordance with Specification A 961.

<sup>1</sup> For definition of Class 300, see ASME B16.5.

<sup>2</sup> For definition of special class, see ASME B16.34.

### C. Chemical Composition :-

The steel shall conform to the chemical requirements specified in Table 1.

**Table 1**

| Element    | Composition, %             |
|------------|----------------------------|
| Carbon     | 0.35 max.                  |
| Manganese  | 0.60–1.05                  |
| Phosphorus | 0.035 max.                 |
| Sulfur     | 0.040 max.                 |
| Silicon    | 0.10–0.35                  |
| Copper     | 0.40 max. [Note (1)]       |
| Nickel     | 0.40 max. [Note (1)]       |
| Chromium   | 0.30 max. [Notes (1), (2)] |
| Molybdenum | 0.12 max. [Notes (1), (2)] |
| Vanadium   | 0.08 max.                  |

*GENERAL NOTE: For each reduction of 0.01% below the specified carbon maximum (0.35%), an increase of 0.06% manganese above the specified maximum (1.05%) will be permitted up to a maximum of 1.35%.*

**NOTES:**

(1) The sum of copper, nickel, chromium, molybdenum and vanadium shall not exceed 1.00%.

(2) The sum of chromium and molybdenum shall not exceed 0.32%.

**D. Mechanical Properties :-**

1. The material shall conform to the mechanical property requirements prescribed in Table 2 and Table 3.
2. *Tension Tests* —
  - i. Testing shall be performed in accordance with Test Methods and Definitions A 370.
  - ii. Forgings too small to permit obtaining a subsize specimen of 0.250 in. [6.35 mm] diameter or larger (see Test Methods and Definitions A 370) parallel to the dimension of maximum working, and produced in equipment unsuitable for the production of a separately forged test bar such as an automatic or semi-automatic press, may be accepted on the basis of hardness only. One percent of the forgings per lot, or ten forgings, whichever is the lesser number, shall be selected at random, prepared, and tested using the standard Brinell test in Test Methods and Definitions A 370.

**Table 2** [Note (1)]

|  |                 |
|--|-----------------|
| Tensile strength, min., psi [MPa]  | 70 000 [485]    |
| Yield strength, min., psi [MPa] [Note (2)]   | 36 000 [250]    |
| Elongation in 2 in. or 50 mm, min., %:<br>Basic minimum elongation for walls 5/16 in. [7.9 mm] and over in thickness, strip tests.   | 30              |
| When standard round 2 in. or 50 mm gage length or smaller proportionally sized specimen with the gage length equal to 4D is used   | 22              |
| For strip tests, a deduction for each 1/32 in. [0.8 mm] decrease in wall thickness below 5/16 in. [7.9 mm] from the basic minimum elongation of the percentage points of Table 3 | 1.50 [Note (3)] |
| Reduction of area, min., % [Note (4)]  | 30              |
| Hardness, HB, max.   | 187             |

**NOTES:**

- (1) For small forgings, see point D.2.ii.
- (2) Determined by either the 0.2% offset method or the 0.5% extension-under-load method.
- (3) See Table 3 for computed minimum values.
- (4) For round specimens only.

**Table 3**

| Wall Thickness |     | Elongation in 2 in. or in. mm 50<br>mm, min., % |
|----------------|-----|---|
| in.            | mm  |   |
| 5/16 (0.312)   | 7.9 | 30  |
| 9/32 (0.281)   | 7.1 | 28.5  |
| 1/4 (0.250)    | 6.4 | 27  |
| 7/32 (0.219)   | 5.6 | 25.5  |
| 3/16 (0.188)   | 4.8 | 24  |
| 5/32 (0.156)   | 4   | 22.5  |
| 1/8 (0.125)    | 3.2 | 21  |
| 3/32 (0.094)   | 2.4 | 19.5  |
| 1/16 (0.062)   | 1.6 | 18  |

**GENERAL NOTE:** The above table gives the computed minimum elongation values for each 1/32 in. [0.8 mm] decrease in wall thickness. Where the wall thickness lies between two values shown above, the minimum elongation value is determined by the following equation:

$$E = 48T + 15.00$$

where:  $E$  = elongation in 2 in. or 50 mm, %, and  
 $T$  = actual thickness of specimen, in. [mm]

3. *Hardness Tests* —
  - i. Testing shall be in accordance with Test Methods and Definitions A 370.

- ii. The purchaser may check the hardness of any or all forgings supplied at any location on the forging and the hardness shall be 137 to 187 HB.

**E. Hydrostatic Test :-**

1. Forgings manufactured under this specification shall be capable of passing a hydrostatic test compatible with the rating of the finished item.

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