3.5.1.1 Tensile Properties

Product 3.25 inches (82.6 mm) and under in nominal diameter or thickness shall have the properties shown in Table 2, determined in accordance with ASTM E8/E8M.

Table 2 - Minimum tensile properties

Property	Value
Tensile Strength	160 ksi (1103 MPa)
Yield Strength at 0.2% Offset	110 ksi (758 MPa)
Elongation in 4D	15%
Reduction of Area	18%

3.5.1.1.1 Unless otherwise specified, the strain rate shall be set at 0.005 in/in/min (0.005 mm/mm/min) and maintained within a tolerance of ±0.002 in/in/min (0.002 mm/mm/min) through 0.2% offset yield strain. After the yield strain, the speed of the testing machine shall be set between 0.05 and 0.5 in/in (0.05 and 0.5 mm/mm) of the length of the reduced parallel section (or distance between the grips for specimens not having a reduced section) per minute. Alternatively, an extensometer and strain rate indicator may be used to set the strain rate between 0.05 and 0.5 in/in/min (0.05 and 0.5 mm/mm/min). The requirement for compliance becomes effective for material produced 1 year after the publication date of this document.

3.5.1.1.2 Tensile property requirements of 3.5.1.1 apply to both the longitudinal and transverse directions except that transverse tests are not required on product from which a test specimen not less than 2.50 inches (63.5 mm) in length can be obtained. Specific orientation and location of specimens from forgings and flash welded rings shall be as agreed upon by purchaser and supplier. Longitudinal tensile properties need not be determined on product tested in the transverse direction.

3.5.1.1.3 Mechanical property requirements for product outside of the range covered by 1.1 shall be agreed upon between purchaser and producer and reported in 4.4.4.

3.5.1.2 Hardness

Shall be 321 to 437 HBW, or equivalent (see 8.2), determined in accordance with ASTM E10.

3.5.1.3 Stress-Rupture Properties

Shall be as follows; testing of notched specimens and of combination smooth-and-notched specimens shall be performed in accordance with ASTM E292 and of smooth specimens in accordance with ASTM E139:

3.5.1.3.1 At 1350 °F (732 °C)

A standard cylindrical combination smooth-and-notched specimen conforming to ASTM E292, maintained at 1350 °F ± 3 °F (732 °C ± 2 °C) while a load sufficient to produce an initial axial stress of 75.0 ksi (517 MPa) or higher is applied continuously, shall not rupture in less than 23 hours. The test shall be continued to rupture without change of load. Rupture shall occur in the smooth section. Elongation of the smooth section after rupture, measured at room temperature, shall be not less than 8% in 4D.

3.5.1.3.1.1 As an alternate procedure, separate smooth and notched specimens, machined from adjacent sections of the same piece, with gage sections conforming to the respective dimensions shown in ASTM E292, may be tested individually under the conditions of 3.5.1.3.1. The smooth specimen shall not rupture in less than 23 hours and elongation after rupture, measured at room temperature, shall be not less than 8% in 4D. The notched specimen shall not rupture in less time than the companion smooth specimen but need not be tested to rupture.

3.5.1.3.1.2 The tests of 3.5.1.3.1 and 3.5.1.3.1.1 may be conducted using incremental loading. In such case, the load required to produce an initial axial stress of 75.0 ksi (517 MPa) or higher shall be used to rupture or for 23 hours whichever occurs first. After the 23 hours and at intervals of 8 hours minimum, thereafter, the stress shall be increased in increments of 5.0 ksi (34.5 MPa). Time to rupture, rupture location, and elongation requirements shall be as specified in 3.5.1.3.1.

3.5.1.3.2 At 1500 °F (816 °C)

A tensile specimen, maintained at 1500 °F ± 3 °F (816 °C ± 2 °C) while a load sufficient to produce an initial axial stress of 40.0 ksi (276 MPa) or higher is applied continuously, shall not rupture in less than 23 hours. The test shall be continued to rupture without change of load. Elongation after rupture, measured at room temperature, shall be not less than 5% in 4D.

3.5.1.3.2.1 The test of 3.5.1.3.2 may be conducted using incremental loading. In such case, the load required to produce an initial axial stress of 40.0 ksi (276 MPa) or higher shall be used to rupture or for 23 hours, whichever occurs first. After the 23 hours and at intervals of 8 hours minimum, thereafter, the stress shall be increased in increments of 5.0 ksi (34.5 MPa). Time to rupture and elongation requirements shall be as specified in 3.5.1.3.2.

3.5.1.4 Average Grain Size

Shall be ASTM No. 3 or finer, determined in accordance with ASTM E112.