



Designation: A 291 – 02

An American National Standard

Standard Specification for Steel Forgings, Carbon and Alloy, for Pinions, Gears and Shafts for Reduction Gears¹

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1. Scope *

1.1 This specification covers normalized and tempered carbon steel and quenched and tempered alloy steel forgings for pinions, gears, and shafts.

1.2 Several classes of steel are covered as follows:

1.2.1 *Class 1* is normalized and tempered carbon steel.

1.2.2 *Classes 2 to 9, incl*, are liquid quenched and tempered alloy steel.

1.3 All classes are considered weldable under proper conditions. Welding technique is of fundamental importance and it is presupposed that welding procedure and inspection shall be in accordance with approved methods for the class of material used.

1.4 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

2. Referenced Documents

2.1 ASTM Standards:

A 275/A 275M Test Method for Magnetic Particle Examination of Steel Forgings²

A 370 Test Methods and Definitions for Mechanical Testing of Steel Products³

A 388/A 388M Practice for Ultrasonic Examination of Heavy Steel Forgings²

A 788 Specification for Steel Forgings, General Requirements²

3. Ordering Information

3.1 Instructions for purchasing forgings to this specification should be in accordance with Specification A 788. In addition, a detailed drawing, sketch, or written description of the forging should be included with the inquiry or order.

3.2 Supplementary requirements are provided and shall apply only when specified in the purchase order.

4. Heat Treatment

4.1 Preliminary Heat Treatment:

4.1.1 The forgings shall be given such preliminary heat treatment as is proper for the design and composition. The forgings shall be heated to a suitable temperature for a sufficient length of time for austenitization and shall be suitably cooled to bring about complete transformation.

4.1.2 Forgings may be immediately treated for mechanical properties after preliminary heat treatment or may be rough turned prior to treatment for mechanical properties.

4.2 *Heat Treatment for Mechanical Properties*—The forging shall be reheated to a temperature above the upper critical temperature and held a sufficient length of time for complete austenitization. Class 1 shall be air cooled while Classes 2 through 8 shall be liquid quenched.

4.3 *Tempering*—The forgings shall be tempered to develop the specified properties. Minimum tempering temperatures shall be as follows:

Class	Minimum Tempering Temperature	
	°F	(°C)
1 and 2	1150	(620)
3, 3A, and 4	1075	(580)
5, 6, 7	1050	(565)
8	1100	(595)
9	1000	(540)

The charge shall be cooled under uniform conditions in the furnace at a maximum rate of 100°F (55°C) per h to 600°F (316°C).

4.4 *Stress Relief*—If the manufacturer elects to heat treat for mechanical properties prior to machining, the forgings shall be stress relieved after machining (4.5) at a temperature that is 50 to 100°F (28 to 55°C) below the last previous tempering temperature but in no case below 1000°F (540°C). The forgings shall be cooled under uniform conditions in the furnace at a maximum rate of 100°F (55°C)/h to 600°F (316°C).

4.5 Machining:

4.5.1 Rough machining before heat treatment for mechanical properties may be performed at the option of the manufacturer.

4.5.2 If the producer elects to heat treat for mechanical properties prior to machining, the forgings shall be stress

¹ This specification is under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel and Related Alloys, and is the direct responsibility of Subcommittee A01.06 on Steel Forgings and Billets.

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² *Annual Book of ASTM Standards*, Vol 01.05.

³ *Annual Book of ASTM Standards*, Vol 01.03.