



Designation: ~~A290/A290M – 05 (Reapproved 2010)~~ A290/A290M – 05 (Reapproved 2015)

## Standard Specification for Carbon and Alloy Steel Forgings for Rings for Reduction Gears<sup>1</sup>

This standard is issued under the fixed designation A290/A290M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 1. Scope

1.1 This specification covers normalized and tempered, and quenched and tempered, carbon and alloy steel forged or rolled rings for reduction gears.

1.2 Several grades and classes of steel are covered as follows:

1.2.1 Grade 1, Classes A and B, and Grade 2, Classes C and D, are carbon steel.

1.2.2 Grade 3, Classes E and F, Grade 4, Classes G, H, I, J, K and L, Grade 5, Classes M and P, and Grade 6, Class T, are alloy steel.

1.2.3 All grades and classes are considered weldable under proper conditions. Welding techniques are of fundamental importance and it is pre-supposed that welding procedure and inspection will be in accordance with proper methods for the class of material used.

1.3 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

### 2. Referenced Documents

2.1 *ASTM Standards:*<sup>2</sup>

[A275/A275M Practice for Magnetic Particle Examination of Steel Forgings](#)

[A370 Test Methods and Definitions for Mechanical Testing of Steel Products](#)

[A388/A388M Practice for Ultrasonic Examination of Steel Forgings](#)

[A788/A788M Specification for Steel Forgings, General Requirements](#)

### 3. Terminology

3.1 Definitions of the terms used may be found in Specification [A788/A788M](#).

### 4. Ordering Information and General Requirements

4.1 In addition to the ordering information required by Specification [A788/A788M](#), the purchaser shall specify in the inquiry, contract, and order the grade and class desired and the supplementary requirements, if any, which should apply.

4.2 Material supplied to this specification shall conform to the requirements of Specification [A788/A788M](#), which outlines additional ordering information, manufacturing requirements, testing and retesting methods and procedures, marking, certification, product analysis variations, and additional supplementary requirements.

### 5. Materials and Manufacture

5.1 *Melting Process:*

<sup>1</sup> 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.

Current edition approved April 1, 2010 June 1, 2015. Published May 2010 June 2015. Originally approved in 1946. Last previous edition approved in 2005 2010 as ~~A290/A290M – 05~~ A290/A290M – 05(2010). DOI: 10.1520/A0290\_A0290M-05R10.10.1520/A0290\_A0290M-05R15.

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

\*A Summary of Changes section appears at the end of this standard

5.1.1 The steel shall be produced by any of the melting requirements in Specification **A788/A788M**, which may be supplemented by Supplementary Requirement S6, Vacuum Degassing.

5.2 *Discard*—Sufficient discard shall be taken from each ingot to secure freedom from piping and undue segregation.

5.3 *Forging Process*—The forgings shall receive their hot mechanical work in accordance with the requirements of Specification **A788/A788M**.

5.4 *Heat Treatment*:

5.4.1 *Cooling Prior to Heat Treatment*—After forging and before reheating for heat treatment, the forgings shall be allowed to cool in a manner to prevent injury, to accomplish transformation, and prevent flakes.

5.4.2 Heat treatment shall consist of normalizing and tempering for Grade 1 classes A and B and quenching and tempering for all other grades and classes.

5.4.2.1 *Normalizing*—A furnace charge thus treated is termed a normalizing charge.

5.4.2.2 *Quenching*—The forgings shall be completely austenitized and then quenched in a suitable medium. A group thus treated is termed a quenching charge.

5.4.2.3 *Tempering*—A furnace charge thus treated is termed a tempering charge. Minimum tempering temperatures shall be as follows:

Grade and Class	Minimum Tempering Temperature	
	°F	[°C]
Grade 1 Classes A and B	1200	[650]
Grade 2 Classes C & D, E, F, G, H, M, P	1100	[595]
Grade 3 Classes E & F	1100	[595]
Grade 4 Classes G & H	1100	[595]
Grade 5 Classes M & P	1100	[595]
Grade 4 Classes I, J, K & L	1050	[565]
Grade 6 Class T	1000	[540]

5.5 *Machining*:

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

5.5.2 The forgings shall conform to the sizes and shapes specified by the purchaser.

## 6. Chemical Composition

6.1 *Composition*—The steel shall conform to the requirements for chemical composition prescribed in **Table 1**. Alternative compositions may be agreed upon in accordance with Supplementary Requirement S1.1.

6.1.1 *Heat Analysis*—The heat analysis obtained from sampling in accordance with Specification **A788/A788M** shall comply with **Table 1**.

6.1.2 *Product Analysis*—An analysis may be made by the purchaser from a forging representing each heat. Samples for analysis may be taken from the forging or from a full-size prolongation at any point midway between the inner and outer surfaces of the ring or samples may be taken from the test specimen. The chemical composition thus determined shall not vary from the requirements prescribed in **Table 1** by more than the amounts prescribed in Specification **A788/A788M**.

## 7. Mechanical Properties

7.1 *Tension and Impact Test Requirements*—The requirements for tensile and impact properties shall be as prescribed in **Table 2**.

**TABLE 1 Chemical Requirements**

Element	Composition, %					
	Grade 1 Classes A and B	Grade 2 Classes C and D	Grade 3 Classes E and F	Grade 4 Classes G, H, I, J, K, and L	Grade 5 Classes M and P	Grade 6 Class T
Carbon	0.35–0.50	0.40–0.50	0.35–0.45	0.35–0.45	0.38–0.45	0.25–0.39
Manganese	0.60–0.90	0.60–0.90	0.70–1.00	0.60–0.90	0.40–0.70	0.20–0.60
Phosphorus, max	0.040	0.040	0.040	0.040	0.040	0.015
Sulfur, max	0.040	0.040	0.040	0.040	0.040	0.015
Silicon <sup>A</sup> , max	0.35	0.35	0.35	0.35	0.40	0.35
Nickel	0.30 max	0.30 max	0.50 max	1.65–2.00	0.30 max	3.25–4.00
Chromium	0.25 max	0.25 max	0.80–1.15	0.60–0.90	1.40–1.80	1.25–1.75
Molybdenum	0.10 max	0.10 max	0.15–0.25	0.20–0.50	0.30–0.45	0.30–0.70
Vanadium, max	0.06	0.06	0.06	0.10	0.03	0.05–0.15
Copper, max	0.35	0.35	0.35	0.35	0.35	0.35
Aluminum	...	...	...	...	0.85–1.30	...

<sup>A</sup> When vacuum carbon deoxidation is used, silicon maximum shall be 0.10 %.