



Standard Specification for Vacuum-Treated Alloy Steel Forgings for Turbine Rotor Disks and Wheels¹

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1. Scope*

1.1 This specification covers vacuum-treated alloy steel forgings intended for use as turbine rotor disks and wheels.

1.2 The values stated in inch-pound units are to be regarded as the standard.

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

E 30 Test Methods for Chemical Analysis of Steel, Cast Iron, Open-Hearth Iron, and Wrought Iron⁴

E 139 Practice for Conducting Creep, Creep-Rupture, and Stress-Rupture Tests of Metallic Materials⁵

3. Ordering Information

3.1 The purchaser shall specify in the inquiry and order the class of steel desired and test and purchase options (see 4.5.5, 5.2.2, 6.1, 6.3, 7, and 15.1).

3.2 *Forging Drawing*—Each forging shall be manufactured in accordance with a purchaser-supplied drawing showing the finished dimensions and the locations of mechanical test specimens.

3.3 Supplementary requirements are provided and shall apply only when specified in the purchaser's order.

4. Materials and Manufacture

4.1 *Melting Process*—The steel shall be made by one or more of the following processes: electric-arc, electric-induction, or consumable-electrode.

4.2 Vacuum Degassing:

4.2.1 The molten steel shall be vacuum treated prior to or during the pouring of the ingot, in order to remove objectionable gases, particularly hydrogen.

4.2.1.1 When the vacuum stream degassing process⁶ is used, the vacuum system must be of sufficient capacity to effect a blank-off pressure low enough (usually less than 1000 μm) to break up the normal tight, rope-like stream of molten metal into a wide-angled conical stream of relatively small droplets. The capacity of the system must also be sufficiently high to reduce the initial surge pressure at the start of the pour to a low level within 2 min.

4.2.1.2 When the vacuum-lift process⁶ is utilized, the molten metal shall be repeatedly drawn into the evacuated vessel to give a recirculation factor (Note 1) of at least 2.5 to ensure thorough degassing and mixing of the entire heat. The evacuation system shall be capable of reducing the pressure surges, which occur each time a new portion of steel is admitted to the vessel, to increasingly lower levels until a blank-off pressure (usually less than 1000 μm) is achieved.

NOTE 1—The recirculation factor is obtained as follows:

$$\frac{\text{tons of steel lifted per cycle} \times \text{number of cycles}}{\text{heat weight in tons}}$$

4.2.1.3 When the ladle degassing process is used, the evacuation system shall be capable of reducing the system vacuum pressure to a low level (usually less than 1000 μm). The molten metal shall be adequately stirred for a sufficient length of time to maximize exposure to the evacuated atmosphere. When this process is used, hydrogen testing per Supplemental Requirement S2 is mandatory.

4.2.1.4 Other methods of degassing may be used if the supplier can demonstrate their adequacy to the satisfaction of the purchaser. When other processes are used, hydrogen testing per the supplemental requirement S2 is mandatory.

4.3 *Discard*—Sufficient discard shall be taken from each ingot to secure freedom from pipe and undue segregation in the finished forging.

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.

⁴ *Annual Book of ASTM Standards*, Vol 03.05.

⁵ *Annual Book of ASTM Standards*, Vol 03.01.

⁶ Details of the vacuum stream degassing process may be found in the *Journal of the Iron and Steel Institute*, Vol 191, January 1959; "Vacuum Pouring of Ingots for Heavy Forgings" by J. H. Stoll.

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