



Designation: A966/A966M – 15 (Reapproved 2025)

Standard Practice for Magnetic Particle Examination of Steel Forgings Using Alternating Current¹

This standard is issued under the fixed designation A966/A966M; 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 (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice covers a procedure for the magnetic particle examination of steel forgings using alternating current as the power source. The procedure will produce consistent results upon which acceptance standards can be based. This practice does not contain acceptance limits or recommended quality levels.

1.2 Only alternating 50–60 cycle current shall be used as the electric power source for any of the magnetizing methods.

1.3 When subsurface indications are sought in forgings, then dc magnetization in accordance with Practice [A275/A275M](#) should be used.

1.4 The values stated in either inch-pound units or SI units are to be regarded separately as standard. Within the text, the SI units are shown in brackets. The values stated in each system are not necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other, and values from the two systems shall not be combined. Unless the order specifies the applicable “M” specification designation [SI units], the inch-pound units shall be used.

1.5 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

¹ This practice 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 March 1, 2025. Published March 2025. Originally approved in 1996. Last previous edition approved in 2020 as A966/A966M – 15 (2020). DOI: 10.1520/A0966_A0966M-15R25.

2. Referenced Documents

2.1 *ASTM Standards:*²

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

[A508/A508M](#) Specification for Quenched and Tempered Vacuum-Treated Carbon and Alloy Steel Forgings for Pressure Vessels

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

[A963/A963M](#) Specification for Deep Drawing Steel (DDS), Sheet, Carbon, Cold-Rolled (Withdrawn 2000)³

2.2 *Other Document:*⁴

Practice No. SNT-TC-1A, Supplement B—Magnetic Particle Method

3. Terminology

3.1 *Definitions:*

3.1.1 *(ac) magnetic particle method of examination, n*—a method for detecting discontinuities on the surface in suitably magnetized materials, which employs finely divided magnetic particles that tend to congregate in regions of leakage fields.

3.1.2 *indication, n*—the visual magnetic particle buildup resulting from leakage fields in the magnetic field.

3.1.3 *linear indication, n*—an indication in which the length is at least three times the width; the minimum length of indications to be considered linear shall be $\frac{1}{16}$ in. [1.5 mm].

3.1.4 *magnetic flux, n*—the product of the magnetic induction and the area of a surface (or cross section) when the magnetic induction is uniformly distributed and normal to the plane of the surface.

3.1.4.1 *Discussion*—The concept that the magnetic field is flowing along the lines of force suggests that these lines are therefore “flux” lines, and they are called magnetic flux.

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

³ The last approved version of this historical standard is referenced on www.astm.org.

⁴ Available from American Society for Nondestructive Testing (ASNT), P.O. Box 28518, 1711 Arlingate Ln., Columbus, OH 43228-0518, <http://www.asnt.org>.

3.1.5 *nonrelevant indications, n*—indications produced by leakage fields where the conditions causing them are present by accident or part design, or other features of the part having no relation to the damaging flaws being sought.

3.1.5.1 *Discussion*—This term signifies that such an indication has no relation to the discontinuities that might constitute defects.

4. Basis of Application

4.1 When in accordance with the requirements of the inquiry, contract, order, or specifications, forgings are to be examined by the magnetic particle method using alternating current; the manufacturer and the supplier shall be in agreement concerning the following:

4.1.1 The locations on the forging that are to be subjected to magnetic particle examination.

4.1.2 The type, size, number, location, and orientation of indications that are to be considered injurious.

4.1.3 The method of application and type of magnetic particles, demagnetization requirements, and magnetic field strengths.

4.1.4 Acceptance standards.

5. Significance and Use

5.1 For ferromagnetic materials, magnetic particle examination is widely specified for the detection of surface and near-surface flaws such as cracks, laps, seams, and linearly oriented nonmetallic inclusions. Such examinations are included as mandatory requirements in some forging standards such as Specifications **A508/A508M** and **A963/A963M**.

5.2 Use of alternating current as the power source for magnetic particle examination imposes a significant restriction on the detection of subsurface indications, so that the procedure is essentially limited to the finding of flaws that are open to the surface. Attention therefore is drawn to the need to have the component in the finish-machined condition before conducting the magnetic particle examination.

5.3 The presence of residual magnetic fields in a component may be undesirable, and an advantage of the use of an ac power source for magnetic particle examination is that an acceptable level of demagnetization can be readily achieved.

6. Personnel Requirements

6.1 Personnel performing the magnetic particle examination in this practice shall be qualified and certified in accordance with a written procedure conforming to Practice No. SNT-TC-1A or another national standard that is acceptable to both the purchaser and supplier.

7. Stage of Examination

7.1 Unless otherwise specified by the purchaser, acceptance examination shall be performed on a forging in the final machined surface condition.

8. Magnetizing Apparatus

8.1 A 50 or 60 cycle alternating current shall be used. When current is passed through the forging itself, the equipment shall

consist of contacting or clamping elements with sufficient surface area and clamping pressure to allow the required current to flow without damaging (burning) the part being examined.

8.2 Portable electromagnetic alternating current yokes may be used as a magnetizing apparatus.

9. Magnetic Particles

9.1 The inspection medium shall consist of finely divided ferromagnetic particles (which may be coated with a fluorescent material) suspended in a suitable liquid medium or used in dry powder form.

10. Surface Preparation

10.1 The sensitivity of the magnetic particle examination will depend to a considerable extent upon the condition of the surface being examined. While defects may be satisfactorily revealed on shot-blasted or otherwise cleaned forged surfaces, without any further surface treatment, all heat treatment or forging scale must be removed. However, to reveal fine defects of $\frac{1}{8}$ in. [3 mm] or less in length, the surfaces to be examined shall be smooth machined to at least a 250 μ in. [6.35 μ m] finish where the definition for surface finish is in accordance with Specification **A788/A788M**.

10.2 The surfaces shall be free from grease, oils, or other substances to which the particles may adhere.

11. Methods of Magnetization

11.1 The forging may be magnetized either by passing current through the piece or by inducing a magnetic field by means of a central conductor, by coils, or by yoke.

11.1.1 *Continuous Method*—In the continuous method the inspection medium is applied to the surface under examination while the current is still flowing. The alternating current source generates high amperage current in pulses of up to 1 s duration. The duration of this flow shall allow at least three pulses of current, or in the case where machines supply continuous current flow, a minimum shot of $\frac{1}{5}$ s to $\frac{1}{2}$ s duration should be applied.

11.1.2 The surge and residual methods are not applicable to this practice.

11.2 At least two separate examinations shall be carried out on each area. The second examination shall be with the lines of magnetic flux approximately perpendicular to those used for the first examination in that area. A different means of magnetization may be used for the second examination. Magnetizing in more than one direction cannot normally be accomplished simultaneously. An exception to the above rule is overall sequential multivector magnetization whereby several magnetizing circuits are provided for sequentially magnetizing a part in multiple directions depending on the locations of the current connectors. By this technique, indications of any orientation can be detected with a single application of magnetic particles.

11.3 The two general types of magnetization with regard to direction are longitudinal and circular as follows: