AEROSPACE MATERIAL SPECIFICATION

AMS2442™	REV. A

Issued 1993-01
Revised 20007-04
Reaffirmed 2022-10

Superseding AMS2442

Magnetic Particle Acceptance Criteria for Parts

RATIONALE

AMS2442A has been reaffirmed to comply with the SAE Five-Year Review policy.

1. SCOPE

1.1 Purpose

This specification establishes acceptance criteria for discontinuities revealed by magnetic particle inspection of parts made from wrought, ferromagnetic materials.

1.2 Application

These criteria are intended typically for, but not limited to, aerospace parts that require magnetic particle inspection following the completion of fabrication operations.

1.3 Classification

Five grades are listed in Table 1 to allow selection of the appropriate grade for each specific application. The engineering drawing or purchase order will normally specify the appropriate grade for each part, or in the case of a zoned drawing, the appropriate grade for each zone. When a specific acceptance grade is not specified, Grade 2 shall apply. (See 8.2).

2. APPLICABLE DOCUMENTS

The issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been cancelled and no superseding document has been specified, the last published issue of that document shall apply.

2.1 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM E 1417	Liquid Penetrant Testing
ASTM E 1444	Magnetic Particle Testing

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: **http://www.sae.org**

For more information on this standard, visit
https://www.sae.org/standards/content/AMS2442A/

2.2 AIA Publications

Available from Aerospace Industries Association, 1000 Wilson Boulevard, Suite 1700, Arlington, VA 22209-3928, Tel: 703.358.1000, www.aia-aerospace.

NAS 410 NAS Certification and Qualification of Nondestructive Test Personnel

3. TECHNICAL REQUIREMENTS

3.1 Procedure

Magnetic particle inspection shall be conducted in accordance with ASTM E 1444, unless another procedure is specified by the drawing or purchase order.

3.2 Inspection Personnel

Personnel performing magnetic particle inspection shall be qualified and certified in accordance with NAS 410, unless another procedure is specified by the drawing or purchase order.

3.3 Acceptance Criteria

3.3.1 Arcing

Parts shall not contain evidence of arcing or overheating (temper color) caused by magnetic particle testing.

3.3.2 Discontinuities Open at the Surface

Parts shall not contain relevant indications of discontinuities that are open at the surface (such as cracks, laps, seams, tears, flakes, bursts, pipe, and laminations).

3.3.2.1 Magnetic particle indications of superficial surface blemishes (such as scratches, tool marks, dings, and nicks) shall require further evaluation for conformance with applicable visual quality standards.

3.3.3 Discontinuities Not Open at the Surface

Parts shall not contain indications exceeding the acceptance limits of Table 1 for the specified grade. When a specific acceptance grade is not specified, Grade 2 shall apply (See 8.2). Note that there are separate categories of Table 1 that exist for discontinuities that are located at the surface but closed (such as inclusions located at the surface) and for discontinuities that are subsurface (such as inclusions located entirely below the surface).

3.3.4 Alloy Segregation

3.3.4.1 Unless specified otherwise, Grade A and Grade 1 parts with indications of alloy segregation (3.4.5) shall be submitted for review by the cognizant engineering organization.

3.3.4.2 For all other grades of parts, indications of alloy segregation shall be considered nonrelevant, unless otherwise specified by the cognizant engineering organization.

3.4 Evaluation of Indications

The inspector(s) shall determine whether indications are caused by discontinuities (relevant indications) or testing process variables, part geometry, excessive field strength effects, surface finish, or differential magnetic effects, such as weld beads (false indications and nonrelevant indications). When a group of parts contains similar indications that cannot be clearly classified by the Level 2 magnetic particle inspector(s), a sample of the typical indications shall be further evaluated as directed by the Level 3 magnetic particle inspector to define the characteristics of the discontinuity. When specified or when directed by the Level 3 magnetic particle inspector, parts containing these indications shall also be forwarded for review by the cognizant engineering organization.

3.4.1 Visual Examination

The surface of the part containing indications may be examined visually or with magnification to determine if the indication is caused by a discontinuity that is open at the surface. The degree of magnification shall be determined by the Level 3 magnetic particle inspector. The indication shall be marked at either end, removed using a solvent dampened swab, and then examined at the appropriate level of magnification to determine if the discontinuity is open to the surface.

3.4.2 Penetrant Examination

To determine if the indication is caused by a discontinuity that is open at the surface, the part may be further examined using fluorescent penetrant inspection in accordance with ASTM E 1417, or other procedure acceptable to the cognizant engineering organization. The region to be examined shall be cleaned and properly prepared for penetrant inspection. The penetrant inspection may be performed in the region of the magnetic particle indications or may be performed on the entire part. Absence of a penetrant indication by itself, without additional corroboration, shall not be cause for acceptance where open to surface discontinuities are suspected.

3.4.3 Additional Exploration

Further examination to identify the type and nature of the discontinuity may be performed by exploration techniques, such as light grinding or sanding with 180 grit or finer abrasive, followed by magnetic particle inspection, re-examination using the previously described techniques (3.4.1 and 3.4.2), or by metallographic examination. Metallographic examination may be performed after polishing and etching the surface area in question or, when permitted by purchaser, after sectioning, polishing, and etching. Destruction of parts shall not be performed without permission from purchaser. The requirements of 3.5 shall apply when exploration method includes metal removal.

3.4.4 Residual Magnetic Field Examination

An indication formed by the continuous method may be wiped off and the bath or powder re-applied to determine if the indication will reappear under residual magnetization.

3.4.4.1 Indications of surface discontinuities typically reappear under residual magnetization and the discontinuity may be visually observed with the appropriate level of magnification.

3.4.4.2 Indications that do not reappear under residual magnetization shall be carefully evaluated to verify that they are neither nonrelevant indications nor false indications. If such an indication is confirmed to be a relevant indication, it may be caused by a subsurface discontinuity.

3.4.5 Alloy Segregation

Indications of alloy segregation typically appear as straight lines that are parallel to the grain direction. They represent a different distribution of one or more of the constituent elements of the material and may exist throughout the entire part thickness. When lower amperages are used, the indications often do not reappear under residual magnetization. In addition, the frequency and severity of the indications usually increase as the magnetizing current is increased. The indications may appear fuzzy or broad and may tend to appear discontinuous at 10X magnification.

3.5 Removal of Discontinuities

Discontinuities exceeding the specified standards may be removed provided the metal loss does not result in violation of the applicable dimensional requirements, tolerances, or surface finish. The material removal shall be performed by a process acceptable to the cognizant engineering organization and shall be reported (4.3) detailing the nature and location of the rework. These parts shall be re-inspected after rework to verify compliance with the requirements.

3.6 Identification

Parts meeting the acceptance standards shall be identified in accordance with ASTM E 1444 or as specified by the engineering drawing or purchase order.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The contractor shall be responsible for the performance of all required inspections. Purchaser reserves the right to sample and to perform any confirmatory inspection deemed necessary to ensure that the parts conform to specified requirements.

4.2 Sampling and Testing

Inspection shall be performed on 100% of the parts, unless specified otherwise by the cognizant engineering organization or purchase order.

4.2.1 Nonconforming parts shall be submitted for review by the cognizant engineering organization and disposition in accordance with applicable procedures for nonconformance.

4.3 Reports

The inspection facility shall furnish with each shipment of parts a statement that the parts were inspected in accordance with requirements of this specification. This report shall include AMS 2442A, acceptance grade, magnetizing techniques (types of shots and current), number of parts inspected, number of parts accepted, number of parts reworked by removal of discontinuities, and number of parts submitted for review by the cognizant engineering organization.

5. PREPARATION FOR DELIVERY

Not applicable.

6. ACKNOWLEDGMENT

A vendor shall mention this specification number in all quotations and when acknowledging purchase orders.

7. REJECTIONS

Parts not conforming to this specification, or to modifications authorized by purchaser, will be subject to rejection.

8. NOTES

8.1 A change bar (|) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of a specification. An (R) symbol to the left of the document title indicates a complete revision of the specification, including technical revision. Change bars and (R) are not used in original publications, nor in specifications that contain editorial changes only.

8.2 The acceptance criteria specified in Table 1 are applicable to fabricated parts for discontinuities caused by nonmetallic inclusions. However, these criteria are not directly related to the cleanliness requirements applied to raw material by AMS 2300, AMS 2301, AMS 2303, or AMS 2304. The magnetic particle acceptance grade should be selected based on the performance requirements for the fabricated part. The cleanliness requirement for the raw material (i.e., AMS 2300, AMS 2301, AMS 2303, AMS 2304, etc.) should be selected with the desired magnetic particle acceptance grade in mind, based on cost considerations and experience with the specific material. As a general guide, AMS 2300 (vacuum melted) raw material requirements are similar to Grade 1 criteria, and AMS 2301 (air melted) raw material requirements are similar to Grade 3 criteria.

8.3 The category of Grade A has been included in Table 1 to cover the most demanding applications and should only be specified for certain critical zones of a part, not for an entire part. Although Grade A acceptance criteria stipulates rejection of each "observed relevant linear indication", the cognizant engineering organization should also consider the "probability of detection" for various discontinuities on the actual part configuration using the specific inspection method(s). Designers selecting Grade A should also be aware (8.2) that the most demanding material cleanliness specification is not designed to guarantee Grade A.

8.4 A "probability of detection" demonstration may be appropriate to characterize the sensitivity of the magnetic particle inspection technique with respect to the specific part application.

8.5 Terms used in AMS are clarified in ARP1917 and as follows:

8.5.1 Discontinuity

Any interruption in the normal physical structure or configuration of a part, such as cracks, laps, seams, inclusions, or porosity. Discontinuities may be on the surface or subsurface. A discontinuity may or may not affect the usefulness of a part and is not cause for rejection unless it is of a type or size that exceeds the acceptance criteria.

8.5.2 Indication

An accumulation of magnetic particles that forms on the surface of a part during the magnetic particle inspection process.

8.5.3 False Indication

An indication caused by an accumulation of magnetic particles being held on a part surface due to gravity, surface roughness, or improper processing.

8.5.4 Nonrelevant Indication

An indication caused by flux leakage that is not associated with a potentially unacceptable discontinuity in a part.

8.5.5 Relevant Indication

An indication of a discontinuity that could be cause for rejection based on type, size, location, or distribution.

8.6 Dimensions and properties in inch/pound units and the Fahrenheit temperatures are primary; dimensions and properties in SI units and the Celsius temperatures are shown as the approximate equivalents of the primary units and are presented only for information.

PREPARED BY AMS COMMITTEE "E"