AEROSPACE MATERIAL SPECIFICATION

AMS2175™	REV. A

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Superseding AMS2175

Castings, Classification and Inspection of

RATIONALE

AMS2175A results from a Five Year Review and update of this specification.

1. SCOPE

1.1 Purpose

This specification establishes nondestructive testing methods, sampling frequency, and acceptance criteria for the inspection of metal castings.

1.2 Application

This specification has been used typically for structural castings, but usage is not limited to such applications.

1.2.1 Casting Methods

This specification is intended to apply to all casting methods except high pressure die castings. See 8.2.

1.2.2 Casting Alloys

This specification is intended to apply to all casting alloys covered in Tables 6 through 14. Other alloys may be inspected to this standard as described in 3.4.3.2 using criteria specified by the cognizant engineering organization.

1.3 Classification

Castings that are inspected in accordance with this specification are designated by classes and applicable grades. The "Casting Class" governs the frequency of inspection (See 3.1 and 4.3), while the "Casting Grade" controls the acceptance criteria. See 3.1 and 3.4.

1.3.1 Classes

Class 1 - A casting, the single failure of which would endanger the lives of operating personnel, or cause the loss of a missile, aircraft, or other vehicle.
Class 2 - A casting, the single failure of which would result in a significant operational penalty. In the case of missiles, aircraft, and other vehicles, this includes loss of major components, unintentional release or inability to release armament stores, or failure of weapon installation components.
Class 3 - Castings not included in Class 1 or Class 2 and having a margin of safety of 200 percent or less.
Class 4 - Castings not included in Class 1 or Class 2 and having a margin of safety greater than 200 percent.

1.3.2 Grades

Castings, or sections of a casting, shall be of the following grades:

Grade A - The highest quality grade of casting, or area of a casting, with minimum allowable discontinuities and very difficult to produce except in local areas.
Grade B - The second highest quality grade of casting, or area of a casting, which allows slightly more discontinuities than Grade A, and difficult to produce, except in local areas.
Grade C - A high quality grade of casting, or area of a casting, that can be consistently produced.
Grade D - The lowest quality grade of a casting, or area of a casting, that is easily produced and is used primarily for low stress or noncritical areas adjacent to the higher graded areas.

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 155	Reference Radiographs for Inspection of Aluminum and Magnesium Castings
ASTM E 186	Reference Radiographs for Heavy-Walled (2 to 4.5-in. (51 to 114-mm)) Steel Castings
ASTM E 192	Reference Radiographs of Investment Steel Castings for Aerospace Applications
ASTM E 272	Reference Radiographs of High-Strength Copper-Base and Nickel-Copper Alloy Castings
ASTM E 280	Reference Radiographs for Heavy-Walled (4.5 to 12-in. (114 to 305-mm)) Steel Castings
ASTM E 310	Reference Radiographs for Tin Bronze Castings
ASTM E 446	Reference Radiographs for Steel Castings up to 2 in. (51 mm) in Thickness
ASTM E 1255	Radioscopy
ASTM E 1320	Reference Radiographs for Titanium Castings
ASTM E 1417	Liquid Penetrant Testing
ASTM E 1444	Magnetic Particle Testing
ASTM E 1742	Radiographic Examination
ASTM E 2033	Computed Radiology (Photostimulable Luminescence Method)
ASTM E 2104	Radiographic Examination of Advanced Aero and Turbine Materials and Components
ASTM E 2422	Digital Reference Images for Inspection of Aluminum Castings

2.2 NAS Publications

Available from Aerospace Industries Association, 1000 Wilson Boulevard, Suite 1700, Arlington, VA 22209-3928, Tel: 703-358-1000, www.aia-aerospace.org.

NAS 410 Certification and Qualification of Nondestructive Test Personnel

3. TECHNICAL REQUIREMENTS

3.1 Classification of Castings

3.1.1 Determination of Classes and Grades

The cognizant engineering organization shall establish the class and grade(s) for each casting design in accordance with 1.3). If the grade of casting is not specified on the drawing or other contractual document, Grade C shall apply, except for Class 4 castings, where Grade D shall apply. Sections of a casting may be of varying grades depending on the applied stresses to that portion of the casting. Particular attention should be given to areas that contain, or will eventually contain, stress risers after machining (such as sharp internal corners, holes, or notches).

3.1.1.1 Class 1 Casting Requirements

All areas of Class 1 castings shall be of a quality equivalent to, or higher quality grade than, Grade C, except that all highly stressed areas of a Class 1 casting shall be of a quality equivalent to, or higher quality grade than, Grade B.

3.2 Inspection Sequence

It is the responsibility of the supplier to perform and comply with appropriate inspections as necessary and in the proper sequence during processing to assure freedom from harmful discontinuities in the final product. The intent of inspections during processing is to detect discontinuities that would be detrimental to the final product at the earliest stage in processing so as to minimize the cost of rejected or scrapped castings. The sequence for penetrant, magnetic particle, and radiographic inspections shall be as specified in ASTM E 1417, ASTM E 1444, and ASTM E 1742, respectively, or as otherwise specified by the cognizant engineering organization.

3.3 Personnel Qualification

Personnel performing penetrant, magnetic particle or radiographic inspections shall be qualified and certified in accordance with NAS 410 for the applicable method and technique.

3.4 Inspection Methods and Acceptance Criteria

3.4.1 Visual Inspection

Visual inspection shall be performed in areas with ambient lighting that is not less than 75 foot-candles.

3.4.1.1 Surface Characteristics

Castings shall be free of foreign materials, and shall not contain cracks, hot tears, cold shuts, and negative core seams (also called parting line below flush). In addition, castings shall conform to the criteria specified on the engineering drawing, specification, or agreed upon observational standards. See 8.3.

3.4.1.2 Surface Roughness

Surface roughness shall conform to the engineering drawing requirements. Surface roughness requirements specified on the engineering drawing (e.g., 63 Ra, 125 RMS, etc.) do not preclude the presence of acceptable liquid penetrant or magnetic particle indications. Visual and tactile comparison with commercially available observational standards may be used to determine conformance to surface roughness requirements.

3.4.1.3 Gate, Riser, and Parting Line Projections

If allowance limits for gate, riser, or parting line projections are not specified on the engineering drawing or casting (material) specification, then the maximum limit for gates, risers and parting lines shall be in accordance with Table 3.

3.4.1.4 Surface Pits and Raised Metal

Allowable surface pits and raised metal (also called positive metal), other than gates, risers and parting lines, that are not specifically controlled by the engineering drawing or agreed-upon observational standards shall be allowed as specified in 3.4.1.4.1 and 3.4.1.4.2.

3.4.1.4.1 For sand castings, surface pits are acceptable if they have smooth, rounded contours and do not cause the casting to fall outside the dimensional requirements of the engineering drawing. Raised metal that has a jagged or irregular surface, or which causes the casting to fall outside of the dimensional requirements of the engineering drawing, shall be removed or blended to conform to the dimensional and surface roughness requirements of the engineering drawing.

3.4.1.4.2 For investment and permanent mold castings, random raised metal shall be limited to a height of 0.015 to 0.030 inch (0.38 to 0.76 mm) in an area 0.125 x 0.125 inch (3.2 x 3.2 mm) and no more than 1 per square inch (650 mm^2). Random surface pits shall be limited to 0.030 to 0.060 inch (0.76 to 1.5 mm) in diameter and 0.030 inch (0.76 mm) in depth and no more than 1 per square inch (650 mm^2). Surface pits less than 0.030 inch (0.76 mm) deep or raised metal less than 0.015 inch (0.38 mm) in height may be present.

3.4.2 Magnetic Particle and Penetrant Inspection

3.4.2.1 Inspection Method for Ferromagnetic Materials

The method for inspection of ferromagnetic materials shall be in accordance with ASTM E 1444. When approved by cognizant engineering organization, penetrant inspection may be performed in lieu of magnetic particle inspection (e.g., casting size or complex shape prevent adequate magnetic particle inspection). All precipitation hardening stainless steels shall be penetrant inspected in accordance with 3.4.2.2, unless otherwise specified by the cognizant engineering organization.

3.4.2.2 Inspection Method for Nonferromagnetic Materials

The method for inspection of nonferromagentic materials shall be in accordance with ASTM E 1417. The cognizant engineering organization may specify the sensitivity level of the penetrant materials to be used. If no sensitivity level is specified, the inspection facility shall use Sensitivity Level 1 or higher level.

3.4.2.3 Magnetic Particle and Penetrant Acceptance Criteria

If the magnetic particle or penetrant acceptance criteria are not specified, the surface quality shall conform to Table 4.

3.4.3 Radiographic Inspection

3.4.3.1 Radiographic Inspection Method

The method for inspection shall be in accordance with ASTM E 1742, or when specified, in accordance with ASTM E 2104. The use of nonfilm radiographic techniques (i.e., radioscopy, digital radiography, etc.) is permitted provided the method used is sufficiently sensitive to resolve the required radiographic quality level. Non-film inspection shall be conducted in accordance with ASTM E 1255 or ASTM E 2033; however, prior approval shall be obtained from the cognizant engineering organization on the detailed inspection, evaluation, documentation, and quality control procedures.