



# Standard Reference Radiographs for Inspection of Aluminum and Magnesium Die Castings<sup>1</sup>

This standard is issued under the fixed designation E505; 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 reappraisal. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reappraisal.

## 1. Scope

1.1 These reference radiographs illustrate the categories and severity levels of discontinuities that may occur in aluminum-alloy and magnesium-alloy die castings. They are intended to provide:

1.1.1 A guide enabling recognition of discontinuities and their differentiation both as to type and severity level through radiographic examination.

1.1.2 Example radiographic illustrations of discontinuities and a nomenclature for reference in acceptance standards, specifications, and drawings.

NOTE 1—The set of reference radiographs consists of five 8½ by 11-in. cardboard frames containing radiographs covering discontinuities in aluminum and magnesium alloy die castings. The first four frames each contain two sets of four graded levels of increasing severity, while the last frame contains two ungraded radiographs. The 5 frames are contained in a 10½ by 11½-in. ring binder.

NOTE 2—Reference radiographs applicable to aluminum and magnesium castings up to 2 in. (50 mm) in thickness are contained in ASTM Reference Radiographs E155, for Inspection of Aluminum and Magnesium Castings, Volumes I and II.

1.2 Two kinds of illustration categories are covered as follows:

1.2.1 *Graded*—Three discontinuity categories for aluminum die castings and three discontinuity categories for magnesium die castings, each illustrated in four levels of progressively increasing severity. Category A discontinuities are illustrated for aluminum and magnesium die castings having thicknesses of ⅛ in. (3.2 mm) and ⅝ in. (15.9 mm); Category B discontinuities are illustrated for ⅛-in. thick aluminum and magnesium die castings; and Category C discontinuities are illustrated for ⅝-in. thick aluminum and magnesium die castings.

1.2.2 *Ungraded*—One illustration of one discontinuity for 0.20-in. (5.1-mm) thickness aluminum die casting; and one illustration of one discontinuity for ⅛-in. (3.2-mm) thickness magnesium die casting.

1.3 This document may be used for other materials, thicknesses, or with other energy levels for which it has been found to be applicable and agreement has been reached between the purchaser and manufacturer.

1.4 From time to time, there may be minor changes to the process for manufacturing of the reference radiograph adjunct materials. These changes could include changes in the films or processing chemicals used, changes in the dies or printing for the cardboard mats, etc.; however, in all cases, these changes are reviewed by the Illustration Monitoring Subcommittee and all reference radiographs are reviewed against a fixed prototype image to ensure that there are no changes to the acceptance level represented by the reference radiographs. Therefore, the adjunct reference radiographs remain valid for use with this standard regardless of the date of production or the revision level of the text standard.

1.5 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.6 *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>

E94 Guide for Radiographic Examination

E155 Reference Radiographs for Inspection of Aluminum and Magnesium Castings

E1316 Terminology for Nondestructive Examinations

2.2 *ASTM Adjuncts*:

Reference Radiographs for Inspection of Aluminum and Magnesium Die Castings<sup>3</sup>

<sup>1</sup> These reference radiographs are under the jurisdiction of ASTM Committee E07 on Nondestructive Testing and is the direct responsibility of Subcommittee E07.02 on Reference Radiological Images.

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

<sup>3</sup> Available from ASTM Headquarters. Order RRE0505.

**TABLE 1 Reference Radiographs for Aluminum and Magnesium Die Castings**

Discontinuity	Plate Thickness, in. (mm)	Applicable Casting Thickness, in. (mm)
<b>Aluminum Die Castings</b>		
Category A (Porosity)	1/8 (3.2)	up to 3/8 (9.5), incl over 3/8 to 1 (9.5 to 25.4), incl
Category A (Porosity)	5/8 (15.9)	
Category B (Cold fill)	1/8 (3.2)	up to 3/8 (9.5), incl over 3/8 to 1 (9.5 to 25.4), incl
Category C (Shrinkage)	5/8 (15.9)	
Category D (Foreign material)	0.200 (5.08)	up to 1 (25.4), incl
<b>Magnesium Die Castings</b>		
Category A (Porosity)	1/8 (3.2)	up to 3/8 (9.5), incl over 3/8 to 1 (9.5 to 25.4), incl
Category A (Porosity)	5/8 (15.9)	
Category B (Cold fill)	1/8 (3.2)	up to 3/8 (9.5), incl over 3/8 to 1 (9.5 to 25.4), incl
Category C (Shrinkage)	5/8 (15.9)	
Category D (Foreign material)	1/8 (3.2)	up to 1 (25.4), incl

### 3. Terminology

3.1 *Definitions*—For definitions of terms used in this document, see Terminology E1316.

### 4. Appearance of Radiographic Indications

4.1 The following descriptions are for use in discontinuity identification and classification. These descriptions apply to these reference radiographs only.

4.1.1 *Category A (Porosity)*—Round or elongated, smooth-edged dark spots occurring individually distributed or in clusters.

4.1.2 *Category B (Cold Fill)*—A distinct darkened line or band of variable length and definite smooth outline, usually continuous or interconnected.

4.1.3 *Category C (Shrinkage)*—Filamentary or jagged darkened areas, usually continuous or interconnected.

4.1.4 *Category D (Foreign Material)*—Isolated irregular variation in film density, either lighter or darker than surrounding areas. They may indicate the inclusion of oxide or dross or metallic compounds of different density. Illustration shows a more dense material.

### 5. Significance and Use

5.1 These radiographs are so designed that acceptance standards, which may be developed for particular requirements, can be specified in terms of these radiographs. The radiographs are of castings that were produced under conditions designed to produce the discontinuities. These reference radiographs are intended to be used for casting thickness ranges in accordance with Table 1.

5.2 The radiographic illustrations listed in Table 1 illustrate three types of discontinuities in four severity levels. Two ungraded illustrations have been included to establish the radiographic appearance of foreign material.

5.3 These reference radiographs were produced in accordance with Guide E94. All of the references are original radiographs.

5.4 *Film Deterioration*—Radiographic films are subject to wear and tear from handling and use. The extent to which the image deteriorates over time is a function of storage conditions, care in handling and amount of use. Reference radiograph films are no exception and may exhibit a loss in image quality over time. The radiographs should therefore be periodically examined for signs of wear and tear, including scratches, abrasions, stains, and so forth. Any reference radiographs which show signs of excessive wear and tear which could influence the interpretation and use of the radiographs should be replaced.

### 6. Basis for Application

6.1 These reference radiographs may be applied as acceptance standards tailored to the end use of the product. Application of these reference radiographs as acceptance standards should be based on the intended use of the product and the following considerations (see Note 3):

6.1.1 Unless otherwise specified, discontinuities of equal or lesser severity than that in the specified reference radiograph are acceptable in any specified unit area of the casting. The size of the unit area should be specified in the acceptance criteria. Discontinuities more severe than those in the specified reference radiograph shall be considered rejectable.

6.1.2 Any combination or portion of these reference radiographs may be used as is relevant to the particular application. Different grades or acceptance limits may be specified for each discontinuity type. Further, different grades may be specified for various regions or zones of the component.

6.1.3 Special consideration may be required where more than one discontinuity type is present in the same area. Any modification of the acceptance criteria required on the basis of multiple discontinuity types must be specified.

6.1.4 Where the reference radiograph contains multiple discontinuities, as in that case of gas holes, acceptance may be based upon the aggregate area of the discontinuities, the maximum discontinuity size in the reference radiograph, the

spacing between discontinuities, or a combination of these or other criteria, or both.

6.1.5 As a minimum the acceptance criteria should contain information addressing; zoning of the part (if applicable), acceptance severity level for each discontinuity type, and the specific area to which the reference radiographs are to be applied.

NOTE 3—Caution should be exercised in specifying the acceptance

criteria to be met in the casting. Casting design coupled with foundry practice should be considered. It is advisable to consult with the manufacturer or foundry before establishing the acceptance criteria to ensure the desired quality level can be achieved.

## 7. Keywords

7.1 aluminum; die castings; discontinuities; magnesium; reference radiographs; X-ray

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