



Designation: E2973 – 22

Standard Digital Reference Images for Inspection of Aluminum and Magnesium Die Castings¹

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1. Scope

1.1 These digital reference images illustrate various categories, types, 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 digital radiographic imaging.

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

NOTE 1—The basis of application for these reference images requires a prior purchaser supplier agreement of radiographic examination attributes and acceptance criteria as described in Sections 5 and 6 of this standard.

1.2 These digital reference images consist of nine images covering discontinuities in aluminum and magnesium alloy die castings. Four contain graded sequences of four levels of increasing severity in aluminum castings. Four contain graded sequences of four levels of increasing severity in magnesium castings. The last image contains ungraded illustrations of inclusions in aluminum and magnesium alloy die castings.

1.3 Two kinds of illustration categories are covered as follows:

1.3.1 *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 $\frac{1}{8}$ in. (3.2 mm) and $\frac{5}{8}$ in. (15.9 mm); Category B discontinuities are illustrated for $\frac{1}{8}$ in. thick aluminum and magnesium die castings; and Category C discontinuities are illustrated for $\frac{5}{8}$ in. (15.9 mm) thick aluminum and magnesium die castings.

¹ These digital reference images are under the jurisdiction of ASTM Committee E07 on Nondestructive Testing and are the direct responsibility of Subcommittee E07.02 on Reference Radiological Images.

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1.3.2 *Ungraded*—One illustration of one discontinuity for 0.20 in. (5.1 mm) thickness aluminum die casting and one illustration of one discontinuity for $\frac{1}{8}$ in. (3.2 mm) thickness magnesium die casting.

1.4 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 purchaser and supplier.

1.5 All areas of this standard may be open to agreement between the cognizant engineering organization and the supplier, or specific direction from the cognizant engineering organization. These items should be addressed in the purchase order or the contract.

1.6 These digital reference images are not intended to illustrate the types and degrees of discontinuities found in aluminum and magnesium die castings when performing film radiography. If performing film radiography of aluminum or magnesium die castings, refer to Reference Radiographs E505.

1.7 Only licensed copies of the software and images shall be utilized for production inspection. A copy of the ASTM/User license agreement shall be kept on file for audit purposes. (See Note 2.)

NOTE 2—The set of digital reference images consists of nine digital data files, and software to load the desired format and specific instructions on the loading process. The nine reference images illustrate eight sets of graded discontinuities and one category of ungraded discontinuities. Available from ASTM International Headquarters, Order No: RRE2973.

1.8 *Units*—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.

1.9 *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.*

1.10 *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.

2. Referenced Documents

- 2.1 *ASTM Standards*:²
 - E505 Reference Radiographs for Inspection of Aluminum and Magnesium Die Castings
 - E1316 Terminology for Nondestructive Examinations
 - E2002 Practice for Determining Image Unsharpness and Basic Spatial Resolution in Radiography and Radioscopy
 - E2446 Practice for Manufacturing Characterization of Computed Radiography Systems
 - E2597 Practice for Manufacturing Characterization of Digital Detector Arrays
- 2.2 *ASTM Adjuncts*:³
 - Digital Reference Images for Inspection of Aluminum and Magnesium Die Castings
- 2.3 *SMPTE Standard*:⁴
 - RP133 SMPTE Recommended Practice Specifications for Medical Diagnostic Imaging Test Pattern for Television Monitors and Hard-Copy Recording Cameras

3. Terminology

3.1 *Definitions*—Definitions of terms used in this standard may be found in Terminology E1316.

3.2 *Definitions of Terms Specific to This Standard*:

3.2.1 *aliasing, n*—artifacts that appear in an image when the spatial frequency of the input is higher than the output is capable of reproducing. This will often appear as jagged or stepped sections in a line or as moiré patterns.

3.2.2 *contrast normalization, v*—the adjustment of contrast between the production image and the reference image that makes the change in digital driving level versus change in thickness equal for both images.

3.2.3 *discontinuity severity level, n*—a relative rank in terms of “quantity, size, and distribution” of a collection of discontinuities where “1” is the least and “4” is the greatest “quantity, size, and distribution” present on the reference image.

3.2.4 *discontinuity type, n*—a specific discontinuity characterized by its cause and appearance. For example: shrinkage is a specific discontinuity type.

3.2.5 *graded illustrations, n*—a category of discontinuity that is assigned a severity level.

3.2.6 *measured resolution, n*—the characteristic resolution of a digital radiographic system as measured in accordance with 10.5.

3.2.7 *production image, n*—an image under review for compliance with this standard.

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

³ Available from ASTM International Headquarters. Order Adjunct No. RRE2973.

⁴ Available from the Society of Motion Picture and Television Engineers, 3 Barker Avenue, White Plains, NY 10601, www.smpte.org/smpte_store.

3.2.8 *ungraded illustrations, n*—a category of discontinuity without an assigned severity level.

4. Appearance of Radiographic Indications

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

4.1.1 *Category A (Porosity)*—Round or elongated, smooth-edged spots of greater X-ray transmission occurring individually distributed or in clusters.

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

4.1.3 *Category C (Shrinkage)*—Filamentary or jagged areas of greater X-ray transmission, 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 Graded reference images are intended to provide a guide enabling recognition of specific casting discontinuity types and relative severity levels that may be encountered during typical manufacturing processes. Reference images containing ungraded discontinuities are provided as a guide for recognition of a specific casting discontinuity type where severity levels are not needed. These reference images are intended as a basis from which manufacturers and purchasers may, by mutual agreement, select particular discontinuity classes to serve as standards representing minimum levels of acceptability (see Sections 7 and 8). The reference images are intended to be used for casting thickness ranges in accordance with Table 1.

5.2 Reference images represented by this standard may be used, as agreed upon in a purchaser supplier agreement, for

TABLE 1 Reference Radiographs for Aluminum and Magnesium Die Castings

Discontinuity	Plate Thickness, in. (mm)	Applicable Casting Thickness, in. (mm)
Aluminum Die Castings		
Category A (Porosity)	1/8 (3.2)	Up to 3/8 (9.5), incl.
Category A (Porosity)	5/8 (15.9)	Over 3/8 to 1 (9.5 to 25.4), incl.
Category B (Cold Fill)	1/8 (3.2)	Up to 3/8 (9.5), incl.
Category C (Shrinkage)	5/8 (15.9)	Over 3/8 to 1 (9.5 to 25.4), incl.
Category D (Foreign Material)	0.200 (5.08)	Up to 1 (25.4), incl.
Magnesium Die Castings		
Category A (Porosity)	1/8 (3.2)	Up to 3/8 (9.5), incl.
Category A (Porosity)	5/8 (15.9)	Over 3/8 to 1 (9.5 to 25.4), incl.
Category B (Cold Fill)	1/8 (3.2)	Up to 3/8 (9.5), incl.
Category C (Shrinkage)	5/8 (15.9)	Over 3/8 to 1 (9.5 to 25.4), incl.
Category D (Foreign Material)	1/8 (3.2)	Up to 1 (25.4), incl.