



Designation: E3185 – 21

Standard Digital Reference Images for Tin Bronze Castings¹

This standard is issued under the fixed designation E3185; 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 (ϵ) indicates an editorial change since the last revision or reappraisal.

1. Scope

1.1 These digital reference images illustrate various categories, types and severity levels of discontinuities occurring in tin bronze and related alloy castings. The digital reference images are an adjunct to this document and must be purchased separately from ASTM International if needed (see Section 2). Categories and severity levels for each discontinuity type represented by these digital reference images are described in 1.2.

NOTE 1—The basis of application for these reference images requires a prior purchaser supplier agreement of radiographic examination attributes and classification criterion described in Sections 4, 6, and 7 of this standard.

1.2 These digital reference images consist of 22 2½ by 5½-in. (63.5 by 139.7-mm) nominal size reproductions originally exposed with low voltage X-rays. Fifteen of these images were produced with 1 in. (25.4 mm) plate castings and seven (sand inclusions, inserts, chaplets) were produced with ¾-in. plate castings originally derived for NAVSHIPS 250-537-1 and -2. The 1-in. plate castings address gas porosity, linear shrinkage, and feathery shrinkage discontinuity types. The original radiographs illustrate discontinuities in sand cast 88:8:4 Cu-Sn-Zn, “G” type, bronze alloy plates and are representative of those found in wide solidification range copper-tin base alloys. The categories, types and severity levels for the adjunct digital reference images of this standard are shown in 1.2.1 to 1.2.5:

1.2.1 *Category A*—Gas porosity; severity levels 1 through 5 for thicknesses up to and including 2 in. (50.8 mm).

1.2.2 *Category B*—Sand inclusions; severity levels 1 through 5 for thicknesses up to and including 2 in. (50.8 mm).

1.2.3 *Category C*—Shrinkage; two types:

1.2.3.1 *Ca*—Linear shrinkage; severity levels 1 through 5 for thicknesses up to and including 2 in. (50.8 mm).

1.2.3.2 *Cd*—Feathery and spongy shrinkage (see Note 2); severity levels 1 through 5 for thicknesses up to and including 2 in. (50.8 mm).

NOTE 2—The feathery shrinkage discontinuity type is used to illustrate

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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aggregate severity levels for either feathery or spongy shrinkage discontinuity types (see 5.1).

1.2.4 *Category D*—Hot tear; one illustration.

1.2.5 *Category E*—Inserts, chaplets; one illustration.

1.3 All areas of this standard may be subject 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.

1.4 These digital reference images are not intended to illustrate the types and degrees of discontinuities found in tin bronze castings when performing film radiography. If performing film radiography of tin bronze castings, refer to Reference Radiographs E310.

1.5 Only licensed copies of the software and images shall be utilized for production examination. A copy of the ASTM/User license agreement shall be kept on file for audit purposes (see Note 3).

NOTE 3—The digital reference images consist of a set of digital image files, software to load the desired format, and specific instructions on the loading process. The 22 reference images illustrate four categories of graded discontinuities (1.2.1 (Gas porosity), 1.2.2 (Sand inclusion), 1.2.3.1 (Linear shrinkage), and 1.2.3.2 (Feathery shrinkage)) and two categories of ungraded discontinuities (1.2.4 (Hot tear) and 1.2.5 (Inserts)) and contain an image of a step wedge. Available from ASTM International Headquarters, Order No: RRE3185.

1.6 *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.

1.7 *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.*

1.8 *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

- B61 Specification for Steam or Valve Bronze Castings
- B62 Specification for Composition Bronze or Ounce Metal Castings
- B271 Specification for Copper-Base Alloy Centrifugal Castings
- B584 Specification for Copper Alloy Sand Castings for General Applications
- E310 Reference Radiographs for Tin Bronze Castings
- E1316 Terminology for Nondestructive Examinations
- E2002 Practice for Determining Total Image Unsharpness and Basic Spatial Resolution in Radiography and Radioscopy

2.2 SMPTE Practice:³

- RP133 SMPTE Recommended Practice Specifications for Medical Diagnostic Imaging Test Pattern for Television Monitors and Hard-Copy Recording Cameras

2.3 ASTM Adjuncts:⁴

- Digital Reference Images for Tin Bronze Castings

2.4 Military Standards:⁵

- MIL-B-16541 Bronze, Valve Castings
- MIL-B-16444 Bronze, Hydraulic (Ounce Metal) (Castings)

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 *classification specification*, *n*—a set of user defined acceptance criteria that prescribes the radiographic workmanship discontinuity class requirements for a specified user casting service application (see Sections 6 and 7).

3.2.3 *contrast normalization*, *n*—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.

3.2.4 *DDL*, *n*—digital driving level, also known as monitor pixel value.

3.2.5 *discontinuity category*, *n*—a nomenclature system used for grouping discontinuity types. For example, linear shrinkage is assigned category “Ca”, where “C” represents the general shrinkage category and “a” represents the specific linear shrinkage discontinuity type.

3.2.6 *discontinuity class*, *n*—an assigned fabrication quality rating characterized by a discontinuity type, category and severity level. For example, “Ca 2” is a discontinuity class comprised of linear shrinkage with a severity level of “2”.

3.2.7 *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 “5” is the greatest “quantity, size and distribution” present on the reference image. For example, a severity level of “1” is more restrictive (requires a higher level of fabrication quality) than a severity level of “2”.

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

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

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

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

3.2.12 *prorating*, *v*—assignment of quantity, size and distribution on a production image in proportion to a similar size area of a reference image. For example, a production image covers an area that is smaller than the unit area of a reference image and the extent of discontinuity on the applicable reference image is reduced proportionately.

3.2.13 *ungraded illustrations*, *n*—a category of discontinuity without an assigned severity level and is for descriptive purposes only.

4. Significance and Use

4.1 Reference images for tin bronze and related alloy castings are intended to be used as a guide to the recognition of common discontinuities and their differentiation both as to type and severity level. Discontinuity types most common to these alloys are illustrated. For reference, descriptions of typical casting discontinuities and corresponding image indication types are contained in Section 5. Purchasers and suppliers may, by mutual agreement, select particular discontinuity categories (see 1.2) to serve as standards representing minimum levels of acceptability (see Sections 6 and 7).

4.2 Reference images represented by this standard may be used, as agreed upon in a purchaser supplier agreement, for energy levels, thicknesses, or both, outside the range of this standard when determined applicable for the casting service application. Section 9 addresses purchaser supplier requisites where weld repairs may be required.

4.3 Procedures for evaluation of production images using applicable reference images of this standard are prescribed in Section 8; however, there may be manufacturing-purchaser issues involving specific casting service applications where it may be appropriate to modify or alter such requirements. Where such modifications may be appropriate for the casting application, all such changes shall be called-out in the purchaser supplier agreement or contractual document.

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 the Society of Motion Picture and Television Engineers (SMPTE), 3 Barker Avenue, White Plain, NY 10601, http://www.smpte.org/smpte_store/.

⁴ Available from ASTM International Headquarters. Order Reference Radiograph No. RRE3185

⁵ Available from <https://standards.globalspec.com/>.