Designation: E3030 – 19

Standard Digital Reference Images for Heavy-Walled (2 to 4½ in. (50.8 to 114 mm)) Steel Castings[1]

This standard is issued under the fixed designation E3030; 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 reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 These digital reference images illustrate various categories, types, and severity levels of discontinuities occurring in steel castings that have section thicknesses of 2 in. (50.8 mm) to less than 4½ in. (114 mm). The digital reference images are an adjunct to this standard and must be purchased separately from ASTM International, if needed (see 2.3). 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 acceptance criteria as described in Sections 4, 6, and 7 of this standard.

1.2 These digital reference images consist of three separate volumes (see Note 2) as follows: (I) 1 MV X-rays and Iridium-192, (II) 2 MV to 4 MV X-rays and Cobalt-60, and (III) 4 MV to 30 MV X-rays. Unless otherwise specified in a purchaser supplier agreement (see 1.1), each volume is for comparison only with production digital images produced with radiation energy levels within the thickness range covered by this standard. Each volume consists of five categories of graded discontinuities of increasing severity level and three categories of ungraded discontinuities. Reference images containing ungraded discontinuities are provided as a guide for recognition of a specific casting discontinuity type where severity levels are not needed. The following is a list of discontinuity categories, types, and severity levels for the adjunct digital reference images of this standard:

1.2.1 *Category A*—Gas porosity; severity levels 1 through 5.

1.2.2 *Category B*—Sand and slag inclusions; severity levels 1 through 5.

1.2.3 *Category C*—Shrinkage; 3 types:

1.2.3.1 *Ca – Linear Shrinkage*—Severity levels 1 through 5.

1.2.3.2 *Cb – Feathery Shrinkage*—Severity levels 1 through 5.

1.2.3.3 *Cc – Sponge Shrinkage*—Severity levels 1 through 5.

1.2.4 *Category D*—Crack; 1 illustration.

1.2.5 *Category E*—Hot tear; 1 illustration.

1.2.6 *Category F*—Insert; 1 illustration.

NOTE 2—The digital reference images consist of the following:
Volume I: 1 MV X-rays and Iridium-192
Volume II: 2 MV to 4 MV X-rays and Cobalt-60
Volume III: 4 MV to 30 MV X-rays

1.3 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.

1.4 *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.

1.5 These digital reference images are not intended to illustrate the types and degrees of discontinuities found in steel castings 2 in. (50.8 mm) to 4½ in. (114 mm) in thickness when performing film radiography. If performing film radiography of such steel castings, refer to Reference Radiographs E186.

1.6 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 3.)

NOTE 3—Each volume of digital reference images consists of 6 digital data files, software to load the desired format, and specific instructions on the loading process. The 28 reference images in each volume illustrate five categories of graded discontinuities and three categories of ungraded discontinuities. Available from ASTM International Headquarters, Order No: RRE303001 for Volume I, No: RRE303002 for Volume II, and No: RRE303003 for Volume III.

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.*

[1] This standard is 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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2. Referenced Documents

2.1 *ASTM Standards:*[2]

E186 Reference Radiographs for Heavy-Walled (2 to 4½ in. (50.8 to 114 mm)) Steel Castings

E1316 Terminology for Nondestructive Examinations

E2002 Practice for Determining Total Image Unsharpness and Basic Spatial Resolution in Radiography and Radioscopy

E2868 Digital Reference Images for Steel Castings up to 2 in. (50.8 mm) in Thickness

2.2 *SMPTE Practice:*[3]

RP133 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 Heavy-Walled (2 to 4½ in. (50.8 to 114 mm)) Steel Castings:

Volume I, 1 MV X-rays and Iridium-192[5]

Volume II, 2 MV to 4 MV X-rays and Cobalt-60[6]

Volume III, 4 MV to 30 MV X-rays[7]

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 criterion 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.

3.2.5.1 *Discussion*—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 workmanship fabrication quality rating characterized by a discontinuity type, category, and severity level.

3.2.6.1 *Discussion*—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.

3.2.7.1 *Discussion*—For example, a severity level of "1" is more restrictive (requires a higher level of workmanship fabrication quality) than a severity level of "2."

3.2.8 *discontinuity type, n*—a specific discontinuity characterized by its cause and appearance.

3.2.8.1 *Discussion*—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 9.5.

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

3.2.12 *prorating, n*—assignment of quantity, size, and distribution on a production image in proportion to a similar size area of a reference image.

3.2.12.1 *Discussion*—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.

4. Significance and Use

4.1 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 fabrication 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 5 and 6).

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. Severity levels of similar discontinuity categories and energy level range of Digital Reference Images E2868 reference images may alternatively be used, as determined appropriate for the casting service application, if so agreed upon in a purchaser supplier agreement.

[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 Society of Motion Picture and Television Engineers (SMPTE), 3 Barker Ave., White Plains, NY 10601, https://www.smpte.org.

[4] Available from ASTM International Headquarters.

[5] Order RRE303001.

[6] Order RRE303002.

[7] Order RRE303003.