Designation: E2868 – 22

Standard Digital Reference Images for Steel Castings up to 2 in. (50.8 mm) in Thickness[1]

This standard is issued under the fixed designation E2868; 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 up to 2 in. (50.8 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) medium voltage (nominal 250-kV) X-rays, (II) 1-MV X-rays and Iridium-192 radiation, and (III) 2-MV to 4-MV X-rays and Cobalt-60 radiation. 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 six categories of graded discontinuities of increasing severity level and four 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; 4 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.

1.2.3.4 *Cd–combinations of linear, feathery, and 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.

1.2.7 *Category G*–Mottling; 1 illustration. (See Note 3.)

NOTE 2—The digital reference images consist of the following:
Volume I: Medium Voltage (nominal 250-kVp) X-Ray Reference Images – Set of 34 illustrations.
Volume II: 1-MV X-Rays and Iridium-192 Reference Images – Set of 34 illustrations.
Volume III: 2-MV to 4-MV X-Rays and Cobalt-60 Reference Images – Set of 34 illustrations.

NOTE 3—Although Category G – Mottling is listed for all three volumes, the appearance of mottling is dependent on the level of radiation energy. Mottling appears reasonably prominent in Volume I; however, because of the higher radiation energy levels mottling may not be apparent in Volume II nor Volume III.

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 These digital reference images are not intended to illustrate the types and degrees of discontinuities found in steel castings up to 2 in. (50.8 mm) in thickness when performing film radiography. If performing film radiography of steel castings up to 2 in. (50.8 mm) in thickness, refer to Reference Radiographs E446.

1.5 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 4.)

NOTE 4—Each volume of digital reference images consists of 7 digital data files, software to load the desired format and specific instructions on the loading process. The 34 reference images in each volume illustrate six categories of graded discontinuities and four categories of ungraded discontinuities and contain an image of a step wedge. Available from ASTM International Headquarters, Order No: RRE286801 for Volume I, RRE286802 for Volume II, and RRE286803 for Volume III.

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] 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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***A Summary of Changes section appears at the end of this 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]

E446 Reference Radiographs for Steel Castings Up to 2 in. (50.8 mm) in Thickness

E1316 Terminology for Nondestructive Examinations

E2002 Practice for Determining 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:*

Digital Reference Images for Inspection of Steel Castings Up to 2 in. (50.8 mm) in Thickness (Volume I) : Medium Voltage (nominal 250-kVp) X-Ray Reference Images[4]

Digital Reference Images for Inspection of Steel Castings Up to 2 in. (50.8 mm) in Thickness (Volume II): 1-MV X-Rays and Iridium-192 Reference Images[4]

Digital Reference Images for Inspection of Steel Castings Up to 2 in. (50.8 mm) in Thickness (Volume III): 2-MV to 4-MV X-Rays and Cobalt-60 Reference Images[4]

3. Terminology

3.1 *Definitions:*

3.1.1 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 *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.

3.2.5 *discontinuity class, n*—an assigned workmanship 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.”

3.2.6 *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. Example: a severity level of “1” is more restrictive (requires a higher level of workmanship fabrication quality) than a severity level of “2”.

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

3.2.8 *graded illustration, n*—a category of discontinuity that is assigned a severity level.

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

3.2.10 *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.

3.2.11 *ungraded illustration, n*—a category of discontinuity without an assigned severity level.

4. Significance and Use

4.1 Personnel utilizing reference radiographs to this standard shall be qualified to perform radiographic interpretation in accordance with a nationally or internationally recognized NDT personnel qualification practice or standard and certified by the employer or certifying agency, as applicable. The practice or standard used and its applicable revision shall be identified in the contractual agreement between the using parties. If assistance is needed with interpreting specifications and product requirements as applied to the reference radiographs, a certified Level III shall be consulted before accept/reject decisions are made (if the Level III is the radiographic interpreter, this may be the same person).

4.2 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

[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, 3 Barker Avenue White Plains, NY 10601; or http://www.smpte.org/smpte_store/

[4] Available from ASTM International Headquarters, Order No: RRE286801 for Volume I, RRE286802 for Volume II, and RRE286803 for Volume III.