Designation: E1320 – 20

Standard Reference Radiographs for Titanium Castings[1]

This standard is issued under the fixed designation E1320; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope*

1.1 The reference radiographs provided in the adjunct to this standard are reproductions of original radiographs and are supplied as a means for establishing some of the categories and severity levels of discontinuities in titanium castings that may be revealed by radiographic examination. Use of this standard for the specification or grading of castings requires procurement of the adjunct reference radiographs which illustrate the discontinuity types and severity levels. They should be used in accordance with contractual specifications.

NOTE 1—The original radiographs produced for Volume I were taken with X-rays in the range of 110 kVp to 220 kVp. The original radiographs produced for Volume II were taken with X-rays in the range of 200 kVp to 340 kVp.

1.2 These film reference radiographs are not intended to illustrate the types and degrees of discontinuities found in titanium castings when performing digital radiography. If performing digital radiography of titanium castings, refer to Digital Reference Images E2669.

1.3 These reference radiographs consist of two volumes. Volume I, described in Table 1, is applicable to a wall thickness of up to 1 in. (0 to 25.4 mm). Volume II, described in Table 2, is applicable to a wall thickness of over 1 in. to 2 in. (25.4 mm to 50.8 mm). The standard may be used, where there is no other applicable standard, for other thicknesses for which agreement has been reached between purchaser and manufacturer.

NOTE 2—The reference radiographs are not impacted by this revision. There have been no revisions to the adjunct reference radiographs since original issue. The adjunct reference radiographs of any issue remain valid and may be used to this standard.

1.4 The plates produced to serve for use in this standard were purposely cast to exhibit the desired discontinuity. The plates were cast using different processes as shown in Table 1 and Table 2. Hot isostatic pressing was not used on any of the plates.

1.5 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.

1.6 *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]

E94 Guide for Radiographic Examination Using Industrial Radiographic Film

E1316 Terminology for Nondestructive Examinations

E2669 Digital Reference Images for Titanium Castings

2.2 *ASTM Adjuncts:*

Reference Radiographs for the Inspection of Titanium Castings

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

Current edition approved June 1, 2020. Published June 2020. Originally approved in 1990. Last previous edition approved in 2015 as E1320 – 15. DOI: 10.1520/E1320-20.

[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.

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

TABLE 1 VOLUME I—0 to 1 in.

Discontinuity	Casting Process	Alloy	Plate Thickness, in.	Applicable Casting Thickness, in.
Gas hole	Centrifugal ram graphite	Ti 6AL 4V	N/A	up to 1
Clustered gas holes	Centrifugal precision	Ti 6AL 4V	¼	up to ⅜
Clustered gas holes	Centrifugal precision	Ti 6AL 4V	½	over ⅜ to ⅝
Clustered holes	Centrifugal precision	Ti 6AL 4V	¾	over ⅝ to 1
Scattered gas holes	Top pour lost wax	Ti 6AL 4V	¼	up to ⅜
Scattered gas holes	Top pour lost wax	Ti 6AL 4V	½	over ⅜ to ⅝
Scattered gas holes	Top pour lost wax	Ti 6AL 4V	¾	over ⅝ to 1
Shrinkage cavity	Centrifugal ram graphite	Ti 6AL 4V	½	over ¼ to ⅝
Shrinkage cavity	Centrifugal ram graphite	Ti 6AL 4V	¾	over ⅝ to 1
Scattered shrinkage cavity	Top pour lost wax	Ti 6AL 4V	¼	up to ⅜
Scattered shrinkage cavity	Top pour lost wax	Ti 6AL 4V	½	over ⅜ to ⅝
Scattered shrinkage cavity	Top pour lost wax	Ti 6AL 4V	¾	over ⅝ to 1
Centerline shrinkage	Centrifugal ram graphite	Ti 6AL 4V	¼	up to ⅜
Centerline shrinkage	Centrifugal ram graphite	Ti 6AL 4V	½	over ⅜ to ⅝
Centerline shrinkage	Centrifugal ram graphite	Ti 6AL 4V	¾	over ⅝ to 1
Less dense inclusions	Varied	Ti 6AL 4V	N/A	up to 1
More dense inclusions	Varied	Ti 6AL 4V	N/A	up to 1

NOTE 1—1 in. = 25.4 mm.

TABLE 2 VOLUME II—Over 1 in. to 2 in.

Discontinuity	Casting Process	Alloy	Plate Thickness, in.	Applicable Casting Thickness, in.
Gas hole	Centrifugal ram graphite	Ti 6AL 4V	1¼	over 1 to 2
Clustered gas holes	Centrifugal ram graphite	Ti 6AL 4V	1¼ to 1¾	over 1 to 2
Scattered gas holes	Centrifugal ram graphite	Ti 6AL 4V	1¼	over 1 to 1½
Scattered gas holes	Centrifugal ram graphite	Ti 6AL 4V	1¾	over 1½ to 2
Shrinkage cavity	Centrifugal ram graphite	Ti 6AL 4V	1¼	over 1 to 1½
Shrinkage cavity	Centrifugal ram graphite	Ti 6AL 4V	1¾	over 1½ to 2
Centerline shrinkage	Centrifugal ram graphite	Ti 6AL 4V	1¼	over 1 to 1½
Centerline shrinkage	Centrifugal ram graphite	Ti 6AL 4V	1¾	over 1½ to 2

NOTE 1—1 in. = 25.4 mm.

Volume I, applicable up to 1 in. (25.4 mm)[3,4]

Volume II, applicable over 1 in. to 2 in. (25.4 mm to 50.8 mm)[4,5]

2.3 *AIA Document:*[6]

NAS 410 Certification & Qualification of Nondestructive Test Personnel

2.4 *ASNT Documents:*[7]

SNT-TC-1A Recommended Practice for Personnel Qualification and Certification in Nondestructive Testing

ANSI/ASNT-CP-189 ASNT Standard for Qualification and Certification of Nondestructive Testing Personnel

2.5 *ANSI/ISO Standard:*[8]

ISO 9712 NDT—Qualification and Certification of NDT Personnel

[3] Available from ASTM International Headquarters. Order Reference Radiograph No. RRE132001.

[4] Volumes I and II are available from ASTM International Headquarters as a set. Order Reference Radiographs RRE1320CS.

[5] Available from ASTM International Headquarters. Order Reference Radiograph No. RRE132002.

[6] Available from Aerospace Industries Association (AIA), 1000 Wilson Blvd., Suite 1700, Arlington, VA 22209, http://www.aia-aerospace.org.

[7] Available from American Society for Nondestructive Testing (ASNT), P.O. Box 28518, 1711 Arlingate Ln., Columbus, OH 43228-0518, http://www.asnt.org.

[8] Available from International Organization for Standardization (ISO), ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, http://www.iso.org.

3. Terminology

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

4. Significance and Use

4.1 Personnel utilizing reference radiographs to this standard shall be qualified and authorized to perform radiographic interpretation in accordance with a nationally or internationally recognized NDT personnel qualification practice or standard such as ANSI/ASNT-CP-189, SNT-TC-1A, NAS 410, ISO 9712, or a similar document 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. A certified Level III shall be available to assist with interpreting specifications and product requirements as applied to the reference radiographs (if the Level III is the radiographic interpreter, this may be the same person).

4.2 These reference radiographs are designed so 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. The reference radiographs are intended to be used for casting thickness ranges in accordance with Table 1 and Table 2.