



## Standard Reference Radiographs for Ductile Iron Castings<sup>1</sup>

This standard is issued under the fixed designation E 689; 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.

<sup>ε1</sup> NOTE—Editorially changed “defect” to “discontinuity” in paragraph 7.6 in January 2004.

### 1. Scope

1.1 These reference radiographs extend the application of reference radiographs for steel castings to ductile iron castings.

1.2 In some instances, reference radiographs for steel castings may not be entirely applicable to ductile cast iron material dependent upon design or other usage criteria. Refer to 4.1 for guidance.

1.3 *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 and health practices and determine the applicability of regulatory limitations prior to use.*

### 2. Referenced Documents

#### 2.1 ASTM Standards:<sup>2</sup>

E 186 Reference Radiographs for Heavy-Walled (2 to 4½-in. [51 to 114-mm]) Steel Castings

E 280 Reference Radiographs for Heavy-Walled (4½ to 12-in. [114 to 305-mm]) Steel Castings

E 446 Reference Radiographs for Steel Castings up to 2 in. [51 mm] in Thickness

E 1316 Terminology for Nondestructive Examinations

### 3. Terminology

3.1 Definitions of terms used in these reference radiographs may be found in Terminology E 1316, Section D.

### 4. Significance and Use

4.1 These reference radiographs invoke Reference Radiographs E 446, E 186, and E 280 for establishing categories and severity levels of internal discontinuities common to ductile iron castings subject to mutual agreement between purchaser and supplier in contractual specifications. The casting process

has shown radiographic similarities between internal discontinuities for ductile cast iron and cast steel to the extent that the reference radiographs for steel castings are applicable. The exact application and usage of the above categories and severity levels must, however, give consideration to the differences in material properties between cast steel and ductile cast iron end usage applications.

4.2 Production radiographs are to be compared with the applicable set of reference radiographs for classification on the basis of section thickness, radiation energy level and type, and category and severity level of discontinuity specified.

4.3 The standard reference radiographs are published in three nominal section thickness ranges in separate documents as follows:

4.3.1 Castings up to 2 in. [51 mm]: Reference Radiographs E 446.

4.3.2 Heavy-walled castings 2 to 4½ in. [51 to 114 mm]: Reference Radiographs E 186.

4.3.3 Heavy-walled castings 4½ to 12 in. [114 to 305 mm]: Reference Radiographs E 280.

### 5. Determination of Radiographic Classification

5.1 For purposes of evaluation of castings, a determination must be made of the radiographic classification to be assigned to individual castings or specific areas of castings. The determination of the applicable radiographic-severity classification shall be based on an evaluation of the casting applications, design, and service requirements. In these evaluations, consideration shall be given to such factors as pressure, temperature, section thickness, applicable design safety factor, vibration, shock, resistance to corrosion, involvement of penetrating radiations or radiation products, and involvement of dangerous gases or liquids.

### 6. Classification Specifications

6.1 The applicable radiographic severity level should be designated for each discontinuity type by the contracting agency in formal specifications or drawings and in the specific contract or order. For castings, the level should be independently specified for each discontinuity type, since they have been shown to affect strength properties differently. For example, in the same casting Severity Level 2 might be specified for shrinkage Type 3 and Severity Level 4 for gas porosity

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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

Type 1. The specifications, drawings, contract, or order should also designate the sampling plan for the castings to be radiographed and the extent and quality level of the radiographic coverage.

## 7. Procedure for Evaluation

7.1 Compare radiographs of the casting submitted for evaluation with the reference radiographs applicable to the section thickness and the source used.

7.2 When a particular class or severity is called for and the radiograph being evaluated is equal to or better than the reference, indicate the casting as radiographically acceptable. If the radiograph shows a discontinuity of greater severity than the reference radiograph, the casting shall be rejected.

7.3 When two or more types of discontinuities are present in the same radiograph, the predominating ones, if unacceptable, shall govern without regard to the other types of discontinuities.

7.4 When two or more categories of discontinuity are present to an extent equal to the maximum permissible level, as

shown in the pertinent standards for each category, then that part of the casting shall be judged unacceptable until satisfactorily repaired.

7.5 In general, there is no limit with regard to the extent of acceptable discontinuities in a casting, provided that no area throughout the casting contains discontinuities that exceed those indicated on the minimum acceptable area of applicable reference radiographs.

7.6 Where the reference image consists of a collection of discontinuities, as in the case of porosity, for example, acceptability may be based on the aggregate size of the discontinuities present on both the reference radiograph and the object radiograph, the maximum discontinuity size present, the spacing between discontinuities, or a combination of these or other criteria. These criteria must be determined based upon the particular application or part under consideration and must be specified by agreement between the purchaser and supplier.

## 8. Keywords

8.1 casting; discontinuity; radiograph; radiographic severity level; reference radiograph

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