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MILITARY STANDARD

RADIOGRAPHIC INSPECTION, CLASSIFICATION AND SOUNDNESS REQUIREMENTS FOR STEEL CASTINGS

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DEPARTMENT OF DEFENSE

Washington, DC 20301

Radiographic Inspection, Classification and Soundness Requirements For Steel Castings

MIL-STD-1265A(MR)

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2. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Director, US Army Materials Technology Laboratory, ATTN: SLCMT-MSE, Watertown, Massachusetts 02172-0001, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

FOREWORD

This standard prescribes classification and soundness requirements for steel castings. The castings are classified by classes, grades and criticality levels.

Included in the standard are four tables of maximum permissible radiographic severity levels for discontinuities in various wall thickness for steel castings per ASTM E186, E192, E280 and E446.

CONTENTS

TABLES

1. SCOPE

1.1 Scope. This standard prescribes the requirements for the classification and soundness of steel castings exclusive of weld repair. This standard supplements detail casting specifications when specified.

2. REFERENCED DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation.

STANDARDS

MILITARY

MIL-STD-410 - Nondestructive Testing Personnel Qualification and Certification
MIL-STD-453 - Inspection, Radiographic

(Copies of specifications, standards, handbooks, drawings, publications, and other Government documents required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting activity.)

2.2 Other publications. The following document(s) form a part of this standard to the extent specified herein. Unless otherwise specified, the issues of the documents which are indicated as DOD adopted shall be issue listed in the issue of the DODISS specified in the solicitation. Unless otherwise specified, the issues of documents which have not been adopted shall be those in effect on the date of the cited DoDISS.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E186 - Standard Reference Radiographs for Heavy Walled [2 - 4.5 in (51 - 114 mm)] Steel Castings
ASTM E192 - Standard Reference Radiographs of Investment Steel Castings for Aerospace Applications
ASTM E280 - Standard Reference Radiographs for Heavy Walled [4.5 - 12 in (114 - 305 mm)] Steel Castings
ASTM E446 - Standard Reference Radiographs for Steel Castings Up to 2 in (51 mm) in Thickness

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

bearing surface

3. DEFINITIONS

3.1 Classification. Castings shall be classified by classes, applicable grades and criticality levels.

3.1.1 Classes.

3.1.1.1 Class 1. A casting in which a single failure would cause significant danger to operating personnel or would result in a significant operational penalty. In the case of missiles, aircraft and other vehicles, this includes loss of major components, loss of control, unintentional release or inability to release armament stores, or failure of weapon installation components.

3.1.1.2 Class 2. A casting not included in class 1 but of unknown margin of safety.

3.1.1.3 Class 3. Castings having a margin of safety of 200 percent or less.

3.1.1.4 Class 4. Castings having a margin of safety greater than 200 percent, or for which no stress analysis is required.

3.1.2 Grades Castings shall be of grades A, B, C, D or E as shown in tables I, II, III and IV. Grade A castings would contain the least and/or the smallest size discontinuities. Grades B, C, D and E would contain progressively larger and more numerous discontinuities. Sections of a casting may be of varying grades, depending on the applied stresses to that portion of the castings.

3.1.3 Criticality levels (KL). The criticality level designates the amount of radiographic coverage for each casting. Castings shall be of criticality levels, KL1, KL2, or KL3. Those areas designated KL1 shall have a minimum of 75% radiographic inspection coverage. Areas designated KL2 shall require 50% minimum radiographic coverage. Those areas designated KL3 do not require radiographic inspection but are generally radiographed for information purposes.

3.2 Lot definition.

3.2.1 Inspection lot. Unless otherwise specified, Class 1 castings shall be inspected in accordance with Table No. V. Class 2, 3, and 4 castings shall be selected for inspection in accordance with Table VI. If class of casting is not identified on drawings, Class 2 shall apply.

4. GENERAL REQUIREMENTS

4.1 Inspection.

4.1.1 Responsibility for inspection. The contractor is responsible for furnishing all supplies in conformance to contract or purchase order requirements and, unless otherwise specified in the contract or purchase order, the performance of all inspection requirements contained herein. The inspection provisions contained herein shall become a part of the contractor's overall inspection system or quality program. The absence of inspection requirements does not relieve the supplier of his responsibility for assuring that all supplies submitted to the Government for acceptance conform to all requirements of the contract. The Government reserves the right to perform any of the inspections set forth herein, or otherwise specified in the contract or purchase order, when such inspections are deemed necessary to assure that supplies conform to prescribed requirements.

4.1.2 Qualification for inspection. Personnel performing radiographic inspection shall be qualified in accordance with MIL-STD-410D. Radiographic inspection of production castings shall be conducted in accordance with MIL-STD-453..

4.1.3 Final Inspection. Castings shall be inspected as specified herein unless the design activity has information substantiating the suitability of other inspection plans.

4.1.3.1 Documentation for final inspections. For all castings for which radiographic inspection is specified, the contractor shall prepare either photographs, X-ray film, sketches, documents or drawings containing:

(a) Classification of casting.
(b) Alloy and heat treatment.
(c) Grade(s) or defect limits as applicable.
(d) Deviations from this specification not covered by the purchase order, procurement specification or standard.

5. SPECIFIC REQUIREMENTS

5.1 Determination of classes, grades and criticality levels. The design activity shall establish the class, grade and criticality level by critical areas and stress levels for each casting design. The classification(s) and critical area(s) shall be indicated on the applicable drawing. If grade of casting is not indicated on drawing or other contractual document, grade C shall apply.

5.1.1 Class 1 requirements. All areas of class 1 castings shall be of a quality equivalent to or better than grade C, except that all critical areas of a class 1 casting shall be of a quality equivalent to or better than grade B (see tables I, II, III and IV).

5.1.2 Radiographic grades. The design activity shall specify on the drawing or other document the (quality level) radiographic grade(s) for classes 1, 2 and 3 castings designs. The design activity may specify radiographic grade(s) for class 4 casting designs. Either castings, or section of castings, shall be of grades A, B, C, D or E as shown in tables I, II, III and IV, and shall be in accordance with the reference radiographs specified in the tables, unless the design activity has information substantiating the suitability of castings with more extensive defects.

5.1.3 Criticality levels. The design activity shall specify the criticality level required for each classification of casting. Class 1 castings shall be completly radiographically examined and no criticality level designation is needed. Classes 2, 3 and 4 shall have areas designated by criticality level.

5.2 Standards.

5.2.1 Radiographic standards. Radiographic standard grades shall be established for each casting design for which radiographic inspection is specified. Such standards shall be in terms of ASTM E 186, ASTM E 192, ASTM E 280 and ASTM E 446. Maximum acceptable defects shall be in accordance with paragraph 5.1.

5.3 Examination of resubmitted inspection lots.

5.3.1 Rejection. Defects and/or discontinuities which are so aligned as to cause stress concentration are causes for rejection. If more than 25% of any lot of type I Aircraft or type II Guided Missile castings given 100% inspection is rejected because of discontinuities in highly stressed areas, the entire lot shall be submitted to review procedures. Castings not conforming to this specification shall be rejected and submitted to review procedures.

5.3.2 Review. In performing the review of the rejected lot, the cognizant engineering member of the review board may detail a technique for the subjection of a casting to a destructive test, either by loading (as in service use) or by dissection, as practicable. This consideration shall be predicated on the size of the rejected lot, the size of the castings and criticality of the casting application.

6. NOTES

6.1 Producibility warning. The class assigned to the casting should represent a realistic value for the functional requirements; i.e., do not assign a type I casting for a type II function. Casting design coupled with foundry practice can make overly severe soundness requirements impractical for a manufacturer to satisfy. Caution should be exercised in specifying the grade of maximum permissible radiographic discontinuity level to be met in a casting.

6.2 For Information:

Radiographic grade A - A casting for critical applications that is subject to high stresses.

Radiographic grade B - A casting for critical applications or specified area of a casting with a small safety factor.

Radiographic grade C - A high quality grade of casting for general applications or area of a casting with an average safety factor.

Radiographic grade D - A casting or area of a casting subject to low stresses.

Radiographic grade E - A casting to be used for armor purposes only.

NOTES: These notes are an integral part of tables I, II, III and IV.

(1) When two or more types of defects are present to an extent equal to or not significantly better than the acceptance standards for respective defects, the parts shall be rejected.

(2) When two or more types of defects are present and the predominating defect is not significantly better than the acceptance standard, the part shall be considered borderline.

(3) Borderline castings may be considered acceptable, upon review by competent engineering personnel.

(4) Gas holes or sand spots and inclusions allowed by these tables shall be cause for rejection when closer than twice their maximum dimension to an edge or extremity of a casting.

(5) Drawing tolerance (dwg. tol.) is defined as minimum thickness of material after defect is removed by machining.

(6) Numbers in the tables depict severities. A low number indicates few, small discontinuities while a high number indicates numerous, large discontinuities.

Custodian:
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(WP# ID-1885A/DISC-0001A. FOR MTL USE ONLY)

TABLE I. Maximum permissible radiographic severity levels for discontinuities in thin wall steel castings [1 in (25.4 mm) wall or less] per ASTM E192

DISCONTINUITY	GRADE A INCH			GRADE B INCH			GRADE C INCH			GRADE D INCH		
	1/8	3/8	3/4	1/8	3/8	3/4	1/8	3/8	3/4	1/8	3/8	3/4
GAS HOLES	NONE	NONE	NONE	1	1	1	2	2	2	3	3	3
SHRINKAGE CAVITY	NONE	NONE	NONE	NONE	NONE	1	N/A	N/A	2	N/A	N/A	3
SHRINKAGE SPONGE	NONE	NONE	NONE	1	1	1	2	2	2	3	3	3
SHRINKAGE, DENDRITIC	NONE	NONE	NONE	1	1	1	2	2	2	3	3	3
SHRINKAGE, FILAMENTARY	NONE	NONE	NONE	NA 1/	NA 1/	1	NA 1/	NA 1/	2	NA 1/	NA 1/	3
FOREIGN MATERIAL (LESS DENSE)	NONE	NONE	NONE	1	1	1	2	2	2	3	3	3
COLD SHOT	NONE ALLOWED											
HOT TEAR	NONE ALLOWED											
COLD CRACK	NONE ALLOWED											
MISRUN	NONE ALLOWED											
CORESHIFT	NOT TO EXCEED DRAWING TOLERANCE											
MOLD BUCKLE, POSITIVE	NOT TO EXCEED DRAWING TOLERANCE											
MOLD BUCKLE, NEGATIVE	NOT TO EXCEED DRAWING TOLERANCE											
MOLD RIDGE	NOT TO EXCEED DRAWING TOLERANCE											
EXCESS METAL IN CRACKED CORE	NOT TO EXCEED DRAWING TOLERANCE											

1/ Not available.

TABLE II. Maximum permissible radiographic severity levels for discontinuities in thick wall steel castings [2 - 4.5 in (51 - 114 mm)] per ASTM E186

CATEGORY	DISCONTINUITIES	GRADE A	GRADE B	GRADE C	GRADE D	GRADE E
A	GAS POROSITY	NONE	1	2	3	3
B	SAND/SLAG INCLUSIONS	NONE	1	2	4	4
C	SHRINKAGE TYPE 1	NONE	2	3	4	5
C	SHRINKAGE TYPE 2	NONE	2	3	4	5
C	SHRINKAGE TYPE 3	NONE	2	3	4	5
D	CRACK	----------NONE ALLOWED----------				
E	HOT TEAR	----------NONE ALLOWED----------				
F	INSERT	----------NONE ALLOWED----------				

TABLE III. Maximum permissible radiographic severity levels for discontinuities in steel castings up to 2 in (51 mm) in thickness per ASTM E446

CATEGORY	DISCONTINUITIES	GRADE A	GRADE B	GRADE C	GRADE D	GRADE E
A	GAS POROSITY	NONE	1	2	3	4
B	SAND SPOTS AND INCLUSIONS	NONE	1	2	3	5
CA	SHRINKAGE	NONE	1	2	3	5
CB	SHRINKAGE	NONE	1	2	3	5
CC	SHRINKAGE	NONE	1	2	3	5
CD	SHRINKAGE	NONE	1	2	3	5
D	CRACK	NONE	NONE	DWG. TOL.	DWG. TOL.	NONE
E	HOT TEAR	NONE	NONE	NONE	NONE	NONE
F	INSERT	NONE	NONE	NONE	NONE	NONE

TABLE IV. Maximum permissible radiographic severity levels for discontinuities in heavy walled [4.5 - 12 in (114 - 305 mm)] steel castings per ASTM E280

CATEGORY	DISCONTINUITIES	GRADE A	GRADE B	GRADE C	GRADE D	GRADE E
A	GAS POROSITY	1	2	3	4	4
B	SAND AND SLAG INCLUSIONS	1	2	3	4	4
C	SHRINKAGE TYPE 1	1	2	3	5	5
C	SHRINKAGE TYPE 2	1	2	3	5	5
C	SHRINKAGE TYPE 3	1	2	3	5	5
D	CRACK	----------NONE ALLOWED----------				
E	HOT TEAR	----------NONE ALLOWED----------				
F	INSERT	----------NONE ALLOWED----------				

TABLE V

SAMPLE SIZE

Lot Size	Sample Size	Lot Size	Sample Size
2-5	All	27-36	10
6-8	5	37-51	11
9-11	6	52-82	12
12-15	7	83-162	13
16-20	8	163-971	14
21-26	9	972 and over	15

Acceptance number is 0

TABLE VI

SAMPLE SIZE

Lot Size	Sample Size	Lot Size	Sample Size
2-4	All	18-27	7
5-6	4	28-48	8
7-11	5	49 and over	9
12-17	6		

Acceptance number is 0

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