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18 January 1989
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16 August 1982

MILITARY STANDARD

RADIOGRAPHIC INSPECTION FOR SOUNDNESS OF WELDS IN STEEL BY COMPARISON TO GRADED ASTM E390 REFERENCE RADIOGRAPHS

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DEPARTMENT OF DEFENSE

Washington, DC 20301

Radiographic Inspection for Soundness of Welds in Steel by Comparison to Graded ASTM E390 Reference Radiographs

1. This Military Standard is approved for use by all Departments and Agencies of the Department of Defense.

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

FOREWORD

This standard contains tables from which acceptance/rejection criteria can be prescribed for radiographic inspection for soundness of welds in steel by comparison to selected severity levels of ASTM E390 reference radiographs.

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1. SCOPE

1.1 Scope. This standard prescribes requirements for radiographic inspection for soundness of welds in steel by comparison to selected severity levels of ASTM E390 reference radiographs. The base material varies from greater than 0.25 to 3 in (6.4 - 76 mm) inclusive in thickness. Volume II is applicable. This standard is not suitable for shipyard use.

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 document to the extent specified herein. Unless otherwise specified, the issues of these documents are 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

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Naval Publications and Forms Center, (ATTN: NPODS), 5801 Tabor Avenue, Philadelphia, PA 19120-5099.)

2.2 Non-Government publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation.

ASTM

ASTM E390 - Standard Reference Radiographs for Steel Fusion Welds

(Application for copies should be addressed to ASTM, 1916 Race Street, Philadelphia, PA 19103.)

AMERICAN WELDING SOCIETY (AWS)

AWS B 3.0 - Acceptance Criteria - Porosity - AWS - Welding Procedure and Performance Qualification
AWS D 1.1 - Structural Welding Code - Steel, 1981

(Application for copies should be addressed to the American Welding Society, 2501 N. W. Seventh Street, Miami, FL 33125.)

AMERICAN PETROLEUM INSTITUTE (API)

API STD 1104 - Standard for Welding Pipelines and Related Facilities

(Applications for copies should be addressed to API-AGA Joint Committee on Oil and Gas Pipeline Field Welding Practices, H.C. Price Company, Automatic Welding Division, Box 1118, Bartlesville, OK 74003.)

(Industry association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

3. DEFINITIONS

3.1 Grades.

3.1.1 Grades. Welds shall be designated grades I, II, III or IV as shown in table I. A grade I weld would contain the least and/or smallest discontinuities and a grade IV weld would contain the largest and/or most numerous discontinuities.

3.2 Lot definition.

3.2.1 Inspection lot. Unless otherwise specified, a lot shall consist of all welds of a specific design and size produced at one facility by the same personnel and production technique, and submitted for inspection at one time.

4. GENERAL REQUIREMENTS

4.1 Qualification for inspection. Personnel performing radiographic inspection shall be qualified in accordance with MIL-STD-410. Radiographic inspection shall be conducted in accordance with MIL-STD-453.

5. DETAILED REQUIREMENTS

5.1 Determination of grades. The design activity shall establish the least acceptable grade for each weld design and this grade shall be indicated on the applicable approved drawing. If grade is not provided on drawing or other contractual document, Grade II shall apply.

5.2 Acceptance criteria. Welds graded I, II, III or IV shall contain discontinuities no greater than the acceptance level indicated in table I. Acceptance or severity levels indicated refer to those contained in ASTM E390. Each of the graded discontinuity types has five severity levels, 1 through 5 in order of increasing severity. Arabic number one references a radiograph which indicates smaller, fewer or less severe discontinuities than arabic number two, arabic two indicates smaller, fewer or less severe discontinuities than three, etc..

TABLE I. Severity level requirements for welds per ASTM E390, Vol II reference radiographs.

DISCONTINUITIES	WELD THICKNESS MAXIMUM INCHES INCLUSIVE	GRADE I	GRADE II	GRADE III	GRADE IV
Fine Scattered Porosity	3/8	NONE	1	2	3
	3/4	NONE	2	2	3
	2	1	2	3	4
Coarse Scattered Porosity	3/8	NONE	1	2	3
	3/4	NONE	2	2	3
	2	1	2	3	4
Clustered Porosity	3/8	NONE	1	2	3
	3/4	NONE	2	2	3
	2	1	2	3	4
Linear Porosity or Globular Indications	3/8	NONE	1	2	3
	3/4	NONE	2	2	3
	2	1	2	3	4
Slag Inclusions	3/8	NONE	1	2	3
	3/4	NONE	2	2	3
	2	1	2	3	4
Tungsten Inclusions	3/8	NONE	1	2	3
	3/4	NONE	2	2	3
Incomplete Penetration	3/8	NONE	1	2	3
	3/4	NONE	2	3	4
	2	1	2	3	4
Lack of Fusion	3/8	NONE	1	2	3
	3/4	NONE	2	2	3
	2	1	2	3	4
Ungraded Discontinuities	Up to 3/8 incl				
Crater Crack	----------NOT ALLOWED----------				
Transverse Crack	----------NOT ALLOWED----------				
Longitudinal Crack	----------NOT ALLOWED----------				
Tungsten Inclusions	---NO-GREATER THAN UNGRADED RADIOGRAPH--				

TABLE I. Severity level requirements for welds per ASTM E390, Vol II reference radiographs. (Continued)

Ungraded Discontinuities	3/8
Undercut	----------NOT ALLOWED----------
Burn Through	----------NOT ALLOWED----------
Icicles (Teardrops)	----------NOT ALLOWED----------
Elongated (or Wormhole) Porosity	----------NOT ALLOWED----------
Ungraded Discontinuities	3/4
Crater Crack	----------NOT ALLOWED----------
Transverse Crack	----------NOT ALLOWED----------
Longitudinal Crack	----------NOT ALLOWED----------
Tungsten Inclusions	---NO-GREATER THAN UNGRADED RADIOGRAPH--
Undercut	----------NOT ALLOWED----------
Burn Through	----------NOT ALLOWED----------
Icicles (Teardrops)	----------NOT ALLOWED----------
Elongated (or Wormhole) Porosity	----------NOT ALLOWED----------
Ungraded Discontinuities	2
Crater Crack	----------NOT ALLOWED----------
Transverse Crack	----------NOT ALLOWED----------
Longitudinal Crack	----------NOT ALLOWED----------
Tungsten Inclusions	---NO-GREATER THAN UNGRADED RADIOGRAPH--
Undercut	----------NOT ALLOWED----------
Burn Through	----------NOT ALLOWED----------
Icicles (Teardrops)	----------NOT ALLOWED----------
Elongated (or Wormhole) Porosity	----------NOT ALLOWED----------

NOTES: For table I: (These notes are an integral part of table I).

(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 part 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, and requires further review.

(3) Borderline welds may be considered acceptable, upon review and written approval by competent welding NDE and engineering personnel.

(4) Gas holes or sand spots and inclusions allowed by this table shall be cause for rejection when closer than twice their maximum dimension to an edge or extremity of a weldment, in a highly stressed or critical area as determined by design engineering personnel.

5.2.1 Applicable thickness ranges. The applicable thickness ranges for the reference radiograph illustration plate thicknesses used to determine severity level requirements for welds in table I of this document are given in table I, Applicable Thickness Ranges, under Volume II, ASTM E390. A 3/8 inch (9.5 mm) illustration plate thickness is applicable for weld thicknesses over 1/4 inch (6.4 mm) to and including 1/2 inch (13 mm). A 3/4 inch (19 mm) illustration plate thickness is applicable for weld thicknesses over 1/2 inch (13 mm) to and including 1 1/2 inches (38 mm). A 2 inch (51mm) illustration plate thickness is applicable for weld thicknesses over 1 1/2 inches (38mm) to

and including 3 inches (76 mm). The thickness limits for this document may be extended beyond the limits in table I, ASTM 390 with the approval of the procuring activity.

5.2.2 Further acceptance criteria. The design activity may choose additional acceptance criteria from AWS D 1.1, section 10.17; AWS B 3.0; and API STD 1104, section 6. Above documents will only be applicable when they appear on drawing or other contractual document.

5.3 Radiographic inspection.

5.3.1 Welds, general. Radiographic inspection shall be in accordance with MIL-STD-453. Acceptance inspection shall be in accordance with table I and ASTM E390. Extent of radiographic inspection of all welds shall be accomplished as required by drawing, contract, or other Quality document of contract. If extent is not provided, radiographic inspection shall be 100% of weld joints.

5.4 Standards.

5.4.1 Radiographic standards. Radiographic standard grades shall be established for each weld design for which radiographic inspection is specified (see 3.1). Such grades shall be in terms of ASTM E390 for steel fusion welds. Maximum acceptable defects shall be in accordance with table I.

5.5 Examination of rejected lots.

5.5.1 Rejection. Unless prohibited by the drawing, specification or other contract document, weld joints rejected because of non-compliance to ASTM E390 and table I may be repaired using a repair procedure approved by the authorized government inspector. All repaired areas shall be re-inspected in accordance with paragraph 5.3.1.

5.5.2 Review. In performing the review of the rejected lot, a technique may be detailed for the subjection of welds to various destructive tests, including loading (as in service use) or by sectioning, as practicable. This consideration shall be predicated on the size of the rejected lot, the size of the welds and criticality of the weld application.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Producibility warning. The grade assigned to the weld should represent a realistic value for safety and for the functional requirement, i.e., do not assign a grade I weld for a grade II function. Caution should be exercised in specifying the grade of maximum permissible radiographic discontinuity level to be met in a weld.

6.2 For information:

Radiographic grade I	- A weld subject to high stresses in critical applications.
Radiographic grade II	- A weld for critical applications with a small design safety factor.
Radiographic grade III	- A weld for general applications with an average design safety factor.
Radiographic grade IV	- A weld subject to low stresses.

Custodian:
Army - MR
Navy - AS
Air Force - 11

Review activities:
Army - AR, AV, MI

User activities:
Army - AL, AT, ME, TE, WV
Navy - OS

Preparing Activity:
Army -- MR

Project NDTI-0163

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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

1. DOCUMENT NUMBER	2. DOCUMENT TITLE
MIL-STD-1264B	RADIOGRAPHIC INSPECTION FOR SOUNDNESS OF WELDS IN STEEL BY

3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION (Mark one)
COMPARISON TO GRADED ASTM E390 REFERENCE RADIOGRAPHS	☐ VENDOR ☐ USER ☐ MANUFACTURER ☐ OTHER (Specify):
3b. ADDRESS (Street, City, State, ZIP Code)	

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER (Last, First, MI) – Optional	b. WORK TELEPHONE NUMBER (Include Area Code) – Optional
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