MILITARY STANDARD
INSPECTION, RADIOGRAPHIC

To all holders of MIL-STD-453C.

1. The following pages of MIL-STD-453C have been revised and supersede the pages listed:

New Page	Date	Superseded Page	Date
i	9 September 1988	i	27 Dec 84
ii	9 September 1988	ii	27 Dec 84
iii	9 September 1988	iii	27 Dec 84
iv	27 December 1984	iv	Reprinted without change
vii	9 September 1988	None	None
1	9 September 1988	1	27 Dec 84
2	27 December 1984	2	Reprinted without change
7	9 September 1988	7	27 Dec 84
8	27 December 1984	8	Reprinted without change
26	9 September 1988	None	None
27	9 September 1988	None	None
28	9 September 1988	None	None
29	9 September 1988	None	None

2. Retain this notice and insert before the table of contents.

3. Holders of MIL-STD-453C will verify that page changes and additions indicated above have been entered. This notice page will be detained as a check list. This issuance together with appended pages, is a separate publication. Each notice is to be retained by stocking points until the military standard is completely revised or cancelled.

4. Supersession Data. This standard supersedes MIL-R-11470A Radiographic Inspection, Qualification of Equipment, Operators and Procedures dated 29 July 1971.

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

Preparing activity:
Navy - AS

(Project No. NDTI-0144)

Review activities:
Army - AR, AV, ME, MI
Navy - SH, OS
Air Force - 70, 71, 82, 89

User activities:
Army - AL, GL, MD
DLA - DH, ES

AMSC No. N4522 AREA NDTI

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

9 September 1988

DEPARTMENT OF DEFENSE
WASHINGTON, DC 20402

Inspection, Radiographic

1. This military standard is approved for use by all Departments and Agencies of the Department of Defense. The appendix is applicable only to contractors performing radiographic inspection for the Army.

2. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commanding Officer, Naval Air Engineering Center, Systems Engineering and Standardization Department (SESD), Code 93, Lakehurst, NJ 08733, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

9 September 1988

FOREWORD

This document supersedes MIL-STD-00453B(USAF), Inspection, Radiographic, MIL-STD-453, Inspection, Radiographic, and MIL-R-11470A(MR), Radiographic Inspection: Qualification of Equipment, Operators and Procedures.

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27 December 1984

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APPENDIX

9 September 1988

1. SCOPE

1.1 Purpose. The purpose of this military standard is to prescribe the radiographic inspection requirements for metallic and nonmetallic materials.

1.2 Application. The criteria for radiographic inspection in this standard are applicable to all types of metallic and nonmetallic materials. The requirements expressed in this standard are intended to control the quality of the radiographic images, and are not intended for controlling the acceptability or quality of materials.

1.3 An appendix, for Army use only, is included which contains criteria for radiographic inspection qualification of equipment, operators and procedures.

2. REFERENCE DOCUMENTS

2.1 Issues of documents. The following documents of the issue in effect on date of invitation for bids or request for proposal, form a part of this standard to the extent specified herein.

STANDARDS

MILITARY

MIL-STD-410 - Nondestructive Testing Personnel Qualification and Certification (Eddy Current, Liquid Penetrant, Magnetic Particle, Radiographic and Ultrasonic)

(Copies of specifications, standards, drawings, and publications required by contractors in connection wih specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this standard to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

GOVERNMENTAL

NATIONAL BUREAU OF STANDARDS

NCRP - Basic Radiation Protection Criteria

Handbook 55 - Protection Against Betatron-Synchrotron Radiation up to 100 MeV

Handbook 59 - Permissible Dose from External Sources of Ionizing Radiation (1954)

Handbook 73 - Protection Against Radiations from Sealed Gamma Sources (1960)

Handbook 114 - General Safety Standard for Installations Using Non-Medical X-Ray and Sealed Gamma Ray Sources, Energies Up to 10 MeV (1974)

(Applications for copies should be addressed to the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.)

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 contractor 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 in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements. Unless otherwise specified, qualification of equipment, operators and procedures for Army contracts shall be in accordance with the appendix of this standard.

4.2 Personnel.

4.2.1 Personnel qualification. Personnel making accept/reject decisions based on the results of radiographic inspections perfomed in accordance with this standard shall be qualified and certified in accordance with MIL-STD-410.

4.3 Laboratory installations.

4.3.1 Safety. The premises and equipment shall present no hazards to the safety of personnel or property as specified in NBS Handbook 55, 59, 73, 114 and NCRP 39. All radiographic procedures shall be performed so that personnel shall not receive a radiation dosage exceeding the maximum permitted by city, state or national codes.

4.3.2 Radiographic exposure areas. Radiographic exposure areas shall be clean and equipped so that reproducible radiographs may be produced in accordance with the requirements of this standard.

4.3.3 Darkroom. Darkroom facilities, including equipment and materials shall be capable of producing uniform, blemish-free radiographs.

4.3.4 Film viewing room. Film viewing facilities shall be free of objectionable background light that may cause reflection on the radiographic film. Ambient light of 2.5 foot-candles measured at the viewer is optimum for viewing.

4.4 Materials.

4.4.1 Film. Production radiographs shall be made on safety film. Unexposed films shall be stored in such a manner to protect them from light, excess heat, humidity, pressure, and penetrating radiation. Table I lists the ASTM film type, relative speeds, description of emulsion and suggested application. Selection of films shall be based on radiographic quality level and the minimum permissible exposure time. The films selected shall be

capable of demonstrating the required penetrameter sensitivity. The requirements of this standard are based on radiographic film. Production radiographs on photographic paper or nonfilm methods shall be correlated with film produced in accordance with this standard. ASTM E746 provides a standard method for determining the relative image quality response of industrial radiographic film and may be used as the basis for film selection.

4.4.2 Film processing solutions. Production radiographs shall be processed in solutions capable of consistently producing radiographs which meet this standard. The time and temperature at which radiographs are processed shall be within the manufacturer's recommended range. Solutions which have become exhuasted and are not capable of producing the sensitivity required shall not be used. In semi-automatic and hand processing installations a log shall be maintained to show the number and size of film processed and replenishing dates. A radiograph of thickness standard (step wedge) shall be produced once each week by a standard technique and standard processing. The density shall correspond within ± 15 percent of an original standard radiograph.

4.5 Equipment.

4.5.1 Radiation sources.

4.5.1.1 X-radiation sources. Selection of appropriate X-ray voltage and current levels is dependent upon variables regarding the specimen being examined (material type and thickness) and exposure time. The suitability of these X-ray parameters shall be demonstrated by attainment of required penetrameter sensitivity and compliance with all other requirements stipluated herein.

4.5.1.2 Gamma radiation sources. Isotope sources which are used shall be capable of demonstrating the required radiographic sensitivity.

4.5.2 Film holders and cassettes. Film holders and cassettes shall be light tight and shall be handled properly to reduce the likelihood that they may be damaged. In the event that light leaks into the film holder and produces images on the radiograph, the radiograph need not be rejected unless the images obscure the area of interest. If film holder exhibits light leaks it shall be repaired before use or discard. Film holders and cassettes should be routinely examined to minimize the likelihood of light leaks.

4.5.3. Intensifying screens.

4.5.3.1 Lead foil screens. Unless other wise specified, intensifying screens of the lead foil or lead oxide type shall be used for all production radiography. Screens shall be of the same dimensions as the film being used and shall be in intimate contact with the film during exposure. Recommended screen thicknesses are listed in Table III for the applicable voltage range being used. Lead oxide screens are equivalent to 0.0005 inch of lead. Screens shall be free from any cracks, creasings, scratches, dust, dirt, oxides, sulphides, or any other foreign material that could render undesirable nonrelevant images on the film.

RADIOGRAPHIC INSPECTION: QUALIFICATION OF EQUIPMENT, OPERATORS AND PROCEDURES

UNLESS OTHERWISE SPECIFIED, QUALIFICATION OF EQUIPMENT, OPERATORS AND PROCEDURES FOR ARMY CONTRACTS SHALL BE IN ACCORDANCE WITH THIS APPENDIX OF THIS STANDARD.

10.0 SCOPE

10.1 Scope. This Appendix covers methods for the qualification of equipment, operators and procedures for industrial radiographic inspection.

20.0 REFERENCED DOCUMENTS

20.1 Government documents.

20.1.1 Specifications, standards, and handbooks. Unless otherwise specified, the following specifications, standards, and handbooks of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation form a part of this standard to the extent specified herein.

STANDARDS

MILITARY

MIL-STD-410 - Nondestructive Testing Personnel Qualification and Certification (Eddy Current, Liquid Penetrant, Magnetic Particle, Radiographic and Ultrasonic)
MIL-STD-453 - Inspection, Radiographic

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

30.0 DEFINITIONS

NONE

40.0 GENERAL REQUIREMENTS

40.1 Qualifications For qualification of the radiograpic process, radiographs of items requiring inspection along with detailed procedure sheets and interpretation reports shall serve as the basis for qualification. When different parts are required to be radiographed, the contracting agency will be contacted for guidance regarding the specific parts upon which the qualification process is to be performed.

50.0 DETAILED REQUIREMENTS

50.1 Procedures. Inspection procedures shall meet the general and detailed requirements of sections 4 and 5 of MIL-STD-453. Specific radiographic methods and procedures included in individual product specifications or contracts shall be followed.

50.2 Acceptance Criteria. Acceptance criteria prescribed by the product specification or individual contracts shall be followed. When not included in the product specification or contract, detailed examination points and acceptance criteria shall be stipulated by the contractor and approved by the Government for each radiographed item.

50.3 Documentation. Procedure sheets, technique, radiographic shooting sketches, interpretation reports, and qualifying radiographs shall be submitted to the contracting agency for approval prior to any acceptance inspection. Any such documentation submitted may be retained by the government. For fluoroscopic and filmless radiographic equipment, photographs of the viewing screen, video tapes, or other approved recording media may be submitted instead of radiographic films. In cases where no permanent recording of the radiographic image is required, and otherwise when considered necessary by the contracting agency, qualification may be accomplished by on-site viewing of the fluoroscopic image. DID DI-NDTI-0674, Radiographic Inspection Plan, applies to these requirements. Deliverable data identified on the DD Form 1423 shall be prepared in accordance with instructions specified in that DID.

50.4 Qualification of Personnel. Radiographic equipment operators involved with the qualification process shall be certified to at least a Level I in accordance with MIL-STD-410. The interpretation report required as part of the qualification process shall be signed by an individual certified to at least a Level II in accordance with MIL-STD-410. The inspection procedures submitted as part of the qualification process shall be signed by an individual certified to a Level III in accordance with MIL-STD-410.

50.5 Qualification Period. The qualification once issued shall remain in effect for the life of the contract or three years, whichever is shorter. However the qualification may be revoked at any time by the contracting agency or its representative when the quality of the inspection radiographs is found to be less than the quality of the qualification radiographs or other nonconformance with regulatory requirements is found.

50.6 Notification of Qualification. No radiographic inspection for acceptance purposes shall be performed prior to the receipt of notification of qualification.

60.0 NOTES

60.1 Intended use. This standard is to be used to ensure that contractors who perform radiographic work for the Army be qualified in their equipment, operation and procedures prior to performing work on contract.

60.2 Approval of documentation. The procedure sheets, technique, shooting sketch, interpretation reports, and radiographs (or other recording media) should be reviewed by a representative of the contracting agency who is a Level II radiographer. The Level II Radiographer may obtain assistance from the procuring activity through the Nondestructive Evaluation Group at the Army Materiel Command or the Materials Analysis Group at the U.S. Army Materials Technology Laboratory.

60.3 Data requirements. When this standard is used in an acquisition and data are required to be delivered, the data requirements identified below shall be developed as specified by an approved Data Item Description (DD Form 1664) and delivered in accordance with the approved Contract Data Requirement List (CDRL), incorporated into the contract. When the provisions of DOD FAR Supplement, Part 27, Sub-Part 27.475-1 (DD Form 1423) are invoked and the DD Form 1423 is not used, the data specified below shall be delivered by the contractor in accordance with the contract or purchase order requirements. Deliverable data required by this standard are cited in the following paragraphs.

Paragraph no.	Data requirement title	Applicable DID	Options
50.3	Radiographic Inspection Plan	DI-NDTI-0674	

(Data Item descriptions related to this standard, and identified in section 6 will be approved and listed as such in DoD 5010.12-L., AMSDL. Copies of data item descriptions required by the contractors in connection with specific acquisition functions should be obtained from the Naval Publications and Forms Center or as directed by the contracting officer.)

Custodian:
Army - MR
Navy - AS
Air Force - 20

Reviewing activities:
Army - AV, ME, MI, AR
Navy - AS

User activities:
Army - AT, AL,

Preparing activity
Army - AS

Project No. NDTI-0144

(WP# ID-6896/DISK-0579A. FOR MTL USE ONLY.)

DATA ITEM DESCRIPTION

Form Approved
OMB No 0704-0188

2. TITLE	1. IDENTIFICATION NUMBER
Radiographic Inspection Plan	DI-NDTI- 80674

3. DESCRIPTION / PURPOSE

3.1 This plan describes the contractor's radiographic procedure, technique and contains a sketch as to how the radiograph will be taken. The principal use is to provide the contracting activity a basis upon which to judge the acceptability of the contractor's work.

4. APPROVAL DATE (YYMMDD)	5. OFFICE OF PRIMARY RESPONSIBILITY (OPR)	6a. DTIC APPLICABLE	6b. GIDEP APPLICABLE
880812	AS		

7. APPLICATION / INTERRELATIONSHIP

7.1 This DID contains the format and content preparation instruction for data as specified in 50.3 of the appendix. Radiographic Inspection: Qualification of Equipment, Operators and Procedures of MIL-STD-453C.

8. APPROVAL LIMITATION	9a. APPLICABLE FORMS	9b. AMSC NUMBER
		DID - N4523

10. PREPARATION INSTRUCTIONS

10.1 Content and format. The Radiographic Inspection Plan shall consist of the Radiographic Procedure, Technique, Shooting Sketch and Interpretation Report that shall document in detail the contractor's plan for performing the required radiographic inspection.

10.1.1 The Radiographic Procedure sheet shall include procedure data (sample format) in figure 1.

10.1.2 An outline for the Technique (sample format) in figure 2.

10.1.3 The information required for Radiographic Shooting Sketch (sample format) is given in figure 3.

10.1.4 Data required for Radiographic Interpretation Report (sample format) in figure 4.

(Continued on page 2)

11. DISTRIBUTION STATEMENT

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

10. Preparation Instructions (continued)

Procedure No._____

Part, Acceptance Sheet

Part Name_____ Part ID_____

Drawing No._____ Stage of Mfg._____

Material _____ Surface Condition _____

Requirements Doc_____ Technique Doc_____

Acceptance STD/Doc_____ Penetrameter Block_____

Acceptance Criteria_____

Equipment

X-Ray

Mfg._____

Model & Type_____

Focal Spot_____

Current/RAD Rating_____

Voltage Rating_____

Isotope

Source_____

Source Strength_____
Curries Date

Camera Mfg. & Model_____

Source Spot Size_____

Film Processing

_____ Manual _____ Automated

Intensifying Screen/Filters

Front Screen: Material _____ Thickness _____

Back Screen: Material _____ Thickness _____

Filters: Material _____ Thickness _____

Location _____

Automatic Processor Mfg. & Model _____
Developer Temperature _____
Complete Cycle Time _____

FIGURE 1. Radiographic procedure sheet.

10. Preparation Instructions (continued)

Procedure No._____

No. of Exposures _____

Exposure No.	1	2	3	4	5	6
Quality Level						
Density Requirement						
No. of Films						
Film Brand						
Film Type						
Film Size						
No. of Pen.						
Pen. Material						
Pen. Size						
Shim Material						
Source to Film Distance						
KV						
Milliamps						
Exposure Time						
Material Thickness						
Shim Thickness						
Masking or Blocking Instructions						
Shot/Film Identification						

Special Instructions_____

Reporting Requirements_____

Disposition_____

FIGURE 2. Technique.

10. Preparation Instructions (continued)

Procedure No._____

Showing:
a. Areas to be radiographed
b. Thickness of material
c. Location marker
d. Direction of radiation
e. Penetrameter placement (IQI)
f. Block/masking
g. Source to film distance
h. Location of film

Prepared by_____ Approved by_____

Title_____ Title_____

Date_____ Date_____

Company Name_____

FIGURE 3. Radiographic shooting sketch.

10. Preparation Instructions (continued)

Part Name _____ Part ID _____

Drawing No. _____ Requirements Doc. _____

Technique Doc. _____ Stage in Mfg. _____

Material _____ Surface Condition _____

Acceptance Std/Doc. _____ Acceptance Criteria _____

_____

_____

Inspection Procedure No. _____

DATA

Part/Shot I.D.						Identifying rejectable defects including size and location

Inspector	Cert Leval	Date	Reviewer	Cert Level	Date

FIGURE 4. Radiographic interpretation report.