

INCH-POUND

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18 JULY 1996

SUPERSEDING
MIL-I-6870E
29 AUGUST 1979

MILITARY HANDBOOK

INSPECTION PROGRAM REQUIREMENTS NONDESTRUCTIVE FOR AIRCRAFT AND MISSILE MATERIALS AND PARTS



AMSC N/A

AREA NDTI

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29 August 1979

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MILITARY SPECIFICATION

INSPECTION PROGRAM REQUIREMENTS
NONDESTRUCTIVE FOR AIRCRAFT AND
MISSILE MATERIALS AND PARTS

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1 SCOPE

1.1 Scope. This specification covers requirements for establishing the nondestructive inspection (NDI) program for the procurement of all supplies and products when directly referenced in the item specification contract or order.

1.2 Applicability. This specification shall apply to new structural components for aircraft and missiles and their propulsion systems when the design activity or system specification requires nondestructive inspection for acceptance.

2 APPLICABLE DOCUMENTS

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

SPECIFICATIONS

MILITARY

MIL-I-6866	Inspection, Penetrant Method of
MIL-I-6868	Inspection Process, Magnetic Particle
MIL-I-8950	Inspection Ultrasonic, Wrought Metals, Process for
MIL-I-83387	Inspection Process, Magnetic Rubber
MIL-A-83444	Airplane Damage Tolerance Requirements

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Air Force Materials Laboratory, MXA, WPAFB, OH 45433, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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STANDARDS

FEDERAL

FED-STD-151 Metals; Test Methods

MILITARY

MIL-STD-143 Standards and Specifications, Order of
Precedence for the Selection of
MIL-STD-410 Qualification of Inspection Personnel
MIL-STD-453 Inspection, Radiographic
MIL-STD-00453 Inspection, Radiographic
MIL-STD-860 Fokker Ultrasonic Adhesive Bond Test
MIL-STD-867 Temper Etch Inspection
MIL-STD-1530 Aircraft Structural Integrity Program
Requirements
MIL-STD-1537 Electrical Conductivity Test For
Measurement of Heat Treatment of
Aluminum Alloys, Eddy Current Method

FORMS

DD1423 Contract Data Requirements List

(Copies of specifications, standards, drawings, and publications required by contractors in connection with 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 specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B244 Measuring Thickness of Anodic Coating on
Aluminum with Eddy Current Instruments
ASTM B342 Electrical Conductivity by Use of Eddy
Currents
ASTM E113 Recommended Practice for Ultrasonic Testing
by the Resonance Method
ASTM E164 Standard Method for Ultrasonic Contact
Inspection of Weldments

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ASTM E215	Recommended Practice for Standardizing Equipment for Electromagnetic Testing of Seamless Aluminum Alloy Tubing
ASTM E309	Recommended Practice for Eddy Current Testing of Steel Tubular Products with Magnetic Saturation
ASTM E376	Recommended Practice for Measuring Coating Thickness by Magnetic Field or Eddy Current (Electromagnetic) Test Methods
ASTM E426	Recommended Practice for Electromagnetic (Eddy Current) Testing of Seamless and Welded Tubular Products, Austenite Stainless Steel and Similar Alloys
ASTM E427	Recommended Practice for Testing of Leaks Using the Halogen Detector (Alkali-Ion Diode)

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

3. REQUIREMENTS

3.1 Preparation of NDI plan. The prime contractor shall establish in writing an overall systems plan to assure adequate nondestructive inspection of structural components for which the prime contractor determines NDI acceptance is necessary in an aircraft or missile system.

3.1.1 Objective. NDI detection capability must be considered by the prime contractor during system design as indicated in applicable design specifications. The objective of the NDI plan is to assure a level of nondestructive inspection capability and confidence consistent with the prime contractor's design requirements.

3.1.2 Applicability. This plan shall include and be applicable to structural components as specified in the system specification and produced by the contractor, subcontractors, and suppliers under government contract.

3.1.3 Elements. This plan shall present the scheme for establishing the NDI requirements and implementing procedures to meet these requirements. It shall include the means of:

- a. Conducting a materials and parts classification.
- b. Coordination of design requirements and NDI procedures.

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- c. Preparing new NDI procedures, as applicable.
- d. Implementing NDI procedures.

3.1.4 Coordination. This plan shall be coordinated with the Aircraft Structural Integrity Plan (ASIP) when MIL-STD-1530 is a contractual requirement.

3.2 Materials and parts classification. The contractor shall classify all structural components according to the structural integrity requirements of applicable specifications. Complex components may be divided into zones and a separate classification or quality grade assigned to each zone in accordance with the reliability requirements. Classification shall be noted on the drawing of the component or other released engineering data. Components shall be classified as follows:

Class 1 - Components which are fracture or fatigue critical (6.2.4) or components the single failure of which would cause significant danger to operating personnel or would result in an operational penalty. This includes loss of major components, loss of control, unintentional release, inability to release armament stores, or failure of weapon installation components.

Subclass 1A - A subclass 1A component is a safety of flight component, the single failure of which would result in the loss of an aircraft or missile system.

Subclass 1B - Components subject to fracture and fatigue but not included in Subclass 1A.

Class 2 - All components not classified as Class 1.

3.3 NDI Technical Requirements Review Board. The contractor shall utilize appropriate competent technical personnel to develop and implement the nondestructive inspection plan required to assure product design integrity. The government shall retain the right of disapproval of the NDI requirements review system.

3.3.1 Purpose. The NDI Requirements Review Board shall determine the nondestructive inspection requirements for those components identified in accordance with 3.2 to assure that the most appropriate inspection technique(s) have been selected for the components being tested, and that the level of inspection is commensurate with the quality required.

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3.3.2 Documentation of the review. Notation indicating NDI Board review and approval shall be documented on the appropriate drawing for each Class 1 and designated Class 2 component identified in 3.2. Acceptable defect size, critical location and orientations shall be referenced on the drawings or other released engineering documents as appropriate. In all cases, the notation will consist of the signature of the contractor's authorized NDI Review Board representative.

3.3.3 Drawings. The NDI Board review shall be the basis for specification of NDI requirements on engineering production drawings. The NDI procedure number, process specification, or coding, thereto, will be referenced on the drawing.

3.4 Preparation of NDI procedures and process specifications.

3.4.1 Use of general NDI process specifications. The use of process specifications such as those listed in 2.1 and 2.2 as sole controlling documents is not permitted. These specifications reflect minimum quality requirements and, of necessity, are broad in scope.

3.4.2 Company NDI process specifications. Company process specifications shall be prepared incorporating the requirements of the referenced process specifications and in addition supplying detailed information necessary to meet or exceed these specifications using the particular equipment, personnel, and test facilities required to meet the reliability requirements of the product. If no general process specification exists for a particular method a company process specification or general NDI procedure shall incorporate sufficient information and criteria to adequately describe the NDI method and control the process.

3.4.2.1 Special NDI procedures. Special procedures to inspect designated components may be used to supplement company process specifications. A contractor may elect to incorporate all processing criteria into each NDI procedure in lieu of generating process specifications.

3.4.2.2 NDI Standardization. The company process specification shall reflect procedures, acceptance criteria and records requirements to assure adequate quality assurance measures are being enforced to keep the NDI process in control. Basic process, equipment, materials, and technique variables as applicable shall be monitored to assure adequate control of the inspection process.

3.4.2.3 Approval. Company process specifications to be applied on aircraft and missile components must be coordinated with an authorized representative of the contractor and be subject to review by the Government as specified by the contract.

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3.4.3 NDI processes. The following methods of nondestructive inspection are acceptable. Company process specifications maybe used to supplement if needed.

- a. Magnetic particle, in accordance with MIL-I-6868.
- b. Penetrant, in accordance with MIL-I-6866.
- c. Radiographic, in accordance with MIL-STD-453 or MIL-STD-00453 for Air Force applications.
- d. Ultrasonic, in accordance with MIL-I-8950 and ASTM E113 or E164, as applicable.
- e. Eddy current, in accordance with MIL-STD-1537 and ASTM B244, B342, E215, E309, E376, or E426, as applicable.
- f. Thermal, in accordance with an approved company process specification.
- g. Magnetic rubber in accordance with MIL-I-83387.
- h. Leak testing in accordance with FED-STD-151 and ASTM E427, as applicable.
- i. Adhesive bond strength testing in accordance with MIL-STD-860.
- j. Temper etch inspection in accordance with MIL-STD-867.
- k. Other methods, in accordance with an approved company process specification or other industry document.

3.4.4 NDI procedures. NDI procedures will be provided for inspection of each part requiring NDI as per 3.3.2, except when special procedures are utilized per 3.4.2.1. These procedures shall be in accordance with the requirements of the component drawing, the company process specification, or other engineering requirements, and shall contain the information listed below:

- a. Specific part or drawing reference.
- b. Surface finish and part preparation, as applicable.
- c. Manufacturer and model number of all instrumentation to be used, indicating optional equivalents, if desired.

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- d. Fixturing requirements, as applicable.
- e. Manufacturer and identification of required inspection materials.
- f. Reference to company process specification procedure if applicable.
- g. Calibration/standardization procedure and reference standard identity as applicable.
- h. Identification of areas to be inspected, detailed steps and level of inspector qualification required, and acceptable defect criteria including location and most critical orientation (based upon primary stress condition and direction) or equivalent drawing or specification reference for these criteria.
- i. Identifiable precautions in use of the inspection procedure.

3.4.5 General NDI procedures. General procedures or company process specifications are acceptable for common product forms such as plate, bar stock, fasteners and tubular products.

3.5 Implementation of NDI procedures.

3.5.1 Personnel. The contractor shall have available records of certification for personnel conducting and interpreting nondestructive inspections in accordance with the applicable sections of MIL-STD-410 or other methods in accordance with the contract.

3.5.2 NDI reports. The contractor's NDI reports and data records shall be kept on file if no time limit is otherwise specified. Reports shall be signed or stamp identified by an authorized representative of the inspection facility.

3.5.3 Equipment and materials. The equipment and materials used for inspection shall be in accordance with the applicable company process specification. Specified equipment shall have adequate maintenance to assure that it is fully operational when used to conduct inspections.

3.5.4 NDI procedure verification. All procedures and procedure families shall be verified to assure repeatable defect sensitivity sufficient for the classification of the part. Procedures may be verified on parts or on test pieces simulating the actual part and which provide the essential features of the part with regard to the important application variables which may affect defect sensitivity and confidence level. Redundant inspections may be utilized.

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3.5.5 Removal of discontinuities. When nondestructive inspection reveals discontinuities in excess of the level permitted by applicable drawings or specifications, such discontinuities may be removed if permitted by applicable drawings and specifications or authorized by Material Review Board action. Evidence of removal shall be shown by reinspection.

3.5.5.1 Reinspection. Reinspection for removal of discontinuities shall be conducted using the same procedure. If a new procedure is still necessary to be used, an addendum or temporary change to the original procedure as approved by Materials Review Board action shall be prepared showing the essential features of the repair test.

3.5.6 Inspection scheduling.

3.5.6.1 Receiving inspections. Incoming materials, parts or assemblies must meet the applicable engineering requirements.

3.5.6.2 Manufacturing and assembly. Inspection shall be performed as necessary during manufacture and assembly of components to assure acceptable final parts or assemblies.

- a. When processing operations are involved which may adversely affect the quality of material or part, such as heat treating, forging, or cold forging, NDI shall be performed subsequent to such operations.
- b. When processing operations are involved which may interfere with the kind(s) of inspection to be used, inspection shall be performed prior to such operations.

3.5.7 Data and documentation. Requirements expressed or implied herein concerning preparation, submittal, approval, availability, retention, or delivery of data or documentation shall be applicable only to the extent provided in the contract (reference DD Form 1423).

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for NDI. Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements as specified in the NDI program. Except as otherwise specified in the contract, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements unless disapproved by the Government.

5. PACKAGING

This section is not applicable to this specification.

6. NOTES

6.1 Intended use. This document is intended to be used by the applicable organization(s) in setting forth specific policy as to the required nondestructive inspection program to be conducted in production of aircraft and missile materials and parts.

6.2 Definitions.

6.2.1 Certification. Certification shall mean written testimony of qualification. The certifying agency may be the employer of the inspection personnel.

6.2.2 Class. Class refers to functional reliability requirements of the material or part and implies a confidence level requirement for NDI. A high-reliability class may require redundant testing to assure adequate NDI confidence level.

6.2.3 Contracting agency. A contractor, subcontractor, or Government agency procuring parts or services.

6.2.4 Contractor. Contractor shall mean that organization having contractual responsibility to the Government.

6.2.5 Final inspection. The last inspection of a part or component, usually just prior to final acceptance. This may occur during manufacturing if the component becomes uninspectable at some later stage or fabrication or if it is inspected just after some processing step and is not subject to reinspection after further processing.

6.2.6 Fracture or fatigue critical component. Components which are susceptible to crack initiation and propagation mechanism such as established in MIL-STD-1530/MIL-A-83444.

6.2.7 General NDI procedure. An NDI procedure applicable to a general category of product such as plate, bar stock, etc.

6.2.8 Materials Review Board. A government approved review of discrepant materials by authorized contractor Engineering and Quality Assurance personnel to determine whether materials can be returned to an acceptable state.

6.2.9 NDI facility. NDI facility shall mean that organization responsible to the contractor and the subcontractor for nondestructive inspection services.

6.2.10 NDI procedure. A procedure providing detail information on "how-to" perform a particular NDI technique as per 3.4.4.

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6.2.11 NDI process specification. A specification defining the nondestructive testing requirements for equipment, materials, personnel, etc., for a particular NDI technique or for the testing of a particular product.

6.2.12 Nondestructive inspection. Inspection processes or techniques intended to reveal conditions at or beneath the external surface of a part or material which cannot be evaluated solely by visual examination with or without magnification or by dimensional measurement.

6.2.13 Special NDI procedures. An NDI procedure to inspect designated components which incorporates all processing criteria and may be used in lieu of company process specifications.

6.2.14 Subcontractors. Subcontractor (supplier) shall mean that organization responsible to the contractor for a portion of the contracted product.

6.2.15 Supplier. The organization directly responsible for delivering a material, part or service to the Government, a contractor, or a subcontractor.

6.2.16 Qualification. The ability of personnel to meet the minimum requirements for a specified level of capability.

Custodians:

Army - MR
Navy - AS
Air Force - 11

Preparing Activity:

Air Force - 11
Project No. NDTI-0029

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL*(See Instructions - Reverse Side)*

1. DOCUMENT NUMBER

2. DOCUMENT TITLE

3a. NAME OF SUBMITTING ORGANIZATION

4. TYPE OF ORGANIZATION *(Mark one)* VENDOR USER MANUFACTURER OTHER *(Specify):* _____b. 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)* - Optionalb. WORK TELEPHONE NUMBER *(Include Area Code)* - Optionalc. MAILING ADDRESS *(Street, City, State, ZIP Code)* - Optional8. DATE OF SUBMISSION *(YYMMDD)*

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