



The Engineering Society
For Advancing Mobility
Land Sea Air and Space

INTERNATIONAL^â

400 Commonwealth Drive, Warrendale, PA 15096-0001

Submitted for recognition as an American National Standard

AEROSPACE STANDARD

SAE AS7114/3

Issued 1997-07
Superseding AS7100/1A

NADCAP REQUIREMENTS FOR NONDESTRUCTIVE TESTING FACILITY ULTRASONIC SURVEY

1. SCOPE:

This Aerospace Standard (AS) is to be used as a supplement to AS7114. In addition to the requirements contained in AS7114, the requirements contained herein shall apply to suppliers seeking NADCAP accreditation for Ultrasonic Nondestructive Testing.

When customer requirements differ from those specified herein, the customer requirements shall take precedence.

2. REFERENCES:

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15086-0001.

AS7003 National Aerospace and Defense Contractors Accreditation Program (NADCAP)
-Program Operation

AS7114 National Aerospace and Defense Contractors Accreditation Program (NADCAP)
-Nondestructive Testing

2.2 U. S. Government Publications

Available from DODSSP Subscription Services Desk, Building 4D, 700 Robbins Avenue,
Philadelphia, PA 19111-5094.

MIL-STD-410 Nondestructive Personnel Qualification and Certification

MIL-STD-2154 Inspection, Ultrasonic, Wrought Metals, Process for

MIL-STD-45662 Calibration Systems Requirements

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2.3 ASTM Publications:

Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187.

ASTM E 317 Practice for Evaluating Performance Characteristics of Ultrasonic Pulse-Echo Testing Systems Without the Use of Electronic Measurement Instruments

ASTM E 428 Practice for Fabrication and Control of Steel Reference Blocks Used in Ultrasonic Inspection

ASTM E 1324 Guide for Measurement of Electronic Characteristics of Ultrasonic Examination Instruments

3. **INSTRUMENTATION AND CALIBRATION:**

3.1 If instrument calibration is performed in-house, procedures defining the instrument calibration operations and parameters shall exist and be available for review by the customer or its representative at the facility performing the instrument calibration.

3.2 Instrument calibration records shall meet the requirements of either MIL-STD-2154, ASTM E 317, or specific customer requirements.

3.3 Instrument calibration intervals shall be annual, as a minimum, unless otherwise specified by the customer.

3.4 If instrument calibrations are not performed by the audited facility, identification of the calibration source shall be available.

3.5 Instrument calibrations shall comply with the requirements of Table II of MIL-STD-2154 or customer requirements as applicable.

3.6 Course and fine attenuator switch checks shall be made on an annual basis unless otherwise specified by a customer.

3.6.1 Records of attenuator switch checks shall be available for review by the customer or its representative.

3.7 If instruments are operated from an AC power source, protection shall be provided to prevent voltage surges or fluctuations, in accordance with MIL-STD-2154, Para. 5.2.4.

4. **TEST SYSTEMS:**

4.1 Scanning and indexing equipment shall be of adequate capacity to accommodate the parts being inspected and shall provide sufficient index capability to assure 100% part coverage.

4.2 Scanning and indexing equipment shall permit measurement of both scanning and indexing distances within ± 0.1 " or as specified by the customer.

- 4.3 Manipulating equipment shall provide for measurable control of the search units within 1° in two mutually perpendicular directions.
- 4.4 Records of equipment maintenance and repair shall be retained and available for review. These records shall include corrective action, repairs, and results.
- 4.5 Data acquisition mediums such as recorders, C-scans, etc., shall have sufficient accuracy to allow location of a defect within the customer or controlling specification's accuracy requirements.
- 4.6 Handling fixtures, turntables, etc. shall have sufficient capacity to permit inspection and movement of parts in such a manner that Will prevent damage to the part or injury to personnel.
- 4.7 If tubing or round bar inspection equipment is used, the scan index shall be synchronized with the scan motion in order to assure complete coverage of the inspected materials.
- 4.8 If inspection equipment is computer operated, the related software documentation shall be controlled to prevent unauthorized changes and to document any alterations in the programming data.
5. **TRANSDUCERS:**
- 5.1 Transducers shall be stored in such a manner as to prevent damage that would adversely affect their performance.
- 5.2 A procedure shall be established which describes how transducers are to be evaluated, and lists the acceptance/rejection criteria for the various types of transducers in use.
- 5.3 Transducers shall be permanently identified with a unique serial number to permit traceability.
- 5.4 Beam profiles shall be established, and beam symmetry shall be checked for all immersion transducers that are currently in use as required by customer.
- 5.5 For focused immersion transducers in use, the focal spot size or effective beam width and the focal length shall be established and documented to determine the maximum scan index. The interval of this check shall conform to applicable customer requirements.
- 5.6 A procedure shall be established which defines the standardization, inspection, and defect evaluation that is performed utilizing the various types of transducers in use, i.e., linear array, paintbrush, pitch catch, etc.
- 5.7 If linear array transducers are being used for straight beam immersion inspection of wrought material, a procedure shall be established which defines standardization, inspection, and defect evaluation.

5.8 If transducer wedges and/or shoes are used for contact inspection, they shall be checked initially for the resulting beam angle and rechecked periodically for wear and changes in the resulting beam angle.

6. **REFERENCE STANDARDS AND REFERENCE STANDARDS DOCUMENTATION:**

6.1 Reference standards shall be stored in such a manner as to prevent damage from mishandling, corrosion, pitting, etc.

6.2 Records shall be maintained for all reference standards that indicate their compliance with applicable customer specifications.

6.3 If hollow cylindrical standards are used, the calibration procedure shall contain the information necessary to determine the offset distance "D" to obtain the maximum response for all inspection grades contained within the procedure.

6.4 The certification records of calibration standards shall certify that the material is free of discontinuities that would be detrimental to their intended use, as required by the customer.

6.5 All reference standards shall be clearly identified as to material type, hole or notch size, angle and depth of hole, etc., or they shall be traceable to documentation that provides this information.

7. **PROCEDURES:**

7.1 If applicable, ultrasonic inspection procedures shall contain a statement that, as a minimum, the requirements of MIL-STD-2154 are being met.

7.2 If required, a unique procedure or technique sheet shall be prepared for each component being tested.

7.3 A general procedure may be established for common product forms such as bar, plate, forgings, etc.

7.4 If special materials, such as beryllium or titanium, are being processed, procedures that address handling of these materials shall be established.

7.5 If applicable, written procedures and/or scan plans shall contain the following information:

- a. Name and address of the testing facility
- b. Number of the procedure, date, and latest revision letter or number
- c. Appropriate Level III approval and customer approval
- d. Reference(s) to the controlling specification(s)
- e. A statement to the effect that all personnel performing the inspection operations are qualified and certified to the applicable contract specification requirements
- f. Identification of program applicability, if applicable

7.5 Continued:

- g. Approved deviations, if applicable
- h. Specific material and form for which the procedure is written
- i. Inspection method, i.e., contact, immersion, etc.
- j. Manufacturer and model number of equipment being used including recording equipment, alarm equipment, and distance-amplitude correction equipment
- k. Type and size of transducer, including frequency, transducer element materials, sound beam angle, and description of any wedges, shoes, bubblers, squirters, etc.
- l. Description of any manipulating and scanning equipment
- m. Any required surface preparation, such as finish, pickling, mechanical cleaning, etc.
- n. Applicable acceptance class requirements
- o. Part marking
- p. Any inspection zones or material envelopes, if applicable
- q. For composite parts, a map or grid of the part with locators to assist in defect location and evaluation
- r. Transducer to part distance for through transmission, if applicable
- s. Couplant
- t. A scan plan
- u. The method for determining the dB correction factor, if required
- v. Pulse repetition rate, if required
- w. Method of establishing scan sensitivity
- x. Effective beam width of transducer
- y. Scan speed and scan index
- z. Any limits on reject, noise level, gate levels
- aa. Discontinuity evaluation instructions
- ab. Identification of any related software programs including manufacturer, version, author, etc.
- ac. Post-inspection cleaning instructions, if required

8. **PROCESSING CONTROLS:**

- 8.1 Applicable procedures, accept/reject criteria, and additional instructions that are required for the inspector to perform the inspection shall be readily available to the inspector.
- 8.2 Reference standards shall be representative of the material being inspected, both in material type and configuration, as specified by customer.
- 8.2.1 If reference standards are not representative of the material being tested, a procedure shall be available to compensate for dB attenuation differences between the standard and the part.
- 8.3 System standardization checks shall be performed prior to and immediately following each inspection, after any change in equipment settings or modules, every two hours, or according to customer instructions.

- 8.4 If required, dynamic (operational) system checks shall be made in accordance with customer requirements.
- 8.5 A written method shall be established to address the corrective action required if the instrument fails the post-inspection standardization check.
- 8.6 Parts or material shall be handled per customer requirements and in such a manner as to prevent damage.
9. **INSPECTION METHODS:**
- 9.1 The couplant shall be free of air bubbles or other foreign materials which could interfere with the ultrasonic test.
- 9.2 Unless otherwise specified, the water path distance for calibration and inspection shall be ± 0.25 in.
10. **COMPLIANCE:**
- 10.1 Compliance audits of representative inspections from current production shall be conducted to determine compliance With the requirements contained herein and applicable customer requirements. Parts should be selected to represent a variety of customer requirements and several different types of processing equipment if more than one ultrasonic line is in use at this facility.
- 10.2 The following forms for parts being tested shall be provided (copies for one part only).
- a. Copy of completed technique card of procedure.
 - b. Copy of completed shop traveler or work order.
 - c. Copy of NDT completed report format.
 - d. Copy of customer specification page.
 - e. Copy of acceptance criteria or drawing data.
- 10.3 If parts are serialized or heat coded, the serial numbers or heat codes shall be maintained on the shop paperwork to assure traceability.
- 10.4 The work instructions shall indicate the correct procedure references.
- 10.5 The inspectors shall follow the planning and other instructions.
- 10.6 Parts shall be clean and free of dirt, scale, oil, or other contaminants that would interfere with the inspection.
- 10.7 The surface condition of the parts or material to be inspected shall be adequate for the level of inspection to be performed.