SAE Aerospace
An SAE International Group

AEROSPACE STANDARD

SAE AS7114/4A

Issued 1997-07
Cancelled 2008-08

Superseded by PRI AC7114/4

NADCAP
Requirements for Nondestructive Testing Facility
Radiography

RATIONALE

AS7114/4A is being cancelled and superseded by PRI AC7114/4. The requirements in the document have not changed.

CANCELLATION NOTICE

This document has been declared "CANCELLED" as of August 2008 and has been superseded by PRI AC7114/4. By this action, this document will remain listed in the Numerical Section of the Aerospace Standards Index noting that it is superseded by PRI AC7114/4.

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1. **SCOPE**:

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

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

ASTM E 155 Reference Radiographs for Inspection of Aluminum and Magnesium Castings
ASTM E 186 Reference Radiographs for Heavy-Walled (2- 4-1/2 in) (51 - 114 mm)) Steel Castings
ASTM E 192 Reference Radiographs of Investment Steel Castings for Aerospace Applications
ASTM E 446 Reference Radiographs of Steel Castings Up to 2 in (51 mm) in Thickness

2.3 Military Publications: Available from Naval Publications and Forms Center, Attn: NPODS, 5801 Tabor Avenue, Philadelphia, PA 19120-5099.

MIL-STD-453 Inspection, Radiographic
MIL-STD-45662 Calibration Systems Requirements

3. **PROCEDURES:**

3.1 If applicable, there shall be defined procedures for special material handling and processing of parts (e.g. for beryllium and titanium, etc.).

3.2 Procedures and/or technique cards shall be prepared for each part number that contain all the information required to X-ray the part or assembly. These procedures and/or technique cards shall include the following information as a minimum:

a. The procedure number, revision letter and date, applicable program and/or customer, and the date the procedure was approved
b. The part name, part number, material, class, grade, model designation (as applicable), sketch, state of fabrication, and dimensions significant to the part to be examined
c. Materials required (i.e., tape, fixtures, etc.)
d. Surface preparation (finishing and cleaning), if required
e. Applicable acceptance class and zone in accordance with engineering drawing specification (accept/reject criteria and source of criteria)
f. A statement to the effect that all personnel are qualified and certified to the applicable contract requirements
g. Disposition of reports, films, and inspection records; and methods of marking parts after inspection
h. A sketch or photograph(s) of the set-up detailing the following for each view:
   - Film location relative to the part and radiation beam
   - Thickness ranges to be radiographed
   - Location of IQI's/Penetrameters
i. Type and thickness of IQI's/penetrameters, shims, and blocks
j. Exposure parameters (kV, mA, and time)
k. Source-to-film distance (SFD)
l. Part-to-film distance (PFD)
m. Angle between the central beam and the part or film
n. Film brand, type, and size
o. Effective focal spot size of the X-ray equipment to be used (i.e., large, small, dimension)
p. Cassette/film holder type, if applicable
q. Type and thickness of screens and film loading instructions, if needed
r. Blocking or masking materials and techniques, if used
s. Filter material, thickness, and location, if used
t. Film viewing and interpretation instructions
u. H & D film density range in the area of interest
v. Radiographic quality level
w. X-ray machine used, manufacturer, model number, and peak voltage rating
x. Film processing techniques, methods, and chemicals used
y. Identification of organization performing inspection
z. Other data as required, e.g., multi-film techniques, location of markers, etc.
aa. Prime contractor approval when required by purchase order or specification

3.2 Continued:

ab. Cognizant customer and/or supplier Level III approval signature
ac. Type and amount of backing material used, if required
ad. Additional information for special applications such as in-motion radiography, field operations, isotopes, high energy (above 1 MeV), etc.

4. **NDT PROCESS CONTROL**:

4.1 The facility shall maintain and use a system by which parts and radiographs are identified and correlated.

4.2 The lead letter “B” shall be on the back of the film cassette or placed on the lead covered table under and in direct contact with the film cassette with the lead letter “B” maintained in the area of interest, or per customer requirement.

4.3 Exposed film of step wedge or equivalent shall be processed at least weekly and the results shall be recorded.

4.3.1 Results shall be recorded to within ±15% film density required of original standard radiograph.

5. **FILM PROCESSING AREA**:

5.1 The facility shall be equipped with an adequate darkroom/film processing area for the loading of the film holders and development of film such that production of nonconforming radiographs is minimized.

5.2 The film processing equipment shall be adequate for performing production processing.

5.3 **Automatic Processors:**

5.3.1 Automatic processors shall be maintained within the processor and chemical manufacturer’s specified temperature, processing speed, replenishment rates, and concentrations.

5.3.2 Automatic processors shall be tested periodically, when solutions are changed, and/or when malfunction is suspected.

5.3.3 Automatic processors shall be cleaned and maintained in accordance with manufacturer’s recommendations.

5.3.4 A maintenance log shall be maintained for automatic processors.

5.4 **Manual Processing:**

5.4.1 For manual film processing, a log shall be maintained showing number and sizes of film processed, replenishment dates, volume and composition of solutions.

5.4.2 Manual processing times shall be adjusted in accordance with manufacturer's instructions to compensate for fluctuations in temperature, reduction in batch strength, and age of processing solutions.

5.4.3 Manual processing solutions shall be maintained within manufacturer's specified temperature range and replenishment rate.

5.4.4 A calibrated alarm timer shall be available for manual processing to provide for accurate processing times.

5.4.5 The developer solution activity shall be properly monitored and controlled.

5.5 Film Processing:

5.5.1 The drying of film shall be properly controlled.

5.5.2 The safe light illumination level in the darkroom shall be appropriate.

5.5.3 The storage of film and chemicals shall be adequate to preclude adverse effects on radiograph quality.

5.5.4 Radiographic film shelf life shall be controlled, when required by customer.

5.5.5 Cassettes and other film holders shall be available that are opaque, light-tight, absorb radiation uniformly, and do not interfere with film sensitivity.

5.5.6 Screens shall be available and shall be used, when required.

6. **EXPOSURE ROOM:**

6.1 All X-ray equipment shall have:

a. Voltage and amperage controls and meters
b. Timers to control exposure length

6.2 Adequate provisions shall be made for positioning of the X-ray head, part and/or table for taking the necessary radiographs.

6.3 Filters of copper, lead, or other suitable materials shall be available as necessary.

6.4 Lead numbers, letters, and markers of sufficient height and thickness (or dark room flasher system) shall be available for film identification purposes.

6.5 Penetrameters or other image quality indicators (IQI) of the proper materials, sizes, and quantities shall be available.

6.6 Penetrameters/IQI's shall be verified.

6.7 Penetrameters/IQIs shall be well maintained and properly identified. Holes shall be kept clean.

6.8 If required, shims and blocks shall be available.

6.9 If required, masking material of lead, lead shot, or other suitable material shall be available.

6.10 General exposure charts shall be used when applicable.

7. **FILM VIEWING AREA:**

7.1 The viewing area shall be clean (e.g., free of dust, dirt, and liquids) and conducive to proper film interpretation.

7.2 The film viewing area shall be conducive to film interpretation (e.g., constructed in such a manner that no objectionable light, direct or indirect, interferes).

7.3 Viewers shall be equipped with a fan or other cooling device to prevent damage to film.

7.4 Viewers shall be equipped with light diffusing glass surface to provide a uniform reading surface when required.

7.5 Viewers shall be equipped with a variable control to allow the selection of optimum intensities for film viewing.

7.6 Viewers shall be equipped with a high intensity aperture area for spot viewing, when required by customer.

7.7 The facility shall have a white light meter and test film of required density for checking illuminator brightness, when required by customer.

7.8 The film viewer shall be checked with a calibrated light meter.

7.9 Optical aids, 3X - 10X, and magnifiers shall be utilized as necessary for film review. Instruments and equipment used for flaw evaluations and measurements shall be calibrated.

7.10 If exposed film is stored at inspection facility, there shall be archival procedures/controls.

7.11 Standard Reference Radiographs shall be available, if required.

7.12 Finished radiographs shall be permanently identified on the exposure with the following information as a minimum:

a. The NDT facility name or identifier
b. Part number, if applicable
c. Serial number/control number
d. The date X-rayed
e. The X-ray view number, if applicable
f. Location markers, if applicable
g. Lot number, if applicable
h. R1, R2, R3 etc. if repair radiographs

7.13 There shall be provisions for verification and marking of irrelevant and relevant indications on radiographs.

7.14 A densitometer shall be available that is capable of measuring H & D densities up to 4.0 in increments of no more than 0.02.

7.15 The facility shall maintain step wedge films traceable to NIST for calibration of densitometers.

7.16 Standardization of the densitometer with the known density strip shall be performed at an established frequency. Calibration shall be checked at other times if malfunction is suspected.

7.16.1 Documented evidence of checks and values for densitometer shall be available.

8. **COMPLIANCE:**

8.1 Compliance audits of representative inspections from current production shall be conducted to determine compliance with these requirements. Parts should be selected to represent a variety of customer requirements and several different types of processing equipment if more than one radiographic line is in use at this facility.

8.2 The following documentation for one of the parts being tested during the compliance portion of the audit shall be provided:

a. Copy of completed technique card or procedure.
b. Copy of completed shop traveler or work order.
c. Copy of completed NDT report.
d. Copy of customer specification(s) cover page(s).
e. Copy of acceptance criteria or drawing data.