INCH-POUND

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PERFORMANCE SPECIFICATION

X-RAY APPARATUS SET, RADIOGRAPHIC, INDUSTRIAL, PORTABLE, 160KVCP

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

1. SCOPE

1.1 Scope. This specification contains the technical and performance requirements for a light weight, portable, industrial x-ray apparatus set. These x-ray apparatus sets are intended for use in a military aircraft maintenance environment, which may be at fixed military bases, deployed to austere forward operating locations, or naval vessels afloat. This specification provides for first article testing described herein.

1.2 Classification. The x-ray apparatus set should conform to the following types:

Type I - X-ray apparatus set with a panoramic, liquid-cooled tubehead.
Type II - X-ray apparatus set with a directional, liquid-cooled tubehead.
Type III - X-ray apparatus set with a directional, air-cooled tubehead.
Type IV - X-ray apparatus set with a directional, hybrid liquid/air-cooled tubehead

Comments, suggestions, or questions on this document should be addressed to: AFRL/MLS-OL, 4750 Staff Drive, Tinker AFB OK 73145-3317. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at www.dodssp.daps.mil.

AMSC: N/A FSC 6635

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 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 supplements thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

DEPARTMENT OF DEFENSE

MIL-PRF-28800 - Test Equipment for use with Electrical and Electronic Equipment, General Specification For

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.2.2 Other government documents, drawings, and publications. The following government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those specified in the solicitation.

PUBLICATIONS

Environmental Protection Agency (EPA) List of Pollutants/Toxics (Replacement to SD-14, Listing of Toxic Chemicals, Hazardous Substances, and Ozone-Depleting Chemicals).
See EPA website: http://www.epa.gov/ebtpages/pollutants.html

Code of Federal Regulations 1040.10 – Laser Products.
See Food and Drug Administration website:
http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfCFR/showCFR.cfm?CFRPart=1040&showFR=1

2.3 Non-Government publications. The following document(s) form a part of this document 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 (see 6.2).

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 1165-92	-	Measurement of Focal Spots of Industrial X-ray Tubes by Pinhole Imaging, Standard Test Method
ASTM E 1742-95	-	Radiograph Examination, Standard Practice

(Application for copies should be addressed to ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959.)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

70 Article 500	-	National Electric Code

(Application for copies should be addressed to NFPA, One Batterymarch Park, P.O. Box 9191, Quincy, MA 02279)

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI N43.5	-	Radiological Safety Standards The Design of Radiographic and Radioscope Industrial X-Ray Equipment

(see website www.ansi.org)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supercedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 First Article. When specified in the solicitation (see 6.2), two samples shall be subjected to first article inspection in accordance with paragraph 4.3.

3.2 Description. The x-ray apparatus set shall consist of a x-ray tubehead and control unit. Types I, II, and IV shall include a liquid cooling unit. The x-ray apparatus set (all types) shall be supplied with the following accessories: transit cases, cable assemblies, lightweight laser pointer, interlock connector, safety lock keys, and manuals. Types I, II, and IV shall include coolant hoses.

3.3 The system major components shall be interchangeable with other system major components of the same make and model series with no degradation of performance. The interchangeability of major components shall not change the output of the x-ray source by more than +/- 3 percent.

3.4 Cooling unit. The cooling unit for liquid-cooled types shall be a self-contained, closed circuit (of a closed-loop design) and shall not contain any toxic chemicals, hazardous substances, or ozone depleting compounds as listed in the Environmental Protection Agency list of pollutants/toxins.

3.5 Power Requirements.

3.5.1 Input power. Input power shall automatically adapt from 100-130 Volts Alternating Current (VAC), 50/60 Hertz, 20 Ampere maximum current, to 200-250 VAC, 50/60 Hertz, 10 Ampere maximum current, and include automatic adaptability to portable generator power.

3.5.2 Overvoltage/Overcurrent protection. The components shall be equipped with circuit breakers to prevent damage to components in the event the voltage tolerances and/or proper current levels are exceeded. The circuit breakers shall provide protection to these components when large voltage or current surges are experienced.

3.5.3 Transient-State Conditions. The system shall not experience degradation of performance after the conditions defined in MIL-PRF-28800, section 3.

3.5.4 The system shall be protected from input voltages and frequencies that exceed the steady state envelope conditions in paragraph 3.5.1. If such events should occur the system shall protect itself by automatically disconnecting itself from the power source until the discrepancy is eliminated.

3.6 X-ray output. The X-ray output shall be adjustable in 5 kiloVolt constant potential (kVcp) steps minimum over the range of 20 to 160 kVcp and in 0.1 milliampere (mA) steps minimum over the range of 0.1 to 5.0 mA constant potential, and there shall be no more than 2% ripple.

3.6.1 All high voltages shall be generated in the tubehead.

3.6.2 The duty cycle shall be 100% at 120°F ambient temperature at 160 kVcp and 5 mA.

3.7 Focal spot. For directional tubeheads, the effective focal spot shall be no greater than 0.060 inch square in accordance with ASTM E 1165-92.

3.8 Radiation Output.

3.8.1 Radiation output of directional tubeheads shall be no less than 230 Roentgens per minute at 19.6 inches (unfiltered) at 160kVcp/5mA, and no less than 13 Roentgens per minute at 19.6 inches at 160kVcp/5mA through 0.50 inch of 1000-series aluminum plate.

3.8.2 Radiation output of panoramic tubeheads shall be no less than 14 Roentgens per minute at 19.6 inches (unfiltered) at 160kVcp/5mA, and no less than 6 Roentgens per minute at 19.6 inches at 160kVcp/5mA through 0.50 inch of 1000-series aluminum plate.

3.9 Density. The Hurter and Driffield (H&D) density shall not be less than 2.0 units through 2.0 inches of 1000-series aluminum plate at a source to film distance of 36 inches in 3 minutes or less on Eastman-Kodak Type M100 or equivalent film when operating at 160kVcp/5mA.

3.10 The x-ray unit shall be capable of showing a 0.010 inch hole in a 0.010 inch thick aluminum penetrameter (per ASTM E 1742) placed on a 1.00 inch thick test block of 1000 series aluminum at a source to film distance of 36 inches on Eastman-Kodak Type M100 or equivalent. The penetrameter and film shall be perpendicular to the x-ray beam.

3.11 For directional tubeheads, the x-ray unit shall be capable of showing a density difference of 2.5 H&D units between aluminum foil of 0.003 inches and 0.03 inches thickness at 36 inches source to film distance on Eastman-Kodak Type M100 or equivalent.

3.12 The liquid coolant unit shall be capable of maintaining the x-ray tubehead within normal operating temperatures when the x-ray tubehead is 100 feet in elevation above the cooling unit.

3.13 Duty cycle. The x-ray unit shall operate at 100% duty cycle from 0°F to 120°F.

3.14 Storage temperature. The x-ray unit shall be capable of storage temperatures from –30°F to 160°F.

3.15 Control unit timer. The control unit timer shall be capable of being adjusted from 0.1 to 99.9 minutes in 0.1 minute or smaller increments.

3.16 Transit case. Ruggedized transit case(s), suitable for cargo aircraft transport, shall be provided for all major subassemblies and accessories and shall be made of corrosion-resistant material.

3.16.1 The ruggedized transit cases shall be watertight (just over the top of case only) and be designed to provide protection against shock, vibration, and environmental conditions per MIL-PRF-28800, Class 2, including vibration test, mechanical shock test, transit drop test, and water resistance test.

3.16.2 The ruggedized cases with contents which exceed the one man lift of 44 pounds shall be prominently labeled with the total weight and lift limitations, and under no condition shall the two person lift of 88 pounds be exceeded.

3.17. Tubehead.

3.17.1 Features. The x-ray tubehead shall be end grounded and gas insulated, with a constant potential system. Types II, III, and IV shall include a side port beryllium window. The tubehead shall have a pressure gage, pressure relief valve, and low pressure cut-out switch which will prevent operation below 25 psi.

3.17.2 X-ray Tube Window material and thickness.

3.17.2.1 Panoramic Tubeheads: 0.025 inches thick or less of stainless steel.

3.17.2.2 Directional Tubeheads: 0.075 inches thick or less of Beryllium.

3.17.3 A thermal temperature switch shall be provided to prevent operation if the tubehead overheats beyond stated design temperatures.

3.17.4 The cooling unit shall incorporate a coolant flow sensor which will prevent overheating of the tubehead.

3.17.5 The panoramic tubehead shall have a 360^{o} cone of radiation output (field of view).

3.17.6 The directional tubehead shall have a 40^{o} cone of radiation output (field of view).

3.17.7 A “soft” case, made of foam-lined heavy-duty nylon fabric, shall be provided to protect the tubehead when not in use or in the ruggedized shipping containers.

3.17.8 The x-ray tubehead shall not be a source of ignition of volatile atmospheres as defined by the National Fire Protection Association (NFPA) 70 Article 500 for Class 1, Division 2, Group D during both operation and non-operation of the tubehead. Applies only to Types I and II (liquid-cooled) units and Type IV when liquid-cooled.

3.17.9 X-ray unit. The x-ray unit must be compatible with X-ray safety interlock system: NSN 6635-01-508-1519RN.

3.19 Control unit.

3.19.1 The control unit shall incorporate a safety key switch.

3.19.2 The control unit shall have microprocessor-based diagnostics.

3.19.3 The control unit shall include a continuous display to indicate tubehead voltage set, tubehead voltage applied, tubehead current set, tubehead current applied, time set, and time elapsed/remaining.

3.19.4 The control unit shall be equipped with circuit breakers. (See 3.5.2)

3.20 Physical dimensions and weight. The equipment must not exceed the following dimensions or weights.

3.20.1 Tubehead. Diameter – 7.25 inches, Length – Types I & II – 29 inches and Types III & IV – 31 inches, Maximum Weight – Types I & II – 30 pounds and Types III & IV – 34 pounds when not enclosed in the ruggedized transit cases, and 60 pounds when enclosed in the ruggedized transit cases as specified in 3.16.

3.20.2 Control Unit. Height – 14 inches, Length – 18 inches, Depth – 16 inches, Maximum Weight – 35 pounds when not enclosed in the ruggedized transit cases, and 60 pounds when enclosed in the ruggedized transit cases as specified in 3.16.

3.20.3 Cooling Unit. Height – 14 inches, Length – 18 inches, Depth – 16 inches and Maximum Weight – 55 pounds when not enclosed in the ruggedized transit cases, and 80 pounds when enclosed in the ruggedized transit cases as specified in 3.16.

3.21 Cable connectors. The cable connectors shall be constructed in such a way that each end uniquely fits its intended connector.

3.22 Laser pointer. A lightweight laser pointer which complies with 21 CFR 1040 shall be provided.

3.23 Handles. The transit cases, control unit, and cooling unit shall have collapsible handles with permanent stops to prevent collapsing while handles are in use.

3.24 Operation and maintenance instruction. One copy of the commercial operation and maintenance instructions, including calibration procedures and adjustments, as applicable, shall be shipped with each item. The documentation shall be releasable for third-party repairs.

3.25 Parts kit. A parts kit shall be included to contain adapters, and expendable parts which are expected to be consumed in one year needed to effect user-serviceable repairs.

3.26 Warranty. A minimum one-year warranty, to include parts, labor, and shipping, shall be included against manufacturing defects.

3.27 Additional accessory items. A listing of available accessory items, extended warranties, and standard repairs shall be provided to the Contracting Officer.

4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

a. First Article (see 4.3)
b. Conformance (see 4.4)

4.2 Pre-award Surveys. The government reserves the right to conduct pre-award surveys at the bidder's facilities. Government technical representatives will advise the Contracting Officer of the bidder's capability to produce x-ray apparatus sets in accordance with this specification to an acceptable quality level.

4.3 First Article Tests. The government reserves the right to conduct First Article tests on two complete x-ray apparatus sets, for each Type x-ray apparatus, regardless of the bidder's past performance. The inspection will not exceed 60 days. One system shall be tested to the requirements of paragraph 4.4, Conformance Inspection, by either a U.S. Government or independent commercial laboratory. The other system shall be operational tested at a Department of Defense Aircraft Maintenance Facility in the continental United States. In the event minor deficiencies/problems are found, any corrective action will be negotiated/approved by the Contracting Officer. One (1) additional on-site visit by the bidder to repair/adjust the equipment, plus up to two (2) shipments of user installable replacement parts, shall be permitted during the First Article Test for each of the two x-ray apparatus sets. The x-ray apparatus shall be returned to an operational condition within seven days after notification to the bidder. The solicitation (and/or AFMC Form 260) will provide the location of the first article inspection site(s).

4.4 Conformance inspection.

4.4.1. Examination of Components. Visually inspect to insure the x-ray apparatus contains the following components as specified in paragraph 3.2:

a. X-ray Tubehead, Type I, II, III, or IV per contract order.
b. Control Unit, digital microprocessor-based.
c. Liquid Cooling Unit, applicable to Types I, II, and IV.
d. Operation & maintenance manual.
e. Ruggedized transit case for tubehead, applicable for proper Type.
f. Ruggedized transit case for control unit.
g. Ruggedized transit case for cooling unit applicable to Types I, II, and IV only.
h. Ruggedized transit case for cables, hoses, and accessories.
i. Two (2) keys for control unit safety lock.
j. Control cable assembly – 100 feet with strain relief.
k. Cooling unit cable assembly – 100 feet with strain relief (Types I, II, and IV only).
l. Two (2) twin coolant hose assembly, 50 feet, self-sealing termination (Types I, II, and IV only).
m. Safety Interlock cable assembly – 10 feet with strain relief.
n. Lightweight laser pointer (removable), useable to 50 feet.

4.4.2 Visual inspection of major subassemblies.

4.4.2.1 Visually inspect tubehead to ensure all requirements of 3.17 are met.

4.4.2.2 Visually inspect liquid cooling unit to ensure all requirements of 3.4 are met, including self-contained closed circuit (Types I, II, and IV only).

4.4.2.3 Visually inspect control unit to ensure the unit meets all requirements of 3.19.

4.4.2.4 Visually inspect all handles to ensure collapsible configuration with permanent safety stops as specified in 3.23.

4.4.2.5 Visually inspect all cable connection to assure unique connectors for intended use as specified in 3.21.

4.4.2.6 Visually inspect manufacturer's independent certification for laser pointer meeting 21 CFR 1040 as specified in 3.22.

4.5.3 Dimensional Inspection.

4.5.3.1 Measure equipment dimensions and weight to ensure all components meet the requirements specified in 3.20.

4.5.4 Operational Tests.

4.5.4.1 Test control unit timer to ensure 0.1 to 99.9 minutes in 0.1 minute steps.

4.5.4.2 Ensure control unit continuously displays tubehead voltage – actual and set; tubehead current – actual and set; exposure time – elapsed/remaining and set.

4.5.4.3 Test control unit to ensure continuously adjustable over the range of 20-160kVcp in 5kV steps minimum and 0.1-5.0 mA in 0.1mA steps.

@ 20kV, highest achievable mA: _____
@ 160kV, highest achievable mA: _____
@ 0.1mA, lowest achievable kV: _____
@ 5.0mA, highest achievable kV: _____

4.5.4.4 Using ASTM E 1165, pinhole camera method, measure the effective total focal spot size for directional tubeheads, to ensure it is no greater than 0.060 square inches. Actual size: _____

4.5.4.5 Using a ratemeter with a probe installed in a 2.5 inch lead tube, place the probe 19.6 inches from the center of the anode, energize the tubehead to 160kVcp/5mA, and ensure the radiation output is a minimum of 230 Roentgens per minute for directional tubeheads or 14 Roentgens per minute for panoramic tubeheads.

Actual output at 160kVcp/5mA: _____

Note: Contact the government's cognizant engineer for acceptable ratemeters.

4.5.4.6 Change tubehead types for each control unit and re-accomplish paragraph 4.5.4.5 to ensure radiation output does not vary by more than +/- 3 percent.

Actual output at 160kVcp/5mA: _____

4.5.4.7 Repeat paragraph 4.5.4.5 with 0.50 inch thick aluminum plate between probe and tubehead and ensure the radiation output is a minimum of 13 Roentgens per minute for directional tubeheads or 6 Roentgens per minute for panoramic tubeheads.

Actual output at 160kVcp/5mA: _____

4.5.4.8 Using the ratemeter with a probe, place the directional tubehead (N/A for panoramic) in a horizontal position with the beryllium window facing down and blocked with 25 half-value-layers of lead. Using a mechanical probe drive, plot the leakage rate in polar coordinates at 39.37 inches away from the tubehead. Ensure the leakage radiation is less than 2.0 roentgens per hour.

Actual minimum leakage radiation: _____
Actual maximum leakage radiation: _____

4.5.4.9 Ensure the x-ray apparatus shall produce a H&D density of not less than 2.0 through 2.0 inches of 1000-series aluminum at a source to film distance of 36 inches in 3 minutes or less using Kodak type M100 or equivalent film at 160kVcp/5mA.

Actual film density: _____

4.5.4.10 Ensure the x-ray apparatus shall be capable of showing a 0.010 inch hole in a 0.010 inch thick penetrameter placed on 1.0 inch thick block of 1000-series aluminum at a source to film distance of 36 inches on Kodak type M100 or equivalent film with less than a 10 minute exposure.

Procedure kVcp: _____
Procedure mA: _____
Procedure time: _____

4.5.4.11 Ensure the directional (N/A for Type I) x-ray apparatus shall be capable of showing a density difference of 2.5 H&D units between aluminum foil 0.003 inches and 0.030 inches thick at a source to film distance of 36 inches on Kodak type M100 or equivalent film with less than a 10 minute exposure.

Procedure kVcp: _____
Procedure mA: _____
Procedure time: _____
0.003” H&D Density: _____
0.030” H&D Density: _____

4.5.4.12 Ensure the x-ray apparatus shall be capable of operating with the tubehead 100 feet above the cooling unit (N/A on Type III). Operate the unit at 160kV/5mA for ten successive operating cycles of 5 minutes on and 1 minute off. Any overheat condition is evidence of failure.

4.5.4.13 Ensure the cooler unit flow sensor is operational by operating the system at 100kVcp/5mA and disconnecting the cooler hose. If the system does not cease x-ray generation

in 10 seconds and/or is capable of further operation until the coolant flow is restored, this is evidence of failure.

4.5.4.14 Ensure the x-ray apparatus set is compatible with x-ray safety interlock, NSN 6635-01-508-1519RN.

4.5.4.15 Ensure the x-ray apparatus set will operate for a Failure-Free Operating Period (FFOP) of a minimum of 250 hours of random x-ray generation and 750 hours of power-on stand-by.

4.5.5 Environmental Tests:

4.5.5.1 Low Temperature Ambient Operational Test.

4.5.5.1.1 The unit shall be placed in an environmental chamber with thermocouple attached to the tubehead. The temperature shall be reduced to zero degrees Fahrenheit (0^{o}F) and allowed to stabilize. The unit shall be cold soaked for four hours. Perform radiation intensity test in accordance with paragraph 4.5.4.5. Radiation intensity shall be within 10% of baseline determined in paragraph 4.5.4.5

Actual cold soak radiation intensity: _____

4.5.5.2 High Temperature Ambient Operational Test.

4.5.5.2.1 The unit shall be placed in an environmental chamber with thermocouple attached to the tubehead. The temperature shall be increased to 120^{o}F and allowed to stabilize. The unit shall be heat soaked for four hours. Perform radiation intensity test in accordance with paragraph 4.5.4.5. Radiation intensity shall be within 10% of baseline determined in paragraph 4.5.4.5

Actual heat soak radiation intensity: _____

4.5.5.3 Storage Temperature Test.

4.5.5.3.1 Place all components in ruggedized transit cases, with thermocouple attached to tubehead.

4.5.5.3.2 The unit shall be placed in an environmental chamber with thermocouple attached to the tubehead. The temperature shall be reduced to minus 30 degrees Fahrenheit (-30^{o}F) and allowed to stabilized. The unit shall be cold soaked for four hours.

4.5.5.3.3 The temperature shall be increased to 160^{o}F and allowed to stabilize. The unit shall be heat soaked for four hours.

4.5.5.3.4 After the unit has returned to room temperature, perform radiation intensity test in accordance with paragraph 4.5.4.5. Radiation intensity shall be within 10% of baseline determined in paragraph 4.5.4.5

Actual radiation intensity after storage: _____

4.5.5.4. Ruggedized transit case water resistance test.

4.5.5.4.1 Secure cases to bottom of test tank.

4.5.5.4.2 Fill tank unit top of case is covered with 2 inches of water.

4.5.5.4.3 The unit shall be soaked for four hours.

4.5.5.4.4 Drain tanks.

4.5.5.4.5 Inspect cases for water intrusion. Water intrusion, exceeding 1 fluid ounce per case, is cause for failure.

4.5.6 Electrical Tests:

4.5.6.1 Electronically inspect for automatic adaptation of input voltage using variable power supply. Radiation intensity shall be within 10% of the power-corrected baseline determined in paragraph 4.5.4.5.

4.5.6.1.1 Adjust line voltage to 100 VAC and 60 Hz. Perform radiation intensity test in accordance with paragraph 4.5.4.5.
Actual radiation intensity: _____

4.5.6.1.2 Adjust line voltage to 130 VAC and 60 Hz. Perform radiation intensity test in accordance with paragraph 4.5.4.5.
Actual radiation intensity: _____

4.5.6.1.3 Adjust line voltage to 200 VAC and 60 Hz. Perform radiation intensity test in accordance with paragraph 4.5.4.5.
Actual radiation intensity: _____

4.5.6.1.4 Adjust line voltage to 250 VAC and 60 Hz. Perform radiation intensity test in accordance with paragraph 4.5.4.5.
Actual radiation intensity: _____

4.5.6.1.5 Adjust line voltage to 100 VAC and 50 Hz. Perform radiation intensity test in accordance with paragraph 4.5.4.5.

Actual radiation intensity: _____

4.5.6.1.6 Adjust line voltage to 130 VAC and 50 Hz. Perform radiation intensity test in accordance with paragraph 4.5.4.5.

Actual radiation intensity: _____

4.5.6.1.7 Adjust line voltage to 200 VAC and 50 Hz. Perform radiation intensity test in accordance with paragraph 4.5.4.5.

Actual radiation intensity: _____

4.5.6.1.8 Adjust line voltage to 250 VAC and 50 Hz. Perform radiation intensity test in accordance with paragraph 4.5.4.5.

Actual radiation intensity: _____

4.5.6.2 Electronically inspect for transient voltage performance using variable power supply. Radiation intensity shall be within 10% of the power-corrected baseline.

4.5.6.2.1 Adjust line voltage to 130 VAC and 60 Hz. Perform radiation intensity test in accordance with paragraph 4.5.4.5.

Actual baseline radiation intensity: _____

4.5.6.2.2 Quickly increase voltage to a transient value of 149.5 VAC for approximately 0.5 seconds and quickly return to 130 VAC. Observe equipment performance and perform radiation intensity test in accordance with paragraph 4.5.4.5.

Actual radiation intensity transient 1: _____

4.5.6.2.3 Repeat paragraph 4.5.6.2.2 four more times at two minute intervals.

Actual radiation intensity transient 2: _____
Actual radiation intensity transient 3: _____
Actual radiation intensity transient 4: _____
Actual radiation intensity transient 5: _____

4.5.6.2.4 Adjust line voltage to 103.5 VAC and 60 Hz. Perform radiation intensity test in accordance with paragraph 4.5.4.5.

Actual baseline radiation intensity: _____

4.5.6.2.5 Quickly decrease voltage to a transient value of 80.5 VAC for approximately 0.5 seconds and quickly return to 103.5 VAC. Observe equipment performance and perform radiation intensity test in accordance with paragraph 4.5.4.5.

Actual radiation intensity transient 1: _____

4.5.6.2.6 Repeat paragraph 4.5.6.2.4 four more times at two minute intervals.

Actual radiation intensity transient 2: _____
Actual radiation intensity transient 3: _____

Actual radiation intensity transient 4: _____
Actual radiation intensity transient 5: _____

4.5.6.3 Electronically inspect for transient frequency performance using variable power supply. Radiation intensity shall be within 10% of the baseline.

4.5.6.3.1 Adjust line voltage to 115 VAC and 47.5 Hz. Perform radiation intensity test in accordance with paragraph 4.5.4.5.
Actual baseline radiation intensity: _____

4.5.6.3.2 Quickly decrease frequency to a transient value of 45 Hz for approximately 0.5 seconds and quickly return to 47.5 Hz. Observe equipment performance and perform radiation intensity test in accordance with paragraph 4.5.4.5.
Actual radiation intensity transient 1: _____

4.5.6.3.3 Repeat paragraph 4.5.6.3.2 four more times at one minute intervals.
Actual radiation intensity transient 2: _____
Actual radiation intensity transient 3: _____
Actual radiation intensity transient 4: _____
Actual radiation intensity transient 5: _____

4.5.6.3.4 Adjust line voltage to 115 VAC and 57 Hz. Perform radiation intensity test in accordance with paragraph 4.5.4.5.
Actual baseline radiation intensity: _____

4.5.6.3.5 Quickly decrease frequency to a transient value of 54 Hz for approximately 0.5 seconds and quickly return to 57 Hz. Observe equipment performance and perform radiation intensity test in accordance with paragraph 4.5.4.5.
Actual radiation intensity transient 1: _____

4.5.6.3.6 Repeat paragraph 4.5.6.3.2 four more times at one minute intervals.
Actual radiation intensity transient 2: _____
Actual radiation intensity transient 3: _____
Actual radiation intensity transient 4: _____
Actual radiation intensity transient 5: _____

4.5.6.3.7 Adjust line voltage to 115 VAC and 63 Hz. Perform radiation intensity test in accordance with 4.5.4.5.
Actual baseline radiation intensity: _____

4.5.6.3.8 Quickly increase frequency to a transient value of 66 Hz for approximately 0.5 seconds and quickly return to 63 Hz. Observe equipment performance and perform radiation intensity test in accordance with paragraph. 4.5.4.5.

Actual radiation intensity transient 1: _____

4.5.6.3.9 Repeat paragraph 4.5.6.3.8 four more times at one minute intervals.

Actual radiation intensity transient 2: _____
Actual radiation intensity transient 3: _____
Actual radiation intensity transient 4: _____
Actual radiation intensity transient 5: _____

4.5.6.4 Electronically inspect tubehead constant potential voltage ripple is less than 2 percent.

Actual ripple RMS: _____

4.5.7 Miscellaneous Tests:

4.5.7.1 Remove high-voltage stack to visually inspect that high voltages are generated in the tubehead.

4.5.7.2 Ensure the tubehead pressure release valve releases pressure at the manufacturer's suggested pressure.

Actual pressure valve released: _____

4.5.7.3 Ensure the tubehead thermal cut-out switch automatically disconnects power when the tubehead exceeds the manufacturer's recommended temperature.

Actual temperature at switch deactivation: _____

4.5.7.4 Ensure the tubehead low-pressure cut-out switch automatically disconnects power when the tubehead pressure falls below the manufacturer's recommended minimum pressure.

Actual pressure at switch deactivation: _____

4.5.7.5 Ensure duty cycle is 100% at 120°F ambient temperature at 160kVcp/5mA. Measure the anode temperature at it's hottest part at 5 minute increments over a two hour period to determine it has stabilized with no further temperature rise.

Temperature @ 0 minutes: _____
Temperature @ 5 minutes: _____
Temperature @ 10 minutes: _____
Temperature @ 15 minutes: _____
Temperature @ 20 minutes: _____
Temperature @ 25 minutes: _____
Temperature @ 30 minutes: _____

Temperature @ 35 minutes: _____
Temperature @ 40 minutes: _____
Temperature @ 45 minutes: _____
Temperature @ 50 minutes: _____
Temperature @ 55 minutes: _____
Temperature @ 60 minutes: _____
Temperature @ 65 minutes: _____
Temperature @ 70 minutes: _____
Temperature @ 75 minutes: _____
Temperature @ 80 minutes: _____
Temperature @ 85 minutes: _____
Temperature @ 90 minutes: _____
Temperature @ 95 minutes: _____
Temperature @ 100 minutes: _____
Temperature @ 105 minutes: _____
Temperature @ 110 minutes: _____
Temperature @ 115 minutes: _____
Temperature @ 120 minutes: _____

4.5.7.6 Shock/vibration test.

4.5.7.6.1 Bench handling test from four inches above bench top, with components out of cases.

4.5.7.6.2 Vibration/Loose Cargo Bounce Test in accordance with MIL-PRF-28800 shall be performed with x-ray unit in ruggedized transit cases.

4.5.7.6.3 Drop test from 24 inches in accordance with MIL-PRF-28800 with x-ray unit in ruggedized transit cases.

4.5.7.6.4 Perform radiation intensity test in accordance with paragraph 4.5.4.5. Radiation intensity shall be within 10% of baseline determined in paragraph 4.5.4.5.

Actual radiation intensity after shock/vibration: _____

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES.

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

6.1 Intended use. These x-ray apparatus sets are intended for field and depot use to perform radiographic inspections of metallic and nonmetallic, aerospace and non-aerospace equipment.

6.2 Acquisition requirements.

a. Title, number, and date of this specification.
b. Part or Identifying Number (See 1.2 and 6.4)
c. Inspection requirements (see 3.1 and 4.3)
d. Packaging requirements (see 5.1)

6.3 Supersession data. This specification supercedes Commercial Item Description A-A-58077, dated 6 August 1996.

6.4 Part Identification Number (PIN). The following part or identifying number (PIN) procedure is for government purposes and does not constitute a requirement for the contractor. Example of part or identifying number:

M 32133 - 1

- 1 — Type (See 1.2): 1 – Type I; 2 – Type II; 3 – Type III; 4 – Type IV
- 32133 — Specification Number
- M — Prefix

6.5 National Stock Number (NSN). Interchangeable & Substitutable Master NSN Cross Reference:

NSN	Old Part Number	CAGEC	New Part Number
6635-01-430-2575RN	A-A-58077-1	81348	M32133-1
6635-01-394-5926RN	A-A-58077-2	81348	M32133-2
6635-01-442-6915RN	A-A-58077-3	81348	M32133-3

6.6 Subject term (key word) listing.

Constant potential
Deployable
Hurter and Driffield (H&D)
Interlock
Panoramic
Penetrameter
Tubehead

6.7 Changes from previous issues. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of changes.

Custodians
Air Force – 99
Army - AV
Navy – AS

Preparing activity
Air Force – 51

Agent:
Air Force - 99

Review activities
Navy – CG
Air Force – 70, 71, 84
DLA – GS

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