

REVISIONS

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A	36-455	INITIAL RELEASE	<i>ATB</i>	WFM	1/5/96

	NAME	DATE	MASSACHUSETTS INSTITUTE OF TECHNOLOGY CENTER FOR SPACE RESEARCH			
Drawn:	BRIAN KLATT	12/29/95	<h3 style="margin: 0;">RADIOACTIVE SOURCES,</h3> <h3 style="margin: 0;">Cm²⁴⁴</h3>			
Checked:	<i>ATB</i>	1/5/96				
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1.0 SCOPE

This specification details the design, performance, test, and packaging requirements for curium (Cm^{244}) sources to be used on the AXAF CCD Imaging Spectrometer (ACIS) Instrument. This instrument will be in an elliptical Earth orbit at an altitude of 10,000 km. by 140,000 km.

- 1.1 Purpose The AXAF CCD Imaging Spectrometer (ACIS) instrument requires radioactive curium-244 (Cm^{244}) calibration sources to be mounted so as to illuminate the ACIS CCD detectors when the instrument is not at the AXAF telescope focus. The principal purposes of these sources are to calibrate the energy scale, spectral resolution and detection efficiency of the ACIS CCD detectors. It is essential that each source produces a known, temporally stable X-ray photon output. The sources must function in a hard vacuum (1×10^{-6} Torr) over a broad temperature range, without detectable leakage. The sources must not contaminate the AXAF optical surfaces or ACIS CCD optical blocking filters, with either particulates or molecular contaminants, and are therefore subject to contamination control requirements.

2.0 APPLICABLE DOCUMENTS

- 2.1 Drawings The following documents form a part of this specification to the extent specified herein.

STANDARDS

MIL-STD-129

Marking for Shipment and Storage

MIL-STD-1246B

Cleanliness Requirements for Contamination Sensitive Space Equipment

OTHER

36-40201.02

MIT Drawing: Low Energy Source Assembly

49 CFR 171-179

Department of Transportation Rules and Regulations for the Transportation of Explosives and Other Dangerous Materials.

3.0 REQUIREMENTS

- 3.1 Source Construction and Geometry Cm^{244} shall be deposited on a platinum substrate. The substrate shall be mounted in a standard A-2 capsule as detailed in 36-40201.02. See figure 1. The Cm^{244} shall be overcoated with a protective layer of sputtered gold with a thickness of 400 ± 40 micrograms/cm². The thickness of the gold coating shall be verified by the manufacturer. The Cm^{244} /gold coating shall be covered by a titanium window, of areal density 1.8 milligrams/cm²

When the source is installed in the A-2 capsule, the radioactive Cm²⁴⁴ shall illuminate the target material as defined in table 1. Metal targets shall be at least 99.99% pure, as measured on a metals basis. The purity shall be verified by analysis. For sources with titanium and copper targets, the photon output aperture shall be covered by a 25 ±10% micron thick beryllium window to suppress back-scattered alphas.

- 3.1.1 Plating Cm²⁴⁴ shall be plated by the electro-plating process using Isotope Products Laboratories (IPL) process number TBD.
- 3.2 Radioactivity Sources shall be provided with Cm²⁴⁴ activity levels as specified in table 1. The activity of the source shall be verified by the manufacturer to an accuracy of 5%.
- 3.3 Leakage The source must be leak tested and must be leak free at a level of 1 X 10⁻³ microcuries. Leak testing shall be done by the liquid immersion method, using isopropal alcohol.
- 3.4 Contamination Control The source must be capable of being cleaned to Level 100A of MIL-STD-1246B. Cleaning will be performed by MIT.
- 3.5 Environmental Sources must survive thermal-vacuum and vibroacoustic environments of launch and on-orbit operation without leakage or change in photon output.
 - 3.5.1 Temperature The temperature range shall be -60°C to +50°C
 - 3.5.2 Vibration Cm²⁴⁴ sources shall survive without measurable leakage and function after exposure to random vibration applied to the A-2 capsule.

Power Spectral Density	11.3 "g" rms
Frequency Range	20 to 2000 Hz
Duration per axis	1 minute
Number of axes	3
 - 3.5.3 Acoustic Cm²⁴⁴ sources shall survive without measurable leakage and function after exposure to acoustic pressure.

Sound Pressure level	139 dB
Frequency Range	20 to 10,000 Hz
Duration	1 minute
 - 3.5.4 Humidity Cm²⁴⁴ sources shall withstand storage in air with relative humidity between 30% and 80%.
- 3.6 Identification

- 3.6.1 Part Number The MIT part number of the Cm²⁴⁴ sources shall be in accordance with Table 1.

Table 1

MIT Part Number	Target Material	Activity Level	Nominal Output (photons/second/steradian)
36-02351.01	Teflon	1 millicurie	2.6 X 10 ³
36-02351.02	Aluminum	1 millicurie	2.4 X 10 ³
36-02351.03	Titanium	4 millicuries	690
36-02351.04	Copper	4 millicuries	80

- 3.6.2 Serialization and Marking Each Cm²⁴⁴ source shall be individually serialized with a three (3) digit number. MIT P/N 36-02351.01 (teflon target) serial numbers shall start with 401. MIT P/N 36-02351.02 (aluminum target) serial numbers shall start with 501. MIT P/N 36-02351.03 (titanium target) serial numbers shall start with 601. MIT P/N 36-02351.04 (copper target) serial numbers shall start with 701. In addition, each Cm²⁴⁴ source shall be identified with the MIT part number, activity level, month, day, and year of activity verification, the manufacturers name or logo, and the manufacturers part number (if applicable). Serial numbers shall be engraved, etched, or vibro-etched on the side of the A-2 capsule. Other required markings shall be by the bag-and-tag method.

- 3.7 Nominal photon Output The nominal photon output for each source is listed in Table 1. Output shall be measured by MIT, and shall be within ±25% of the nominal value listed in Table 1.

4.0 QUALITY ASSURANCE PROVISIONS

- 4.1 Responsibility for inspection Unless otherwise specified in this document, the Cm²⁴⁴ Source manufacturer is responsible for all inspection requirements and examinations as specified herein. Cleanliness and stability in environment shall be verified by MIT.
- 4.2 Responsibility for compliance All items submitted for acceptance to MIT shall meet all requirements of this specification, except as detailed in paragraph 4.1 above.
- 4.3 Acceptance Each Cm²⁴⁴ source shall be subjected to the measurements, tests and inspections in paragraphs 3.1, 3.2, 3.3, and 3.7. Conformance to the requirements shall be recorded on a test data sheet which contains the part number, the order number, the serial number of the part tested, the date of the test, and the test results. The test data sheet

may be in the manufacturer's standard format and shall be stamped or signed by the manufacturer's representative.

- 4.5 Inspection and Test Records Test data for all acceptance tests shall be submitted to MIT with the delivery of each Cm²⁴⁴ source. In addition, the source manufacturer shall maintain inspection and test records for 36 months after hardware delivery to MIT.
- 4.7 MIT Source Inspection MIT Performance Assurance will impose a mandatory inspection point at final test and inspection at the Cm²⁴⁴ source manufacturer's facility. Source inspection will include documentation review and witnessing of verification tests detailed in paragraphs 3.2 and 3.3. Notify MIT two (2) weeks before articles are ready for MIT Inspection. (call area code 617, phone 253-7555 or 258-8852).
- 4.8 Product Uniformity All Cm²⁴⁴ sources delivered to a single part number shall be made with the same design, materials, processes, and procedures, and shall be tested and inspected to the same criteria conforming to this specification.

5.0 **PREPARATION FOR DELIVERY**

- 5.1 Packaging, level C The radioactive source shall be packaged to afford adequate protection against deterioration and damage in shipment from the supply source to MIT for immediate use. Packaging shall be in compliance with applicable rules and regulations of the Department of Transportation (DOT) and the Atomic Energy Commission (AEC).
- 5.2 Packing, level C The radioactive sources, packaged as specified in 5.1 above, shall be packed in accordance with applicable requirements specified in DOT regulation 49 CFR 171-179, to insure carrier acceptance and safe delivery to MIT. Containers shall comply with Uniform Freight Classification rules or regulations of other carriers applicable to the mode of transportation.
- 5.3 Marking In addition to any special marking required by this specification, unit packages shall be marked in compliance with DOT regulation 49 CFR 171-179 and Atomic Energy Commission (AEC) requirements.

5.4 Shipping Radioactive sources shall be shipped to:

Mr. Donald L. Haes Jr.
Radiation Protection Officer
MIT 20C-207
77 Massachusetts Avenue
Cambridge, MA 02139

6.0 NOTES

6.1 Approved Source of Supply The manufacturer listed below is the only approved source for products described herein.

Isotope Products Laboratory Inc.
1800 N. Keystone Street
Burbank, CA 91504

Cage Code: TBD