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**MASSACHUSETTS INSTITUTE OF TECHNOLOGY CENTER FOR SPACE RESEARCH**

**RADIOACTIVE SOURCE, Fe\textsubscript{55}**

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**Scale:** NONE

Sheet: 1 of 5
1 Scope
This specification details the design, performance, test, and packaging requirements for Iron (Fe55) sources to be used for ground testing of the AstroE2 X-Ray Imaging Spectrometer (XIS) Instrument.

1.1 Purpose
The AstroE2 X-ray Imaging Spectrometer (XIS) Instrument requires radioactive Iron 55 (Fe55) calibration sources during ground testing of the detectors and assembled instruments.

One source is to be mounted on the inside of the XIS detector vacuum cover and the second will be used inside one of the MIT-CSR calibration chambers.

The principal purposes of these sources are to monitor the soft x-ray detection efficiency and the energy scale of selected XIS CCD detectors. This will be done during ground testing only and not used on orbit. For these purposes, it is essential that the source produce a known, temporally stable photon output in the Mn K (5.9 and 6.5 keV) and Mn L (0.64 and 0.65 keV) characteristic X-ray lines. The goal is to measure the ratio of the L-line to K-line output with an accuracy of one percent (1%).

The source must function in a hard vacuum <1 x 10^-6 torr over a broad temperature range, without detectable leakage. The source must not contaminate the XIS CCD detectors with either particulates or molecular contaminants, and is therefore subject to contamination control requirements.

2 Applicable Documents
The following documents form a part of this specification to the extent specified herein.

2.1 Standards
MIL-STD-129 Marking for Shipment and Storage
MIL-STD-1246B Cleanliness Requirements for Contamination Sensitive Space Equipment

2.2 Other
30-50102.05 MIT AstroE2 Drawing: Fe55 Source Assembly
49 CFR 171-179 Department of Transportation Rules and Regulations for the Transportation of Explosives and Other Dangerous Materials.

3 Requirements

3.1 Source Construction and Geometry
Fe55 shall be deposited on a nickel substrate. The substrate shall be mounted in a standard A-2 capsule as detailed in 30-50102.05. See figure 1. The Fe55 shall be overcoated with a protective layer of sputtered gold with a thickness of 50 ±10 micrograms/cm². When the source is installed in the A-2 capsule, the radioactive Fe55 shall be contained within a 1.0 mm diameter circle, concentric with the symmetry axis of the capsule. The thickness of the gold coating shall be verified by the manufacturer.

3.1.1 Plating
Fe55 shall be plated by the electro-plating process using Isotope Products Laboratories (IPL) process number LP3-4.

3.2 Radioactivity
Sources shall be procured at two (2) activity levels, as specified below. Aside from the specified differences in activity, and associated marking differences, the sources shall be identical.

<table>
<thead>
<tr>
<th>Type</th>
<th>Activity: 0.25 micro-curies ±20%.</th>
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<tbody>
<tr>
<td>Type 2</td>
<td>Activity: 1.0 micro-curies ±20%</td>
</tr>
</tbody>
</table>

The activity of the source shall be verified by the manufacturer.

3.3 Leakage
The source must be leak tested and must be leak free at a level of 2 X 10^-4 micro-curies. Leak testing shall be done by the liquid immersion method.

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 operation without leakage or change in photon output.

3.5.1 Temperature
The temperature range shall be -70°C to +60°C.

3.5.2 Vibration
Fe\textsuperscript{55} sources shall survive shipping conditions from the factory to MIT-CSR.

3.5.3 Humidity
Fe\textsuperscript{55} 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 Fe\textsuperscript{55} sources shall be as follows:

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
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<tbody>
<tr>
<td>30-00104.01</td>
<td>Type 1 Source (0.25 μCi)</td>
</tr>
<tr>
<td>30-00104.02</td>
<td>Type 2 Source (1.0 μCi)</td>
</tr>
</tbody>
</table>

3.6.2 Serialization and Marking
Each Fe\textsuperscript{55} source shall be individually marked with project name, serial number starting with 101, source type, activity and reference date, per MIT CSR Drawing 30-50102.05. Marking shall be engraved, etched or vibro-etched on the side of the A2 capsule.

In addition, each Fe\textsuperscript{55} source storage container 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).

4 Quality Assurance Provisions

4.1 Responsibility for Inspection
Unless otherwise specified in this document, the Fe\textsuperscript{55} Source manufacturer is responsible for all inspection requirements and examinations as specified herein.

4.2 Responsibility for Compliance
All items submitted for acceptance to MIT shall meet all requirements of this specification,

4.3 Acceptance
Each Fe\textsuperscript{55} Source shall be subjected to the measurements, tests and inspections in paragraphs 3.1, 3.2, and 3.3. 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.

4.4 Inspection and Test Records
Test data for all acceptance tests shall be submitted to MIT with the delivery of each Fe\textsuperscript{55} source. In addition, the source manufacturer shall maintain inspection and test records for 36 months after hardware delivery to MIT.

4.5 MIT Source Inspection
MIT does not plan to perform a source inspection for the procurements related to this specification.

4.6 Product Uniformity
All Fe\textsuperscript{55} 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 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 4.1 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, AEC, and MIL-M-19590 requirements.

6 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
**REVISIONS**

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**NOTES:**

1. REFERENCES ARE TO 30-00104

2. MARK PER PARA 3.6.2.
   - PROJECT: "AEZ"
   - S/N: "10x"
   - SOURCE TYPE: "Fe55"
   - ACTIVITY: "1uc" or "2uc"
   - DATE CODE: (MD/YR) "XX/YY"

**PART LIST**

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**SPECIFICATIONS**

- UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES
- TOLERANCES: ANGLES = ±4
- PLACES DECIMALS = 005
- PLACES REACTIONS = 85

**ACKNOWLEDGEMENTS**

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
CENTER FOR SPACE RESEARCH
CAMBRIDGE, MA 02139

**SCALE:** 2/1

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**Figure 1.0** A-2 Capsule Package Drawing