SUBORBITAL AND SPECIAL ORBITAL PROJECTS DIRECTORATE

CREAM INSTRUMENT TEST PLATE AND ROTATION FIXTURE REQUIREMENTS FOR CERN AUG. 2001

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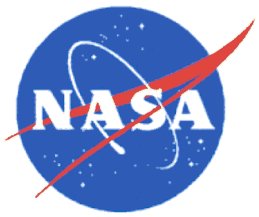

National Aeronautics and
Space Administration

Goddard Space Flight Center
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CREAM INSTRUMENT TEST PLATE AND ROTATION FIXTURE REQUIREMENTS

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CHANGE HISTORY LOG

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1. INTRODUCTION

The University of Maryland (UMD) Cosmic Ray Energetics and Mass (CREAM) science team requires an instrument fixture plate to mount and assemble the instrument components for testing at the CERN facility in August 2001. The testing at CERN will include introducing the UMD calorimeter mounted on the plate to the particle beam over the entire surface, and at angles ranging from 0 degrees (orthogonal with beam) to +90 degrees (horizontal, facing up), with a desired goal of extended rotation as far as possible beyond +90 degrees (up to +180 degrees). A rotation fixture mounted on the elevator table at CERN is also required to suspend the plate on trunnions, and control the movement of the plate to accomplish precise positioning of the calorimeter.

Additionally, a University of Chicago (UC) Transition Radiation Detector (TRD) test will be conducted by supporting the TRD in front of the UMD instrument in the beam orthogonal orientation. No scanning or rotation of either the UMD or UC instruments is required for the TRD test.

2. APPLICABLE DOCUMENTS

NASA Documents

NASA-STD-5005 Ground Support Equipment Design Criteria, May 10, 1996

NSS/GO-1740.9B, "Safety Standards for Lifting Devices and Equipment"

CREAM Project Documents

820-ULDB/CREAM DRD-0001 ULDB/CREAM Mission-Level Requirements Document

3. ABBREVIATIONS AND ACRONYMS

CERN	European Organization for Nuclear Research
CREAM	Cosmic Ray Energetics and Mass
GSFC	Goddard Space Flight Center
HPD	Hybrid Photodiode
ISS	Instrument Support Structure
MGSE	Mechanical Ground Support Equipment
NASA	National Aeronautics and Space Administration
TRD	Transition Radiation Detector
UMD	University of Maryland
UC	University of Chicago

4. REQUIREMENTS

4.1 Instrument Fixture Plate

4.1.1 Mechanical

4.1.1.1 The fixture plate will consist of a 48 in. square flat surface area, aligned horizontally, and centrally mounted on a support frame.

4.1.1.2 The following primary instrument components shall be mounted on the plate by UMD at final locations determined by UMD.

a. The calorimeter
b. Eight each HPD boxes
c. T1 target with S0 and S1 hodoscopes mounted on four legs
d. T2 target mounted on four legs
e. Added components must fit within the perimeter of the plate and not exceed the height of the T1 target, including S0 and S1 hodoscopes.

4.1.1.3 The support frame will have a housed trunnion bearing mounted on each end to facilitate rotation of the frame

4.1.1.4 Swivel style caster wheels shall be mounted to the bottom of the support frame in a stable configuration to provide mobility.

4.1.1.5 The support frame will have four each vertical lift attachment points for slings at each corner.

4.1.2 Stresses and Deflections

4.1.2.1 A minimum safety factor of 2 against yield or permanent deformation and 3 against ultimate failure or collapse shall be used in accordance with NASA-STD-5005 Ground Support Equipment Design Criteria, May 10, 1996. The safety factor shall not be used to justify exceeding the safe working load. This safety factor applies to all instrument component attachment points on the plate.

4.1.2.2 A stress analysis shall show that with the prescribed factor of safety, the plate can mechanically support the total weight of the UMD instrumentation given the following assumptions:

a. The maximum total weight of mounted instrumentation shall not exceed 1800 pounds. Refer to the project website for the current weight allocation for each instrument.

UMD Instrumentation	Design Location	Design CG (Inches)
Calorimeter	centered on plate	1.8

UMD Instrumentation	Design Location	Design CG (Inches)
T1 (centered on plate)	centered on plate	10.1
T2 (centered on plate)	centered on plate	6
"Free Weight"	evenly distributed outside T1	6
8 ea. HPDs	equally spaced around edge	5

b. The overall design-to center of gravity of the mounted instruments shall not exceed 4.5 in. above the top surface of the plate.

4.1.2.3 Maximum deflection of the plate at the mounting points of the calorimeter, T1 bracket and T2 bracket shall not exceed 0.05 inch under a:

a. 1 g. load down, support frame and plate pinned on casters
b. 1.2 g. load down (-z), support frame and plate pinned on trunnions
c. 1.2 g. lateral load (x,y), support frame and plate pinned on trunnions

4.1.2.4 Fasteners used to mount components on the plate shall demonstrate the prescribed factor of safety under the following conditions:

a. 2 g. up (+z), plate pinned at corners
b. 3 g. lateral (x,y), plate pinned at corners

4.1.3 Lifting Sling

A four-way sling is required to lift, from above, the support frame and plate with mounted instruments. The sling shall have an appropriately sized spreader bar to permit the slings to attach vertically to the fixture. The vertical legs shall be of sufficient length when taut to avoid contact by the spreader bar with the instruments. Overall height from the top of the plate to the hook eye shall not exceed 10 ft. Design and certification of the lifting sling shall be in accordance with NSS/GO-1740.9B, "Safety Standards for Lifting Devices and Equipment" where applicable.

4.2 Rotation Fixture

The rotation fixture requirements described in this section are to uniquely support the instrument fixture plate as described in the preceding section for the beam test in CERN during August 2001. The rotation fixture is required to be re-configurable to support the full CREAM instrument and the Instrument Support Structure (ISS) after the beam test in CERN in 2001.

4.2.1 Clearance

4.2.1.1. An area 60 in. x 60 in. and 24 in. along the beam, centered on the UMD T1 detector, shall be free of any mechanical interference in order to allow the TRD with support structure to stand independently in front of the UMD detector in the beam orthogonal orientation.

4.2.1.2. The rotation fixture shall fit within the constraints of the beam enclosure (H2A) at CERN.

4.2.2 Motion

4.2.2.1 The rotation fixture shall rotate the fixture plate with mounted instrumentation from a position with the plate vertical (facing the beam) to a position with the plate horizontal (facing the zenith), with a desired goal of extended rotation as far as possible (up to the plate vertical and facing away from the beam).

4.2.2.2 The direction of rotation of the fixture plate shall be reversible.

4.2.2.3 The rotation of the fixture plate shall be repeatable within +/- .5 degree.

4.2.2.4 The rotation of the fixture plate shall occur with a minimum rotational increment of no more than 1 degree.

4.2.2.5 The average speed of rotation of the fixture plate shall be at least 0.5 degree per second so that 90 degrees of rotation occurs within 180 seconds.

4.2.2.6 The rotation driver shall be failsafe without electrical power.

4.2.2.7 The rotation shall be limited to prevent exceeding the design range of motion so as to protect the instrument from damage. The limit system shall be testable after setup with no undue risk of damage to the instrument if it fails.

4.2.2.8 The rotation driver shall be protected from damage due to intermittent and/or persistent restraints on its motion. This protection shall not impose undue risk of damage to the instrument.

4.2.2.9 The entire S0 with a maximal margin loss of 2 inches coverage shall be scanned with entire instrument centered over table surface. It is desirable to maximize TRD/TCD surface area scanned.

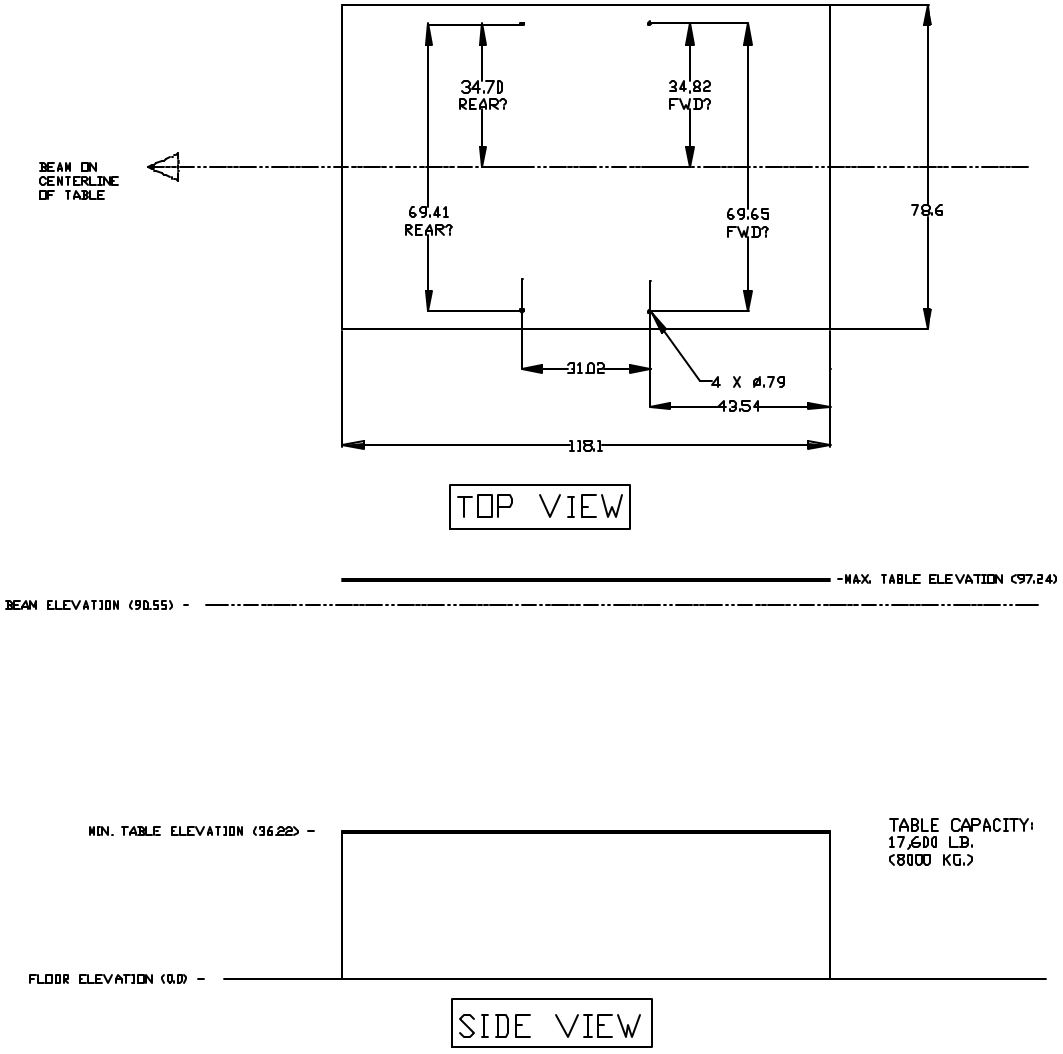

Figure 1. Table Range of Motion and Beam Height

4.2.3 Control and Feedback

4.2.3.1 All sensors, mechanisms, and harnesses shall be positioned to the right of the fixture, when facing into the beam ("Jura side"), whenever possible so that they may be observed by personnel during calibration.

4.2.3.2 It is required for the rotation fixture to be remotely controlled by an operator positioned up to 100 ft. from the fixture.

4.2.3.3 The angle of rotation of the fixture plate shall be displayed to the operator with an accuracy and repeatability of 0.25 degrees or better

4.2.3.4 All sensors and mechanisms shall operate on power available both domestically and at CERN.

a.	Domestic power:	Single Phase 110V AC 60 Hz, Single Phase 220V AC 60 Hz
b.	CERN power:	Single Phase 220V AC 50 Hz Single Phase 240V AC 50 Hz.

4.2.4 Handling

4.2.4.1 The rotation fixture shall be independently mobile on casters. These casters shall not reduce stability or scannable height when positioned on the table.

4.2.4.2 An analysis shall show that the rotation fixture with the instrument mounted pointed upwards will not tip over if the base were suddenly stopped when the fully loaded fixture was moving at a speed of 3 miles per hour.

4.2.4.3 A sling for lifting the rotation fixture onto and off of the CERN table shall be provided.

a. This method shall be in conformance with NSS/GO-1740.9B Safety Standards for Lifting Devices and Equipment

b. The maximum height of the crane above the floor is 20 ft.

c. The diameter of the crane hook is 16 inches

4.2.4.4 Containers shall be provided for the rotation fixture and the instrument plate for shipment to and from CERN.

4.2.5 Rotation Fixture Stresses and Deflections

4.2.5.1 A minimum safety factor of 2 against yield or permanent deformation and 3 against ultimate failure or collapse shall be used in accordance with NASA-

STD-5005 Ground Support Equipment Design Criteria, May 10, 1996. The safety factor shall not be used to justify exceeding the safe working load. This safety factor applies to all attachment points.

4.2.5.2 A stress analysis shall show that with the prescribed factor of safety, the rotation fixture can mechanically support the total weight of the fixture plate with instrumentation mounted, at any angle within the required range of motion.

4.2.6 Test and Acceptance

4.2.6.1 A test procedure for qualifying the rotation fixture in accordance with requirements of section 4.2 shall be written by the 546 PDL.

4.2.6.2 The approved test procedure shall be successfully conducted prior to delivery of the test fixture to UMD.

4.3 Deliverables from NASA to UMD

The following items will be delivered to UMD by the dates defined:

a. One each instrument fixture plate in accordance with 4.1 by June 15, 2001
b. One each rotation fixture in accordance with 4.2, certified in accordance with 4.2.6 with shipping container for overseas shipment by July 15, 2001.
c. One each certified lifting sling for the instrument fixture plate by July 15, 2001

5. LIST OF TBDS