36-01510.107

ACIS Verification Summary Report

Specification:	ACIS Contract End Item Specification
Requirement Number/Title:	3.2.6 Transportability and Transportation (VRSD 3.2.6-2)

Requirement Statement: Vibration, shock, temperature, pressure, humidity, electrostatic potential, and contamination shall be controlled during transportation to not exceed flight hardware design levels.

Verification Method:	Validation of Records

Procedure Number:

Configuration:

Cycle Time:

Verification Discussion/Results:

Except for the subject dealing with Electrostatic potential, his requirement has been verified by verification of several other requirements, as per the following Verification Summary Reports:

Vibration and shock: Reference 36-01510.112
Humidity: Reference 36-01510.113
Temperature: Reference 36-01510.114
Pressure: Reference 36-01510.115
Contamination: Reference 36-01510.116

Relative to ESD protection, ACIS is shipped mounted on the SIM Simulator. The entire assembly is double bagged in ESD protective plastic wrap, serving the dual purpose of ESD protection as well as contamination protection.

Philip Bontempo 6/22/97

ACIS Cognizant Engineer Date

ACIS-36-01510.107

AXAF-I CCD Imaging Spectrometer
(ACIS)

Verification Assessment Report
-Power and Thermal-Control Structure-
-Mechanical Ground Support Equipment-
-Shipping and Handling Design Analysis Report-

Document No. ACIS-717-A-26VR

DPD 727 DR SVR04

Contract # NAS8-37716

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CHANGE/REVISION RECORD

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1. INTRODUCTION

1.1 Scope

This document provides a collection of information which results from the implementation of the ACIS Verification Plan, 36-01203. It is intended to show that the delivered instrument meets a specific set of requirements from the ACIS Power and Thermal-Control Structure (PTS) Specification, ACIS-36-02101.

In particular, this report provides the analytical data to support the verification of specific PTS Specification requirements. These requirements were assessed to be best verified by a analysis. The method selected in the verification of each specific requirement is the method which provides the assurance to the program that the requirements have been verified.

The Verification Cross Reference Matrix contained in the ACIS PTS Specification shows how each contractual requirement will be verified. The requirements documented herein have been designated to be verified by analysis and/or a combination of other verification methods.

1.2 Applicable Documents

ACIS Project Documents

36-02101	ACIS Power and Thermal-Control Structure (PTS) Specification
36-01203	ACIS Verification and Calibration Plan

2. METHODOLOGY

2.1 Requirements & Specifications

Verification methods to be used are defined in the verification matrix, compiled as an appendix to the ACIS Power and Thermal-Control Structure Specification, 36-02101.

2.2 Verification Descriptions

Summary level descriptions of each verification activity are located in the ACIS Verification Plan, 36-01203 and the ACIS Power and Thermal-Control Structure Specification, 36-02101. The specific definitions for this report are as follows:

2.2.1 Analysis Definition

Analysis is a method of verification, taking the form of the processing and accumulated results and conclusions, intended to provide proof that verification of a requirement(s) has been accomplished. The analytical results may be based on engineering study, compilation or interpretation of existing

information, similarity to previously verified requirements, or derived from lower level examinations, tests, demonstrations, or analyses. Verification by analysis is a process used in lieu of or in addition to testing to verify compliance with specification requirements. The selected techniques may include systems engineering analysis, statistics and qualitative analysis, computer and hardware simulations, and analog modeling. Analytical techniques may be used in lieu of tests for such things as life, storage, failure analysis, safety, interchangability, and some other performance requirements which cannot be verified by test.

3. ANALYSIS

3.1 Applicable Requirements

	Requirement Reference	Requirement
1.	3.2.1.6.4a	Mechanical Shipping and Handling Equipment The Mechanical Shipping and Handling Equipment shall: Supply environmental protection for the hardware.
2.	3.2.8a	Handling and Transportation The Power and Thermal-Control Structure shall be transported using equipment specifically designed to protect the flight hardware during ground or air transportation.
3.	3.2.8b	Handling and Transportation The Power and Thermal-Control Structure will meet the specifications herein following exposure to the handling and transportation natural environments specified in section 3.2.7.
4.	3.2.8f	Handling and Transportation Vibration, shock, temperature, pressure, humidity, electrostatic potential, and contamination for flight hardware shall be controlled during transportation to not exceed flight hardware design levels or not actively controlled if hand carried point to point.
5.	3.2.8g	Handling and Transportation Transportation and handling of the Power and Thermal-Control Structure shall comply with the requirements of MMI 6400.2, MSFC-STD-126, and NHB 6000.1.
6.	3.2.9a	Storage The ACIS shall be stored using equipment specifically designed to protect the flight hardware.

7. 3.2.9b Storage
   Temperature, pressure, humidity, and contamination shall be controlled during storage so as not to exceed flight hardware design levels.

8. 3.2.9d Storage
   The Power and Thermal-Control Structure shall be capable of storage in its shipping container.

9. 3.2.9f Storage
   The Mechanical Ground Support Equipment shall be capable of storage in its shipping container.

3.2 Analytical Discussion

The Power and Thermal-Control Structure Mechanical Ground Support Equipment Shipping and Handling design analyses are provided for review and comment per contractual data requirement SE03.

Requirement Reference — Requirement

1. 3.2.1.6.4a Mechanical Shipping and Handling Equipment
   The Mechanical Shipping and Handling Equipment shall: Supply environmental protection for the hardware.

   DISCUSSION
   The ACIS shipping container has an integral environmental cover. The SCPS, TCR and VGSE are supplied with integral shipping containers and covers. This discussion verifies compliance with paragraph 3.2.1.6.4a of the PTS Specification, no further action is required.

2. 3.2.8a Handling and Transportation
   The Power and Thermal-Control Structure shall be transported using equipment specifically designed to protect the flight hardware during ground or air transportation.

   DISCUSSION
   The ACIS shipping container has been designed to withstand the expected loads and safety factors as specified in table 3.1.2.1.1-1 in document DPD692 SE29. Further, the shipping container is outfitted with shock watches during shipment and ground handling. This discussion verifies compliance with paragraph 3.2.8a of the PTS Specification, no further action is required.

3. 3.2.8b Handling and Transportation
The Power and Thermal-Control Structure will meet the specifications herein following exposure to the handling and transportation natural environments specified in section 3.2.7.

DISCUSSION
The Mechanical Ground Support Equipment Shipping and Handling Equipment has been designed to specifically protect the flight hardware following exposure to the handling and transportation natural environments specified in section 3.2.7. This discussion verifies compliance with paragraph 3.2.8b of the PTS Specification, no further action is required.

4. 3.2.8f Handling and Transportation
Vibration, shock, temperature, pressure, humidity, electrostatic potential, and contamination for flight hardware shall be controlled during transportation to not exceed flight hardware design levels or not actively controlled if hand carried point to point.

DISCUSSION
The Mechanical Ground Support Equipment Shipping and Handling Equipment has been designed to control vibration, shock, temperature, pressure, humidity, electrostatic potential, and contamination during transportation to not to exceed flight hardware design levels. The shipping containers are 0.090" aluminum that form a faraday cage when closed and latched. Purge ports are supplied to allow an inert gas purge where required to maintain cleanliness and humidity. Shock, and vibration environments during ground operation shall be controlled in two ways. First, a set of shock isolators are an integral part of the ACIS shipping container. Second, all ground handling operations will be controlled to minimize shock and vibration loads. This discussion verifies compliance with paragraph 3.2.8f of the PTS Specification, no further action is required.

5. 3.2.8g Handling and Transportation
Transportation and handling of the Power and Thermal-Control Structure shall comply with the requirements of MMI 6400.2, MSFC-STD-126, and NHB 6000.1.

DISCUSSION
The Mechanical Ground Support Equipment Shipping and Handling Equipment has been designed to comply with the requirements of MMI 6400.2, MSFC-STD-126, and NHB 6000.1 for handling and transportation. This discussion verifies compliance with paragraph 3.2.8g of the PTS Specification, no further action is required.

6. 3.2.9a Storage
The ACIS shall be stored using equipment specifically designed to protect the flight hardware.

DISCUSSION
The ACIS shipping and storage equipment has been designed with purge fittings and environmental seals to establish and maintain appropriate environmental conditions. This discussion verifies compliance with paragraph 3.2.9a of the PTS Specification, no further action is required.

7. 3.2.9b Storage
Temperature, pressure, humidity, and contamination shall be controlled during storage so as not to exceed flight hardware design levels.

DISCUSSION
The VGSE shipping containers have been designed and manufactured to meet these criterion. These parameters shall also be met by controlling the operating procedures used when handling flight hardware or GSE. This discussion verifies compliance with paragraph 3.2.9b of the PTS Specification, no further action is required.

8. 3.2.9d Storage
The Power and Thermal-Control Structure shall be capable of storage in its shipping container.

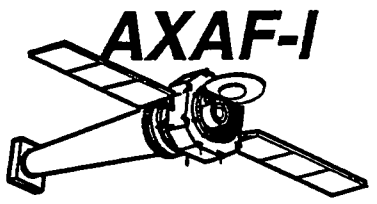
DISCUSSION
The ACIS shipping container has been designed to house all of ACIS except the radiator shades. These items have there own shipping container. This discussion verifies compliance with paragraph 3.2.9d of the PTS Specification, no further action is required.

9. 3.2.9f Storage
The Mechanical Ground Support Equipment shall be capable of storage in its shipping container.

DISCUSSION
All MGSE has been designed with an integral shipping container except lifting fixtures. Lifting fixtures, slings, and VGSE flex hoses have been packaged in suitable shipping containers. This discussion verifies compliance with paragraph 3.2.9f of the PTS Specification, no further action is required.

APPENDIX A
AXAF SHIPPING LOADS AND FACTORS TABLE

EV1-8
5 June1995
NAS8-37710
DPD692 SE29
Type 3 Document



Advanced X-ray Astrophysics Facility - Imaging

AXAF-I Environment Document

Submitted to:
George C. Marshall Space Flight Center
National Aeronautics and Space Administration
Marshall Space Flight Center, AL 35812

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A-2

Table 3.1.2.1.1-1 Design Limit Load Factors for GSE and Test Fixtures

Medium/Mode	Load Factors (Gs)			Load	Safety Factor	
	Fore/Aft	Lateral	Vertical**	Apply	Yield	Ultimate
Water Barge/Dock Bumping	+0.5 -0.5	+1.0 -1.0	+2.5 -0.5	S	2	3
Water Barge in Transient*	±0.09 ±0.00025h	±0.05 ±0.0013h	±1.0 ±0.0025x ±0.0013L	S	2	3
Air C5A	+3.0 -3.0	+1.5 -1.5	+3.0 -1.0	S	2	3
Truck Trailer	+2.0 -2.0	+2.0 -2.0	+3.5 -1.5	I	2	3
Truck Trailer, Air-Ride	+2.0 -2.0	+2.0 -2.0	+3.5 -1.5	I	2	3
Rail, Slow Moving No hump < 5 MPH	+1.0 -1.0	+0.75 -0.75	+1.5 -0.0	I	2	3
Dolly, Slow Moving 30 ft/min. Max.	+1.0 -1.0	+0.75 -0.75	+1.5 -0.0	I	2	3
Hoisting, Handling Erecting, Lowering			+1.0 -1.0	D	3	5
Fork-Lifing, Fork-Lowering	+1.0 -1.0	+0.5 -0.5	+2.0 -0.0	S	2	3
Seismic	+0.5 -0.5	+0.5 -0.5	+1.0 -1.5	S	2	3

*Distance in inches where:

L = Horizontal distance between center-line of barge roll to GSE cg
h = Vertical distance between center-line of barge roll to GSE cg
x = Axial distance between barge center-of-pitch to GSE cg

**Loads include the effect of gravity

S = Loads occur simultaneously in the three directions
I = Loads occur independently in the three directions except for gravity
D = Load in direction of travel

Note: The vertical direction "+" sign is directed toward the center of the earth