ACIS 36-02202

Ground Support Equipment (GSE)
to
AXAF CCD Imaging Spectrometer (ACIS)/Facility

Interface Control Document (ICD)

Revision ~~A~~ 02

Contract # SC-A-124624

October 15, 1996

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REVISION SUMMARY

Change or Revision	Page(s) Affected	Description	Date
	All	Outline Submittal	7 May 93
Rev NEW	All	PDR Baseline	23 May 94
Rev. A	All	Complete Rewrite to revise scope and update document.	15 Oct 1996

Table of Contents

LIST OF FIGURES

1.0 SCOPE

This Interface Control Document (ICD) addresses the interfaces between the Electrical Ground Support Equipment (EGSE) and the AXAF-I CCD Imaging Spectrometer (ACIS) and facilities and the Mechanical Ground Support Equipment (MGSE) and the ACIS and facilities.

This document is prepared and maintained by Lockheed Martin Astronautics (LMA), with inputs and concurrence from Massachusetts Institute of Technology/Center for Space Research (MIT/CSR).

1.1 General

Ground Support Equipment (GSE) is that specialized equipment, supplies, and support required to test and verify the operation and flight readiness of ACIS when in the flight configuration. The GSE will include a complete set of operating manuals, schematics, drawings, and procedures required to operate, maintain and troubleshoot the GSE in a safe manner to the operators, GSE and ACIS. This document describes the interface between the MGSE the EGSE and the Instrument/Facilities.

ACIS GSE comprises mechanical ground support equipment (MGSE), and electrical ground support equipment (EGSE) with associated software. The MGSE includes some electrical equipment, and both the EGSE and MGSE include shipping containers. The EGSE will also include set of cables to interconnect the high speed data tap to the High Speed Tap Archive computer at the vacuum test facilities. LMA is primarily responsible for the MGSE, and MIT is primarily responsible for the EGSE.

Bench Checkout Equipment (BCE) is the electrical and mechanical equipment needed to build, test and verify the operation of instrument modules and subsystems, but not needed when ACIS is in the flight configuration. Bench Checkout Equipment is not deliverable; as such there is no acceptance program for this equipment. The BCE defined within this document may have manual control, without automatic or computer controlled operation. A full set of flight like tests is not possible using only BCE.

2.0 APPLICABLE DOCUMENTS

The following documents, of the exact issue shown, form a part of this specification only to the extent specified herein. Should a document not be specifically referenced by a specific paragraph herein, then the document is to be used for reference only. If the issue of a document is not specified, the issue in effect on the date of release of this specification shall be applicable. In the event of conflict among the documents referenced herein, the NASA documents shall be considered the superseding document.

2.1 Specifications

Document Number	Description	Reference
MIL-B-5087B	Bonding, Electrical, and Lightning Protection for Aerospace Systems	3.2.3.1, 3.2.3.2
FED-STD-209	Clean Room & Workstation Environments	3.3.1.1.2.c

2.2 Military Standards

Document Number	Description	Reference
MIL-STD-1686	ESD Control Program for Protection of Electrical and Electronic Parts, Assemblies, and Equipment	3.3.2.3.b, 3.4.2.3.b

2.3 ACIS Documents

Document Number	Description	Reference
36-02201	PTS to DPS ICD	3.0.f
36-02203	Focal Plane to detector Housing ICD	3.0f
36-01207	Contamination Control Plan	3.1.2.1, 3.1.2.2, 3.1.2.2.5, 3.1.4, 3.3.1.1.2.a, 3.3.1.1.2.d, 3.3.2.3.c
36-01101	ACIS CEI Specification	3.1.3, 3.1.5
36-02101	PTS Specification	3.1.3, 3.1.5
36-03020.02	ACIS Wire List	3.3.1.2.d

2.4 AXAF Documents

Document Number	Description	Reference
IF1-20	Observatory to Science Instrument ICD	3.0e

3.0 INTERFACES

a. This ICD briefly describes the Electrical Ground Support Equipment and the Mechanical Ground Support Equipment for the AXAF-I CCD Imaging Spectrometer. (Section 3.1)

b. This ICD documents the Ground Support Equipment to facilities requirements (Section 3.2). The interface conditions between the GSE and Facilities are mechanical, fluid, and electrical.

c. This ICD documents the interfaces between the MGSE and ACIS (Section 3.3). The interface conditions between the MGSE and ACIS Instrument are mechanical, electrical, power, environmental, and contamination control.

d. This ICD documents the interfaces between the EGSE and the ACIS (Section 3.4). The interface conditions between the EGSE and ACIS Instrument are electrical and environmental.

e. All interfaces between ACIS and the SIM are defined and characterized in the Observatory to Science Instrument Interface Control Document, IF1-20.

f. The Power and Thermal-Control Structure to Detector and Processor Subsystem interfaces are documented in Power and Thermal-Control Structure to Detector and Processor Subsystem Interface Control Document, 36-02201 and the Focal Plane to Detector Housing Interface Control Document, 36-02203.

3.1 MGSE and EGSE Characteristics

a. The Mechanical Ground Support Equipment comprises the following items:
   i) Vacuum Ground Support Equipment (VGSE) and cabling
   ii) Spacecraft Power Simulator (SCPS) and cabling
   iii) Test Connector Readout (TCR) and cabling
   iv) Mechanical Shipping and Handling Equipment, which includes shipping containers, for the following:
      1. the Venting Subsystem components ;
      2. the Detector Housing components;
      3. the Collimator;
      4. the PSMC;
      5. the assembled ACIS flight Detector Assembly in flight configuration, and/or the Support Structure, when integrated on the SIM simulator;
      6. the Test Connector Readout;
      7. the Sun Shade and Telescope Shade (one container);
      8. the Radiator Assembly;
      9. handling and installation fixtures for the detector assembly, PSMC and MGSE as required.

   Non-reusable shipping boxes will be provided for the Remote Valve Assembly and the Turbo Pump Chiller.

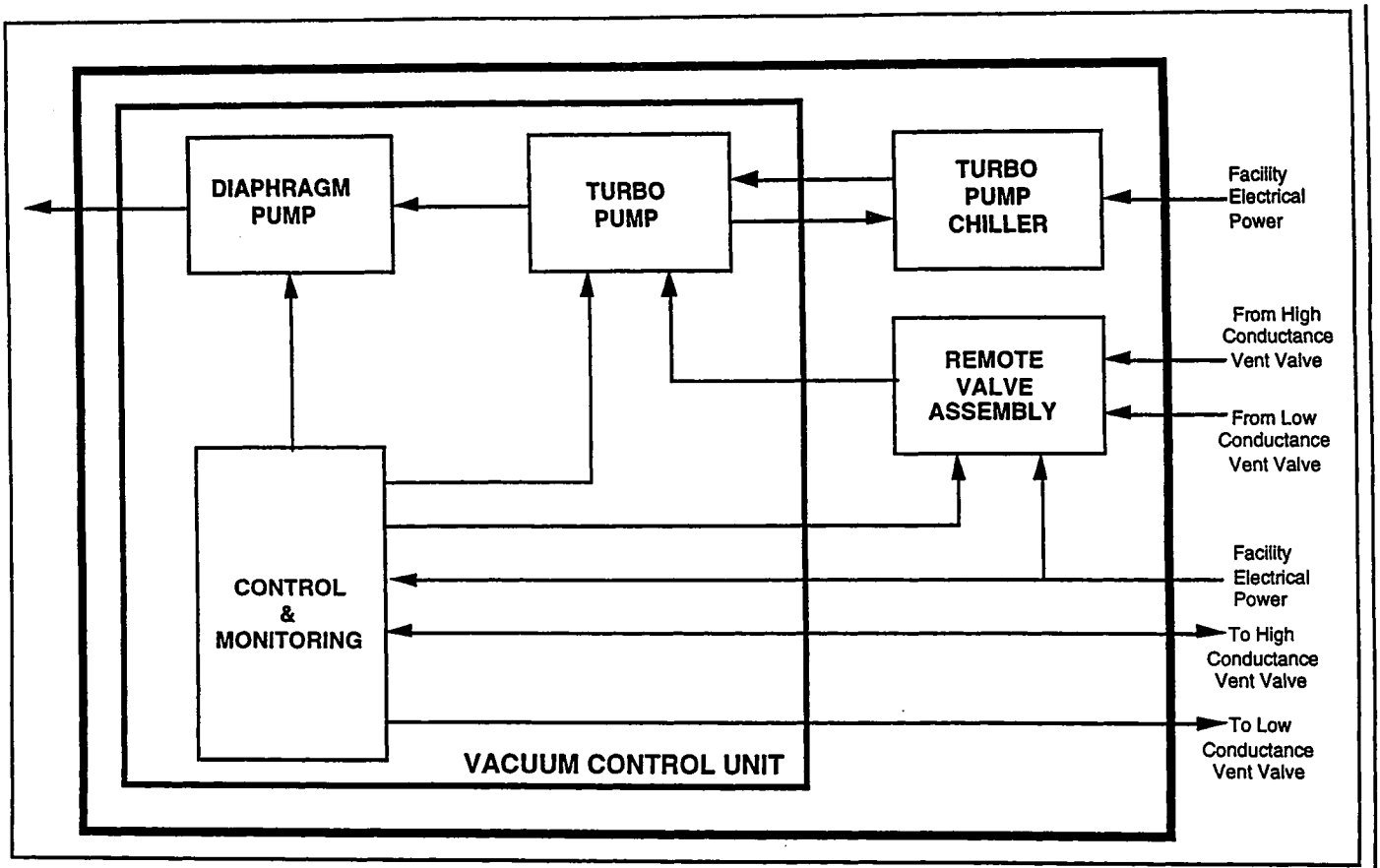

Figure 3.1-1 VGSE Interface Diagram

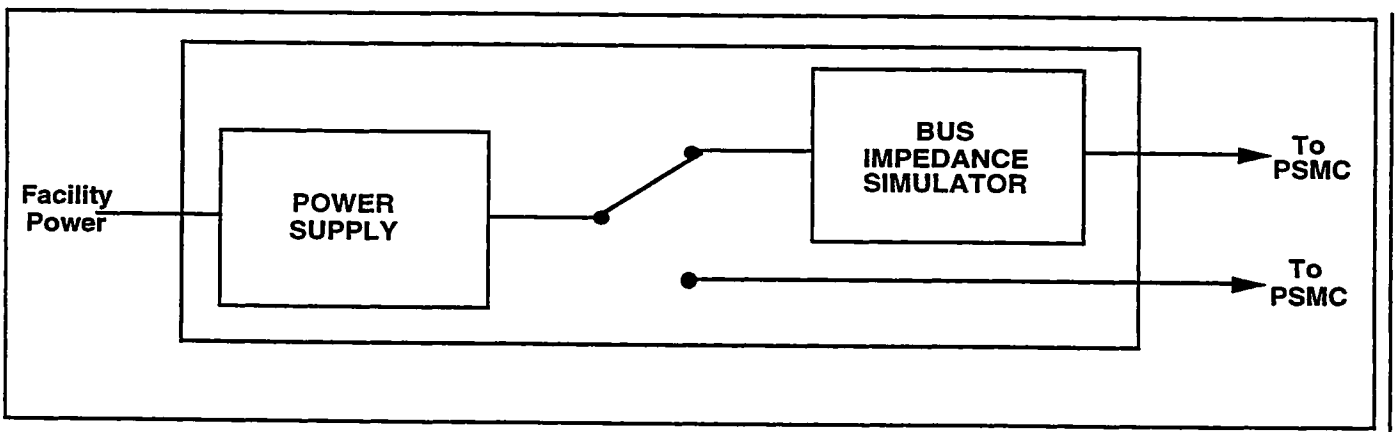

Figure 3.1-2 SCPS Interface Diagram

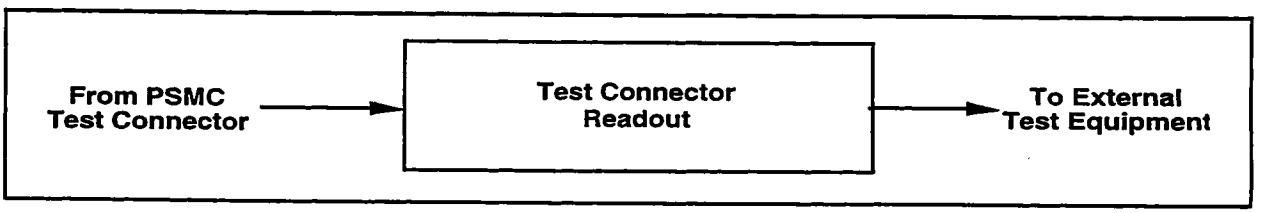

Figure 3.1-3 TCR Interface Diagram

b. Electrical Ground Support Equipment and BCE hardware comprise the following items:
   i) a single ACIS EGSE computer (SPARC workstation), which is a deliverable end item provided by MIT (ref. Figure 3.1-4);
   ii) an RCTU Emulator, provided by MIT for use as non-deliverable Bench Checkout Equipment at MIT;
   iii) a Terminal Server, provided by MIT for use as non-deliverable Bench Checkout Equipment at MIT;
   iv) a High Speed Tap Archive computer, non-deliverable science equipment provided by MIT to interface with the ACIS high speed data taps.
c. The Electrical Ground Support Equipment Shipping and Handling Equipment comprises the following items:
   i) Handling and Integration Slings and Harnesses
   ii) Shipping containers for the following;
      1) the combined DEA, DPA and Support Structure (not mounted on the SIM simulator);
      2) the SPARC Workstation;
      3) support equipment (including BCE) as required.

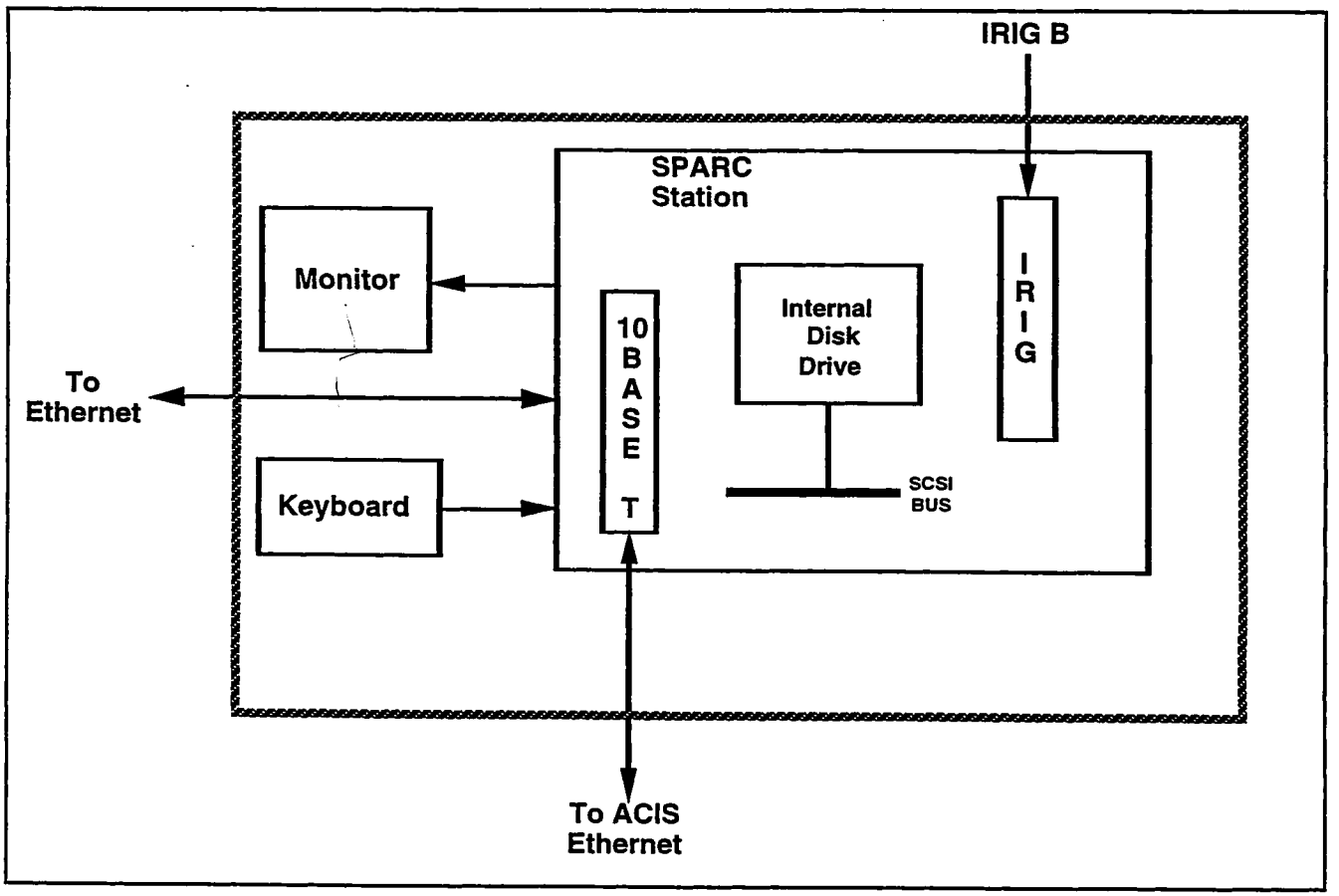

Figure 3.1-4 ACIS Electrical Ground Support Equipment Block Diagram

3.1.1 Physical Characteristics

3.1.1.1 Size and Configuration

3.1.1.1.1 MGSE

a. The Vacuum GSE Vacuum Control Unit (VCU) and Remote Valve Assembly (RVA) will fit into a rectangular volume 30 inches wide by 48 inches deep by 54 inches high.

b. The Vacuum GSE Turbo Pump Chiller will fit into a rectangular volume 14-3/8 inches wide by 23-1/2 inches deep by 24-1/2 inches high.

c. The Spacecraft Power Simulator will fit into a rectangular volume 16 inches wide by 24 inches deep by 30 inches high.

d. The Test Connector Readout will fit into a rectangular volume 32 inches wide by 24 inches deep by 8 inches high.

e. Requirements for handling equipment, (assembly and integration slings and harnesses) volumes are not applicable.

f. Shipping containers dimensions and volume will be compatible with domestic air and freight carriers constraints while providing the necessary protection.

3.1.1.1.2 EGSE

a. The SPARC Station (without monitor) will fit into a rectangular volume approximately 18 inches wide by 18 inches deep by 6 inches high.

b. The Monitor will not exceed 8 cubic feet in volume.

c. The Terminal Server will fit into a rectangular volume approximately 12 inches wide by 12 inches deep by 6 inches high.

d. Requirements for handling equipment, (assembly and integration slings and harnesses) volumes are not applicable.

e. Shipping containers dimensions and volume will be compatible with domestic air and freight carriers constraints while providing the necessary protection.

3.1.1.2 Weight

3.1.1.2.1 MGSE

a. The VGSE will weigh less than 410 lbs when ready for shipping. The VGSE comprises the following major components, whose weights are:
   i) The Vacuum Control Unit (VCU) and the Remote Valve Assembly (RVA) will weigh less than 250 lbs (combined weight).
   ii) The Turbo Pump Chiller will weigh less than 160 lbs.

b. The Spacecraft Power Simulator will weigh less than 100 lbs. when ready for shipping.

c. The Test Connector Readout will weigh less than 50 lbs. when ready for shipping.

d. Requirements for handling equipment, (assembly and integration slings and harnesses) weights are not applicable.

e. Shipping containers weight will be compatible with domestic air and freight carriers constraints while providing the necessary protection.

3.1.1.2.2 EGSE

a. The SPARC Station (without monitor) will weigh less than 50 lbs when ready for shipping.

b. The Monitor will weigh less than 50 lbs when ready for shipping.

c. The Terminal Server will weigh less than 50 lbs when ready for shipping.

d. Requirements for Handling equipment, (assembly and integration slings and harnesses) weights are not applicable.

e. Shipping containers weight will be compatible with domestic air and freight carriers constraints while providing the necessary protection.

3.1.1.3 Orientation

3.1.1.3.1 Shipping Orientation

a. The VGSE will be shipped in the vertical position with wheels down and within ±30° of level.

b. The SCPS will be shipped in the normal operating position within ±30° of level.

c. The SPARC Station and Monitor will be shipped in the normal operating position within ±30° of level.

d. The High Speed Data Archive Computer will be shipped in the normal operating position within ±30° of level.

e. The remaining GSE is not orientation sensitive during shipping.

f. Shipping case orientation is driven by the content orientation constraints above; when not in use they are not orientation sensitive.

3.1.1.3.2 Operating Orientation

a. The VGSE will be operated in the vertical position with wheel down and within ±5° of level.

b. The SCPS will be operated in the normal operating position within ±5° of level.

b. The TCR will be operated in the normal operating position within ±20° of level.

c. The SPARC Station and Monitor will be operated in the normal operating position within ±5° of level.

d. The High Speed Data Archive Computer will be operated in the normal operating position within ±5° of level.

e. The Terminal Server will be operated in the normal operating position within ±20° of level.

f. GSE Cabling, other than proper connector orientation controlled by keying, is not orientation sensitive during operation.

g. The Detector Housing Handling fixture will be oriented so as to maintain the Detector Housing X-axis to within 20 degrees of vertical.

3.1.2 Construction Characteristics

3.1.2.1 Mounting surfaces

The GSE will provide mounting surfaces in compliance with the ACIS Contamination Control Plan, 36-01207.

3.1.2.2 Coatings /Corrosion Control

The GSE will provide external surfaces in compliance with the ACIS Contamination Control Plan, 36-01207.

3.1.2.2.1 Coating of Metallic Parts

All metallic parts will be surface treated to prevent corrosion.

3.1.2.2.2 Coating of Aluminum Parts

Irradite, anodize or zinc chromate will be used on aluminum components in the GSE.

3.1.2.2.3 Coating of Ferrous Metals

Ferrous metals will be painted, lacquered, galvanized or plated to prevent rusting. Stainless steel requires no further corrosion protection.

3.1.2.2.4 Copper Seals

Copper used as seals will not have corrosion protection.

3.1.2.2.5 Commercial Hardware

Commercial hardware utilized by the GSE will meet the requirements of the ACIS Contamination Control Plan, 36-01207.

3.1.2.3 Sealing

a. The VGSE will supply a standard 2.75" Conflat flange for connection to other non-GSE equipment.

b. A standard NW25 Clamp Flange (KF) will be available from the VGSE for connection to a standard helium leak detector.

c. No other interface requiring seals is present on the remaining GSE.

3.1.3 Environmental conditions

The GSE will meet criteria documented in this document after exposure to the non-operating transportation, storage, and handling environments; and during and after exposure to the operating environments. The environmental characteristics are as specified in the AXAF-I CCD Imaging Spectrometer CEI Specification, 36-01101, paragraphs 3.2.5 and 3.2.6 for the EGSE and per the PTS Specification, 36-02101, paragraph 3.2.7 for the MGSE.

3.1.3.1 Shipping Loads

The GSE will meet the criteria of this document after sustaining the following shipping loads:

Transportation Method	Load Factors (G)			Application Axis
	Fore/Aft	Lateral	Vertical*	
Air (C5A)	±3.0	±1.5	+3.0/-1.0	S
Truck Trailer	±2.0	±2.0	+3.5/-1.5	I
Truck Trailer, Air-Ride	±2.0	±2.0	+3.5/-1.5	I
Rail (< 5 MPH)	±1.0	±0.75	+1.5/-0.0	I
Dolly (< 30 ft/min)	±1.0	±0.75	+1.5/-0.0	I
Hoisting & Handling			±1.0	D
Fork Lifting & Lowering	±1.0	±0.5	+2.0/-0.0	S
Seismic	±0.5	±0.5	+1.0/-1.5	S

* Loads include the effect of gravity
S = Loads occur simultaneously in the three axes
I = Loads occur independently in the three axes, except for gravity
D = Load in direction of travel

3.1.3.2 VGSE and SCPS Specific Environmental Constraints

The VGSE and SCPS will operate in the following environments:

a. Temperature; between 50°F and 90°F (10°C to 32°C).

b. Humidity; between 25% and 70% RH for electrostatic discharge control.

c. Altitude (simulated or otherwise);
   i) For the VGSE, lower than 7000 ft (2150 m),
   ii) For the SCPS, lower than 10,000 ft (3000 m)

3.1.4 Contamination Control

Contamination control will be in accordance with the ACIS Contamination Control Plan, 36-01207.

3.1.5 Safety

The GSE interfaces will be designed for compliance with the following MSFC and NASA safety requirements, as well as any additional ACIS specific safety requirements. The safety constraints are as specified in the AXAF-I CCD Imaging Spectrometer CEI Specification, 36-01101, paragraphs 3.2.4 for the EGSE and per the PTS Specification, 36-02101, paragraph 3.2.6 for the MGSE.

3.2 GSE to Facility Interface Characteristics

3.2.1 Mechanical Interfaces

a. The ACIS GSE will require facility interfaces compatible with the volumes and weights described in paragraph 3.1.1.

b. The ACIS GSE will operate in a laboratory environment compliant with the program contamination control and environment requirements as documented herein, paragraphs 3.1.3 and 3.1.4.

3.2.2 Fluid/Gas Interfaces

a. The Vacuum Ground Support Equipment requires bottled nitrogen for purging. Nitrogen used will meet the following requirements:

1. Total hydrocarbon content	$\leq$ 0.5 ppm
2. Moisture content	Dew point less than -40°C
3. Particulate content	Filtered to less than 1.0 microns
4. Regulator fitting	CGA 580

b. The Vacuum Ground Support Equipment requires compressed air for operating pneumatic valves. Compressed air used will meet the following requirements:

1. Hydrocarbon content	Specified by facility requirements, not VGSE requirements
2. Moisture content	Preclude reaching the dew point at the facility
3. Pressure	70 to 100 psig.
4. Fitting	Standard Hansen 1/4" bayonet

c. The VGSE (Turbo Pump Chiller) will use distilled water for cooling. The chiller will be filled with distilled water (4.1 liters) prior to use.

3.2.3 Electrical Interfaces

3.2.3.1 MGSE

a. All MGSE components will be grounded to facility, each other, and the instrument in compliance with MIL-B-5087B.

b. The MGSE Shipping Containers do not require facility electrical power.

3.2.3.1.1 Vacuum Ground Support Equipment

The facility will provide two 15 amp, 120 volts, 50/60 hertz standard duplex grounded wall outlets for use by the VGSE.

3.2.3.1.2 Spacecraft Power Simulator

The facility will provide a single 15 amp, 120 volts, 60 hertz standard duplex grounded wall outlet for use by the SCPS.

3.2.3.2 EGSE

All EGSE components will be grounded to facility, each other, and the instrument in compliance with MIL-B-5087B.

3.2.3.2.1 ACIS EGSE (SPARC Station)

a. The facility will provide a single 15 amp, 120 volts, 60 hertz standard duplex grounded wall outlet for use by the ACIS EGSE, except as follows:
When the ACIS is being tested in a vacuum, the facility will provide 115 volts, 60 Hz uninterruptible power, in a standard duplex grounded outlet, capable of supplying 850 watts for at least 30 minutes in the event of primary power failure.

b. The SPARC Station will provide an Ethernet interface for communications via the XRCF Ethernet bus.

3.3 MGSE to ACIS Instrument Interface Characteristics

This section describes the interface between the Mechanical Ground Support Equipment and ACIS. This section is included to provide control over and documentation of this interface.

3.3.1 VGSE to ACIS Instrument Interface Characteristics

This section describes the interface between the VGSE and ACIS. This section is included to provide control over and documentation of this interface.

3.3.1.1 Mechanical Interfaces

a. The VGSE will provide a port to allow leak checking of the system and ACIS.

b. The VGSE will provide a 14 foot vacuum line from the RVA to the ACIS Detector Assembly.

c. The VGSE will provide a standard interface to the ACIS detector assembly with a leak rate less than 10^{-7} atm-cc/sec.

3.3.1.1.1 Mechanical Interface Characteristics

a. The Vacuum GSE will interface with the science instrument via a flange at the Venting Subsystem exit (+Y panel) to the Science Instrument Module (SIM) or the Venting Subsystem at the vacuum line only.

b. The vacuum interface between the Instrument and the RVA will be a compliant, all metal connection, with the exception of the Viton seals.

c. The vacuum interface will consist of an NW16 fitting.

3.3.1.1.2 Contamination Control

a. The VGSE will be internally cleaned in accordance with the ACIS Contamination Control Plan (36-01207).

b. The VGSE will supply an interface compatible with clean room materials requirements in accordance with the ACIS Contamination Control Plan (36-01207) and FED-STD-209.

c. The VGSE, when attached to the Detector Assembly, will prevent particles with nominal diameters greater than 10 μm from entering the ACIS Detector Assembly during purge operations.

d. The VGSE will provide a clean, oil-free vacuum and a clean, oil-free purge system to maintain the quality and cleanliness of the ACIS detector assembly, in accordance with the ACIS Contamination Control Plan (36-01207).

3.3.1.2 Electrical Interfaces

a. The VGSE will have an electrical interface to the flight Venting Subsystem pressure transducers and valve control via a dedicated GSE connector in the flight design.

b. The VGSE to Venting Subsystem will supply energizing voltage and readout to the two pressure transducers mounted as part of the Venting Subsystem.

c. The VGSE to Venting Subsystem will supply energizing voltage, open and close commands, and position readout to/from the Venting Subsystem high and low conductance vent valves mounted as part of the Venting Subsystem.

The VGSE to Venting Subsystem will supply energizing voltage, open and close commands, and position readout to/from the Venting Subsystem high conductance vent valve mounted as part of the Venting Subsystem via the "B" side (flight redundant side) actuator pair.

The VGSE to Venting Subsystem will supply energizing voltage, open and close commands, and position readout to/from the Venting Subsystem low conductance vent valve via a GSE dedicated solenoid.

d. The VGSE to Venting Subsystem interface connector part numbers and pinouts are shown in the ACIS Wire List, 36-03020.02.

e. When the Detector Assembly/Venting Subsystem is in flight configuration (i.e. mounted to the collimator, with the vent line attached between the Detector Assembly and the SIM interface plate) the VGSE will mate to the interface connector on the SIM interface plate.

3.3.1.2.1 Power Outputs

a. The VGSE will provide excitation voltages for the pressure transducers, 15 Vdc maximum.

b. The VGSE will supply energizing pulses to open and close the low conductance vent valve on the flight Venting Subsystem.

c. The low conductance vent valve will be a latching solenoid valve operated with 28 ±4 volt dc pulses.

d. The low conductance vent valve operating pulses will be between 10 and 100 ms in length.

e. The low conductance vent valve design current for the system will be for two amps minimum.

f. The low conductance vent valve will be opened and closed by reversing the polarity of the two drive wires.

g. The VGSE will supply energizing power to open and close the high conductance vent valve on the flight Venting Subsystem, at a voltage of 24 to 35 Vdc.

3.3.2 Other MGSE to ACIS Instrument Interface Characteristics

This section describes the interface between the Mechanical Ground Support Equipment, except the Vacuum GSE (as documented in section 3.3.1), and ACIS. This section is included to provide control over and documentation of this interface.

3.3.2.1 Spacecraft Power Simulator

The spacecraft power simulator will provide 22 to 35 Vdc power to the PSMC via banana jacks on the SCPS.

3.3.2.2 Test Connector Readout

The two Test Connector Readout interface connectors will be identical to the test connectors on the PSMC (MS27505E23F35PD and MS27505E23F35PC).

3.3.2.3 Shipping Containers

a. The shipping containers will protect the MGSE and PTS flight hardware from damage when exposed to vibration levels consistent with air and surface transportation, per paragraph 3.1.3.1.

b. The shipping containers will protect the MGSE and PTS flight hardware from electrostatic discharge, in accordance with MIL-STD-1686.

c. The interior of the shipping container for the Detector Assembly will be cleanable in accordance with the ACIS Contamination Control Plan (36-01207).

3.4 EGSE to ACIS Instrument Interface Characteristics

This section describes the interface between the Electrical Ground Support Equipment and ACIS. This section is included to provide control over and documentation of this interface.

3.4.1 ACIS EGSE (SPARC Station) to ACIS Instrument Interface Characteristics

The SPARC workstation has no direct interface with the ACIS instrument.

3.4.2 Other EGSE to ACIS Instrument Interface Characteristics

3.4.2.1 RCTU Emulator

The RCTU Emulator will interface to the DPA connectors A5J6 (MS27656T15F35SA) and A5J7 (MS27656T15F35SB).

3.4.2.2 High Speed Data Tap Archive Computer

The HSDT Archive computer will interface to the DEA connector A4J5 (311P409-1S-B-12).

3.4.2.3 Shipping Containers

a. The shipping containers will protect the EGSE, BCE, and flight hardware from damage when exposed to vibration levels consistent with air and surface transportation, per paragraph 3.1.3.1.

b. The shipping containers will protect the EGSE, BCE, and flight hardware from electrostatic discharge, in accordance with MIL-STD-1686.