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Fluids and Combustion Facility Document

FCF Requirements for Receiving Flight Racks

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Approved by Robert Zurawski, FCF Project Manager, Microgravity Science Division, 6700

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1.0 INTRODUCTION

1.1 Purpose

This document applies to all flight racks, as well as their Rack Handling Adapter (RHA) and Rack Shipping Container (RSC) received by the Fluids and Combustion Facility (FCF) Project Office of the Glenn Research Center at Lewis Field (GRC). This document applies to this hardware from the time of the signing of the Hardware User Inspection Card, NASA-C-80, until the hardware is formally handed over to the Microgravity Research Development and Operations Contract (MRDOC) Exhibit 1 Contractor. The FCF Project Office does not accept responsibility for any rack, RHA, or RSC until it is accepted by the GRC as signified by the signing of the NASA-C-80 Card.

1.2 Scope

This document provides procedures by which the rack, RHA, and RSC will be received, handled, stored, and inspected in Building 333 of the GRC. The provisions of this document shall be in effect from the time the RSC arrives at the GRC until the hardware is turned over to the MRDOC Exhibit 1 Contractor.

2.0 REFERENCES

2.1 Reference Documents

Document Number	Document Title
FCF-PLAN-0007	FCF Risk Management Plan (FCF Project Office document)
FCF-PLN-0056	Contamination Control and Implementation Plan (MRDOC document)
FCF-PO-PLAN-0001	FCF Project Plan (FCF Project Office document)
FCF-SPC-0001	System Specification (MRDOC document)
GRC-M0510.001	Glenn Product Assurance Manual
GRC-M0530.001	NASA Glenn Safety Manual
GRC-P3.11.1	Center Procedure for Control of Inspection, Measuring, and Test Equipment
GRC-P3.11.2	Center Procedure for the Instrument Pool
GRC-P3.3.1	Procedure for Training and Career Development
GRC-P3.7.6	Center Procedure for Information Storage and Retrieval
GRC-P3.9	Center Procedure for Acquisition Process
GRC-P3.9.3	Center Procedure for Handling, Storage, Packaging, Preservation, and Delivery
GRC-P4.4	Center Procedure for Control of Nonconforming Product
GRC-P4.7	Center Procedure for Corrective and Preventative Action
GRC-W0620.3.9.001	Work Instruction for Receiving
FCF-PO-PLAN-0002	International Space Station Rack Handling Adapter Operation & Maintenance Plan

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Document Number	Document Title
FCF-PO-PLAN-0003	International Space Station Rack Shipping Container Operation & Maintenance Plan
K-STSM-14.2.1	KSC Payload Facility Contamination Control Requirements/Plan
NHB 1441.1	NASA Procedure and Guidelines for Records Retention Schedule
OMI No.: R5005	Operation and Maintenance Instruction: Flight Rack Ground Support Operations – Space Station Processing Facility (SSPF)
S684-10101	Critical Item Development Specification for Rack Standard/Payload
SN-C-0005	Space Shuttle Contamination Control Requirements
SSP30233	Problem Reporting and Corrective Action for the Space Station Program

2.2 Records and Forms

The following records and forms are generated from this process:

- Logbook, FCF-PO-FORM-0003
- Procedure History/Log Sheet, FCF-PO-FORM-0004
- Hardware User Inspection Card, NASA-C-80
- Test Reports
- As Run Procedures
- Minutes from the Inspection Readiness Review (IRR)
- Memorandums relating to this process (as applicable)
- Mishap Report, NASA Form 1627 (if applicable)
- Failure Report and Analysis, NASA-C-8192 (if applicable)
- Problem Reports (if applicable)
- Supporting Plans, such as an Inspection Plan, Hardware Repair Plan, etc. (if applicable)
- Lessons Learned (if applicable)
- Record of environment extreme conditions (if applicable)

2.3 Acronyms

Acronym	Definition
CCB	Configuration Control Board
CCP	Contamination Control Plan
ERB	Engineering Review Board
FCF	Fluids and Combustion Facility
FOD	Foreign Object Damage
GFE	Government Furnished Equipment
GRC	Glenn Research Center
GSE	Ground Support Equipment
IPT	Integrated Product Team
IRR	Inspection Readiness Review
ISPR	International Standard Payload Rack (Part Number 683-50243-004)

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Acronym	Definition
kph	kilometers per hour
mph	miles per hour
MRDOC	Microgravity Research Development and Operations Contract
NDE	Non-Destructive Evaluation
PRACA	Problem Reporting, Analysis & Corrective Action
QA	Quality Assurance
RHA	Rack Handling Adapter (Part Number 220G07455-001)
RHA Base	Rack Handling Adapter Base, also know as the KSC Base (Part Number 220G07475-001)
RSC	Rack Shipping Container (Part Number 220G07505-001)
SSPF	Space Station Processing Facility
VS-C	Visibly Clean - Sensitive

2.4 Definition of Terms

Term	Definition
Hardware	Includes rack, Rack Handling Adapter, Rack Handling Adapter Base (when in use), and Rack Shipping Container.
High Risk	Likely to cause significant, serious disruption of schedule, increases in cost, or degradation of performance even with a special Integrated Product Team (IPT) or other advanced emphasis.
Low Risk	Has little or no potential for disruption of schedules, increase in cost or degradation of performance. Normal IPT or other activity emphasis should be sufficient to overcome diffraction.
Medium Risk	Can potentially cause some disruption of schedule, increases in cost, or degradation of performance. Special IPT emphasis will probably be sufficient to overcome difficulties.
Mishap	An event that causes unplanned occurrence or event resulting from any NASA operation or NASA equipment anomaly, involving injury or death to persons, damage to or loss of property, or equipment, or mission failure.
Non-particulate	Film matter without a definite dimension.
Particulate	Matter of miniature size with an observable length, width, and thickness.
Rack	Flight Rack (ISPR) delivered in a Rack Shipping Container.
Responsible Person	The FCF Quality Assurance Representative or Designate, the FCF Ground Systems Manager, or the FCF Structures Lead.
Visibly Clean	The absence of all particulate and non-particulate matter visible to the normal unaided eye (except corrected vision).
Visibly Clean - Sensitive	The level of cleanliness defined as being visibly clean when looking under a 50-foot-candles (538 lumens per square meter) at a distance of two to four feet (61 to 122 cm) upon exposed surfaces.

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3.0 RESPONSIBILITIES

Title	Responsibilities
FCF Chief Engineer	<ul style="list-style-type: none"> • Chairs FCF Engineering Review Board (ERB). • Reviews this document • Takes role of the “Responsible Manager” in Problem Reporting, Analysis, and Corrective Action (PRACA). • Approves procedures developed in support of this document.
FCF Documentation Specialist	<ul style="list-style-type: none"> • Maintains documents, drawings, and records received with racks. • Maintains documents (including Logbooks) called out by this document.
FCF GFE Manager	<ul style="list-style-type: none"> • Approves access to the hardware. • Completes the Hardware User Inspection Card, NASA-C-80. • Contacts the Freight Traffic Office if hardware inspection results are not acceptable. • Advises Receiving to expect shipment.
FCF Ground Systems Manager	<ul style="list-style-type: none"> • Represents the FCF Project Office at hardware inspections. • Approves access to the hardware.
FCF Project Control Specialist	<ul style="list-style-type: none"> • Maintains and administers electronic records and websites. • Provides backup to the FCF Documentation Specialist. • Establishes configuration management requirements for the FCF project.
FCF Project Manager	<ul style="list-style-type: none"> • Chairs the Configuration Control Board (CCB). • Leads Type C mishap investigations. • Responsible for the development of corrective and/or preventative action plans as required. • Approves this document.
FCF Quality Assurance Designate	<ul style="list-style-type: none"> • Represents Office of Safety and Mission Assurance (OSAT) at hardware inspections.
FCF Quality Assurance Representative	<ul style="list-style-type: none"> • Signs and dates the Logbook once every month. • Designates a Quality Assurance Designate for an inspection.
FCF Structures Lead	<ul style="list-style-type: none"> • Chairs the Inspection Readiness Review (IRR). • Approves access to the hardware. • Approves inspection plan. • Performs documentation review. • Informs FCF GFE Manager of successful inspection. • Source for procedures associated with this document.

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4.0 PREPARATION FOR HARDWARE ARRIVAL

4.1 Safety

The FCF Project Office shall receive the rack in Building 333 using procedures approved by the Area 7 Safety Committee. The FCF Project Office shall obtain a Safety Permit before the rack is brought into Building 333. If required, a second Safety Permit shall be obtained from the Area 7 Safety Committee before any inspection of the rack itself commences. These Safety Permits shall be obtained in accordance with the NASA Glenn Safety Manual, GRC-M0530.001, Chapter 1 - Safety Management and the Safety Permit System and Chapter 1a - Safety Permit System.

4.2 Documentation, Drawings, and Records

All documents, drawings, and records received with the composite flight racks, or generated by the GRC while the racks are the responsibility of GRC, will initially be the property of the GRC under the auspices of the Microgravity Science Division (6700).

The FCF Documentation Specialist shall maintain these documents, drawings, and records in accordance with the FCF Project Plan and supporting documents, and the Center Procedure for Records Management, GRC-P3.7.3.

The FCF Project Control Specialist is responsible to maintain any electronic versions of these records and project websites in accordance with the FCF Project Plan and supporting documents and the Center Procedure for Information Storage and Retrieval, GRC-P3.7.6.

Documents, drawings, and records shall be maintained for at least one-year after the FCF is decommissioned, unless GRC requirements or the NASA Procedure and Guidelines for Records Retention Schedule, NHB 1441.1, require these items to be maintained for a longer period.

Copies of all documents, drawings, and records shall be provided to the MRDOC Contractor in accordance with the MRDOC Contract.

4.3 Requirements for Ground Support Equipment (GSE), Equipment, and Instruments

Any Ground Support Equipment (GSE), transport equipment, handling equipment, or instruments that are required to be certified or calibrated before use, shall be certified or calibrated before use. Furthermore, users of certified equipment and calibrated instruments shall verify that the certifications and calibrations are still valid before use. Performance of this verification shall be recorded in the Logbook for the hardware. Any equipment or instrument that cannot be verified to be currently certified or calibrated shall not be used. No activity (other than emergency activity) shall commence until all equipment and instruments are verified to be currently certified or calibrated.

In accordance with the Center Procedure for Control of Inspection, Measuring, and Test Equipment, GRC-P3.11.1, all recorded data specified in procedures shall be obtained using calibrated instruments, unless otherwise specified. The level of precision required for calibrated instruments shall be provided in the procedure requiring the measurement. As practical, the GRC Calibration Laboratory shall calibrate instruments as requested. Instrument calibration shall be verified as part of the Inspection Readiness Review (IRR).

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4.4 Training

There shall be trained personnel who do not work under the MRDOC Contract (Exhibit 1) to work with the racks once they arrive at the GRC until the MRDOC Contractor takes possession of both racks. These personnel shall be trained in accordance with the Center Procedure for Training and Career Development, GRC-P3.3.1, and must meet the requirements of the following sections of the NASA Glenn Safety Manual, GRC-M0530.001:

- Chapter 2, Training Requirements
- Chapter 13, Laboratory Safety
- Chapter 14, Shop Safety
- Chapter 20, Cranes and Lifting Devices

Personnel shall be certified and checked out for both non-critical and critical lifts for cranes, forklifts, and other lifting devices described in Chapters 14 and 20 of the NASA Glenn Safety Manual. Records of personnel training, certification, and checkout status shall be maintained in accordance with both the Center Procedure for Training and Career Development, GRC-P3.3.1, and the NASA Glenn Safety Manual, GRC-M0530.001.

No personnel shall use any equipment if they cannot supply documented evidence that they are properly trained, certified, and checked out to operate at the time they are to operate that equipment.

4.5 Procedure Development

Pre-planned operations shall be documented in an approved FCF procedure. Procedures shall be developed for each operation to be performed as described in Appendix A. A Procedure History/Log Sheet(s), Form FCF-PO-FORM-0003, shall be used to document real-time changes necessary to an approved procedure, minor deviations, or unplanned activities, per the Glenn Product Assurance Manual, GRC-M0510.001 (PAI 315). The Procedure History/Log Sheet format shall be as shown in Figure 2.

A procedure shall be developed to bring the Rack Shipping Container (RSC) into Building 333. At a minimum, this procedure shall address the following:

- Removing the RSC from the common carrier
- Using a forklift to bring the RSC into Building 333
- The contingency of using a crane to lift the RSC over obstacles that prevent the forklift from transporting the RSC to the desired location
- Location outside the Clean Room to place the RSC
- Certification, training, and checkout requirements for personnel operating the cranes and forklifts

The activities listed below concerning the rack, Rack Handling Adapter (RHA), RHA Base, and RSC will be implemented in support of the visual inspection of the rack and RHA. Procedures shall be developed to address the following steps in the hardware inspection process:

1. The Rack Shipping Container (RSC) doors will be opened.
2. Once the doors are open, a visual inspection will be made to check for loose or damaged hardware or instruments that might cause injury or damage.
3. The RHA holding the rack will be removed from the RSC. The forklift shall pull the RHA with rack out of the RSC at a speed of no more than 2.2 meters per second (7.3 feet per second or 5 mph).
4. The RHA will next be placed on the RHA Base.
5. The rack and RHA will be inspected while sitting in the RHA Base.
6. The RHA will then be removed from the RHA Base.
7. Before the RHA is placed back into the RSC, the container, including the trunnions, will be visually checked for damage and check for cleanliness.
8. The RHA housing the rack will next be placed back into the RSC.
9. Finally, the doors for the RSC will be closed and locked.

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Detailed, step-by-step written procedures shall also be developed for recording environmental condition extremes that the hardware encounters over each seven-day period.

4.6 Procedure Requirements

4.6.1 Procedure Format

- Numbering shall be as assigned by the FCF Documentation Specialist.
- The cover page shall be the standard FCF document cover page, with the addition of two blocks as shown in Figure 1 (Name and Date).
- Step-by-step instructions on how to accomplish the operations will be documented in a secure manner so as to prevent unauthorized persons from accessing the Logbook.
- Places will be provided to record key information prior to and during the performance of the procedure. Such information includes part/serial numbers of hardware and supporting equipment, dates of last proof load for handling equipment, data from instrumentation, findings from inspections, etc.
- For procedures involving lifting, places shall be provided for the following to be recorded for each lifting device: part and serial number, rated capacity, date of last proof load and expected load. In addition, access controls/barriers shall be specified, to assure that unauthorized personnel are not put at risk.
- Places shall also be provided, after key steps, for signature and date by the person performing the procedure, Quality Assurance Representative, and/or others as appropriate.
- External procedures, such as ones provided by Boeing or Teledyne-Brown, may be used provided that the external procedures meet the intent of these requirements or deficient areas are supplemented by using a Procedure History/Log Sheet.
- FCF procedures may reference external procedures, such as ones provided by Boeing or Teledyne-Brown, provided that the external procedures meet the intent of these requirements or deficient areas are supplemented in the FCF procedure or a Procedure History/Log Sheet.
- Any procedure developed for the direct handling of the Rack and the RHA shall address the potential for Foreign Object Damage (FOD). FOD is a particular concern for those sections of the rack built from composite materials. Any procedure written involving activities concerning the rack shall either address how the composite portion of the rack will be protected from unintentional contact, how the composite will be handled, or how the composite will be inspected.

Figure 1 - As Run Blocks

Document No. *(assigned by FCF Documentation Specialist)*

Revision *(assigned by FCF Documentation Specialist)*

Date: ****Fill this in****

Name: ****Fill this in****

4.6.2 Procedure Approval

- After review by the FCF Structures Lead, the FCF Chief Engineer shall be required to approve all procedures, as a minimum.

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- All procedures containing crane operations shall also be approved by the Quality Management Office (QMO), per the GRC Safety Manual, GRC-M-0530.001, Chapter 20.
- Once approved, procedures shall be configuration controlled by the FCF Documentation Specialist.

4.6.3 Procedure Use

- Each time an operation will be performed, the latest approved copy of the procedure shall be obtained from the FCF Documentation Specialist.
- When a copy is used, the responsible person shall enter "AS RUN" in the first line of the block on the cover page. In this same block, they shall also enter the date the procedure is being run (only the first day if a multi-day procedure) and their name.
- Procedure History/Log Sheets will be attached to each as-run procedure to record real-time changes, minor deviations, or unplanned activities.
- Following completion of the procedure, the original document showing all signatures and entries, along with the Procedure History/Log Sheets, shall be submitted to the FCF Documentation Specialist.

4.7 Request Support From GRC Receiving

Once an estimated date of arrival has been received for the rack, RHA, and RSC, the FCF GFE Manager shall notify the FCF Ground Systems Manager and the FCF Structures Lead of this date. The GFE Manager shall also request support from GRC Receiving. The GFE Manager will inform Receiving as to FCF's desire to have the RSC delivered directly to Building 333. A request will also be made to have riggers made available to remove the RSC from the common carrier and to place the RSC at a location in Building 333 as designated by the FCF Ground Systems Manager in a manner prescribed by the FCF Structures Lead.

5.0 RECEIVING OF HARDWARE

5.1 Receiving and Handling of the Hardware

The RSC with the rack shall be received at Building 333 of the GRC in accordance with the Glenn Product Assurance Manual, GRC-M0510.001 (PAI 322 - Receiving Inspection and Storage of Spaceflight Hardware) and the Organizational Work Instruction for Receiving, GRC-W0620.3.9.001. The RSC may be delivered in either a vertical or horizontal orientation as described in the International Space Station Rack Shipping Container Operation & Maintenance Plan.

5.2 Receiving of Racks

The Microgravity Science Division (MSD) of the GRC will take control of the rack, RHA, and RSC upon delivery at the GRC. This hardware shall not be considered accepted by FCF until the FCF GFE Manager completes and returns the Hardware User Inspection Card, NASA Form C-80, as described in Section 6.14. This hardware shall be received in accordance with Center Procedure for Acquisition Process, GRC-P3.9. MSD shall maintain control of the rack, RHA, and RSC until they are turned over to the MRDOC Contractor in accordance with the MRDOC Contract.

Once the rack is delivered to the GRC, they shall be received in Building 333 in accordance with the Center Procedure for Handling, Storage, Packaging, Preservation, and Delivery, GRC-P3.9.3. At Building

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333, this rack, RHA, and RSC shall be handled in accordance with procedures developed by The Boeing Company and outlined in Section 4.5 of this document. With the exception of inspecting the rack as described in Section 6.12 of this document, the rack shall remain stored in the RHA in the RSC. A record of all activities concerning the rack, RHA, and RSC shall be maintained in the Logbook as described in Appendix A. Access to this hardware shall require the approval of the FCF GFE Manager, the FCF Ground Systems Manager, or the FCF Structures Lead.

5.3 Transferring Hardware Into Building 333

The RSC shall be removed from the common carrier and transported into Building 333 by forklift. This transport shall be accomplished by using the procedure for bringing the RSC into Building 333 per the requirements described in Section 4.5. All forklift operations shall be accomplished in accordance with the NASA Glenn Safety Manual, GRC-M-0530.001 (Chapter 14 - Shop Safety), following procedures provided in the Safety Permit and in accordance with International Space Station Rack Shipping Container Operation & Maintenance Plan.

5.4 Storing Rack Shipping Container Containing Rack

The RSC shall be stored in the vertical position. The RSC shall be stored in such a manner so as to allow the RSC to be lifted by crane or forklift without any translation or rotation. The RSC shall also be stored in such a manner so as to allow the RSC doors to be opened. The RSC breather valves shall be unobstructed and readily accessible. The RSC humidity indicator shall also be readily accessible for inspection. The RSC shall then be placed into bonded storage. A lock shall be placed on the door to the RSC in accordance with procedures followed for bonded storage in Building 333. Access to the RSC shall require the approval of the FCF GFE Manager, the FCF Ground Systems Manager, or the FCF Structures Lead.

5.5 Handling, Storing, Preserving, Packaging, and Delivering Hardware

MSD shall handle, store, preserve, package, and deliver the rack in the RHA that in turn are inside the RSC in accordance with the Center Procedure for Handling, Storage, Packaging, Preservation, and Delivery, GRC-P3.9.3. In addition to these requirements, MSD shall maintain the rack, RHA, RHA Bases, and RSC within the combined environmental constraints for the rack as specified in the Critical Item Development Specification for Rack Standard/Payload, S684-10101, and the System Specification, FCF-SPC-0001.

5.6 Maximum Velocity of Hardware

Once the hardware has been removed from the common carrier, the rack, RHA, and the RSC shall not be moved at a rate exceeding 2.2 meters per second (7.3 feet per second) or 8.0 kilometers per hour (5 miles per hour). All movement of the hardware shall begin and end gradually, with no jerks. When the hardware is being lifted or lowered, the hardware shall be brought to a complete stop before translating the hardware in a forward, aft, or lateral direction.

5.7 Documenting Activities Concerning Hardware

All operations associated with the rack, RHA, RHA Bases, and RSC shall be documented from the time of GRC acceptance, until the time of turnover to the MRDOC Exhibit 1 Contractor.

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A separate logbook shall be prepared and maintained for each set of hardware. These logbooks shall record each operation performed by referencing other documentation, such as an as-run procedure, as referenced by this document. These logbooks shall also be used to record environmental condition extremes encounter over each seven-day period.

6.0 INSPECTION OF HARDWARE

6.1 Inspection Readiness Review (IRR)

Before hardware is visually inspected, an Inspection Readiness Review (IRR) shall be held. All participants who will have roles in the planned inspection including the FCF Ground Systems Manager and the Quality Assurance Designate who will oversee the inspection, the inspectors, the forklift operators, and the person maintaining the logbook shall attend this review. A representative of the Area 7 Safety Committee, the Quality Assurance Office, the FCF GFE Manager, the FCF Chief Engineer, and the Building 333 Clean Room will also be invited to this review. The FCF Structures Lead shall chair this review. At this review, the Inspection Plan shall be presented so as to describe the procedures to be followed during the inspection being discussed in a step-by-step manner. The reviews for visual inspection plans of multiple sets of hardware may be held simultaneously.

The Inspection Plan shall be reviewed as part of this IRR. The Inspection Plan shall meet the pertinent requirements provided in the following:

- the Critical Item Development Specification for Rack Standard/Payload, S684-10101
- the International Space Station (ISS) and National Space Transportation System (NSTS) Program requirements
- GRC requirements (especially the Area 7 Safety Requirements)
- FCF Project requirements

At the minimum, the Inspection Plan shall address the following:

- identification of the particular hardware to be inspected
- precision and availability of calibrated instruments
- personnel training, qualification, and checkout
- equipment qualification
- step-by-step procedures, including what information may need to be recorded and who needs to initial or sign to indicate completion of a particular step
- Clean Room utilization, including the hardware, GSE, and personnel
- compliance with the requirements listed in the previous paragraph

Minutes shall be taken at this review. These minutes shall provide a complete list of meeting attendees, date of the IRR, results of the review, issues raised at the IRR, and actions assigned at the IRR. These minutes shall be provided to the FCF GFE Manager, FCF Chief Engineer, FCF Quality Assurance Representative, FCF Documentation Specialist, and the IRR attendees.

The FCF Structures Lead shall approve the Inspection Plan. The signature of the FCF Structures Lead in the plan's approval block shall signify approval. The FCF Structures Lead will not approve the Inspection Plan until the Lead is convinced the plan meets all pertinent requirements, contains a complete set of instructions for the visual inspection, and is confident that all participants in the planned inspection understand their roles.

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6.2 Qualification/Operation of Equipment and Instruments

All operations conducted concerning hardware shall be performed using qualified equipment and instruments. When practical, instruments used in association with the hardware shall be acquired from the Instrument Pool in accordance with the Center Procedure for the Instrument Pool, GRC-P3.11.2. All cranes and other lifting equipment (with the exception of forklifts) shall be qualified and operated in accordance with Chapter 20 of the NASA Glenn Safety Manual, GRC-M-0530.001. Forklifts shall be qualified and operated in accordance with the NASA Glenn Safety Manual, GRC-M0530.001, Chapter 14.

6.3 Instrument Calibration

All instruments used for measurements shall be calibrated. The instrument's calibration shall be confirmed both before and after each inspection. Instrument calibration shall be accomplished in accordance with Center Procedure for Control of Inspection, Measuring, and Test Equipment, GRC-P3.11.1. Any instrumentation for which calibration cannot be demonstrated before and after the inspection shall be replaced. The results of the inspection being performed using the instrument that did not remain calibrated shall be assessed. If necessary, portions of the inspection shall be repeated to assure valid results.

6.4 The Clean Room in Building 333

The Clean Room shall be verified to be providing a clean work area Level 4 environment as defined in Section III, Table 3-1 of the KSC Payload Facility Contamination Control Requirements/Plan, K-STSM-14.2.1. Furthermore, the Clean Room shall be capable of maintaining the rack within the following environmental limits:

- Temperature: 2 to 48 degrees Celsius (35 to 118 degrees Fahrenheit)
- Pressure: 96 to 104 MPa (13.9 to 15.0 Psi)
- Humidity: 10 to 75 percent relative humidity
- Cleanliness: visual clean, sensitive (as defined in the Space Shuttle Contamination Control Requirements, SN-C-0005)

Documented evidence that the Clean Room in Building 333 is capable of maintaining the aforementioned environment shall be obtained before the RSC enters the Clean Room with the rack. Any personnel working within three feet (approximately one meter) of the rack, RHA, or RSC shall don caps and smocks, in that order. Latex or other approved gloves shall be worn when handling the rack. Smocks shall be made of a carbon grid material. **Cotton lab coats shall not be deemed acceptable.** Smocks shall be worn for no more than one week without being laundered. Garments that are defective, do not properly fit, have been soiled or damaged, or have been allowed to touch the floor, shall be exchanged for new Clean Room garments.

6.5 Transferring the Hardware into the Building 333 Clean Room

Before the RSC is moved to the Building 333 Clean Room, a Contamination Control Plan (CCP) shall be developed and approved prior to the RSC being moved into the Building 333 Clean Room. This CCP shall describe how contamination will be prevented as well as how the lack of contamination will be verified. The CCP shall also describe the controls, inspections, tests, analyses, and documentation needed to measure and maintain required cleanliness levels for the hardware. The requirements of the Building 333 Clean Room shall be considered in the development of the CCP.

Once an approved CCP is in place, the RSC shall then be moved to the Clean Room in Building 333. Once in the Clean Room, the RSC shall be placed in the room in a vertical orientation. The exterior of the RSC shall be visibly clean - special on all six sides of all particulate and non-particulate matter that is

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visible to the unaided eye. This will allow it to be transported into the Building 333 Clean Room without jeopardizing the environment at a Level 4 criteria. There shall be provided sufficient space to allow the container to be opened and the rack removed without placing the other hardware and instruments in the Clean Room at more than a low risk, as defined in the FCF Risk Management Plan, FCF-PLAN-0007.

6.6 Cleanliness Inspection Requirements

The hardware, while awaiting use, shall have its cleanliness maintained as visible clean - sensitive as specified in the Space Shuttle Contamination Control Requirements, SN-C-0005, paragraphs 2.4 and 2.14. Accessible areas shall be cleaned as required. If the accessible areas cannot be sufficiently cleaned, or if the inaccessible areas do not meet cleanliness requirements of SN-C-0005, then the hardware shall be nonconforming.

6.7 Requirements for Ground Support Equipment (GSE)

All equipment brought into the Building 333 Clean Room to support the inspection of the rack shall meet the same visibly clean - sensitive criteria as the RSC and not jeopardize the Clean Room environment being maintained at that time. Any such GSE that becomes contaminated so that it no longer may meet this cleanliness requirement shall be removed from the Clean Room and cleaned as required before being used further.

6.8 Acceptable Risk

No inspection shall be required where the RHA or GSE prevent safe access without imposing a medium or high risk, as defined by the FCF Risk Management Plan, FCF-PLAN-0007, on the rack, RHA, or personnel.

6.9 Rack Safety Inspection Requirements

The racks received by the GRC shall be evaluated as to whether NASA, GRC, ISS Program, NSTS Program, and FCF Project safety requirements are met. This evaluation shall be performed by means of reviewing documentation provided with the rack and by visual inspection of the hardware.

6.10 Personnel Requirements

Before using a particular piece of equipment or instrument, any person performing a function with that particular piece of equipment or instrument that requires them to be trained, certified, and possibly checked out for a piece of equipment or instrument shall obtain that required training, certification, and checkout. Such persons shall be capable of providing documented evidence of being currently certified and checked out to use equipment or instruments to the Quality Assurance Designate or FCF Ground Systems Manager on the scene upon request. No person shall use equipment or instruments requiring them to be certified and checked out if they do not provide evidence of being certified or checked out for that equipment or instrument. No activity concerning the hardware shall commence until all equipment and instrumentation that require certified and checked out personnel to use them are in place, in order to allow convenient operation of equipment and instruments. No person shall take part in or observe an activity concerning the rack without having the proper head, arm, hand, foot, eye, and/or face protection as described in the NASA GRC Safety Manual, GRC-M-0530.001, Chapter 15 - Personal Protection Equipment, and as specified in the Safety Permit for the activity.

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6.11 Inspection by Means of Document Review

Documentation provided with the hardware shall be reviewed on the following basis:

- A check as to whether all documents have been provided as required by contract shall be performed.
- The mass properties for the rack shall be reviewed to verify the rack's total mass and CG location.
- To verify that the rack dimensions comply with the requirements of the Critical Item Development Specification for Rack Standard/Payload, S684-10101.
- A review of Non-Destructive Evaluation (NDE) test report information shall be performed to determine the number, size, location, and orientation of any flaws in rack fracture critical hardware.
- Test and inspection reports shall be reviewed for anomalies in the hardware.

The FCF Structures Lead will perform this documentation review. The results of this review shall be provided to the FCF GFE Manager by means of memorandum with the FCF Chief Engineer, the FCF Quality Assurance Representative, and the FCF Documentation Specialist copied on distribution. Any information listed above that is missing shall be obtained from Boeing or obtained by performing the necessary inspections to obtain the missing information.

6.12 Visual Inspection Requirements

No visual inspection of any hardware shall be performed without an Inspection Plan approved by the FCF Structures Lead. A visual inspection shall also be performed in accordance with the Space Shuttle Contamination Control Requirements, SN-C-0005. The purpose for this inspection will be to ensure that the hardware meets all safety requirements. Any anomaly found during the visual inspection shall be designated as a nonconformance.

The following inspections shall be performed:

- The RHA accelerometers shall be checked for indications of accelerations that exceeded requirements at the beginning and at the end of the visual inspection.
- The RSC temperature indicator shall be checked for indications of temperatures that exceeded requirements.
- The RSC humidity indicator shall be checked for an indication of humidity that exceeded requirements.
- The rack and RHA shall be checked for loose, damaged, and missing fasteners, nuts, pins, keys, inserts, and washers.
- The rack and RHA shall be visually inspected with the unaided eye for cracks, particles, films, and damage in all components, as well as hardware, and de-lamination of composite material and adhesive joints.
- A check shall be made for any exposed uncapped ends of threaded fasteners of 3.0 mm (0.12 inches) in length or longer.
- A check shall be made for any exposed edges and corners that have not been rounded or chamfered to 0.76 mm (or 0.03 inches) or greater.
- A check shall be made for any exposed edges and corners with missing edge guards.
- A check shall be made for any exposed burrs or lock wires.
- A check shall be made for any uncovered holes between the diameters of 10.0 mm and 25.4 mm. (0.4 and 1.0 inches).

Upon completion of the visual inspection, the FCF Quality Assurance Designate for the particular inspection shall inform the FCF Structures Lead as to the results of the inspection. The FCF Quality Assurance Designate shall be provided a report as to whether any of the ten items listed above were found, whether any abnormalities occurred during the inspection that caused significant deviations from

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the Inspection Plan (including inspection interruptions), whether any of the environmental constraints for the rack have been exceeded, and whether there were any substitutions of personnel between the IRR and the end of the inspection.

An inventory of all items found in the RSC shall also be made. The inventory shall be checked against both the shipping list and the requirements of the contract, and the discrepancies shall be recorded. Where practical, photographic evidence shall be obtained to document issues identified during visual inspections. A visual inspection shall be stopped if the FCF Quality Assurance Representative or their representative supporting an inspection determines that significant safety issues have arisen.

6.13 Contingency for Interruption of Inspection

If inspection is interrupted due to the end of work shifts, equipment, instrument, or power failure, the first priority shall be given to personnel safety. No operation involving a greater than low risk shall be carried out without the approval of the Quality Assurance Designate on the scene. If it appears that the interruption will last more than a few hours, then the rack will be placed back into the RSC following the procedures provided above. The RSC will be closed and secured until inspection can begin again. If the rack and RHA cannot be returned to the RSC, then other means for securing the rack and RHA may be performed. The FCF Quality Assurance Representative and the FCF Structures Lead shall be informed as to the interruption of the inspection and what measures were taken to protect the rack and RHA from contamination or damage. If possible, the FCF Quality Assurance Representative and the FCF Structures Lead will be informed of what means are to be used to secure the rack and RHA before that approach is implemented. Once the inspection begins again, an assessment shall be made by the FCF Structures Lead and Quality Assurance Representative as to at what point to restart the inspection.

6.14 Successful Completion of Hardware Inspection

The inspection of the hardware shall be considered complete when the following has occurred:

- all documents described in Section 6.11 have been reviewed
- all visual inspection requirements provided in Section 6.12 have been met
- the RSC has been successfully received in Building 333 as discussed in Section 4.5
- the rack has been successfully removed, handled, inspected, and returned to the RSC as mentioned in Section 4.5

Once these activities have been met, the FCF Structures Lead shall inform the FCF GFE Manager by memorandum. This memorandum shall make a recommendation, based on the results of the aforementioned activities, as to whether or not the hardware should be accepted by the FCF Project Office. If the FCF GFE Manager agrees to accept the rack, then the GFE Manager shall complete the Hardware User Inspection Card, NASA Form C-80. All information described in Figure 4 shall be provided. The form should then be returned to GRC Receiving, Organization 0620. If the GFE Manager determines that the hardware should not be accepted by the FCF Project Office, then the GFE Manager shall contact the Freight Traffic Office, Organization 0620, and request instructions as to how to proceed.

7.0 WORKING ISSUES CONCERNING HARDWARE

7.1 Nonconformances

Once the hardware arrives at the GRC, all access to the hardware shall be limited in order to minimize the possibility of damaging the hardware. Permission to access the hardware shall be provided by the FCF GFE Manager, the FCF Ground Systems Manager, or the FCF Structures Lead.

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Nonconformances may arise due to the hardware not meeting cleanliness or safety requirements. Nonconformances may also be found as a result of inspections performed to supplement information missing from documentation. When the rack is found to not conform to the Critical Item Development Specification for Rack Standard/Payload, S684-10101, the following steps shall be performed:

1. The FCF Quality Assurance Representative shall enter the nonconformance into the Logbook on the scene, following the procedures set forth in Appendix A.
2. The FCF Project Office shall administer all nonconforming hardware in accordance with the Center Procedure for Control of Nonconforming Product, GRC-P4.4, with the FCF Quality Assurance Designate on the scene taking the responsibilities of the "Originator" and the FCF Chief Engineer or Designee taking the role of the "Responsible Manager" as defined in GRC-P4.4. A Problem Report shall be generated and processed for closure of the nonconformance using form NASA-C-8192, Failure Report and Analysis, as described in PAI 440 of the Glenn Product Assurance Manual, GRC-M0510.001. When the nonconformance meets the definition of being a Level 1 problem as defined in Section 3.3 of Problem Reporting and Corrective Action for the Space Station Program, SSP30233, then the PRACA for ISS hardware as presented in SSP30233 shall be followed in addition to the procedure defined in PAI 440. The FCF Project Office shall endeavor to meet the requirements of both PAI 440 and SSP 30233; however, any conflicts between the requirements of the two documents shall be resolved so as to envelop the requirements specified by both documents. The hardware with the nonconformance may then be repaired, returned, or used "as is" as described in Appendix B of this document.
3. If the Quality Assurance Designate at the scene decides the nonconformance raises a safety concern, the Quality Assurance Designate may stop all activities concerning the hardware.

7.2 Mishap Investigation

If the nonconformance of the hardware was created after the hardware came into the possession of the GRC with a cost impact exceeding \$1,000.00, there shall be an investigation in accordance with the NASA Glenn Safety Manual, GRC-M0530.001, Chapter 21 - Mishap Reporting/Accident Investigation. The FCF Project Office shall conduct investigations of Type C mishaps, incidents, close calls, test failures, mission failures, contractor mishaps (Type C only), and Illnesses as defined in the NASA Glenn Safety Manual. The FCF Project Manager shall lead these investigations and implement necessary actions to correct hazards discovered during the investigation. The FCF Project Office shall support investigations of Type A and Type B mishaps concerning FCF project activities as required.

7.3 Corrective/Preventative Action Plan

If the investigation of the nonconformance uncovers a systemic cause for the nonconformance, the FCF Project Manager shall develop a Corrective and/or Preventative Action Plan to eliminate the cause. In developing such a plan, The FCF Project Office shall follow the procedure at the local level as described in the Center Procedure for Corrective and Preventative Action, GRC-P4.7.

8.0 HARDWARE STORAGE REQUIREMENTS

8.1 Rack Storage

While in the government's possession, the rack shall be stored in the RSC along with the RHA. No RSC shall be opened without a Quality Assurance Representative or Designate being present. The Quality Assurance Representative or Designate shall have the authority to stop any or all activities concerning

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the rack, RHA, RSC, associated GSE, transport or handling equipment, or any person working with the aforementioned hardware or instruments.

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APPENDIX A - LOGBOOK REQUIREMENTS

A.1 Logbook Format

The logbook format shall be as shown in Figure 3. Additional sheets shall be used as necessary.

A.2 Logbook Use

A responsible person will be identified to assure that work activity entries are made into the logbook. All responsible people who make entries into a logbook shall sign so as to indicate what entries they are responsible for providing.

- Each operation performed shall be recorded by referencing the as-run procedure, or controlling documentation.
- The logbook shall be physically located in conjunction to the particular set of hardware that it is for.
- Environmental extremes shall be recorded every seven days, for the prior period. As a minimum, this will be maximum and minimum temperature and humidity in the area(s) in which the rack was located.
- The FCF Quality Assurance Representative shall sign and date the logbook once every month to assure that it is maintained and shall then make a copy and submit it to the FCF Documentation Specialist.
- Upon turnover of the hardware to the MRDOC Exhibit 1 Contractor, the responsible person and the FCF Quality Assurance Representative shall enter a final signature and date. The logbook shall then be submitted to the FCF Documentation Specialist.

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APPENDIX B - DISPOSITIONING NONCONFORMING HARDWARE

B.1 Report for Nonconforming Hardware

Except when there is a Level 1 ISS hardware problem, as discussed in Section 7.1, a Problem Report shall be generated and processed to report nonconforming hardware per PAI 440 of the Glenn Product Assurance Manual, GRC-M0510.001. A Level 1 Problem Report shall be processed in accordance with SSP30233. Section A of this report shall be generated to describe how the rack does not conform to the Critical Item Development Specification for Rack Standard/Payload, S684-10101. This report shall be submitted to the FCF Chief Engineer with copies being provided to the FCF GFE Manager and the FCF Structures Lead. At a minimum, this report shall provide the following information:

- A description of the nonconformance should be provided, including the location of the nonconformance on the hardware, how the nonconformance manifests itself, as well as photographs of the nonconformance (if practical and descriptive).
- Identification of which requirement is violated (including reference to the paragraph number of the violated requirement).
- A description of the expected consequences of the hardware not meeting the violated requirement.
- A recommendation as to how the hardware should be dispositioned should be provided. Options for disposition include:
 - attempt to repair the hardware
 - return the hardware
 - document the nonconformance(s) and utilize the hardware
 - A description of how the nonconformance was identified, including who found the nonconformance, who witnessed the identification of the nonconformance, and the date and time when the nonconformance was found. As part of this description, any activity concerning the hardware during, or just prior to, the discovery of the nonconformance shall be included. Examples of noteworthy activities could include hardware handling, lifting, transporting, or inspection.

B.2 Plan to Repair Hardware

If the hardware will be repaired, a plan to repair the hardware shall be developed. Any repair plan for the hardware shall be submitted to the FCF Engineering Review Board (ERB), then the FCF Configuration Control Board (CCB) for approval.

The plan to repair the hardware shall consist of the following, at a minimum:

- Identify potential impacts of the repair on project budget, schedule, safety, and prospects for mission success.
- Identify who is to perform the repair. If the repair is not to be performed at the GRC, then a procedure for transporting the hardware shall be developed.
- Identify the criteria for a successful repair.
- A comparison of the programmatic risks of the proposed approach for repairing the hardware versus other options for repairing the hardware, returning the hardware or using the hardware in its current state shall be performed and included in the presentation to the FCF ERB and CCB. This risk assessment should include the effects on budget, schedule, safety, and mission success.
- If possible, lessons learned as to how effective similar repairs have been shall be examined and included in the presentation to the FCF ERB and CCB.
- Describe the approach to be used to prevent use of the hardware until a successful repair has been completed.

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B.3 Plan if Hardware Will Be Used “As Is”

If the hardware will be used without repair, an assessment of the state of the hardware shall be developed. An assessment of the hardware shall be submitted to the FCF ERB for approval. If the FCF ERB determines that the state of the hardware has been sufficiently decreased so as to limit the utility of the hardware relative to plan, then the assessment shall be forwarded to the FCF Configuration Control Board for approval. The plan to use the hardware in its current state shall consist of the following, at a minimum:

- Identify limitations as to how the hardware could be used and provide an assessment of the possible impact on project budget, schedule, safety, and prospects for mission success.
- Identify exactly what the new requirements for the hardware will be.
- A comparison of the programmatic risks of the proposed approach for using the hardware in its current state versus returning the hardware or repairing the hardware shall be performed and included in the presentation to the FCF ERB and CCB. This risk assessment should include the potential effects on budget, schedule, safety, and mission success.
- If possible, lessons learned as to how effective similar hardware have been when used in a configuration other than “blueprint” shall be examined and included in the presentation to the FCF ERB and CCB.

B.4 Plan if Hardware Will Be Returned

If the hardware will be returned to The Boeing Company, this return shall be performed in a manner as close to the manner that the hardware was shipped to the GRC as is possible and practical. A plan shall be developed for returning the hardware to The Boeing Company. The FCF ERB shall review and approve this plan before the hardware is packaged or shipped. The plan for returning the hardware shall consist of the following, at a minimum:

- Identify potential impacts of returning the hardware on project budget, schedule, safety, and prospects for mission success.
- Provide a plan as to how FCF development will continue without the hardware. If replacement hardware is anticipated as part of the plan, the plan shall include contingency for late arrival or cancellation of the delivery of the replacement hardware.
- A comparison of the programmatic risks of the proposed approach for returning the hardware versus other options for repairing the hardware or using the hardware in its current state shall be performed and included in the presentation to the FCF ERB and CCB. This risk assessment shall include the potential effects on budget, schedule, safety, and mission success.
- If possible, lessons learned as to how Boeing has dealt with returned hardware shall be examined and included in the presentation to the FCF ERB and CCB.
- Describe the approach to be used to prevent use of the hardware so that it may be returned.

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APPENDIX C - HARDWARE USER INSPECTION CARD

C.1 Completing the Hardware User Inspection Card

It is the responsibility of the FCF GFE Manager to provide all information requested on the Hardware User Inspection Card, NASA Form C-80. The information that shall be provided is shown in Figure 4. Upon completion, this card shall be returned to GRC Receiving.

Figure 4 - Hardware User Inspection Card, NASA Form C-80

THIS MATERIAL REQUIRES USER INSPECTION	
<p>Due to the nature of this material, the Receiving Area is unable to complete the inspection process. Please inspect the item(s) and the yes or no box provided below indicating that material ordered matches material received. Sign and return this pre-addressed card as soon as possible. Contact Receiving at 3-2253 with any questions.</p>	
Receiver Name: _____	
Purchase Order Number _____	Line Item(s) _____
YES	NO*
If NO , please site the line item number(s) _____	
Recipient Name (PRINT) _____	Phone No. _____
Recipient Signature _____	
*If any material did not pass the inspection process, refer to Center Level Procedure GRC-P4.4, Control of Nonconforming Product.	
NASA C-80 (Rev. 1-00)	