

# APPROVAL SHEET FOR SUSPENDED LOAD OPERATIONS

SLO-KSC- 1995-006

TITLE NASA Suspended Load Operation Analysis/Approval, GLOBAL LEOSPACE SCIENCE (GWS) POLAR LIFTING OPERATIONS IN BUILDING 936 LAB 1 AND IN BUILDING 1610 HIGH BAY

DOCUMENT NUMBER/TITLE TP-PAK23001005 SHIPPING CONTAINER LOADING/ UNLOADING, TP-SHP23001005 LABORATORY HANDLING & SHIPPING

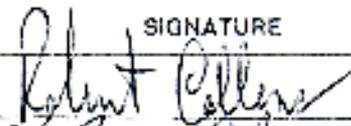
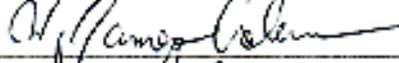
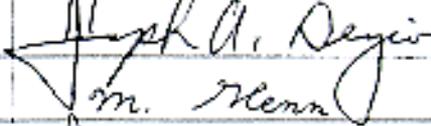
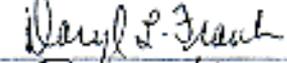
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**REQUIRED APPROVAL**

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NASA SUSPENDED LOAD OPERATION  
ANALYSIS/APPROVAL

OPERATION: Global Geospace Science (GGS) POLAR lifting operations in Building 836 Lab 1 and in Building 1610 high bay.

SUPPORTING DOCUMENTS: The associated System Assurance Analyses (SAA) and GGS POLAR Test Procedures are as follows:

SAA-88CR000-030	5-ton Bridge Crane - Building 836, Lab 1
SAA-88CR000-028	10-ton Bridge Crane - Building 1610
TP-PAK23001005	Shipping Container Loading/Unloading
TP-SHP23001005	Laboratory Handling and Shipping

GENERAL DESCRIPTION: The following GGS POLAR operations require personnel to work under a suspended load (Laboratory):

- Lower Laboratory onto dolly in 836, Lab 1 - 2 mechanical technicians
- Lower Laboratory onto Laboratory Integration Fixture (Aronson) in 836, Lab 1 - 2 mechanical technicians
- Lower Laboratory onto dolly in 836, Lab 1 - 2 mechanical technicians
- Lower Laboratory onto shipping container base in 836, Lab 1 - 2 mechanical technicians
- Lower Laboratory onto static balance fixture in 1610 High Bay - 4 mechanical technicians
- Lift Laboratory off of static balance fixture in 1610 High Bay - 4 mechanical technicians
- Weigh Laboratory in 1610 High Bay - 4 mechanical technicians
- Mate Laboratory to Delta third stage in 1610 High Bay - 4 MDA personnel

These operations require two to four mechanical technicians to work below the Laboratory when suspended from the facility crane. These Laboratory lifting operations will be performed using GGS POLAR test procedures TP-PAK23001005 and TP-SHP23001005. These test procedures will include warnings and precautions to minimize the exposure of personnel to suspended loads. When possible separation and mating during crane operations will be between two GSE items (i.e. non-flight interface).

RATIONALE/ANALYSIS: The GGS POLAR suspended load operations comply with the NASA Alternate Safety Standard for Suspended Load Operations as follows:

Alternate Standard Requirement 1a - Because the Laboratory mating/separation ring is smaller in diameter than the outer diameter of the Laboratory, it is necessary to position four personnel beneath the Laboratory to ensure proper mating and proper

separation to prevent damaging the flight separation surface or position two personnel beneath the Laboratory to ensure proper alignment of the GSE interfaces.

Alternate Standard Requirement 1b - The use of secondary support structures to "catch" the Laboratory in the event of a failure was analyzed. A secondary support system is not feasible for the GGS POLAR Laboratory because the separation interface represents the only primary structure support interface for the Laboratory.

Alternate Standard Requirement 1c - The test procedures will limit the number of personnel beneath the suspended Laboratory to four when lifting or mating the Laboratory at the flight separation interface and two when mating at a GSE interface.

Alternate Standard Requirement 1d - GGS POLAR mechanical technicians will accomplish the mating and separation tasks as quickly and safely as possible to minimize exposure. Each operation is expected to expose personnel to a suspended load for less than five minutes. TP-PAK23001005 and TP-SHP23001005 will control the operations.

Alternate Standard Requirement 4 - Operational requirements will be included in TP-PAK23001005 and TP-SHP23001005. These test procedures will be on-site during GGS POLAR operations for inspection.

Alternate Standard Requirement 6 - The Building 836, Lab 1 5-ton bridge crane and the Building 1610 10-ton bridge crane are tested, inspected, maintained, and operated in accordance with the NASA Safety Standard for Lifting Devices and Equipment, NSS/GO-1740.9.

The cranes are load tested at 100 percent rated capacity annually and have a monthly, quarterly, semiannual, and annual preventative maintenance program to ensure proper operation. The cranes are load tested to 125 percent rated capacity when new or following a major repair or modification.

The Laboratory lift fixture was designed with an ultimate factor of safety of five times its rated load and proof tested to twice its rated load annually. The lift fixture was designed to handle the worst case Laboratory weight.

When lifting the Laboratory the cranes will be connected to a NASA/KSC supplied hydraset, a crane scale, the Laboratory lift fixture, and the Laboratory. Maximum weight of the Laboratory will be approximately 2750 lbs.

Operation of the cranes will be by trained and certified crane operators per KMI 6340.4, Examination and Licensing of KSC Facility Crane Operators;

An individual will be stationed at the crane main circuit breaker during hoisting to immediately remove power, thus setting the brakes, should a failure occur with the crane controls;

The crane will be operated in a slow speed mode when in close proximity of the Laboratory shipping container base, Laboratory dolly, static balance fixture, or third stage payload attach fitting (PAF);

A NASA/KSC supplied hydraset will be used for the initial one inch of travel during separation and the final one inch of travel during mating.

Alternate Standard Requirement 7 - System Assurance Analyses (SAAs) have been completed for the Building 836, Lab 1 bridge crane and for the Building 1610 bridge crane. The SAA includes a Failure Modes and Effects Analysis/Critical Items List (FMECA/CIL) and a Hazard Analysis (see supporting documents). The SAAs for Building 836, Lab 1, 5-ton bridge crane and the Building 1610 10-ton crane identify one Single Failure Point (SFP) for each use, the hoist gear reducer, which transmits power and reduces rotational speed from the hoist motor to the rope drum. Broken teeth downstream of the mechanical load brake, broken gear shafts or shaft to gear interface failure would cause interruption of the load path at the gearbox. This failure would result in the load dropping, which could cause loss of life and/or payload.

There is no history of failure with the SFP in the critical failure mode. The use of high-quality, reliable components and a comprehensive maintenance, inspection, and test program (including pre-operational checks) ensures that the crane systems operate properly. In addition, the crane was proof load tested at 125% prior to acceptance.

The associated SAA CIL Sheets identify all the rationale for accepting the risk of the SFP including design information, failure history, and the operational controls in effect to minimize the risks (maintenance, inspection, test, etc.).

Alternate Standard Requirement 8 - Pre-operational inspections of the lifting equipment will be performed. The Laboratory lift fixture has been proof tested and tagged and will be visually inspected prior to each Laboratory lift. Pre-operational checks of the crane control system will be performed prior to each lift of the Laboratory.

Alternate Standard Requirement 9 - Trained and certified crane operators shall man the crane controls at all times when personnel are beneath suspended loads.

Alternate Standard Requirement 10 - GGS POLAR test procedures TP-PAK23001005 and TP-SHP23001005 establish appropriate safety control areas before initiating operations.

Alternate Standard Requirement 11 - A pre-task briefing and a safety walk-down of the hazard control area will be performed prior to each operation.

