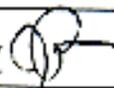


APPROVAL SHEET FOR SUSPENDED LOAD OPERATIONS

SLO-KSC-1995-001

TITLE INSTALLATION OF THE SURFACE TENSION DRIVEN CONVECTION EXPERIMENT (STDCE) FLUID LINES INTO UNITED STATES MICRO-GRAVITY LABORATORY-2 (USML-2) RACK 3

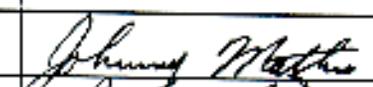
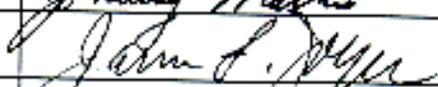
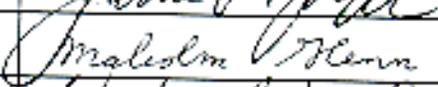
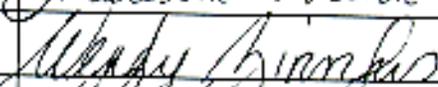
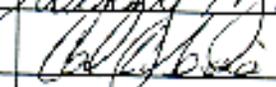
DOCUMENT NUMBER/TITLE L5074 DOUBLE RACK AND FLOOR MATE/DEMATE

PREPARED BY ISABELINO RODRIGUEZ 

DATE 23 FEBRUARY 1995

REQUIRED APPROVAL

CONTRACTOR	<input type="checkbox"/> DESIGN	<input type="checkbox"/> R & QA	<input checked="" type="checkbox"/> OPERATIONS	<input checked="" type="checkbox"/> SAFETY
NASA	<input type="checkbox"/> DESIGN	<input type="checkbox"/> R & QA	<input checked="" type="checkbox"/> OPERATIONS	<input checked="" type="checkbox"/> SAFETY

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**NASA SUSPENDED LOAD OPERATION
ANALYSIS/APPROVAL**

**NUMBER: SLO-KSC-1995-001
CHANGE 1: 23 FEBRUARY 1995
PAGE 1 OF 4**

OPERATION

To install the Surface Tension Driven Convection Experiment (STDCE) fluid lines into United States Micro-gravity Laboratory -2 (USML-2) rack 3 during the installation of rack 3 onto the flight floor. This is a one time only operation.

SUPPORTING DOCUMENTS - The associated operational procedure and System Assurance Analysis (SAA) are as follows:

- SAA01FS027-002, 27.5 Ton Bridge Cranes - O&C
- OMI L5074, Double Rack And Floor Mate/Demate

GENERAL DESCRIPTION

Installation of the fluid lines into rack 3 requires a maximum of one person under the suspended rack to route the fluid lines through the lower connector bracket and then out the front of the rack. This person will be required to reach his/her arms under the suspended load.

- OMI L5074, Location And Installation Of Rack On Segment Floor

This task requires personnel to be in the area of increased hazard directly under the suspended load. OMI L5074 is the controlling procedure used in the Operations and Checkout Building (O&C) for this operation.

RATIONALE/ANALYSIS - The suspended load tasks comply with the NASA Alternate Safety Standard as follows:

Alternate Standard Requirement #1a:

1. These tasks cannot be conducted without placing personnel beneath the suspended load because there is no other access to the fluid line routing.

2. The rack design requires fluid lines to be routed through the bottom of the rack. The length of the STDCE fluid line connected to the underfloor requires the technician to reach within the rack to facilitate fluid line routing.

During the rack operation, the load must be hoisted above the flight floor in order to allow fluid line installation. As a result, there are no operational or procedural means to eliminate personnel exposure to the suspended load.

All items limiting access to the fluid line routing which can be installed into rack 3 after installation on the flight floor will be removed to provide the best access possible for this activity.

3. During installation of the rack onto the flight floor, the technician must reach beneath and inside the suspended payload to route the fluid lines through the lower connector bracket and then out the front of the rack. There is no alternate access to the fluid line areas, and the fluid lines cannot be installed prior to rack installation on the flight floor. This physical limitation precludes any design, operational, or procedural changes that would eliminate personnel exposure to a suspended load.

Alternate Standard Requirement #1b - The possible use of a secondary support system, to catch the load in the event of a crane failure, was analyzed. It was determined that the use of a secondary support system was not feasible because of positioning of the rack over the flight floor.

Alternate Standard Requirement #1c - The maximum number of personnel allowed under the suspended rack for installation of the rack fluid lines is one.

Alternate Standard Requirement #1d - Installation of the rack fluid lines will be accomplished as quickly and safely as possible to minimize exposure time. It will take one person up to 5 minutes to install the rack fluid lines.

Alternate Standard Requirement #4 - OMI L5074 will permit only the approved number of persons under the suspended loads addressed in this analysis. The OMI will be available on site for inspection during the operation.

Alternate Standard Requirement #6 - The suspended load operations addressed in this analysis involve one of the 27.5 ton bridge cranes. The cranes are designed, tested, inspected, maintained, and operated in accordance with the NASA Safety Standard for Lifting Devices and Equipment, NSS/GO-1740.9.

The 27.5 ton crane hoists are equipped with two magnetic holding brakes (one on the motor shaft and one on the gear reducer input shaft extension), each capable of holding the load up to the crane's rated capacity. Each brake's ability to hold the rated load (27.5 tons) is verified annually. The cranes are designed to meet a 5 to 1 safety factor based on ultimate strength for the hoist load bearing components.

The 27.5 ton cranes are load tested annually at 100% of their rated capacity. Detailed preventive maintenance is performed monthly, quarterly, semiannually, and annually on the cranes to ensure proper operation. A detailed inspection of the lifting slings is performed annually. Nondestructive testing of the slings and crane hooks is performed annually.

The rack is expected to weight approximately 750 lbs, actual weight determination will occur prior to rack installation onto the flight floor. The lifting sling is rated at 2700 lbs and is designed to meet a 5 to 1 safety factor based on ultimate strength.

Alternate Standard Requirement #7 - A System Assurance Analysis (SAA) has been completed on the 27.5 ton bridge cranes in the O&C. The SAA includes a Failure Modes and Effects Analysis/Critical Items List (FMEA/CIL) and a hazard analysis (see supporting documents).

The SAA identifies one Single Failure Point (SFP), the hoist gear reducer, which transmits power and reduces rotational speed from the hoist motor to the rope drum. A sheared key or broken teeth 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. A detailed inspection of the gear reducer is performed monthly, and gear reducer oil samples are verified annually. The use of high-quality, reliable components and a comprehensive maintenance, inspection, and test program, including preoperational checks, ensures that the crane systems operate properly.

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

Alternate Standard Requirement #8 - Visual inspections for cracks or other signs of damage or anomalies are performed on the hoist hooks, hoist beams, hoist cables, hoist rod assemblies, and hoist fittings, and crane functional checks are performed before each operation per NSS/GO-1740.9.

Alternate Standard Requirement #9 - Trained and licensed crane operators shall remain at the hoist controls while personnel are under the load.

Alternate Standard Requirement #10 - Appropriate safety control areas are established before initiating operations. Only the minimum number of people (manloaded in the procedure) will be permitted in this area.

Alternate Standard Requirement #11 - A pretask briefing and a safety walkdown of the area are conducted prior to the lift to ensure that all systems and personnel are ready to support. All participants are instructed on their specific tasks and warned of any hazards involved. Following any crew change, the new personnel are instructed by the task leader on their specific tasks and warned of any hazards involved.

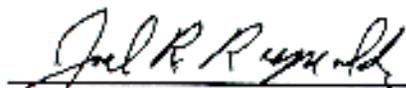
Alternate Standard Requirement #12 - Personnel beneath the suspended load will be in voice contact with the hoist operator and/or task leader. Upon loss of communication, the operation shall stop immediately, personnel shall clear the hazardous area, and the load shall be safed. Operations shall not continue until communications are restored.

Alternate Standard Requirement #13 - Personnel working beneath the load shall be in continuous sight of the hoist operator and/or task leader.

APPROVAL:

DATE:

2/28/95



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