

APPROVAL SHEET FOR SUSPENDED LOAD OPERATIONS

SLO-KSC-1991-024

TITLE PAYLOAD TRANSFER FROM TEST STAND TO TEST STAND: REMOVAL OR INSTALLATION OF PALLET SUPPORT STRUTS AND STRUCTURAL BOLTS

DOCUMENT NUMBER/TITLE OMI L5027, PAYLOAD TRANSFER FROM TEST STAND TO TEST STAND

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REQUIRED APPROVAL

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**NASA SUSPENDED LOAD OPERATION
ANALYSIS/APPROVAL**

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OPERATIONS

1. To remove or install the pallet(s) support struts during pallet transfer from or to the Payload Segment Structure Integration Trolley (PSSIT).
2. To remove or install the structural bolts and load cell support struts/pads during Spacelab Module transfer.

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

- OMI L5027, Payload Transfer from Test Stand to Test Stand
- SAA01FS027-002, 27.5 Ton Bridge Crane - O&C

GENERAL DESCRIPTION

1. Removal or installation of the pallet(s) support struts requires four persons under the suspended NASA payload strongback and payload during pallet transfer from or to the PSSIT.
2. Removal or installation of the structural bolts and load cell support struts requires six persons under the suspended NASA payload strongback and payload during Spacelab Module transfer.

These tasks are completed in the following OMI L5027 sequences:

- Removal of Pallet from Payload Segment Support Integration Trolley (PSSIT)
- Removal of Payload from Module Handling Cage (MHC)
- Install Pallet into PSSIT

- Install Payload into MHC

During contingency payload grounding operations, one person will be permitted to work under the suspended load.

These tasks require personnel to be in the area of increased hazard directly under the suspended NASA payload strongback and the payload. OMI L5027 is the controlling procedure, which is used in the Operations and Checkout (O&C) Building low bay.

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

Alternate Standard Requirement #1a - These operations cannot be conducted without placing personnel under the suspended NASA payload strongback (lifting fixture) and the payload during payload transfer operations. Payload strongback lifting operations at the O&C have been evaluated for alternate methods to complete these tasks, and it has been determined that there are no design, procedural, or operational means to eliminate personnel exposure to a suspended load.

During these tasks, the payload has to be hoisted out of its respective support structure (the PSSIT for pallets or test stand for Modules) to gain access for the removal or installation of the respective hardware [pallet(s) support struts or Spacelab Module structural bolts and load cell support struts]. These tasks place the technician beneath the strongback and payload to remove or install the necessary hardware.

Because of the size of the NASA payload strongback (which extends out over the payload) and the location of the support struts or structural bolts and load cell support struts, which are beneath the payload, there is no other access for completing these tasks. These physical limitations preclude any operational or procedural workaround. A support structure for the strongback is not a feasible design consideration because the strongback is required to suspend the payload over its support structure to provide access for hardware removal or installation.

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 payload over the test stand and under the payload strongback.

Alternate Standard Requirement #1c

1. The maximum number of personnel allowed under the load during removal or installation of the pallet(s) support struts is four.
2. The maximum number of personnel allowed under the load during removal or installation of the structural bolts and load cell support struts is six.

Alternate Standard Requirement #1d

1. Removal or installation of the pallet(s) support struts will be accomplished as quickly and safely as possible to minimize exposure time. It will take four persons up to a half hour to remove or install the pallet(s) support struts.
2. Removal or installation of the structural bolts and load cell support struts will be accomplished as quickly and safely as possible to minimize exposure time. It will take six persons up to two hours to remove or install the structural support bolts and load cell support struts.

Alternate Standard Requirement #4 - OMI L5027 has been revised to permit only the approved number of persons under the suspended payload. The OMI is available on site for inspection during the operation.

Alternate Standard Requirement #6 - Suspended load operations associated with hoisting payloads with the strongback in the O&C involve two 27.5 ton bridge cranes in the low and high bays. 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.

Dual 27.5 ton cranes are being utilized for these tasks. The weight of the NASA strongback is 28,000 lbs and the payload may weigh as much as 34,000 lbs. The total load is 62,000 lbs, which is 56.4% of the cranes' capacity.

The lifting slings are rated at 34,000 lbs and are designed to meet a 2.25 to 1 safety factor based on yield strength and a 5 to 1 safety factor based on ultimate strength.

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.

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 SFP 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.

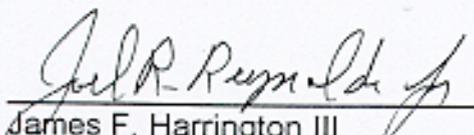
Alternate Standard Requirement #10 - Appropriate safety control areas are established before initiating operations. Only the minimum number of people (manloaded in the procedure) will be permitted in this area.

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: 8/29/94


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