

APPROVAL SHEET FOR SUSPENDED LOAD OPERATIONS

SLO-KSC-1994-006

TITLE INSTALLATION OF KEEL TRUNNION TARGET ASSEMBLY ON PAYLOAD ELEMENT USING THE NASA STRONGBACK, CELA, OR IPPLA

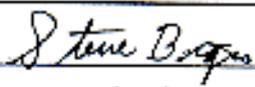
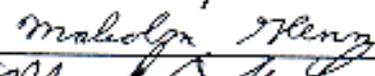
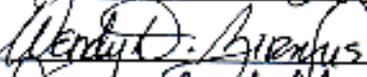
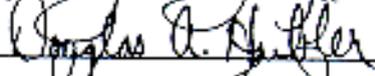
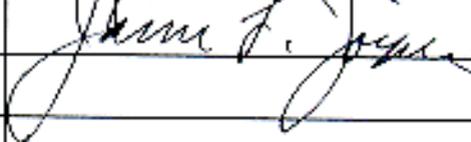
DOCUMENT NUMBER/TITLE OMI L7011 PAYLOAD CENTERING IN TEST STAND

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DATE 2 JUNE 1994

REQUIRED APPROVAL

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NASA SUSPENDED LOAD OPERATION ANALYSIS/APPROVAL

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OPERATIONS

To center the payload into centerline of test stand at the Operations and Checkout (O&C) building using one of the following lifting fixtures: NASA Strongback; Integrated Partial Payload Assembly (IPPLA); or Cargo Element Lifting Assembly (CELA).

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

- OMI L7011, Payload Centering in Test Stand
- SAA01FS027-002, 27.5 Ton Bridge Crane - O&C

GENERAL DESCRIPTION

Installation of the keel trunnion target assembly on the payload element requires one person working under the suspended lifting fixture and payload.

This task is completed in the following OMI sequence:

- OMI L7011, Center Payload Element into Test Stand

This task requires personnel to be in the area of increased hazard directly under the suspended lifting fixture and the payload. OMI L7011 is the controlling procedure, which is used in the Operations and Checkout (O&C) Building.

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

Alternate Standard Requirement #1a - This operation cannot be conducted without placing personnel under the suspended lifting fixture and the payload during installation of the keel trunnion target assembly. The operation has been evaluated for alternate methods, and it has been determined that there are no design, procedural, or operational means to eliminate personnel exposure to the suspended load.

Because of the size of the lifting fixture (which extends out over the payload) there is no other access for completing the task. This physical limitation preclude any operational or procedural workaround. A support structure for the lifting fixture is not a feasible design consideration because the lifting fixture is required to suspend the payload over its support structure to conduct the payload alignment

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 lifting fixture.

Alternate Standard Requirement #1c - The maximum number of personnel allowed under the load during installation of the keel trunnion target assembly on the payload element is one person.

Alternate Standard Requirement #1d - Installation of the keel trunnion target assembly will be accomplished as quickly and safely as possible to minimize exposure time. It will take one person up to five minutes to complete the installation.

Alternate Standard Requirement #4 - OMI L7011 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 - The suspended load operation associated with the installation of the keel trunnion target assembly on the payload element using either the IPPLA or the CELA lifting fixtures involve one of the 27.5 ton bridge cranes at the O&C building. When the NASA strongback is used for this operation, two 27.5 ton bridge cranes are employed. 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.

IPPLA Operation. One of the 27.5 ton cranes is being utilized for this task. The weight of the IPPLA is 11,000 lbs and the weight of the payload is 8,600 lbs. The total weight is 19,600 lbs. The combined load is 35.6% of the crane's capacity. The lifting sling is rated at 12,000 lbs and is designed to meet a 5 to 1 safety factor based on ultimate strength.

CELA Operation. One of the 27.5 ton cranes is being utilized for this task. The weight of the CELA is 26,500 lbs and the weight of the payload is 23,000 lbs. The total weight is 49,500 lbs. The combined load is 90% of the crane's capacity. The lifting sling is rated at 36,500 lbs and is designed to meet a 5 to 1 safety factor based on ultimate strength.

NASA Strongback Operation. Dual 27.5 ton cranes are utilized on this task. The weight of the strongback is 29,000 lbs and the weight of the payload is 34,000 lbs. The total weight is 63,000 lbs. This combined load is 57.3% of the cranes' capacity. The lifting slings are rated at 65,000 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.

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.

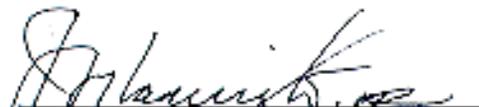
Alternate Standard Requirement #10 - Appropriate safety control areas are established before initiating operations. Only the minimum number of people (manloaded in the procedure) will be permitted in this area.

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: 6/2/94


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