

APPROVAL SHEET FOR SUSPENDED LOAD OPERATIONS

SLO-KSC- 1991-022

TITLE HOISTING AND LOWERING OF PAYLOAD CANISTER AT LAUNCH COMPLEX-39 (LC-39)

PAD A OR B

DOCUMENT NUMBER/TITLE OMI E5026, ORBITER PAYLOAD CANISTER HANDLING - LC-39 PAD A OR B

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REQUIRED APPROVAL

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**NASA SUSPENDED LOAD OPERATION
ANALYSIS/APPROVAL**

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OPERATION - To hoist/lower the Payload Canister at Launch Complex-39 (LC-39) Pad A or B.

SUPPORTING DOCUMENTS - The associated operational procedure/ System Assurance Analyses (SAAs) are as follows:

- OMI E5026, Orbiter Payload Canister Handling - LC-39 Pad A or B
- SAA09FTA3-004, 90 Ton Hoist - Pad A
- SAA09FTB3-003, 90 Ton Hoist - Pad B

GENERAL DESCRIPTION - The tasks below require two technicians to be directly under the canister lifting sling during installation/removal of the lifting sling as follows:

- OMI E5026, Hoisting payload canister at the Rotating Service Structure (RSS)
- OMI E5026, Lowering payload canister at the RSS

The lifting sling assembly is connected to the canister forward lifting trunnions with the canister still pinned to the transporter. Access to the top of the canister is provided by a platform specifically designed for that purpose, which is extended from the RSS after the canister is in position on the pad surface.

Two technicians are located on top of the canister with their safety harnesses attached to the adjacent safety restraint system. Each technician guides his respective part of the lifting sling as it is raised into position on the lifting trunnion. After the sling is connected, the technician then extends the canister outriggers so they will ride up the PCR guide rails during hoisting. While performing these two tasks, the canister lifting beam is 6 feet above and directly over the technician's head. When these two tasks are complete, the technicians exit the top of the canister via the access platform, which is subsequently retracted. Then, upon removal of the transporter pins, the canister is ready to be lifted.

After the canister is lowered and pinned to the transporter, the lifting sling assembly is disconnected and the outriggers are retracted following the same procedure as described above.

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

Alternate Standard Requirement #1a - The operation cannot be conducted without personnel beneath the canister lifting sling during installation/removal operations. Canister hoisting/ lowering operations at LC-39 Pads A and B have been evaluated, and it has been determined that there are no procedural/operational means to eliminate personnel exposure to a suspended load. This task was performed using a high ranger for access rather than tethering to the safety restraints on top of the canister. Even in moderate wind (well below hoisting limits), operating 70 feet above the ground and maneuvering the high ranger in close proximity to large confining structures in the exposed atmosphere was more hazardous than the present method. The alternate method also increased the length of time personnel were exposed to hazardous operations. In addition, it is not feasible to redesign the canister/canister lifting equipment to eliminate personnel from working under a suspended load.

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

Alternate Standard Requirement #1c - The maximum number of personnel allowed under the load at any time is two.

Alternate Standard Requirement #1d - Installing/removing the lifting sling to/from the canister will be accomplished as quickly and safely as possible to minimize exposure time. It will take two technicians 15-20 minutes to install/remove the lifting sling.

Alternate Standard Requirement #4 - OMI E5026 has been revised to permit only two technicians to be directly under the canister lifting sling to install/remove the hardware. The OMI is available on site for inspection during the operation.

Alternate Standard Requirement #6 - Suspended load operations associated with hoisting the payload canister at LC-39 Pads A and B involve the 90 ton hoists at each pad. The hoists are designed, tested, inspected, maintained, and operated in accordance with the NASA Safety Standard for Lifting Devices and Equipment, NSS/GO-1740.9. The 90 ton hoists at LC-39 Pads A and B are designed with a minimum safety factor of 5 (based on ultimate material strength) for the hoist load bearing components.

The lifting beam assembly excluding the lower yoke meets design safety factors of 3 to yield strength and 5 to ultimate strength. The lower yoke meets design safety factors of 2.6 to yield strength and 3.6 to ultimate strength. The 90 ton hoist wire rope meets a minimum design safety factor of 5 to ultimate strength.

The 90 ton hoists are load tested annually at 100% of the rated capacity. Detailed preventive maintenance is performed quarterly and annually on the 90 ton hoist to ensure proper operation. A detailed inspection of the lifting beam assembly is performed annually. Nondestructive testing of the hoist hook is performed annually, immediately following the rated load test.

The canister lifting beam assembly at the pad (including wire rope assemblies) weighs approximately 4000 lbs., which is 2.2% of the rated capacity of the hoist. The wire rope assemblies attached from the lifting beam to the 90 ton hoist hook are each rated to 90 tons.

The hoists are equipped with three brakes; a motor brake, a gear reducer brake, and an emergency drum brake. The Pad B hoist is equipped with dual wire ropes, each capable of holding the hoist-rated load.

Alternate Standard Requirement #7 - System Assurance Analyses (SAAs) have been completed on the LC-39 Pad A and Pad B 90 ton hoists. Each SAA includes a failure modes and effects analysis/critical items list (FMEA/CIL) and a hazard analysis (see supporting documents).

The SAAs identify no single failure points on the 90 ton hoists.

Alternate Standard Requirement #8 - Visual inspections for cracks or other signs of damage or anomalies are performed on the crane hook, lifting sling assembly, and canister lifting trunnions, 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.

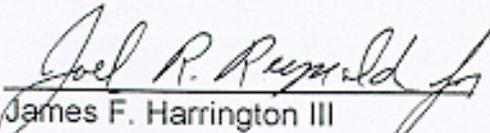
Alternate Standard Requirement #10 - Appropriate safety control areas are established before initiating operations. Only the minimum number of people (manloaded in the procedure) will be permitted in this area.

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 hazards involved. Following any crew change, the new personnel are instructed by the task leader on their specific tasks and warned of hazards involved.

Alternate Standard Requirement #12 - Personnel beneath the suspended load will be in voice contact with the crane controller/signal person. 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 operator and/or the signal person.

APPROVAL: DATE: 8/29/94


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