# APPROVAL SHEET FOR SUSPENDED LOAD OPERATIONS

**SLO-KSC** -2007-003B

TITLE ELM-PS Receiving & Inspection, ELM-PS W/CG measurement and Mechanical GSE Receiving & Inspection, ELM-PS Weight & CG Measurement (Launch Conf), ELM-PS Moving (CEWS -> FP#4)

DOCUMENT NUMBER/TITLE JTP-451005, JTP-451009, JTP-461115, JTP-461121

PREPARED BY JAXA JEM Development Project / S&MA DATE Jan. 2008

**REQUIRED APPROVAL**

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KSC FORM 20-200 NS (01/05)

# NASA SUSPENDED LOAD OPERATION ANALYSIS/APPROVAL (SLOAA)

**OPERATION:**

1. To check the physical interference of Experiment Logistics Module - Pressurized Section (ELM-PS) Keel trunnion to ELM-PS container.
2. To check the physical interference of ELM-PS Keel trunnion to rotation rings of ELM-PS Dolly.
3. To attach 6 Air bearing pallets to the bottom of ELM-PS Dolly bases.
4. To check the physical interference of ELM-PS Keel trunnion to rotation rings of ELM-PS Dolly under deployment operation for the transfer to Canister. (After deployment, crane operation responsibility is totally transferred to NASA.)

**SUPPORTING DOCUMENTS:**

The associated operational procedure/systems assurance analysis are as follows:

1. JTP-451005 ELM-PS Receiving & Inspection and W/CG measurement
2. JTP-451009 GSE Receiving and Inspection
3. SAA21CRS1-001, 30 Ton Highbay Bridge Crane-Space Station Processing Facility(SSPF)
4. OMI L5166, Cargo Element Lifting Assembly (CELA) – O&C/SSPF
5. JTP-461115 "ELM-PS Weight & CG Measurement (Launch Configuration)"
6. JTP-461121 "ELM-PS Moving (CEWS -> FP#4)

**GENERAL DESCRIPTION:**

1. When lifting ELM-PS from ELM-PS container, two workers and one CAPPS observer under ELM-PS will check the physical interference between ELM-PS keel trunnion and trunnion block of ELM-PS container.
2. When lifting ELM-PS to rotating rings, 4 workers and one CAPPS observer under ELM-PS will check the physical interference between ELM-PS Keel trunnion and rotation ring of ELM-PS Dolly.
3. When attaching 6 Air bearing pallets to the ELM-PS Dolly bases, 4 workers will insert their hands under ELM-PS Dolly bases to attach Air bearing pallets.
4. When lifting ELM-PS from Dolly, 2 workers and two CAPPS observer will check physical contact under ELM-PS.

These tasks are completed in the following JTP-451005 sequences:

- Removal of ELM-PS container lid.
- Removal of upper section of Rotation Ring from ELM-PS Dolly.
- Lifting ELM-PS from ELM-PS container.
- Transfer of ELM-PS to CEWS from ELM-PS container.
- Measurement of W&CG of ELM-PS on CEWS.
- Transfer of ELM-PS to ELM-PS Dolly from CEWS.
- Attachment of upper section of Rotation ring to ELM-PS Dolly.
- Attachment of ELM-PS container lid.

These tasks are completed in the following JTP-451009 sequences:

- Lifting ELM-PS Dolly bases.
- Attachment of 6 Air bearing pallets to ELM-PS Dolly bases.
- Replacement of ELM-PS Dolly bases on the SSPF Airlock floor.
- Assembling Rotation Ring of ELM-PS Dolly.
- Attachment of rotation rings to ELM-PS Dolly bases.
- Transfer of ELM-PS Dolly to FP4 of SSPF Highbay.

These tasks are completed in the following JTP-461115 sequences:

- Removal of upper section of Rotation Ring from ELM-PS Dolly.
- Attach Y-Restraint Fitting to each longeron trunnion.
- Lifting ELM-PS from lower section of Rotation Dolly.

The tasks are completed in the following JTP-461121 sequences:

- Lifting ELM-PS from CEWS
- Installing ELM-PS onto the lower section of Rotation Ring mounted on ELM-PS Dolly.

**RATIONAL/ANALYSIS:**
The suspended load tasks comply with the NASA Alternate Safety Standard for Suspended Load Operations as follows:

**Alternate Standard Requirement #1a:**
These operations cannot be conducted without placing personnel or hands under the suspended ELM-PS and JEM GSE during ELM-PS setup operations. It has been determined that there are no design, procedural, or operational means to eliminate personnel exposure to a suspended load, without exposing flight hardware to unacceptable damage.

**Alternate Standard Requirement #1b:**

1. The possible use of a secondary support system to catch the load in the event of a crane failure was analyzed. It was determined use of a secondary support system was not feasible because of positioning of the ELM-PS over ELM-PS container inside structures and under the CELA.
2. The possible use of a secondary support system to catch the load in the event of a crane failure was analyzed. It was determined use of a secondary support system was not feasible because of positioning of the ELM-PS over ELM-PS Dolly and under the CELA.
3. The possible use of a secondary support system to catch the load in the event of a crane failure was analyzed. It was determined use of a secondary support system was not feasible because of positioning and attaching direction of Air bearing pallets.

**Alternate Standard Requirement #1c:**

1. The maximum number of personnel allowed under the load during checking keel trunnion is three.
2. The maximum number of personnel allowed under the load during checking interference of ELM-PS Keel trunnion with rotation rings is five. This number is based on experience in TKSC.

3. The maximum number of personnel allowed under the load during attaching Air bearing pallets to ELM-PS Dolly bases is four.

**Alternate Standard Requirement #1d:**

1. Checking keel trunnion will be accomplished as quickly and safely as possible to minimize exposure time. It will take two workers and one CAPPS observer up to 10 minutes to check interference during ELM-PS lift under suspended load.
2. Checking interference of keel trunnion with rotation rings will be accomplished as quickly and safely as possible to minimize exposure time. It will take four workers and one CAPPS observer up to 20 minutes to check interference during ELM-PS lift to rotation rings under suspended load.
3. Attachment of Air bearing pallet to ELM-PS dolly bases will be accomplished as quickly and safely as possible to minimize exposure time. It will take four workers up to 15 minutes to attach each Air bearing pallet under suspended load.

**Alternate Standard Requirement #2:** Suspended load operations are reviewed and approved on a case-by-case/specific need basis - see General Description and Alternate Standard Requirement #1.

**Alternate Standard Requirement #3:** Only those suspended load operations approved by the NASA Safety and Mission Assurance Division Chief will be permitted. The NASA Safety and Mission Assurance Division will maintain a list of approved suspended load operations.

**Alternate Standard Requirement #4:** The work authorizing documents are written to allow only required personnel under the suspended load. The work authorizing documents are available on site for inspection during the operation.

**Alternate Standard Requirement #5:** A new suspended load operation not covered by this SLOAA, deemed necessary due to unusual or unforeseen circumstances where real time action is required, shall be documented and approved by the NASA Safety and Mission Assurance Division Chief.

**Alternate Standard Requirement #6:** The suspended load operations addressed in this analysis involve the 30 ton SSPF Highbay bridge cranes. The cranes are designed, tested, inspected, maintained, and operated in accordance with the NASA Standard for Lifting Devices and Equipment, NASA-STD-8719.9.

The SSPF Highbay 30 ton crane hoists are equipped with two magnetic holding brakes, each capable of holding the load up to the crane's rated capacity. Each brake's ability to hold the rated load (30 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 30 ton cranes are load tested annually at 100% of their rated capacities. Detailed preventive maintenance is performed monthly, quarterly, semiannually, and annually on the cranes to ensure proper operation. Nondestructive testing of the crane hooks is performed annually.

The Cargo Element Lifting Assembly (CELA) is utilized for operations 1, 2, described on page 1, and the PM dolly sling is utilized for operation 3.

The Cargo Element Lifting Assembly (CELA) is rated at 36,500 lbs. and is designed to meet a 5 to 1 safety factor based on ultimate strength. The combined weight of the CELA, Long Spacer, and miscellaneous hoisting equipment is approximately 26,000 lbs..

PM dolly sling: The maximum weight of the PM dolly sling is 90 lbs and the payload may weigh as much as 25,000 lbs. The total load is 25,090 lbs.
The PM dolly sling is rated at 44,000 lbs (4 straps rated at 11,000 lbs each) and is designed to meet 5 or more to 1 safety factor based on ultimate strength.

**Alternate Standard Requirement #7:** An SAA has been completed on the 30 ton bridge cranes in the SSPF. The SAA includes a Failure Modes and Effects Analysis/Critical Items List (FMEA/CIL) and a hazard analysis (see supporting documents). No critical single failure points were identified during this analysis

**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 NASA-STD-8719.9.

**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 will be permitted in this area.

**Alternate Standard Requirement #11:** A pretask briefing and a safety walkdown of the area will be 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 potential hazards. 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:** The person 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.

**Alternate Standard Requirement #14:** The NASA Safety and Mission Assurance Division shall conduct periodic reviews to ensure the continued safety of suspended load procedures.

**Alternate Standard Requirement #15:** The NASA Safety and Mission Assurance Division will provide copies of approved SLOAAs, a list of approved suspended load operations, a list of cranes/hoists used for suspended load operations and copies of the associated FMEA/CIL and hazards analyses to NASA Headquarters.

APPROVAL: DATE:

Shawlee Hunt 1/18/08

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