

# APPROVAL SHEET FOR SUSPENDED LOAD OPERATIONS

CHANGE 5

SLO-KSC-1993-003, Rev A

TITLE MVAIK SPACSHAB/External Airlock Operations

DOCUMENT NUMBER/TITLE See supporting documents in SLOAA.

PREPARED BY M. Glenn

DATE 11/16/98

**REQUIRED APPROVAL**

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**NOTE** - This SLOAA, Rev A, November 1998, incorporates previous changes, through Change 4, October 1998.

**OPERATIONS** - This operation is for late access into the SPACEHAB module while the vehicle is in the vertical position at the launch pad. This operation installs late access payloads, performs interface verification tests on late access experiments, removes GSE vertical access floor, provides for launch scrub turnaround, and provides SPACEHAB module close-out procedures.

This operation also includes access into the external airlock while the vehicle is in the vertical position at the launch pad to install EMUs and external airlock stowage bags with contents (maximum allowable weight approximately 250 lbs per bag) and install/remove external airlock GSE platforms (approximate weight 40 lbs or less per platform).

**SUPPORTING DOCUMENTS** - The associated safety and reliability analysis for the Module Vertical Access Kit (MVAK) is SAA01FL00-001. The associated operational procedures for Spacehab access are as follows:

- OMI E59XX, SPACEHAB Pre-Launch Operations - Pad
- SPI-FI003, SPACEHAB Late Access Procedure

A Flight Crew Systems (FCS) Job Card, TPS or OMI will be written to perform the installation/removal of external airlock hardware and GSE. Hardware and supporting GSE will be lowered and controlled by an integrated control sequence of OMI S08XX using OMI E59XX/R59XX via PGOC.

**GENERAL DESCRIPTION** - During SPACEHAB Module close-out or extended scrub turnaround initial ingress, the tasks below require one technician to work under a suspended load (the suspended floor plates, GSE light, and tool bag with tools and ELSAs) as follows:

**OMI E59XX** Operations inside the module are covered by MDA SPI-FI003

**SPI-FI003     Module Equipment Removal and Close-out**

Raise hoist bag containing final floor plate set; 4 plates, total weight 22 lbs  
Raise GSE light; weight 2 lbs

**Scrub Turnaround**

Initial ingress for floor plate installation  
Lower tool kit with two ELSA units in tool bag; total weight 25 lbs  
Lower GSE light; weight 2 lbs  
Lower hoist bag with 4 floor plates; total weight 22 lbs

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During module close-out, the technician is suspended from the MVAK harness to facilitate removal of the last 4 vertical access plates. Once the floor plates are loaded in the hoist bag, they are raised out of the module using a second MVAK hoist cable. The GSE light is also raised at this time. During these operations there is the potential for the technician to be under a suspended load. However, there is room for the technician to pull out from under the hatch area to minimize exposure to the load while it is being hoisted. The SPI contains instructions directing the technician to pull away from the area of the suspended load.

When the technician is not suspended from the harness there is adequate room in the module for the technician to stand away from the tunnel mouth where the experiment hardware is being lowered and therefore, not be under a suspended load.

During scrub turnaround initial ingress, the technician is lowered into the module suspended on the harness. Once the technician is in position in the module, the hoist bag, with tool kit and ELSAs, is lowered to the technician via a second hoist and the GSE light is lowered in. Next, the hoist bag with 4 floor plates is lowered to the technician. During these operations there is the potential for the technician to be under a suspended load. The SPI contains instructions directing the technician to pull away from the area of the suspended load. Once the floor plates are installed, the technician disconnects from the hoist hook and continues normal operations.

During external airlock operations, the tasks below may require up to two technicians to work under a suspended load (flight hardware, GSE platforms, and tools):

**OMI S08XX** - Control OMI integrating various subtask WADs; E59XX, R59XX, V5067, V5097.001

**OMI E59XX/R59XX** - Operations inside external airlock are covered by Job Card V66-50008, TPS FCS-XXX, OMI V5097.001 or OMI V1103.02

During external airlock stowage, the technicians will be suspended from the MVAK harness for installation of GSE in the external airlock. Once the GSE platforms are installed the flight hardware will be lowered and installed. Following these operations the GSE platforms and personnel will be removed from the external airlock using the MVAK hoist. During these operations there is a potential for the technicians to be under a suspended load. The technicians will try to be out from under the hatch area to minimize exposure to the load while it is suspended.

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

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**Alternate Standard Requirement #1a** - These operations cannot be conducted without the risk of personnel being under the suspended load. This risk is due primarily to space constraints inherent in the module configuration coupled with the need for the suspended technician to maintain control of the items being lowered to him or lifted away from him.

MVAK operations at the pad have been evaluated and it has been determined that there are no procedural or operational means to eliminate personnel exposure to a suspended load. The requirement to hoist equipment into and out of the module while a technician is suspended in the harness prevents elimination of the hazard operationally or procedurally. Procedures direct the technicians to tether themselves out from under the load when suspended. This may not always be practical due to a requirement to maintain tag line control and possible interference between the cable used to suspend the technician and the item being lowered or raised.

**Alternate Standard Requirement #1b** - The possible use of a secondary support system to catch the load in the event of crane failure was considered. A secondary support system was judged not feasible due to the nature of the work, loads lifted, limited access and confined areas where MVAK is used.

**Alternate Standard Requirement #1c** - The maximum number of personnel required under the suspended equipment is one for SPACEHAB operations and two for external airlock operations.

**Alternate Standard Requirement #1d** - Operations at the pad will be accomplished as quickly and safely as possible to minimize exposure time. For SPACEHAB operations, the technician will be suspended for approximately 5 minutes while loads are raised or lowered. Module vertical access is scheduled to occur once nominally during launch pad operations (twice in the event of an extended scrub turnaround).

External airlock vertical access requirements are scheduled to occur once nominally during launch pad operations (twice in the event of an extended scrub turnaround) although the operations may be non-continuous due to operational scheduling. Exposure time to the suspended load is approximately 5 minutes while loads are raised or lowered.

**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 Center NASA Safety Assurance Director will be permitted. A list of approved suspended load operations will be maintained by the Center NASA Safety Assurance Directorate.

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**Alternate Standard Requirement #4** - The applicable work authorization documents are written to permit only the approved personnel under the suspended load and are available on site during operations.

**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 Center NASA Safety Assurance Director.

**Alternate Standard Requirement #6** - Suspended load operations associated with MVAK involve three electric hoists. 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 rated load for each of the three hoists is 275 lbs. The MVAK hoist cables are 3/16 inch diameter steel wire rope with a rated minimum braking strength of 3700 lbs.

The three MVAK hoists are equipped with an upper and lower limit switch as well an electro-mechanical disc type brake and a mechanical load brake, each capable of stopping and holding the rated load. The MVAK hoists are load tested annually at 100% of their rated capacity including a check of each brake's ability to hold the rated load.

A preventive maintenance program is performed on MVAK. Inspections and pre-operations checks are performed prior to each use. Nondestructive evaluation is performed annually on the hoist hooks.

**Alternate Standard Requirement #7** - A Systems Assurance Analysis (SAA) has been completed on MVAK. The SAA includes a Failure Modes and Effects Analysis/Critical Items List (FMEA/CIL) and a hazards analysis (see supporting documents). The SAA for MVAK identifies no single failure points.

**Alternate Standard Requirement #8** - Visual inspections for cracks or other signs of damage or anomalies on the lifting equipment and hoist functional checks are performed before each operation per NSS/GO-1740.9.

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

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

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**Alternate Standard Requirement #11** - A pre-task briefing and a safety walkdown of the area are conducted prior to the operations to ensure 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 load will be in voice contact with hoist operator and/or task via the Operational Intercommunication System (OIS). Upon loss of communication, the task leader will safety terminate the activity and 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 and personnel beneath the load shall maintain visual contact with the load.

**Alternate Standard Requirement #14** - The Center NASA Safety Assurance Directorate shall conduct periodic reviews to ensure the continued safety of suspended load procedures.

**Alternate Standard Requirement #15** - The Center NASA Safety Assurance Directorate 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: 11/17/98

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