APPROVAL SHEET FOR SUSPENDED LOAD OPERATIONS

SLO-KSC-1994-003

TITLE ASTRO-2 INSTURMENT POINTING SYSTEM (IPS) UPPER GIMBAL STRUCTURE (UGS) SEPARATION PLANE INSPECTION

DOCUMENT NUMBER/TITLE OMI L5106/IPS - UPPER GIMBAL STRUCTURE INSTALLATION (PALLET)

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DATE 31 JANUARY 1994

REQUIRED APPROVAL

CONTRACTOR	____	DESIGN	____	R & QA	X	OPERATIONS	X SAFETY
NASA	____	DESIGN	____	R & QA	X	OPERATIONS	X SAFETY

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NASA SUSPENDED LOAD OPERATION
ANALYSIS/APPROVAL

OPERATIONS - To hoist the Instrument Pointing System (IPS) Upper Gimbal Structure (UGS) clear of the support structure to inspect the four IPS UGS separation planes and separation bolts. This operation will be performed from OMI L5106/IPS - UPPER GIMBAL STRUCTURE INSTALLATION (PALLET).

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

- OMI L5106 (**Latest Issue**), IPS* - Upper Gimbal Structure Installation (Pallet)
  * Instrument Pointing System
- OMI L3002 (**Latest Issue**), Operation Instructions -27 1/2 Ton Overhead Cranes Operation & Checkout Building (M7-355)
- SAA01FS027-002 (Rev A, 07/26/88), 27.5 Ton Bridge Crane - O&C

GENERAL DESCRIPTION

1. The inspection of the forward IPS/UGS separation bolts and forward separation planes (see Figure 1) requires two technicians to be directly under a suspended load (IPS/UGS).

2. The contingency cleaning of the forward separation bolts and forward separation planes requires two technicians to be directly under a suspended load (IPS/UGS).

These tasks are completed in the following OMI sequence:

- OMI L5106, IPS - UPPER GIMBAL STRUCTURE INSTALLATION (PALLET), "Upper Gimbal Structure Separation Plane Inspection" sequence.

This task requires personnel to be in the area of increased hazard directly under the suspended load of the IPS UGS. OMI L5106 is the controlling procedure, which is performed in the Operations and Checkout (O&C) Building low bay.

During inspection of the two forward UGS separation bolts (see Figure 2), the technicians using a special tool reveal the bolt threads that requires them to be under the load. After assessment of this operation, it has been determined that performance of this task is not feasible without personnel exposure to a suspended load condition. The expected completion time for these tasks is approximately two minutes.

The inspection of the two forward UGS separation planes is performed without personnel exposure to a suspended load condition. The IPS/UGS is hoisted and positioned approximately five feet above the O&C low bay floor, where technicians are able to view the separation planes without exposure to a suspended load.

The cleaning (contingency only) operation of the UGS forward separation bolts and forward separation planes requires the technicians to perform "hands-on" cleaning that is conducted under a suspended load. After assessment of the cleaning operation, it has been determined that this task is not feasible without exposure of personnel to suspended load operations.

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 beneath the suspended IPS/UGS because of the configuration and location of the two forward separation bolts and forward separation planes. IPS/UGS inspection 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 IPS/UGS has to be hoisted from its support fixture to gain access for the forward separation bolts. This task places a technician beneath the IPS/UGS to perform the inspection. If contamination is detected on any of the IPS/UGS separation bolts or planes, it is required to clean the contaminated surfaces. Cleaning the forward separation bolts and forward separation planes will expose two technicians to a suspended load condition.

Because of the configuration and the location of the forward separation bolts/forward separation planes, which are beneath the IPS/UGS, there is no other access for completing these tasks. These physical limitations preclude any operational or procedural workaround. A support structure for the IPS/UGS is not a feasible design consideration because the IPS/UGS support points are being inspected and there are no other structural support points.

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 the location of any available structural support points.

Alternate Standard Requirement #1c

1. The maximum number of personnel allowed under the load during inspection of the IPS/UGS forward separation bolts is two.

2. The maximum number of personnel allowed under the load during cleaning of the IPS/UGS forward separation bolts and forward separation planes is two.

Alternate Standard Requirement #1d

1. Inspection of the IPS/UGS forward separation bolts will be accomplished as quickly and safely as possible to minimize exposure time. It will take two persons up to three minutes to complete the bolt inspection.

2. Cleaning of the IPS/UGS forward separation bolts/forward separation planes will be accomplished as quickly and safely as possible to minimize exposure time. It will take two persons up to ten minutes to adequately clean the bolts and planes.

Alternate Standard Requirement #4 - OMI L5106 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 IPS/UGS lifting device in the O&C involve one 27.5 ton bridge crane in the low bay. 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.

A single 27.5 ton crane is being utilized for these tasks. The weight of the load is 1,715 lbs, which is 3.1% of the cranes' capacity.

The UGS lifting device is rated at 1,715 lbs and was proofloaded at a weight of 5703 lbs.

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:

Joel R. Reynolds 2/2/94

Jackie L. Smith
Director
Safety and Reliability (RT)
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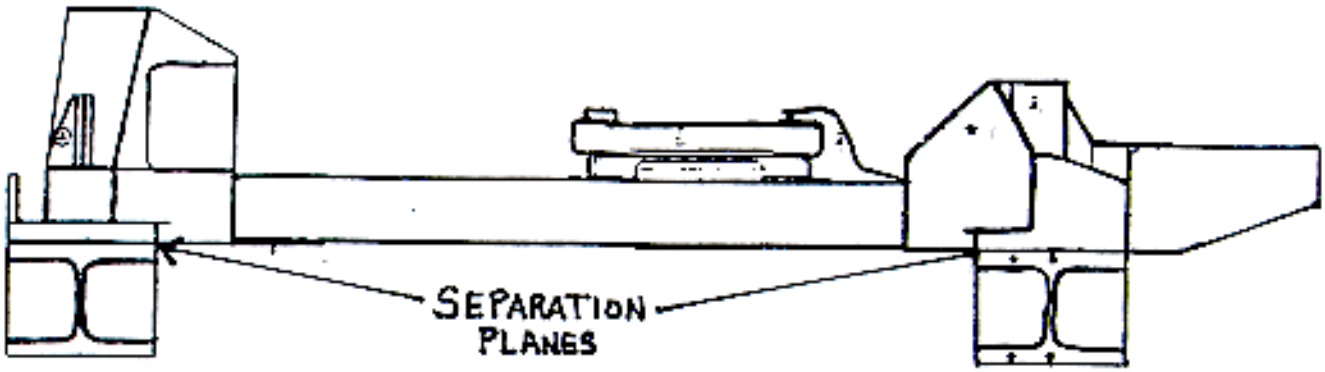
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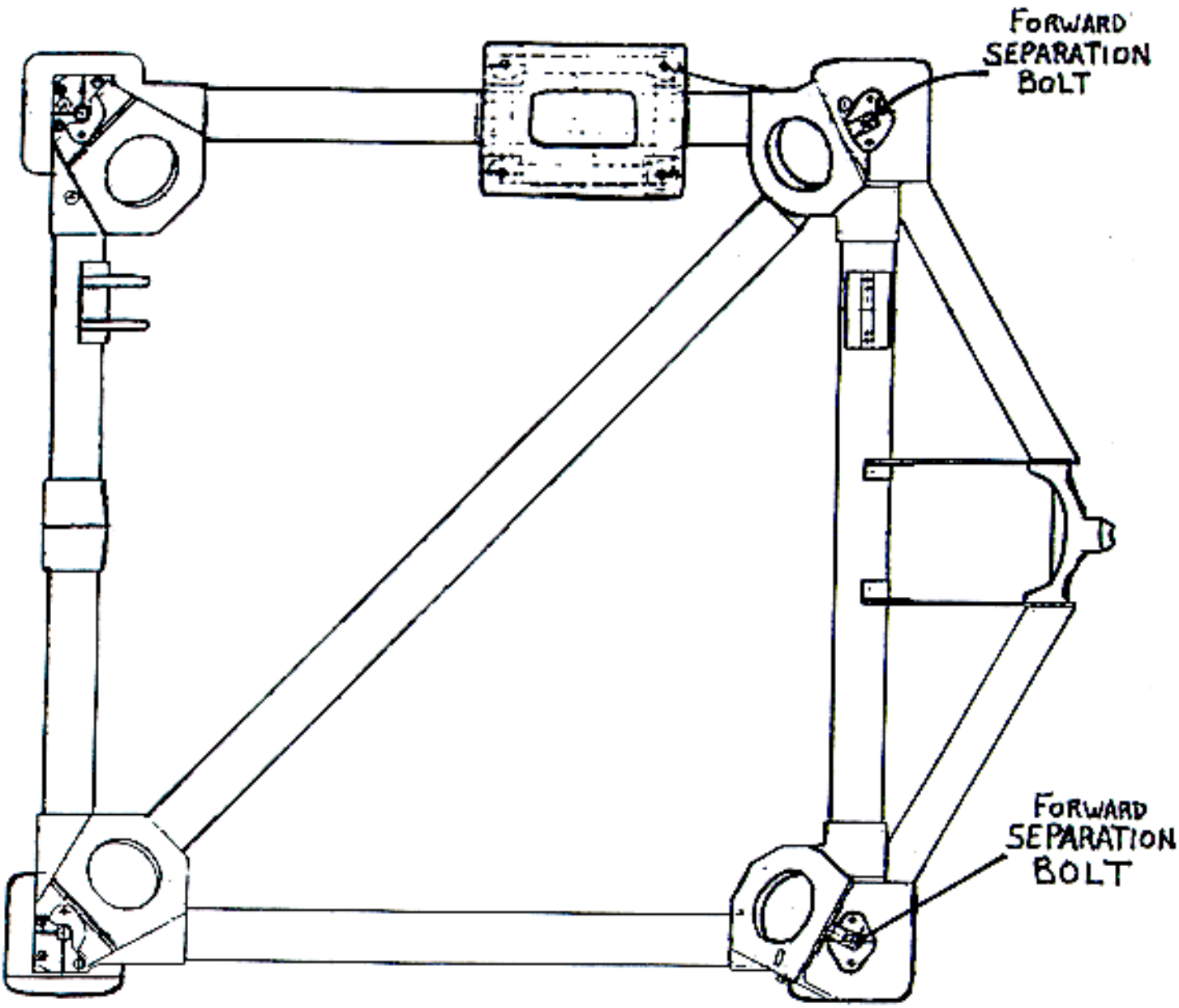
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FIGURE 1.

SEPARATION BOLT CROSS SECTION

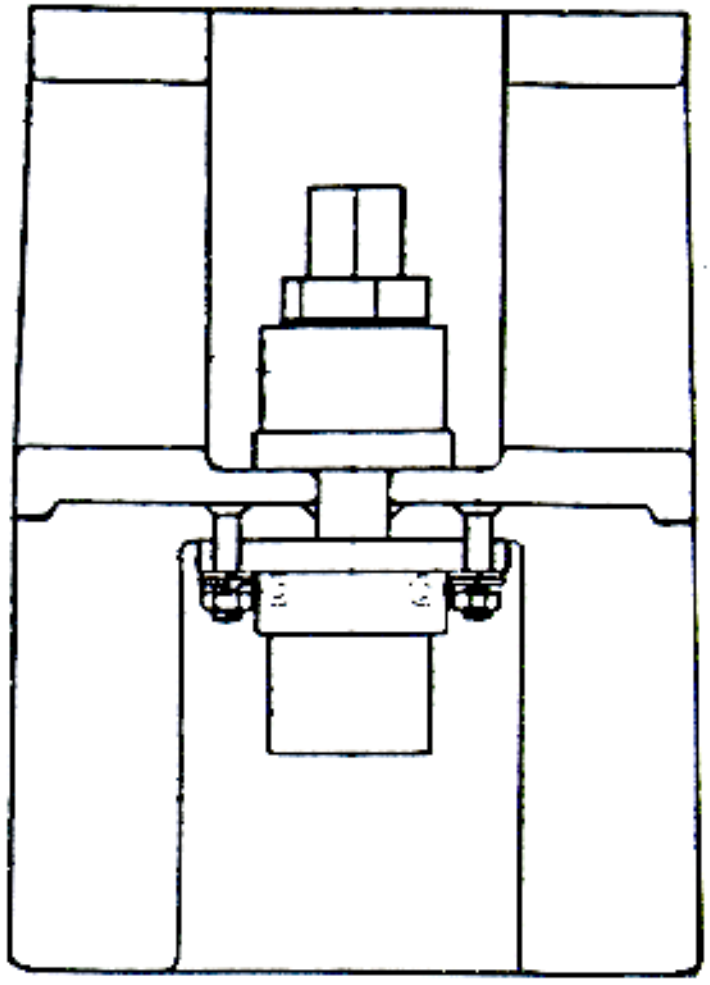

FIGURE 2.

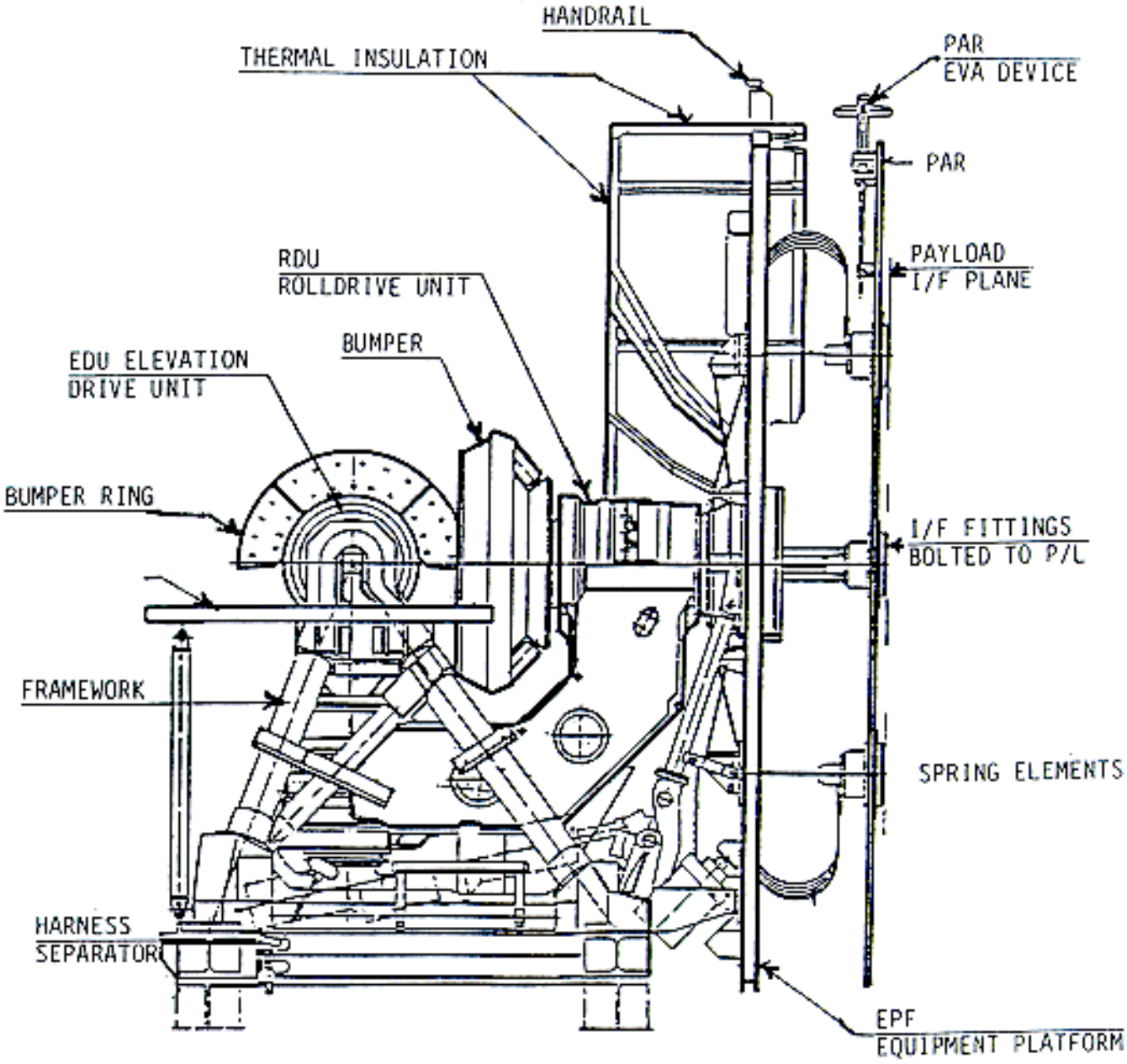

FIGURE 3-4. GIMBAL STRUCTURE