Data Requirements for the Extravehicular Activity Annex

May 1986

National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
Houston, Texas

DESCRIPTION OF CHANGES TO

PAYLOAD INTEGRATION PLAN

BLANK BOOK ANNEX NO. 11

DATA REQUIREMENTS FOR THE EXTRAVEHICULAR ACTIVITY ANNEX

CHANGE NO.	DESCRIPTION/AUTHORITY	DATE	PAGES AFFECTED
--	Basic issue/B14063-1	02/26/81	All
REV A	General revision/B14063-2	07/11/83	All
REV B	General revision/B21000-A11-3	05/29/86	All
1	Change to Signature Sheet, Signature Page, and Appendix A/B21000-A11-4	07/25/86	Signature page,A-3
2	Update to Documentation, Sections 1.0, 2.0, 6.1, 6.4, 7.1, 7.2, 7.4, 7.6, and Table 7-2; In Appendix A, Description of Change page, Preface, Table of Contents, Sections 1.0, 2.0, 2.1, 3.1.1, 3.1.2, Table 4-3, and Appendix C Section 2.0/NSTS-21000-A11-05	10/09/87	1,2,3,4, 5,7,8,9, 10,11,12, 13,A-2, A-4,A-7, A-9, A-13, A-14,A-16, A-20,C-1

BLANK BOOK ANNEX NO. 11

DATA REQUIREMENTS FOR THE EXTRAVEHICULAR ACTIVITY ANNEX

MAY 29, 1986

_______________________________________ Date
PAYLOAD REPRESENTATIVE

_______________________________________ Date
ANNEX BOOK MANAGER

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS

FOREWORD

This document defines the standard format and content of the payload Extravehicular Activity (EVA) data required to support integration of a payload into the Space Shuttle Vehicle (SSV) flight and ground operations by the various Space Transportation System (STS) elements. Use of the standard format will provide a consistent definition of the required integration agreements for the payload organization and STS implementation. The annexes required and scheduled for submittal of data by a specific payload are identified in the basic Payload Integration Plan (PIP) for the payload. The customer is requested to provide the data defined, sign the title sheet, and return the completed data to the STS EVA annex manager.

The EVA annex manager will contact the customer if there are any questions or if further negotiations of the data are required and will subsequently publish the annex.

Signed by L. G. Williams for
Leonard S. Nicholson________
LEONARD S. NICHOLSON
MANAGER, MISSION INTEGRATION

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1.0 INTRODUCTION

This document defines the data required for the payload customer submittal of the Extravehicular Activity (EVA) annex. The format of Appendix A is structured to cover a generalized payload and, as such, may need to be tailored to fit the customer's specific payload requirements. This tailoring will be by mutual agreement of the customer and the National Aeronautics and Space Administration (NASA) annex manager.

In case of any variation between this annex and the Payload Integration Plan (PIP), the PIP shall take precedence. Any requirements submitted in this document that are not within the scope of the PIP will not be considered binding on NASA for implementation.

All questions should be answered, all tables completed, and all requested data should be supplied for each section of the annex. If a question or table is not applicable, so indicate by using the phrase "Not applicable" so that it is clear that the question, etc., was considered and not overlooked. Additional sheets can be added wherever necessary to answer a question or complete a table.

The EVA annex defines the hardware and operations support requirements and specific design configuration details for each payload hardware-to-Space Transportation System (STS) hardware interface associated with the planning of EVA support for attached and deployable type payloads. More specifically, the EVA annex describes the hardware, scenarios, tools, translation paths, worksites, and operational support requirements associated with EVA support of a payload. Areas included in this description are location and configuration of the payload EVA translation paths and worksites and identification and source of payload EVA hardware. Implementation of requirements for crew training, flight planning, and flight operations support as related to EVA are contained in other PIP annexes.

The design of payload-provided hardware and worksites shall conform to the design criteria defined in NSTS 07700, Volume XIV, Appendix 7. It must be emphasized that the EVA annex is dedicated to defining the specific design configuration details, not criteria, for each payload hardware-to-STS hardware interface associated with EVA support of a particular payload.

Data submissions as well as questions and/or comments on these data requirements should be directed to the EVA annex manager, C. E. Whitsett, EC, Lyndon B. Johnson Space Center (JSC), Houston, TX 77058, 713-483-9111 or FTS 525-9111.

2.0 APPLICABLE DOCUMENTS

The following documents are applicable to the specification and implementation of payload EVA.

a. Space Shuttle Systems Payload Accommodations, JSC 07700, Volume XIV

b. STS EVA Description and Design Criteria, JSC 10615, Revision A

c. Mission Integration Control Board Configuration Management Procedures, JSC 18468

d. STS Operational Flight Rules, All Flights, JSC 12820

e. EVA Tool Catalog, JSC 20466

f. Crew Scheduling Constraints, JSC 22354

3.0 DATA SUBMISSION REQUIREMENTS

The payload data requirements are to be specified by the payload representative in the format shown in Appendix A.

The schedule for a payload to submit these required data is defined in the individual PIP. An early draft is recommended for payloads with scheduled EVA's having complex tasks.

4.0 STANDARD SERVICES

A description of the EVA standard services and EVA planning guidelines and constraints is contained in NSTS Optional Services Pricing Manual, JSC 20109. Questions and/or comments on the technical content of standard service provisions available to the payload should be directed to the EVA annex manager.

5.0 OPTIONAL SERVICES

The PIP for the payload will contain the description, the preliminary price estimate, and the proposed schedule of activities for each EVA-related optional service requested by the customer. A description of EVA optional service pricing is contained in the Optional Services Pricing Manual. Questions and/or comments on the technical content of EVA optional services available to the payload should be directed to the EVA annex manager.

6.0 ORBITER INTERFACE REQUIREMENTS

6.1 Airlock Configuration

The STS is responsible for the location and configuration of the airlock. The airlock is inside the middeck compartment attached to the Xo 576 bulkhead.

6.2 Attitude and Pointing

a. Payload orientation and thermal environment requirements prior, during, and between (if appropriate) payload EVA's are described in Annex 2, Part II.

b. Payload EVA constraints for STS attitude and pointing operations (e.g., time critical orientations) or configurations (e.g., thruster/jet selection for proximity operations or attitude changes) are described in Annex 2, Part II.

c. Retrievable and free-flying payloads attitude control data are defined in Annex 1.

6.3 Communications

The Extravehicular Mobility Unit (EMU) EVA communications will use frequencies 259.7 MHz (EMU), 279.0 MHz (EMU), and 296.8 MHz (Orbiter). Payload radiation greater than minus 115 dBm in these bands during EVA will cause EVA communication interference. Payload radio transmitter, receiver, and antenna systems characteristics are defined in Annex 1. Payload antenna locations and transmitter and receiver turn on/turn off requirements during the payload EVA are listed in Annex 1.

6.4 EVA Analysis

a. Thermal environment - An evaluation of the thermal environment that the EVA crew will be exposed to during payload EVA translation and worksite activities will be conducted by STS. The thermal environment analysis will be conducted for the payload EVA configurations shown in Figure 1-1 of the EVA annex to assure compatibility with the Orbiter

EMU equipment. The analysis will assume worst case hot conditions with the beta angle (angle between the Sun line and orbit plane) equal to the inclination angle plus 23.5 deg. The STS will use the representative payload thermal model provided by the payload for Orbiter/payload thermal integration activities.

b. EVA operations - The STS will conduct an evaluation of the EVA timeline and worksite tasks for the payload's EVA configurations shown in Figure 1-1 of the EVA annex to assure compatibility with EMU consumables capability during normal and contingency EVA operations. The JSC Weightless Environment Training Facility (WETF) and 1-g test facilities will be used to support this activity.

6.5 Illumination

Payload constraints on cargo bay, forward bulkhead, overhead, and EMU lights selection and operational duration use for payload EVA tasks, worksites, and translation paths are defined in the PIP.

6.6 Photo/Television

Payload EVA photography or Television (TV) is an optional service. Still and motion picture photography and TV via the EMU, Remote Manipulator System (RMS), and Orbiter bulkhead and keel cameras are available. The payload EVA photo/TV requirements are defined in the PIP. The type of coverage and scene requirements are defined in Annex 2, Part II.

7.0 EVA OPERATIONS REQUIREMENTS

7.1 Payload EVA Operations

a. The STS EVA operations have been divided into three basic categories as follows:

    1. Scheduled EVA - EVA planned prior to launch and included in the nominal scheduled mission timeline

    2. Unscheduled EVA - EVA not included in the nominal scheduled mission activities but which may be required to achieve payload operation success or advance overall mission accomplishments

3. Contingency EVA - EVA necessary to effect the safe return of the Orbiter and crew

b. The maximum number of mission days requested by the payload for EVA is defined in the PIP.

c. Payload EVA scheduling conditions and constraints are defined in Annex 2, Part II.

d. The GO/NO-GO criteria for payload EVA are described in Annex 3.

e. Payload hardware in the cabin that will be operated during the payload EVA(s) is identified in Annex 2, Part I.

f. Orbiter equipment in the cabin required as support equipment by the payload is identified in Annex 2, Part I.

7.2 Safety

a. Payload hardware within the 43-in. diameter translation corridors and the 48-in. working envelope at the payload EVA worksites is required to meet the sharp edges, corners, and protrusions criteria as detailed in NSTS 07700, Volume XIV, Appendix 7. For existing hardware, sharp edge and corner requirements may be met by applying tape and/or protective covers as required.

b. Payload EVA tasks must allow crewmembers to retreat to the airlock within 10 min during an EMU contingency.

c. Payload equipment or surfaces along the translation paths or at worksites sensitive to inadvertent physical contact by an EVA crewmember or restricted from EVA operations shall be documented in a safety review hazards report submitted at the payload safety reviews.

d. Hazardous payload commands (e.g., mechanical movements and pyrotechnics firing of components/systems) planned during payload EVA scenarios are listed in Annex 3. Payload separation planes are identified in Annex 1.

e. Payload components/systems that will not be in a power off configuration during the payload EVA are identified in Annex 2, Part I.

f. Payload safety critical parameters will be monitored for EVA crewmember safety during the payload EVA. Any additional parameters to be monitored for EVA crewmember safety during the payload EVA are identified in the payload hazard reports submitted to the payload safety reviews.

g. The STS will conduct early flight hardware inspections and a walkdown inspection of payload EVA translation paths and worksite envelopes during launch site processing of the payload as defined in the PIP.

h. Documentation and corrective action responsibility for hazards on the payload surfaces in the translation paths and worksite envelopes for other payloads and Orbiter contingency EVA's are defined in the PIP.

7.3 Induced Environment

a. Particulates and gases

   1. Payload contamination constraints and avoidance interval requirements are identified in Annex 2, Part II.

   2. Payload fluid sources are identified in the PIP, and the exhaust locations on the payload are identified in Annex 1.

b. Radio Frequency (RF) radiation - Payload RF radiation data is identified in Annex 1 and the Interface Control Document (ICD).

c. Ionizing radiation - Radioisotope sources provided or mounted on the payload are identified in the radioactive source questionnaire submitted at the payload safety reviews, if applicable.

d. Magnetic field radiation - DC magnetic field radiation sources provided or mounted on the payload are identified in Annex 1.

7.4 Procedures and Training Support

a. The STS is responsible for assessing the mission-specific EVA techniques and crew procedures development and flightcrew training for the payload EVA(s).

b. Conduct of payload-unique EVA techniques and procedures development in STS and payload facilities is an optional service. The STS facility resources available for payload EVA development activities include the precision air bearing floor, altitude chambers for vacuum operations, Environmental Test Article (ETA) for Orbiter airlock and cabin pressure control operations, KC-135 airplane for short duration zero gravity evaluations, Manipulator Development Facility (MDF) for RMS evaluations, 1-g mockup for photo and TV evaluations, 1-g trainer for cabin EVA preparation, post-EVA and stowage evaluations, Shuttle Engineering Simulator (SES) for Manned Maneuvering Unit (MMU) evaluations, and WETF for neutral buoyancy evaluations. The detailed utilization requirements and planning schedule of these resources will be documented in Annex 7.

c. Specific requirements for payload-provided EVA procedures for making contingency decisions are contained in Annex 3.

d. Requirements and schedules for flight-specific payload EVA training will be contained in the flight-specific training plan prepared by STS.

7.5 EVA Mockups and Training Hardware

Mockup and training hardware requirements for payload EVA development and training activities are identified in the PIP. Unique payload EVA mockups for use in the WETF will be provided by STS, if required, as an optional service to the customer. The facilities potentially requiring mockups for payload EVA activities include the altitude chambers, KC-135 aircraft, MDF, 1-g mockup, 1-g trainer, precision air bearing floor, WETF, and scale models for desk top evaluations.

7.6 Flight Hardware

a. Standard mission EVA equipment - A listing of the quantity and weight of the standard mission equipment provided for Orbiter contingency EVA's is shown in Table 7-1. Payload EVA tasks may use the standard mission equipment. Payload requirements for standard mission equipment will be identified in the EVA annex.

b. Optional service EVA equipment - Payloads requiring additional equipment may provide hardware or select from the STS inventory of payload chargeable items listed in the EVA Tool Catalog, JSC 20466. The payload will be weight charged for items flown that are not a part of the standard equipment for that mission. The payload will be charged as an optional service for refurbishment of items used in flight that are to be returned to the STS inventory.

c. Stowage volume available for unique payload EVA support equipment is limited. Where possible, the customer should use standard STS mission equipment listed in Table 7-1 and mount any unique tools at the EVA worksites on payload equipment. The customer may be charged for configuration changes necessary to stow payload EVA hardware.

Table 7-1.- STANDARD MISSION EVA EQUIPMENT LIST

(THIS TABLE IS FOR INFORMATION ONLY)

Reference Volume XIV, Appendix 7.

CONTENTS OF TABLE 7-1 HAVE BEEN DELETED

CONTENTS OF TABLE 7-1 HAVE BEEN DELETED

Table 7-2.- PAYLOAD CHARGEABLE EVA AND EVA SUPPORT EQUIPMENT

Reference EVA Tool Catalog.

CONTENTS OF TABLE 7-2 HAVE BEEN DELETED

8.0 EDITORIAL NOTES

The example format provided in Appendix A uses the heading, spacing, and capitalization standards common to the JSC PIP program. Follow this format as closely as possible.

8.1 General Guidelines

8.1.1 Text.-

a. Spell out all acronyms the first time they are used and include all acronyms in the acronym list.

b. All figures must be referenced in the text, and the figures should follow the section in which they are first referenced. Do not reference a figure from Section 3.0 in the Section 2.0 text.

c. Provide quality figures to JSC for best results. If a figure is necessary but not available, leave a blank figure numbered as required. This prevents later text changes. For the draft copy, rough sketches are preferred to blank pages.

d. Restrict inputs to data requested in the example format. Keep in mind that each annex to the PIP covers a limited subject.

8.1.2 Review Process.-

a. A document is considered a customer submittal until it has completed a series of NASA approvals culminating in the baselining of the annex by the STS Integration and Operations Office.

b. Word processing for changes received during the review cycle may be coordinated by the JSC book manager. Submittal of the text on a floppy disc for the Digital Dec-Mate (preferred) or Xerox Star system will greatly speed the review process. Always keep a copy of any draft or reviewed text.

APPENDIX A

FORMAT OF EXTRAVEHICULAR ACTIVITY ANNEX

DESCRIPTION OF CHANGES TO

DATA REQUIREMENTS FOR THE EXTRAVEHICULAR ACTIVITY ANNEX

(PAYLOAD NAME)

CHANGE NO.	DESCRIPTION/AUTHORITY	DATE	PAGES AFFECTED

(See cover sheet for example format)

EXTRAVEHICULAR ACTIVITY ANNEX

(PAYLOAD NAME)

(DATE)

_______________________________ Date _____
PAYLOAD REPRESENTATIVE

_______________________________ Date _____
ANNEX BOOK MANAGER

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS

PREFACE

This document is issued as an annex to the Payload Integration Plan (PIP) for the (payload).

The Extravehicular Activity (EVA) annex describes the hardware, scenarios, worksites, and operational support requirements associated with EVA support of a payload.

The following National Aeronautics and Space Administration (NASA) activities will be based on requirements in this document.

a. EVA tool development

b. Crew procedures development

c. Crew training

d. EVA equipment manifesting

The following describes the relationship of the PIP annexes for EVA.

a. The payload objectives and requirements for scheduled, unscheduled, and contingency EVA's are defined in Annex 11.

b. The flight timeline requirements for EVA tasks and the Aft Flight Deck (AFD) crew activities that support the payload EVA are defined in Annex 2.

c. The decision points and criteria for effecting an unscheduled or contingency EVA and the operational procedures for obtaining the information to make these decisions are defined in Annex 3.

In case of any variation between Annex 11 and the PIP, the PIP shall take precedence.

This document provides the guidelines and constraints for developing crew procedures. The final crew procedures developed for flight and used for crew training will become part of the Flight Data File (FDF).

The payload EVA tasks and worksites may require integration with the Orbiter and other payloads. The integration assessment will be conducted by the NASA Lyndon B. Johnson Space Center (JSC) as part of the Cargo Integration Review (CIR). Necessary changes to this annex resulting from these reviews will be coordinated with the payload through the PIP change process.

This document identifies the payload EVA crew equipment requiring stowage in the crew compartment and cargo bay. Assignment of stowage locations will be defined in the Crew Compartment Configuration Drawing, SGD 321005(XX).

The EVA task time requirements listed in this annex are used to aid timeline development activities. Final task timelines will be defined by the STS in the mission FDF.

Any consumable, cooling, or power requirements listed in this annex are used to aid timeline, stowage, and worksite definition and do not constitute a budgetary allocation.

Information not at issue but which is yet to be determined or not available at the time of release of the annex is labeled "TBD."

Corrections and updates to this annex will be made as necessary.

Comments or questions relative to this annex should be directed to C. E. Whitsett, EC, JSC, Houston, TX 77058, 713-483-4931 or FTS 525-4931.

The payload data was provided by (company, individual name), telephone ((XXX)-XXX-XXXX).

ACRONYMS AND DEFINITIONS

ACS	Automatic Control System
AFD	Aft Flight Deck
AFTA	Aft Frame Tilt Actuator
ASE	Airborne Support Equipment
CAP	Crew Activity Plan
CB	Cargo Bay
CC	Crew Compartment
CCC	Contaminant Control Cartridge
CCTV	Closed Circuit Television
CIR	Cargo Integration Review
EMU	Extravehicular Mobility Unit
EVA	Extravehicular Activity
FDF	Flight Data File
ICD	Interface Control Document
IUS	Inertial Upper Stage
JSC	Lyndon B. Johnson Space Center
MLI	Multilayered Insulation
MPESS	Mission Peculiar Equipment Support Subsystem
PFR	Portable Foot Restraint
PIP	Payload Integration Plan
PRD	Payload Retention Device
PRLA	Payload Retention Latch Assembly
REM	Remote Engagement Mechanism

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(Use line drawings or photos for figures; label all EVA interfaces. If photos are used, originals must be sumitted to the book manager at JSC.)

1.0 INTRODUCTION

The hardware and operations support requirements and specific design configuration details for each payload hardware-to-Space Transportation System (STS) hardware interface associated with Extravehicular Activity (EVA) support of the (payload name) are defined in this document.

Payload mission objectives for the three classes of EVA defined Tin JSC 10615 are as follows:

a. Scheduled EVA (support payload operations)
(Example: Change out spacecraft battery module)

b. Unscheduled EVA (enhance mission success)
(Example: Retrieve spacecraft after Remote Manipulator System (RMS) failure)

c. Contingency EVA (safe return of Orbiter)
(Example: Jettison spacecraft appendage to clear payload bay door closure envelope)

1.1 Purpose

This document describes the hardware, scenarios, tools, and worksite requirements associated with EVA support of a payload. Areas included in this description are the identification and sequence guidelines for the payload EVA tasks, identification and source of payload EVA hardware, and location and configuration of the payload EVA translation paths and worksites.

1.2 Guidelines

a. The EVA(s) will be performed in low Earth orbit (as defined in the Payload Integration Plan (PIP)) with the cargo bay doors open.

b. The activities described in this document are based on each EVA scenario being performed with two persons. Activities which require two EVA crewmembers are identified.

c. Accommodations are provided at each contingency worksite for accomplishing activities with one EVA crewmember.

1.3 Cargo Bay Configuration

The payload's EVA accommodations must be included in the envelope for selection of a payload's cargo bay location. (Exceptions will be noted in the PIP.) The payload configurations during the EVA's, including reserved envelopes for EVA worksites and translation paths within the payload control length defined in the PIP, are shown in Figure 1-1.

This document is applicable for the (payload name) cargo bay configuration described in (payload name) Payload Data Package, (PIP no.), Annex 1.

1.4 Cabin Configuration

Prior to a payload EVA, the Orbiter cabin pressure may be lowered from 14.7 psia to approximately 10 psia as part of the EVA crew denitrogenation procedure. The STS is responsible for selecting the cabin pressure to be maintained during the payload EVA. The payload (does or does not) require a cabin repressurization (from 10 psia to 14.7 psia) after a payload EVA.

1.5 Mechanism Overview

(Provide a brief description of design philosophy and requirements which led to the incorporation of EVA interfaces. This section should serve as a background for the specific scenarios which follow. Reference Table 1-1, if applicable.)

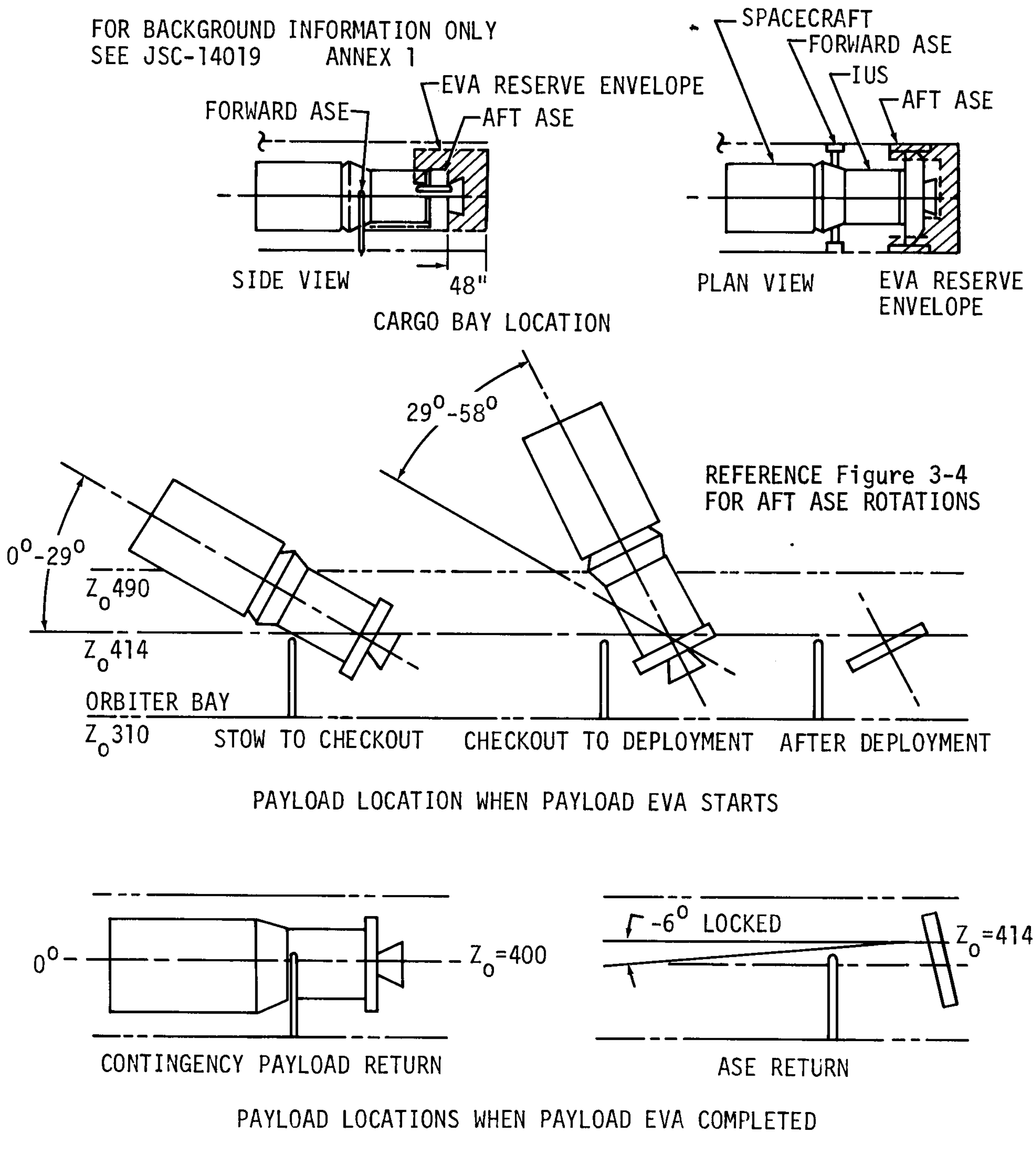
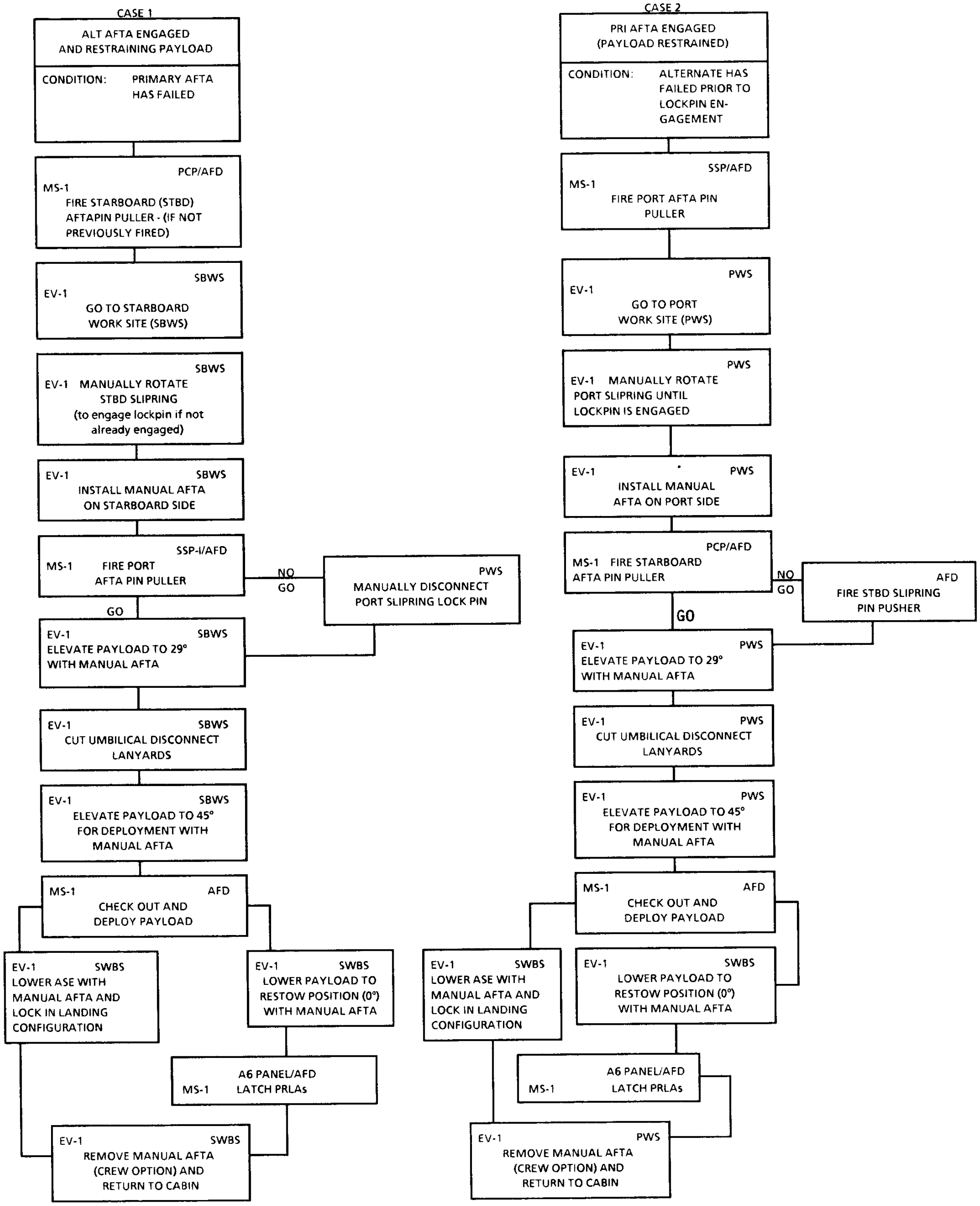


Figure 1-1.- Example of cargo bay locations.

TABLE 1-1.- CRITERIA FOR SLIPRING WORKSITE SELECTION



2.0 EVA SCENARIOS

The EVA scenario is an outline of the essential requirements of the payload EVA. The scenario contains sufficient detail to understand the intent and relationship of the major EVA tasks. Actual tasks and sequence of tasks implemented in a payload EVA will be determined by STS during mission integration and mission-specific training activities.

2.1 Scheduled EVA's

2.1.1 (EVA Scenario Title).-

2.1.1.1 Background:

a. Payload activity at time of EVA requirement - (Brief description of general ongoing payload activities)

b. Specific event(s) preceding EVA requirements - (Brief description of specific events or failures that result in need for EVA.)

2.1.1.2 Pre-EVA Requirements: Prior to committing to this EVA, the following activities will have been completed:

(List actions that verify need and payload's readiness for EVA.)

2.1.1.3 Action(s) Required: EVA Scenario (XX), (Scenario Title)

EVA 1 Scenario: (Describe tasks in a narrative timeline sequence. Using all caps identify any portions of the timeline sequence which should not be changed during mission training activities. Identify figures in Section 2.0 which show the EVA worksite. Do not provide a detailed description of the worksite, task, and hardware. Section 3.0 will contain the detailed worksite and hardware descriptions.)

An example of an EVA scenario is provided in Appendix C.

2.2 Unscheduled EVA's

(Use same format as for planned EVA's)

2.3 Contingency EVA's

(Use same format as for planned EVA's.)

3.0 WORKSITE INTERFACE REQUIREMENTS

The specific tasks and hardware provided at each worksite to accomplish the payload EVA objectives are described below.

An example of a worksite interface definition is provided in Appendix D.

3.1 (Name) Worksite

(This section provides a detailed description of an EVA worksite and the tasks required at the worksite.)

3.1.1 Task Description.-

a. EVA task requirements - The following tasks require (one or two) EVA crewmembers.

   (Title of specific task) - (List each task to be performed at worksite. The task title will include an action, e.g., activate, attach, clean, connect, deactive, deploy, disconnect, extend, inspect, install, jettison, maintain, override, photograph, pull, remove, repair, replace, resposition, rescue, retract, rotate, service, stabilize, store, stow, tiedown, transfer, or etc.)

   (Provide an outline of the essential operations for each task in sufficient detail to understand the intent and relationship of the major elements of the task. Identify any portion of the task which should not be changed during mission training activities. Identify activities requiring Aft Flight Deck (AFD) coordination. The task description shall be generalized to allow maximum implementation flexibility by the STS for EVA techniques and procedures development.)

b. Task time - (Title of specific task): (XX:XX) (hr:min)

(Estimate time required to complete all steps involved in each task.)

3.1.2 Worksite Description.-

a. Mechanical/structural configuration -

1. Access envelope - An overview of the worksite is illustrated in Figure 2-(XX). A detailed view of the working envelope at the worksite is shown in Figure 3-(XX). (Provide basic geometrical, dimensional, and access/clearance volume characteristics of the worksite and specific items to be operated. Use drawings, sketches, illustrations, or photographs as required.)

2. Sharp edges, corners, and protrusions - (List and identify specific locations within worksite of exposed edges, corners, and protrusions that may damage an EVA crewmember's suit or associated equipment by puncturing, cutting, sawing, or abrading. Use drawings, sketches, illustrations, or photographs as required. List any pyrotechnic firings or appendage deployments planned during EVA.)

3. Restraints/translation aids - (List and identify in terms of geometry and location the handholds, handrails, foot restraints, equipment restraints, tether attach points, lights, and equipment transfer aids mounted on the payload at the worksite. Use drawings, sketches, illustrations, or photographs as required.)

b. Surface material -

1. Major surfaces - (List the major payload items' surfaces in the worksite envelope and along payload EVA translation paths in Line of Sight (LOS) of crewmember affecting EVA thermal analysis. Identify surface material/coating for each surface. Use drawings, sketches, and illustrations as required to identify the surfaces. Identify any surfaces beyond the Extravehicular Mobility Unit (EMU) glove temperature limits (minus 180 to plus 235 deg F.)

c. Decals, markings, and color coding - (List devices, mechanisms, and equipment requiring identification, movement, or monitoring of movement by an EVA crewmember. Identify each worksite location requiring operating procedures or hazardous for crew during EVA. Identify decals, markings, and color coding, as appropriate, for each item listed. Use drawings, sketches, illustrations, or photographs as required.)

d. Mass properties - (List and define weight for each item mounted at the worksite which an EVA crewmember is required to transfer from one location to another.)

e. Force/torque requirements -

   1. Identify any operation requiring greater than 25 lb force or 11 ft-lb torque.

   2. Payload-provided restraints - (Define the load limitations on customer-provided worksite restraint provisions (e.g., tether attach points and handholds).)

f. Contamination - (List payload worksite equipment or surfaces susceptible to contamination by emission of STS EVA equipment's EMU sublimator water of up to 2 lb/hr and Manned Maneuvering Unit (MMU) gaseous nitrogen. Use drawings, sketches, and illustrations, as required, to identify equipment and surfaces. Identify any payload emissions which may impact EVA operations.)

4.0 HARDWARE REQUIREMENTS

4.1 Flight Hardware

A summary of the crew equipment required for each task at each payload EVA worksite is shown in Table 4-1.

The payload chargeable nonstandard STS EVA support items required for the payload EVA(s) are shown in Table 4-2. These are STS items added to the manifest to support a payload EVA.

The payload requires the STS provide the new or modified STS EVA support equipment identified in Table 4-3. The payload will provide the payload-provided EVA support equipment identified in Table 4-3.

The payload may be charged for configuration changes necessary to stow unique EVA hardware.

4.2 Stowage

The EVA equipment launch stowage locations are shown in Tables 4-2 and 4-3. Crew compartment location/stowage requirements are provided in Annex 6, if applicable.

Stowage by STS of the remaining mission equipment listed in Tables 4-2 and 4-3 will be as required for crew use based on storage space availability.

Table 4-1.- PAYLOAD EVA WORKSITES CREW EQUIPMENT SUMMARY

Worksite	Task	Equipment list	Quantity required
EXAMPLE			
Aft ASE starboard slipring	Disengage star- board slipring	3/8 in. ratchet drive with 4 in. extension and 7/16 in. socket	1
		mini-workstation	1

Table 4-2.- PAYLOAD CHARGEABLE ORBITER EVA SUPPORT EQUIPMENT

Optional Orbiter equipment item	Quantity required	Launch location*
EXAMPLE		
a. Airlock adapter plate	1	CC
b. Communications carrier assembly	1	CC
c. Liquid cooling vent garment	1	CC
d. Short EMU assembly without battery or Contaminant Control Cartridge (CCC)	1	CC

*PSA - Provisions Stowage Assembly; CC - Crew Compartment; CB - Cargo Bay other than PSA

Table 4-3.- UNIQUE PAYLOAD EVA SUPPORT EQUIPMENT

(List all new EVA tools developed for this payload which are not part of the STS inventory, i.e., tools developed especially for this payload.)

Equipment list	Quantity	Stowage	Figure
EXAMPLE			
STS-provided			
a. IUS cable cutter	1	PSA	Reference EVA Tool Catalog
Payload-provided			
a. IUS socket wrench	1	CC	4-1

3/8-INCH DRIVE RATCHET, EVA WITH 7/16-INCH HEX SOCKET

Technical Information	
Part number	Not available
Weight	1.251 lb.
Material	Drive housing - aluminum drive and socket - tool steel
Design Temperature range	-100° to 200° F certified by test
Socket depth	0.5 in.
Design Pressure range	10^{-7} to 760 MM Mg certified by test

Dimensional Data	
A	10.25 in.
B	3.5 in.
C	6.0 in.
D	1.5 in.
E	2.6 in.
F	0.65 in.

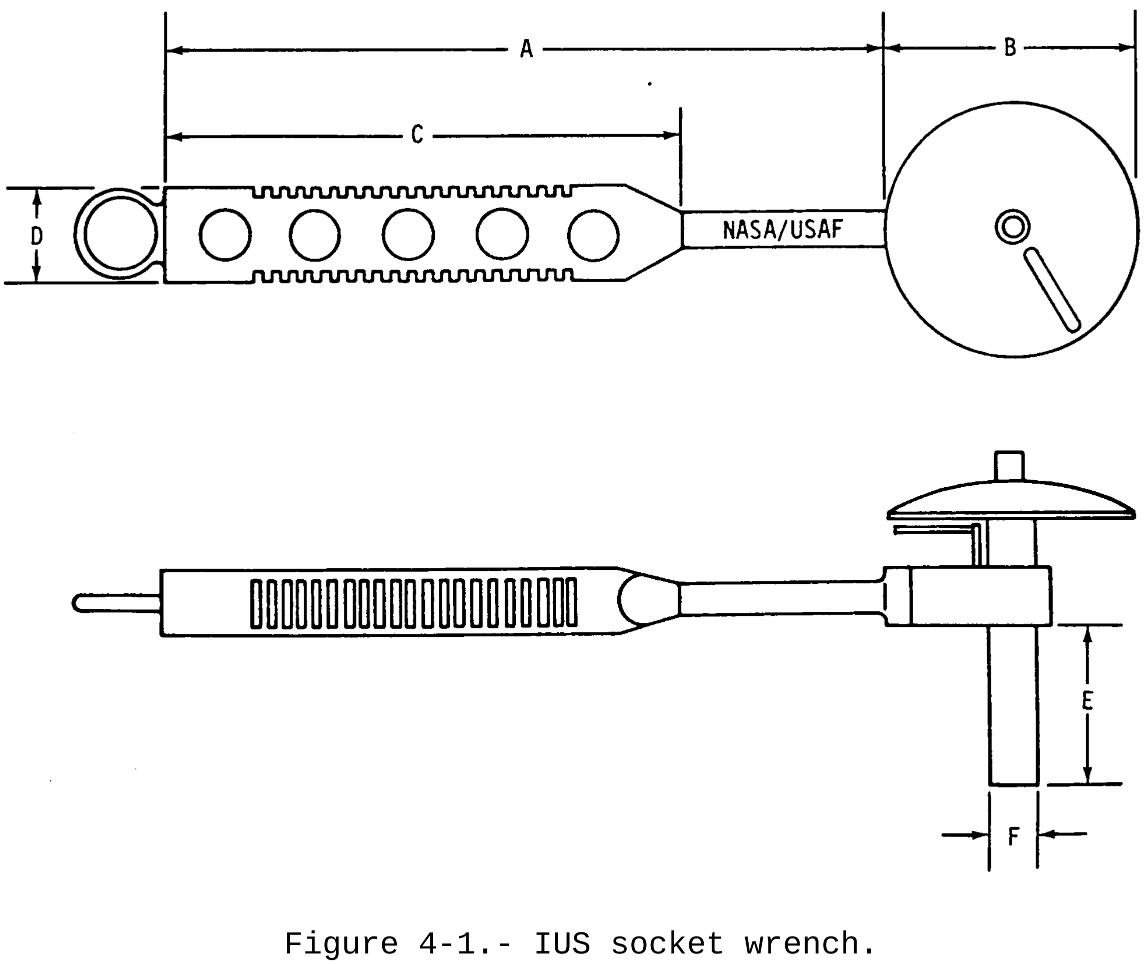


Figure 4-1.- IUS socket wrench.

5.0 EVA BLANK BOOK STANDARD REQUIREMENTS

5.1 Orbiter Interfaces

The Orbiter interfaces requirements paragraphs contained in JSC 21000-A11 are dispositioned as follows:

(X) 6.1 Airlock Configurations
(X) 6.2 Attitude and Pointing
(X) 6.3 Communications
(X) 6.4 EVA Analysis
(X) 6.5 Illumination
(X) 6.6 Photo/Television (TV)

(Insert in (X) one of the following:_
A = Accepted as contained in JSC 21000-A11
E = Exception (Identify change required)

5.2 EVA Operations

The EVA operations requirements paragraphs contained in JSC 21000-A11 are dispositioned as follows:

(X) 7.1 Payload EVA Operations
(X) 7.2 Safety
(X) 7.3 Induced Environment
(X) 7.4 Procedures and Training Support
(X) 7.5 EVA Mockups and Training Hardware
(X) 7.6 Flight Hardware

(Insert in (X) one of the following:)
A = Accepted as contained in JSC 21000-A11
E = Exception (Identify change required)

APPENDIX B

EXAMPLE OF MECHANISM OVERVIEW

1.5 Mechanism Overview

The Inertial Upper Stage (IUS) tilt table rotates to allow the IUS and spacecraft to clear the Shuttle during deployment. One of two Aft Frame Tilt Actuators (AFTA's) drives the tilt table through a slipring. A spring-loaded lock pin engages the slipring to the tilt table after 13 deg of rotation. An AFTA failure after slipring engagement prevents further rotation. An AFTA pin puller allows the Aft Flight Deck (AFD) crewmembers to disconnect a failed AFTA from the slipring. In case of AFTA pin puller failure an AFD controlled pin pusher on the starboard side allows decoupling of the starboard AFTA from the starboard slipring. An EVA disconnect bolt replaces the pin pusher on the portside.

The manual AFTA tool stowed in the crew compartment allows the EVA crewmembers to raise or lower the payload after the port and starboard AFTA have been decoupled by AFTA pin pullers and/or slipring lock pin disengagement. The slipring lock pin must be engaged to allow the manual AFTA to rotate the tilt table. The flowchart in Table 1-1 further explains possible failure modes and failure resolution options.

APPENDIX C

EXAMPLE OF EXTRAVEHICULAR ACTIVITY SCENARIOS

2.0 EVA SCENARIOS

The EVA scenario is an outline of the essential requirements of the payload EVA. The scenario contains sufficient detail to understand the intent and relationship of the major EVA tasks. Actual tasks and sequence of tasks implemented in a payload EVA will be determined by the STS during mission integration and mission-specific training activities.

2.1 Planned EVA's

None identified

2.2 Unscheduled EVA's

None identified

2.3 Contingency EVA's

2.3.1 <u>Disengage Aft Airborne Support Equipment Starboard Slipring</u>.-

2.3.1.1 Background:

a. Payload activity at time of EVA requirements: Payload/Airborne Support Equipment (ASE) above Payload Retention Latch Assembly (PRLA) capture envelope and in one of the following activities:

   1. Payload erection

   2. Payload retraction

   3. ASE tilt table retraction

b. Specific event(s) preceding EVA requirement: The primary AFTA has failed and the primary actuator pin puller has failed to decouple the primary AFTA and slipring.

The ASE primary AFTA contains an Electro Explosive Device (EED) pin puller which disconnects the AFTA from the starboard slipring by switch action at the AFD Power Control Panel (PCP) (Annex 6). An EVA is required if the primary AFTA fails to disconnect after failure.

2.3.1.2 Pre-EVA Requirements: Prior to committing to this EVA, the following activities will have been completed.

a. Primary AFTA pin puller failure to decouple the primary actuator and slipring will have been verified from the AFD visually, if payload cargo configurations allow, or by Closed Circuit Television (CCTV) using the aft bulkhead starboard camera.

b. The ASE alternate actuator will have been engaged from the AFD payload station PCP.

c. The payload ordnance, power and transponder, will have been configured from the AFD payload station PCP for EVA operations.

2.3.1.3 Action Required: EVA Scenario 1, Disengage Aft ASE Starboard Slipring

The EVA function shall be performed at the aft ASE starboard slipring worksite. The translation path(s) and worksite(s) are shown in Figure 2-1. Two EVA crewmembers perform the following steps to complete the task:

a. Obtain the required tools and traverse to the aft ASE starboard slipring worksite.

b. Disengage the slipring by using a wrench to ROTATE THE TILT MECHANISM PIN BOLT UNTIL IT BOTTOMS.

c. Translate to the forward portion of the cargo bay. Normal operation from the flight deck will then be resumed for ASE restowage using the alternate AFTA. The EVA crewmembers will remain in the cargo bay until the ASE is fully restowed.

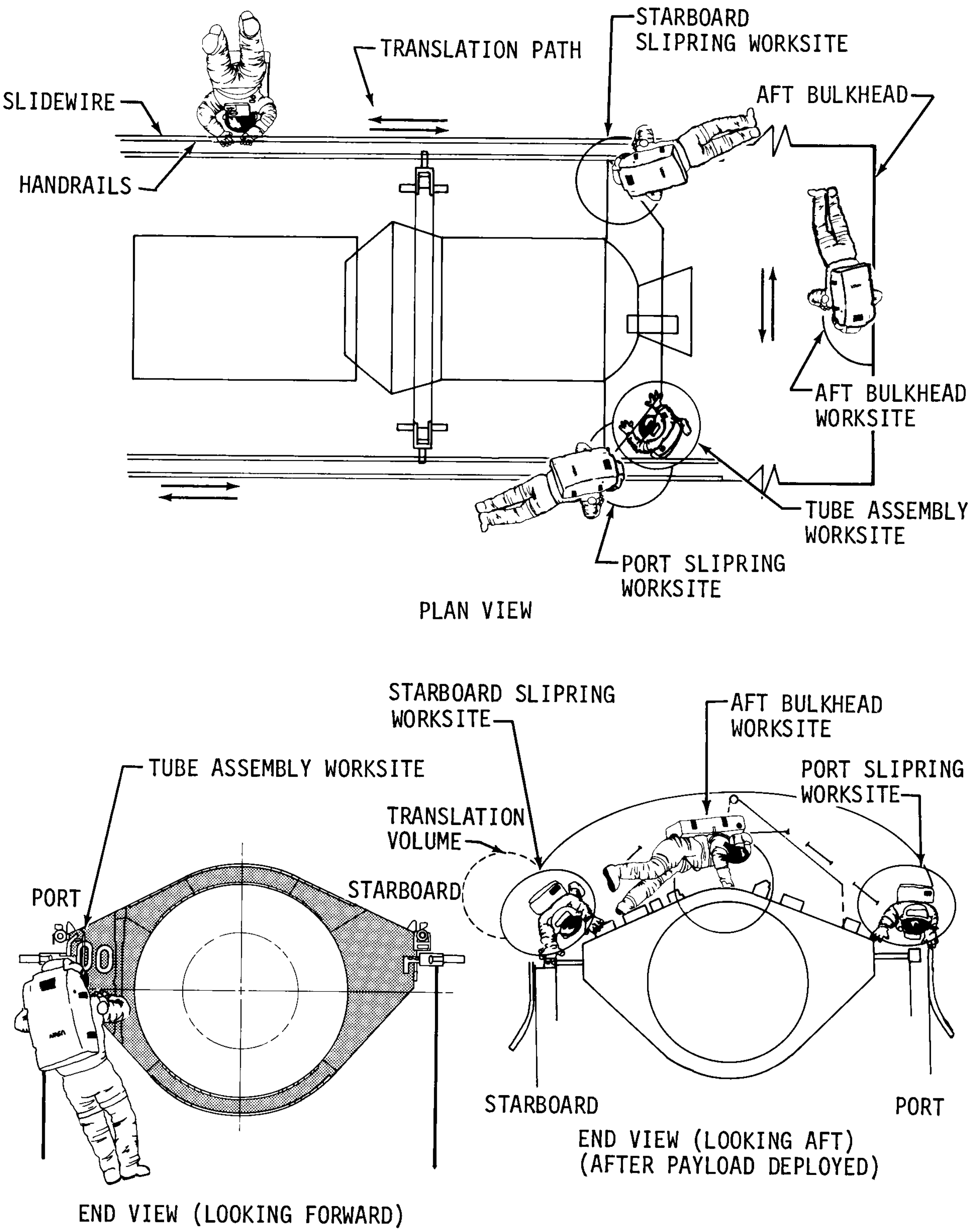


Figure 2-1.- Translation paths and worksite locations.

APPENDIX D

EXAMPLE OF WORKSITE INTERFACE REQUIREMENTS

3.0 WORKSITE INTERFACE REQUIREMENTS

The hardware and specific tasks provided at each worksite to accomplish the payload EVA objectives follow.

3.1 Aft ASE Starboard Slipring Worksite

3.1.1 Task Description.-

a. EVA task requirements - The following task requires one EVA crewmember.

   1. Retract the spring-loaded engagement pin between the starboard slipring and the aft ASE frame.

      An EVA crewmember traverses to the worksite with the IUS socket wrench and manually removes the keeper spring covering the tilt mechanism pin bolt. The spring remains attached to its 6-in. long tether cable. The EVA crewmember attaches the wrench and rotates the bolt clockwise approximately 10.25 turns until the bolt bottoms, forcing the lock pin out of engagement and disengaging the slipring. A positive stop is incorporated to indicate the bolt is bottomed out, and an indicator located on the AFD Power Control Panel (PCP) shows when the slipring is disengaged.

b. Task time -

   1. Bolt disengagement - 00:05 (hr:min)

   2. Cargo bay translation - 00:03 (hr:min)

3.1.2 Worksite Description.-

a. Mechanical/structural configuration -

   1. Access envelope - An overview of the worksite is illustrated in Figure 2-1. A detailed view of the working envelope at the worksite is shown in Figures 3-1 and 3-2.

The worksite is centered approximately 10 in. inboard of the Orbiter longerons at the center of the IUS spreader beam as shown in Figures 2-1 and 3-1. For the ASE rotation envelope and mechanism details reference Figure 3-3.

2. Sharp edges, corners, and protrusions - After IUS separation sharp edges exist around the perimeter of the Super*Zip surface shown in Figure 3-1.

3. Restraint/translation aids - The disengagement operations requires the use of only one hand; therefore, the EVA crewmember's other hand is free to grasp elements of the ASE to provide restraint. The Orbiter handrails just outboard of the longeron rail may be used as a tether point during the EVA.

b. Surface materials -

1. Surfaces - ASE: Multilayer Insulation (MLI) (Kapton)

2. Surface temperatures less than minus 180 deg F or greater than plus 235 deg F: None identified

c. Decals, markings, and color coding -

1. 7/16 bolt head - Painted black with orange stripes overlaid

2. Spring keeper and spring keeper tether holder plate - Painted black with orange stripes overlaid

d. Mass properties - Manual AFTA: 40 lb

e. Force/torque requirements -

1. Payload tasks - Rotate bolt - Approximately 10 in. lb (Note: Minimum torque required must be at least 10 in.-oz to permit proper ratchet operations.)

2. Payload-provided restraints - None identified

f. Emissions contamination - No unique payload or STS concerns.

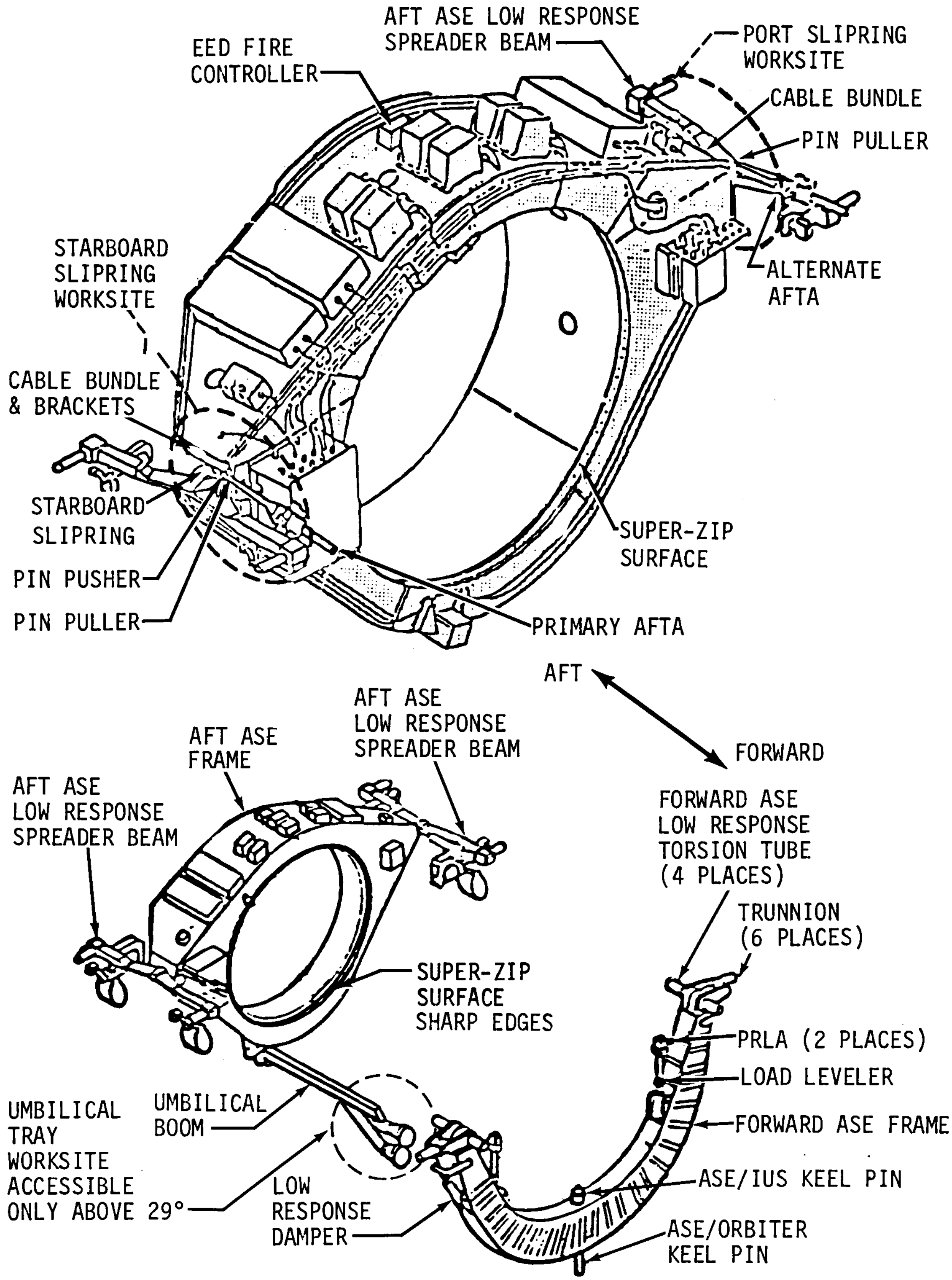


Figure 3-1.- IUS ASE configuration.

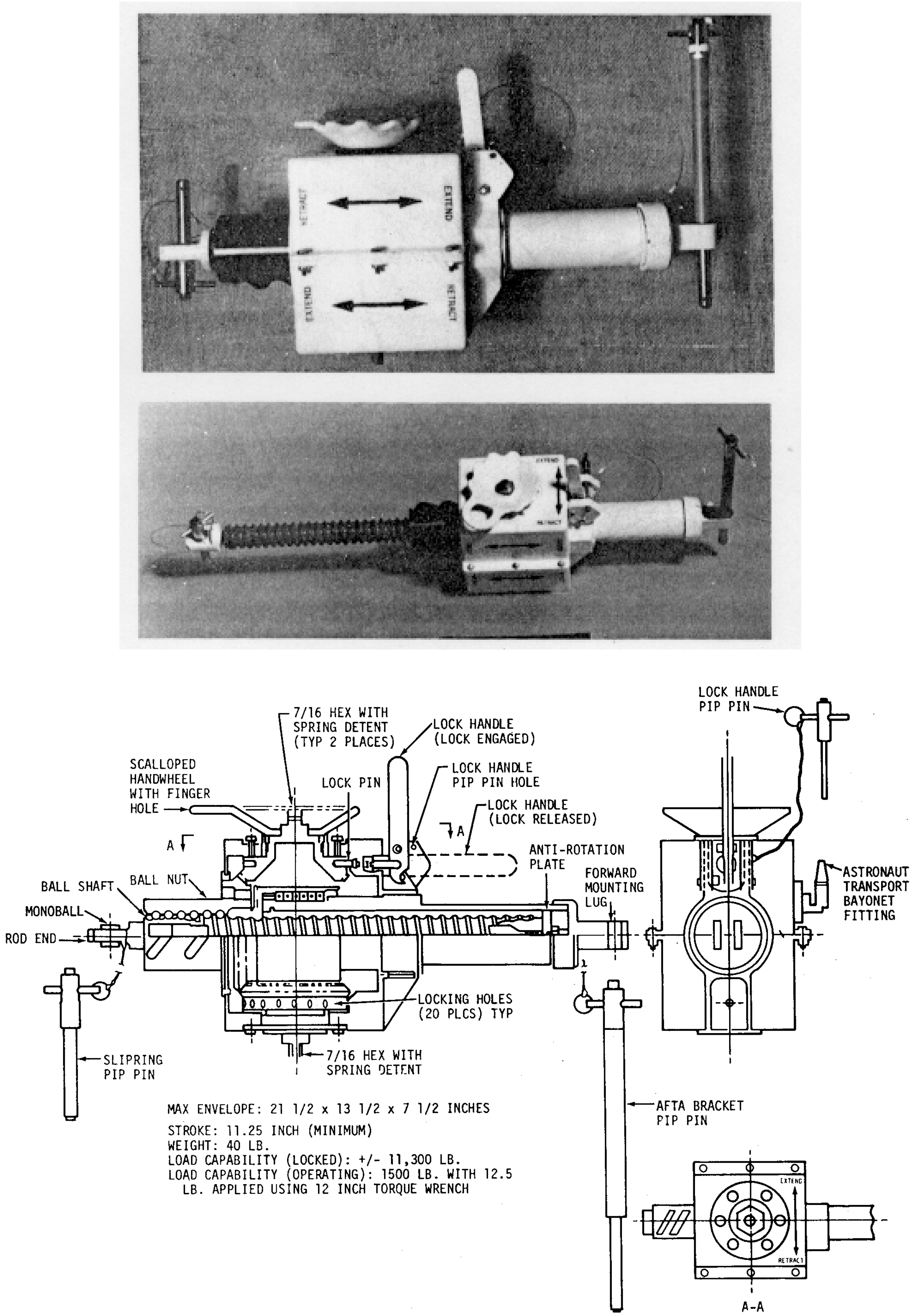
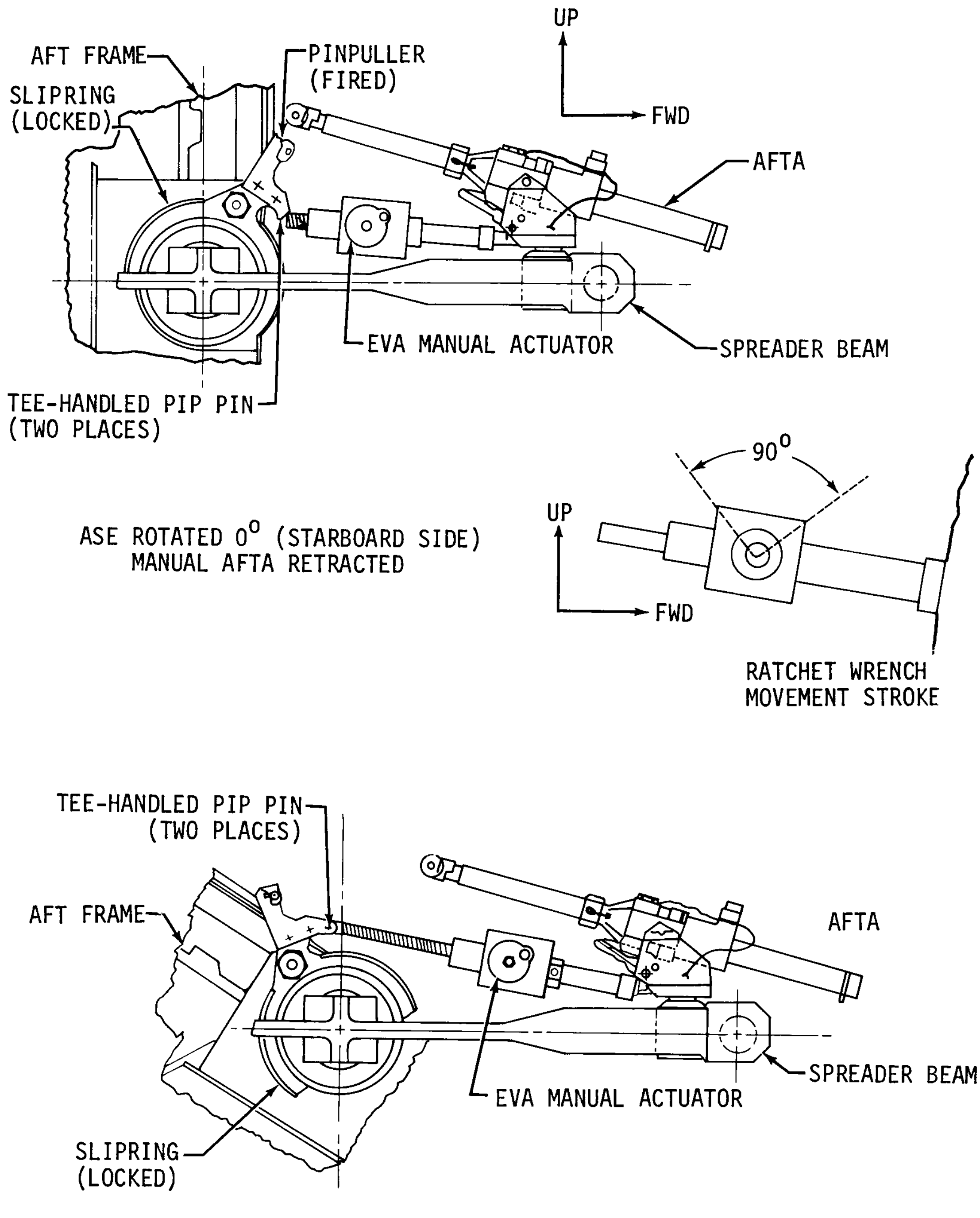


Figure 3-2.- Manual AFT.



ASE ROTATED 58° (STARBOARD SIDE)

Figure 3-3.- Manual AFTA extended.