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Historical Data and Analysis for the First Five Years of KSC STS Payload Processing

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CONTENTS

CONTENTS (Continued)

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS AND ACRONYMS

AFD	aft flight deck
CCAFS	Cape Canaveral Air Force Station
CFES	Continuous Flow Electrophoresis System
CITE	cargo integration test equipment
D1	First German Spacelab Mission
DFVLR	Deutsche Forschungs-und Versuchsanstalt Fur Luft-und Raumfahrt
DOD	Department of Defense
E-E	end-to-end (testing)
EO	Engineering Order
ERBS	Earth Radiation Budget Satellite
ERNO	Entwicklungts Ring Nord Organization
ESA	European Space Agency
FEC	field engineering change
ft	foot
GAS	Getaway Special
GIRD	Ground Integration Requirements Document
GSFC	Goddard Space Flight Center
in	inch
IPR	Interim Problem Report
IPS	Instrument Pointing System
IUS	Inertial Upper Stage
IVT	Interface Verification Test
JSC	Lyndon B. Johnson Space Center
KSC	John F. Kennedy Space Center
lb	pound
LDEF	Long Duration Exposure Facility
LFC/ORS	Large Format Camera/Orbital Refueling System
LSSF	Life Science Support Facility
LV	level
max	maximum
min	minimum
MLP	Mobile Launcher Platform
MLR	Monodisperse Latex Reactor
MSFC	George C. Marshall Space Flight Center
MSL	Materials Science Lab
MUX	multiplexer
NASA	National Aeronautics and Space Administration
O&C	Operations and Checkout (Building)
OAST	Office of Aeronautics and Space Technology
OFT	Orbital Flight Test
OMI	Operations and Maintenance Instruction
OMRS/OMRSD	Operations and Maintenance Requirements Specifications/ OMRS Documents
OPF	Orbiter Processing Facility
OSS	Office of Space Science
OSTA	Office of Space and Terrestrial Applications

PAM-D & D2	Payload Assist Module - Delta and Delta 2 Classes
PCR	Payload Changeout Room
PDRS/PFTA	Payload Deployment and Retrieval System/Passive Flight Test Article
PGHM	Payload Ground Handling Mechanism
PL	payload
POCC	Payload Operations Control Center
PPF	payload processing facility
PR	Problem Report
PRR	Payload Readiness Review
RMS	Remote Manipulating System
R/R	remove/replace
RSS	Rotating Service Structure
SCU	signal conditioning unit
SIP	standard interface panel
SL	Spacelab
SLF	Shuttle Landing Facility
SMRM	Solar Maximum Repair Mission
SSIP	Space Science Student Involvement Project
STS	Space Transportation System
TAP	Test Assembly Procedure
TDRS	Tracking and Data Relay Satellite
T-0	lift-off
TPS	Test Preparation Sheet
U. S.	United States
V	volt
VAB	Vehicle Assembly Building
VFI	Verification Flight Instrumentation
VPF	Vertical Processing Facility

FOREWORD

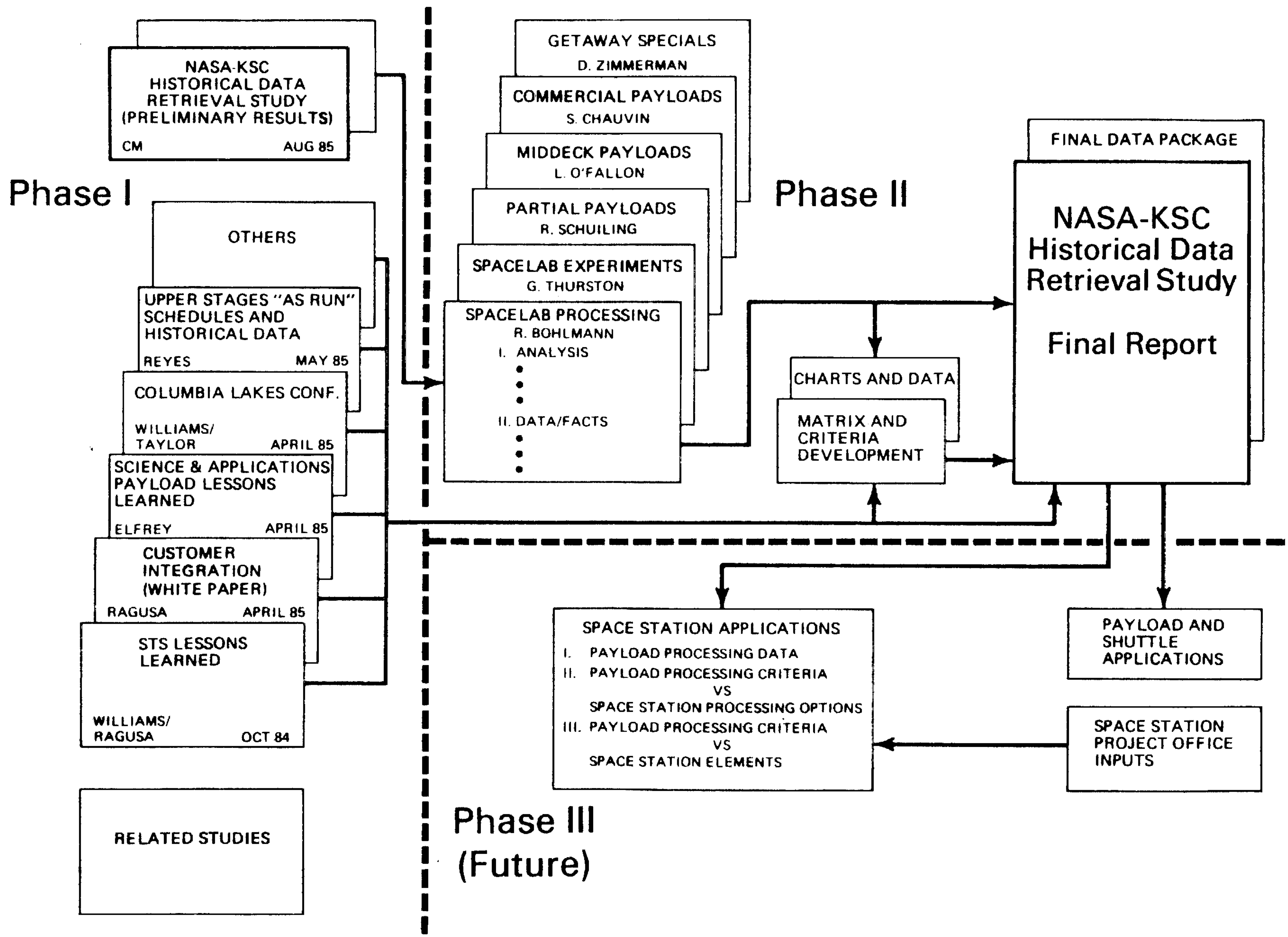
The need for this study grew out of the earliest discussions of Space Station planning when it was realized that more quantitative data and analysis from which to base future planning and processing decisions were essential. None realized this need more than C. M. Geisler, John F. Kennedy Space Center (KSC) Manager of the Space Station Project Office, and John Conway, KSC Director of Payload Management and Operations. By mutual agreement, the study was sanctioned and begun with necessary support commitments and endorsements made. The Challenger accident of January 1986 and the subsequent Space Transportation System (STS) hiatus which resulted highlighted the fact that all aspects of STS processing, including payloads, would benefit from retrospective analysis. At the same time, it offered the opportunity to include in the study all STS missions involving payloads from STS-2 through STS-33 (Challenger) and provided access to key KSC processing specialists.

No comprehensive study can be attributed to any one person, and this study is no exception. Numerous key members of the KSC payload processing team made invaluable data collection efforts and contributions. Without the dedication of these individuals, many of whom have been involved in payload processing since the earliest days of America's space program, this study would not have become a reality. Special thanks go to Tom Breakfield and JoAnn Morgan (Director and Deputy for STS Payload Operations, respectively) for their insight and encouragement, and to Anne Buchanan for her editorial assistance.

The following KSC NASA individuals participated in this study: Craig Baker, Richard Bohlmann, Joseph Bourne, C. A. Chauvin, Priscilla Elfrey, Bill Haynes, Joseph Lackovich, John Link, JoAnn Morgan, Lee O'Fallon, William Paton, R. E. Reyes, Robert Ruiz, Roelof Schuiling, Gene Thurston, Don Tiefenbach, James Weir, Kristy Wetzel, Dean Zimmerman.

McDonnell Douglas Astronautics Company personnel included Anne Buchanan, Charles Curtis, and Joe Gross.

Study Development Strategy



SECTION I

INTRODUCTION

1.1 PURPOSE

The purpose of this document is multi-fold. The initial thrust was to retrieve historical data associated with the National Aeronautics and Space Administration (NASA), John F. Kennedy Space Center (KSC) Space Transportation System (STS) payload operations through STS-33 (51-L). From these data, operational drivers that affected processing were listed, and then trends of selected processing parameters were identified and analyzed. A range of payload processing options was identified by degree of KSC's involvement and the complexity, and the criteria for each option were presented.

1.2 SCOPE

This document is the result of a NASA-KSC civil service study which concentrated on the ground processing aspects of science and applications, commercial satellite, and getaway special (GAS) payload activities at KSC in support of the present STS program. STS payload missions from the first flight of a payload, STS-2, through STS-33 (51-L) are included. The full spectrum of payload processing conducted by NASA-KSC's Payload Management and Operations Directorate is addressed.

1.3 APPROACH

Historical data and cumulative program experiences were used extensively in preparing this compilation of STS payload data. Emphasis was placed on program planning and events, the KSC processing environment and capabilities as they existed, specific payload experiences, the condition of the payload hardware after arrival at KSC, services provided by KSC to the payload owners, and the impact of STS operations and delays. After operational drivers were identified, data for selected processing parameters were analyzed and processing options and criteria determined.

1.4 BACKGROUND

1.4.1 STUDY PHASES. The study strategy involved three phases, as shown on the facing page. The initial historical data retrieval study began as an effort to obtain data on the types of payloads listed in paragraph 1.3 and their processing activities (Phase I).

The second phase involved the analysis of the collected data and delineation of relevant information. Also in this phase were the identification of the operational drivers and parameters that affect the processing time lines, and identification of processing criteria that describe payload processing options. Results and conclusions were developed in Phase II as well.

The third phase--identification of further program trade-off analyses that should be performed and of Space Station implications derived from STS payload processing experiences--has not been completed, so these subjects will not be discussed in this document.

1.4.2 KSC PROCESSING RESPONSIBILITIES. KSC, as the prime launch and landing site, is responsible for managing all payload-to-payload, payload-to-simulated orbiter, and payload-to-orbiter operations. For this reason, KSC becomes involved, frequently many years before a payload flies, providing guidance and advice to customers during their early planning activities--many times even before integration and hardware contracts are finalized. KSC may also supply the flight carrier, flight hardware that serves as the mounting for the payload and its support systems and subsystems. Once the payload is officially manifested, the KSC integration planning process formally begins, sometimes as late as 3 months before launch. Naturally, the more complex the payload, the more time is needed before launch for preparation. Once this planning activity has started, the customer becomes an integral part of the KSC team that prepares the payload for prelaunch integration and testing and performs the postlanding activities.

Complicating factors to processing activities are delays and slips caused for a variety of reasons. One reason is manifest changes due to launch window requirements or modifications to launch vehicles or payloads; another, problems during processing because of payload complexity; finally, delays caused by on-pad abort, launch vehicle problems, or weather.

SECTION II

STS PAYLOAD TYPES

STS payloads are divided into four major categories based on the type, location in the orbiter, and method(s) of processing for flight on the Space Shuttle. These categories are science and applications, deployed satellite, getaway special (GAS), and middeck.

2.1 SCIENCE AND APPLICATIONS PAYLOADS

This category includes major payloads--both Spacelab and partial payloads, as well as the satellite retrieval and repair structures (applications).

2.1.1 SPACELAB PAYLOADS. These are science and applications experiments and demonstrations initiated by a variety of United States (U.S.) and international sponsors that fly on European Space Agency (ESA)-provided hardware. Spacelab payloads occupy the major portion of the orbiter's bay, and the mission is usually dedicated to Spacelab. Figure 2-1 shows a Spacelab payload, Spacelab 1.

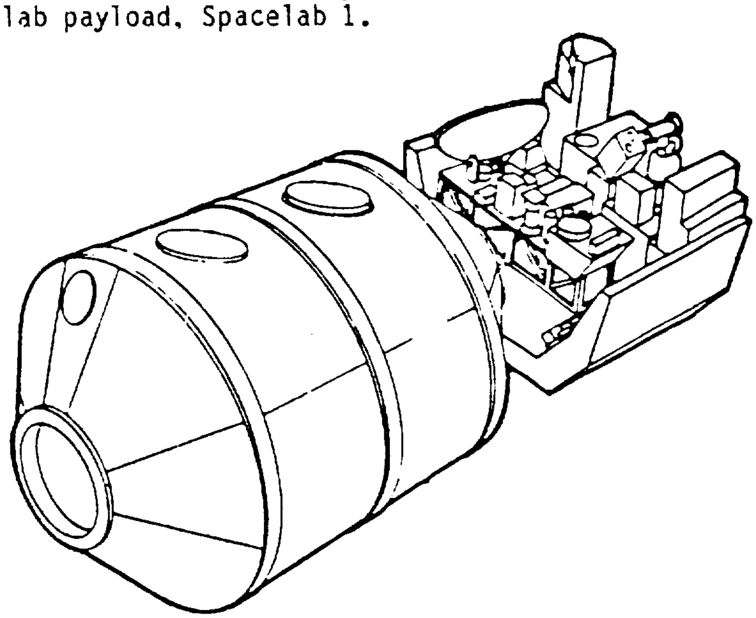


Figure 2-1 Spacelab 1 Payload

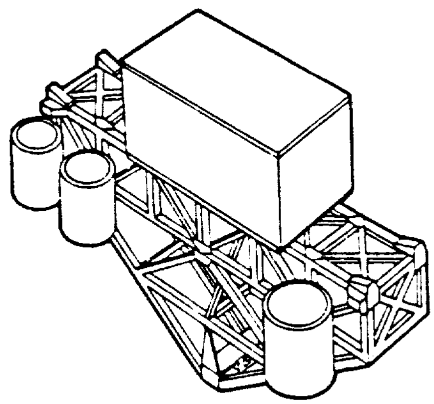
Experiment integration, the installation and checkout of the payload elements on the Spacelab carriers (racks in the module and the pallet), is performed in the Operations and Checkout (O&C) Building. Payload-to-orbiter simulated testing is done by use of the cargo integration test equipment (CITE) in the O&C Building. CITE testing is optional.

Integration of the Spacelab payloads with the orbiter is performed in the Orbiter Processing Facility (OPF), and the Spacelab payload moves with the orbiter through the Vehicle Assembly Building (VAB) to the launch pad. Any time-critical samples and specimens are installed into the orbiter at the launch pad.

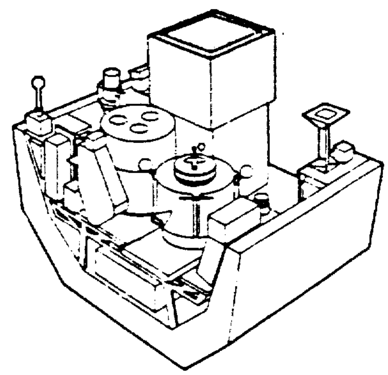
Deintegration of the Spacelab payloads after the mission is performed in the reverse order of integration. The experiments are then returned to the sponsor or developer.

Supporting hardware for the Spacelab payloads are the igloo, containing avionics, and the Instrument Pointing System (IPS).

2.1.2 PARTIAL PAYLOADS. Partial payloads are also science and applications experiments representing many different disciplines. A partial payload is mounted on a structure in the orbiter bay and does not occupy the entire bay. In some instances, the partial payload may be deployed from the bay for some orbits, but is then retrieved by the remote manipulating system (RMS) for return to Earth on the same mission. Figure 2-2 shows examples of partial payloads.



MSL-1



OSS-1

Figure 2-2 Partial Payloads: MSL-1 on Special Structure and OSS-1 on Pallet

Partial payload carriers are pallets or special structures. The payloads are initially processed horizontally, undergoing experiment integration in the O&C Building or in a payload processing facility (PPF). Following integration with the carrier, the payload may undergo CITE testing, but this, again, is optional, as it is with the Spacelab payloads.

The partial payload is installed in the canister horizontally, rotated to the vertical position in the VAB, and transported to the Vertical Processing Facility (VPF), where it is joined in the canister by other payloads in the launch complement. The partial may be installed in the vertical payload handling device for checkout with other payloads, if necessary.

From the VPF, the entire payload launch complement moves to the launch pad, where it is installed into the Rotating Service Structure (RSS) and then into the orbiter bay. If no vertically processed payloads are part of the launch complement, the partial payload can be installed into the orbiter in the OPF.

Once the mixed payloads, including the partial, are installed in the orbiter at the launch pad, final interface verification is made and any ordnance connection or gas servicing is done.

After the mission, deintegration of the partial payload begins in the OPF, and experiments are removed in the PPF or the O&C Building.

2.1.3 OTHER SCIENCE AND APPLICATIONS PAYLOADS. These are generally applications-type payloads processed horizontally or vertically and installed into the orbiter bay with minimal KSC processing. The carriers are pallets, the gas bridge, or specially designed structures. Figure 2-3 shows the pallet used in the repair of the Solar Maximum Mission satellite.

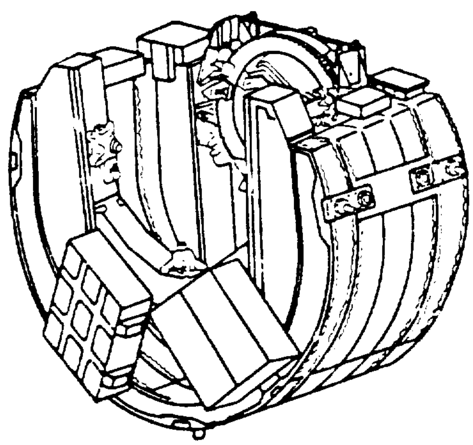


Figure 2-3 Repair Mission Pallet

KSC "hands-on" processing includes transportation from the integration area to the OPF or the launch pad, installation into the orbiter, and final interface verification and end-to-end testing (as required). Deintegration involves removal from the orbiter in the OPF and transportation to a PPF.

2.2 DEPLOYED SATELLITES

Deployed satellites include the U.S. and international commercial and scientific spacecraft deployed from the orbiter bay to orbit the Earth or journey through the solar system and beyond. The satellite usually has an attached or built-in upper stage (or both) using either solid or liquid fuel and a reaction control system for stabilization on orbit.

2.2.1 COMMERCIAL SATELLITES. These satellites, an example of which is shown in Figure 2-4, are usually used for communication. The satellite is prepared in the PPF by the owner. The upper stage is checked out; conditioned; spin balanced (for solid motor) in a hazardous processing area(s) on Cape Canaveral Air Force Station (CCAFS), at Astrotech, or off site; mated to the carrier, and then to the satellite or spacecraft. The spacecraft and upper stage [Payload Assist Module-Delta Class (PAM-D) and Inertial Upper Stage (IUS)] are integrated with other payload elements in the VPF. CITE and mission sequence testing may also be performed in the VPF.

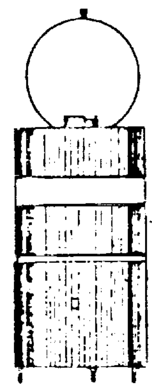


Figure 2-4 Commercial Satellite

Commercial satellites and their upper stages are installed into the orbiter at the launch pad, following functional testing. Interface verification testing, ordnance installation and connection (if required), and end-to-end testing are then accomplished.

The carrier for commercial satellites is a cradle or support structure with airborne support avionics. After the mission, the carrier and airborne support avionics are removed from the orbiter in the OPF and transported to the PPF.

2.2.2 SCIENTIFIC SATELLITES. These satellites are spacecraft deployed from the orbiter bay to collect scientific data in various disciplines. The data may be transmitted to Earth by telemetry or the spacecraft retrieved from orbit on a later mission for ground analysis of the collected data. See Figure 2-5 for an example.

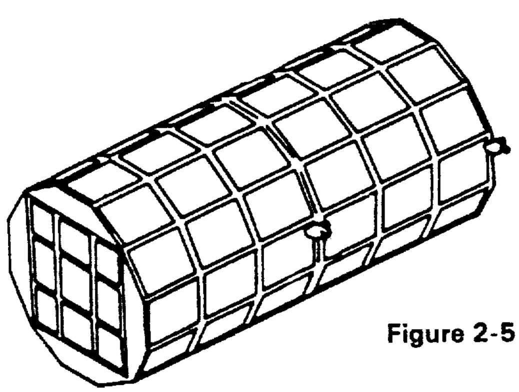


Figure 2-5 Scientific Satellite — Long Duration Exposure Facility (LDEF)

Carriers for the scientific satellites are designed by the payload owner or developer. They may have any shape needed, but must fit within the orbiter bay.

The scientific instruments for the satellites are prepared by the payload owners in the PPF at CCAFS, KSC, or off site. Propellant and ordnance are serviced as necessary in hazardous processing areas at those sites.

The scientific satellites are integrated with other payload elements on the mission in a KSC facility -- O&C Building, VPF, or other designated facility. There experiment installation and checkout of the interfaces, CITE testing (which is optional), and end-to-end testing (also optional) are accomplished.

The spacecraft is installed into the orbiter at the launch pad; battery charging and servicing are then performed, if required.

2.3 GETAWAY SPECIAL (GAS) PAYLOADS

The GAS program is designed for anyone who wishes to fly a small test or experiment aboard the shuttle. The experiment must be self-contained and not draw upon shuttle services. There can be a maximum of three ON-OFF controls for flight crew operation. The GAS program is managed by the Goddard Space Flight Center (GSFC) in Greenbelt, Maryland. Figure 2-6 shows the standard GAS cans.

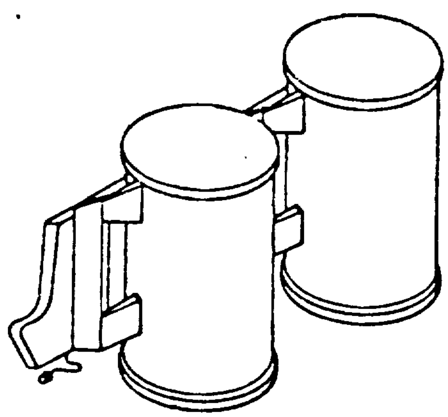


Figure 2-6 Standard Gas Canisters

The carrier system consists of standard canisters of 5 ft^3 accommodating up to 200 lb or 2-1/2 ft^3 accommodating up to 100 lb. Both standard canisters are mounted on an adapter beam attached to longerons in the orbiter payload bay. Also part of the carrier system is the GAS bridge, which can accommodate up to 12 GAS cans (large and small).

GAS subsystems include the handheld keyboard command encoder in the aft flight deck (AFD) and the command decoder. Power is supplied by 9-V transistor batteries. There are two 15-lb/in^2 relief valves in the top of the canister and a thermal subsystem covering the canister. For payloads deployed from GAS cans, a full-diameter motorized door assembly lid is available.

GAS payloads are prepared for flight in the GAS Facility on CCAFS by the payload owner or developer. They are transported by van to the OPF for installation into the orbiter. There is no further GAS payload requirement before launch. Deintegration is begun in the OPF, and the owner completes GAS payload deintegration in the GAS Facility.

The GAS bridge may be processed like standard cans that mount to an adapter beam, or they may be processed like a partial payload and installed at the launch pad with vertically stacked payload elements. The only connections that must then be made at the launch pad in the orbiter are the structural mounting and the cable that joins the handheld AFD unit and the GAS payload.

2.4 MIDDECK PAYLOADS

These science and applications payloads are initiated by U.S. and international sponsors and are stowed in the middeck portion of the orbiter. They are further categorized as KSC-processed and pre-packed experiments and those that are part of the Space Science Student Involvement Project (SSIP).

2.4.1 KSC-PROCESSED MIDDECK PAYLOADS. These payloads require the use of an off-line laboratory for experiment preparation. The laboratory is usually in the O&C Building or, for live plant and animal specimens, in the Life Science Support Facility (LSSF) on CCAFS. See Figure 2-7 for an example of a KSC-processed middeck payload.

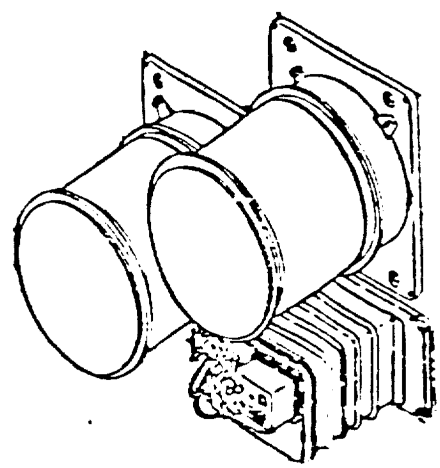


Figure 2-7 KSC-Processed Middeck Payload

The installation of the hardware and the interface checkout occur in the OPF or at the launch pad if live specimens or time-critical samples are involved.

Deintegration occurs at the landing site, where samples and carriers are removed from the orbiter middeck. Carriers are standard middeck lockers or hardware designed to fit in the middeck locker space.

2.4.2 PRE-PACKED MIDDECK PAYLOADS. These payloads require little to no KSC processing. They are prepared and checked out at the Lyndon B. Johnson Space Center (JSC) and shipped to KSC's Shuttle Landing Facility (SLF). They are then stored in the Flight Crew Equipment laboratories until time for installation into the orbiter. Pre-packed middeck payloads may be transported directly to the OPF or to the launch pad from the SLF, also. They are installed in the orbiter either in the OPF or at the launch pad.

Deintegration at the landing site consists of removal of the middeck locker (the carrier) and its contents from the middeck area and turnover of the payload to the owner.

2.4.3 SPACE SCIENCE STUDENT INVOLVEMENT PROJECT (SSIP). These experiments are developed by students in high school and college with the help of industry and NASA sponsors. The aim of the SSIP is to encourage development of young scientists and engineers in the student population.

The carrier is the middeck locker. KSC involvement depends on how much preparation is required at the launch site. Live plant and animal specimens are prepared in the LSSF, then loaded into a carrier for transport to the launch pad. Other time-critical samples and substances may be prepared in the O&C Building laboratories.

The SSIP payloads are processed for launch and deintegration after the mission the same way that the other middecks are.

2.5 STS PAYLOADS FROM STS-2 THROUGH STS-33 (51-L)

The payloads prepared for flight on the STS from the second flight through the twenty-fifth (51-L) were tallied by category and sub-category. The tallies are shown in Figure 2-8. Individual processing flows of each of the middeck payloads were counted, even for those payloads that flew more than once. For example, each flow of the Monodisperse Latex Reactor (MLR) was counted, for a total of five flows. Table 2-1 lists all the STS payloads by flight and category. The upper stages are identified for each satellite. STS flights are identified by both the numerical number and the coded number (year, launch site, sequence = 51-L). Flight numbers that were cancelled or changed are so indicated in the table. Standard GAS payloads are indicated only by the number on each mission. Deployed or deployable payloads flown in GAS cans are named in the "GAS" column.

Appendix A defines the acronym and provides a brief description and drawing of each STS payload prepared for flight through STS-33 (51-L). The appendix is divided into categories of payloads.

SCIENCE & APPLICATIONS = $\boxed{25}$ TOTAL

- SPACELAB — 4
- PARTIAL — 18
- OTHER — 3

GAS = $\boxed{58}$ TOTAL

- ATTACHED — 55
- DEPLOYED — 3

DEPLOYED SATELLITES = $\boxed{28}$ TOTAL

- UNITED STATES — 16
  - COMMERCIAL — 14
  - SCIENTIFIC — 2
- INTERNATIONAL — 12
  - COMMERCIAL — 12
  - SCIENTIFIC — 0

MIDDECKS = $\boxed{75}$ TOTAL

- 10 FLOWN MORE THAN ONCE — 34 (PROCESSING FLOWS)
- FLOWN ONCE — 24
- STUDENT EXPERIMENTS (SSIPs) — 16

TOTAL NUMBER OF PAYLOADS AT KSC — 186

Figure 2-8 Tally of STS Payloads by Type

Table 2-1 STS Payloads Prepared for Flight (STS-2 Through STS-33)

FLT NO. / LAUNCH DATE \ PAYLOAD TYPE	SCIENCE & APPLICATIONS	DEPLOYED SATELLITE	MIDDECK (PRE-PACKED)	GAS
STS-2 11/12/81	OSTA-1/PALLET		PCOC	
STS-3 3/22/82	OSS-1/PALLET		MLR, EEVT, PCOC, PGU, SSIP (1)	TEST
STS-4 6/27/82	....	..........(DOD)..........	MLR, CFES I, (NOSL) SSIP (2)	1
STS-5 (31-A) 11/11/82		SBS-C/PAM-D TELESAT-E/PAM-D	(GLOW), SSIP (3)	1
STS-6 (31-B) 4/4/83		TDRS-A/IUS	MLR, CFES II, (NOSL)	3
STS-7 (31-C) 6/18/83	SPAS-01/SS OSTA-2/MPESS	TELESAT-F/PAM-D PALAPA B-1/PAM-D	MLR, CFES II, (SAS)	7
STS-8 (31-D) 8/30/83	OIM PDRS/PFTA	INSAT 1-B/PAM-D	CFES II, (RME), SSIP (1)	4
STS-9 (41-A) 11/28/83	SL-1 (LM + PALLET)			
STS-10	....	.... CANCELLED	....	....
STS-11 (41-B) 2/3/84	SPAS-01A/SS	PALAPA B-2/PAM-D WESTAR-6/PAM-D	ACES, IEF, C360, MLR, (RME), SSIP (1)	5 IRT & C360
STS-12	....	.... CANCELLED	....	....
STS-13 (41-C) 4/6/84	SMM REPAIR/FSS	LDEF-1	(RME), IMAX, SSIP (1)	
STS-14 (41-D) STS-14R [REMANIFESTED - ON-PAD ABORT] 8/30/84	OAST-1/MPESS	SBS-D/PAM-D TELSTAR 3-C/PAM-D SYNCOM IV-2	CFES III, IMAX, (RME) (CLOUDS), SSIP (1)	
STS-15 & 16	....	.... CANCELLED	....	....
STS-17 (41-G) 10/5/84	OSTA-3/PALLET LFC/ORS on MPESS	ERBS	IMAX, (RME), (TLD), (APE), CANEX	8
STS-18	....	.... CANCELLED	....	....
STS-19 (51-A) 11/8/84	HS376 RETRIEVAL PALLETS (2)	TELESAT-H/PAM-D SYNCOM IV-I	DMOS, (RME)	
STS-20 (51-C) 1/24/85	....	..........[DOD]..........	ARC, SFMD	
STS-21 (51-B)	SL-3	.... REMANIFESTED TO	STS-24 (51-B)	...... NUSAT
STS-22 (51-E) (ROLLBACK FROM PAD)	 C	ANCELLED [VEHICLE ROLLED BACK	FROM PAD - TDRS-B PROBLEM] . ARC (NOT REMANIFESTED ON STS-23)	....
STS-23 (51-D) 4/12/85		TELESAT-I/PAM-D SYNCOM IV-3	CFES III, (AFE), (PPE/SAS), SSIP (2)	2
STS-24 (51-B) 4/29/85	SL-3 (LM + MPESS)	.... [REMANIFESTED FROM	STS-21]	NUSAT, GLOMR
STS-25 (51-G) 6/17/85	SPARTAN-1/MPESS	MORELOS-A/PAM-D ARABSAT-1B/PAM-D TELSTAR 3-D/PAM-D	(FPE), FEE, ADSF [HPTE]	6
STS-26 (51-F) 7/29/85	SL-2 (1 + 2-PALLET, SS, IGLOO)		(SAREX, STTP, CBDE)	
STS-27 (51-I) 8/27/85	SYNCOM SALVAGE	SYNCOM IV-4 AUSSAT-1/PAM-D ASC-1/PAM-D	PVTOS	
STS-28 (51-J) 10/3/85	....	.... [DOD]	....	....
STS-29	....	.... [NUMBER CANC	ELLED]	....
STS-30 (61-A) 10/30/85	SL-D1 (LM + SS)			GLOMR REFLT
STS-31 (61-B) 11/26/85	EASE/ACCESS on MPESS	SATCOM Ku2/PAM-D2 AUSSAT-2/PAM-D MORELOS-B/PAM-D	CFES III, MPSE, DMOS	IPBC + 1
STS-32 (61-C) 1/12/86	MSL-2/MPESS HH-G1/SPOC IR-IE	SATCOM Ku1/PAM-D2	(CHAMP), IBSE, SSIP (3)	GAS BRIDGE (12) 1
STS-33 (51-L) 1/28/86	SPARTAN-HALLEY on MPESS	TDRS-B/IUS	(TIS), (FDE), (PPE), (RME), (CHAMP), SSIP (1)	

SECTION III

OPERATIONAL DRIVERS

3.1 DRIVERS

Those variables affecting the complexity and duration of payload processing activities at KSC were called operational drivers. Identified in the study were time lines to process at KSC; manpower required for flight hardware-element processing; number of tests necessary (particularly, integrated testing); assembly, servicing, and access required; extent of flight crew training; and test procedures needed. Other variables included were type of flight hardware and complexity, work to be completed at KSC, modifications required, lines of software code, and problems during processing.

Of these eleven variables, six are not under KSC's control, especially customer requirements. However, each driver must be considered for planning purposes, and all customer requirements are agreed upon and understood before implementation. After these drivers were identified, processing parameters could then be selected and data abstracted.

Primary study data on the individual payloads are contained in Appendix B. These data were used in compiling material for this section.

3.2 PROCESSING PARAMETERS

Eight key parameters were selected for analysis with data collected for all payloads processed. Payloads were categorized as Spacelab, deployed satellite, GAS, partial, and middeck. Spacelabs (carrier and payload) were treated separately in many instances due to their complexity and KSC involvement.

Data were plotted using the Graphwriter IBM software. The plotted data were analyzed and reasons provided for variations in the data.

Tables 3-1 and 3-2 provide summaries of these processing parameters measured by payload type.

Payload, orbiter, and launch delays affected the measured parameters. Delays can be broken into three categories: manifest changes, problems during processing, and launch delays. Manifest changes were caused by change in launch window(s) for mission objectives and modifications to the launch vehicle (orbiter, external tank, and solid rocket boosters).

Problems during processing were caused by payload complexity (user or customer requirements and extensive integrated testing) and modifications to the payload that were performed at KSC.

Launch delays resulted from on-pad abort, launch vehicle problems, short payload launch window, and weather (rain, cloud cover, lightning). Table 3-3 summarizes the STS launch delays in the first 5 years.

Table 3-1 Summary of Payload Duration at KSC

PARAMETERS	SPACELAB ① (INTEGRATED)			DEPLOYED ② SATELLITES			GAS ③			PARTIAL ④ PAYLOADS			MIDDECK ⑤ PAYLOADS		
	MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG
STAYTIMES (CAL. DAYS)	780	251	571	230	37	116	102	26	54	322	33	142	326	2	32
	100% ←													→	100%
PROCESSING TIME (WORK DAYS)	507	168	335	128	10	65	23	6	9	220	2	69	111	1	13
	65%	67%	59%	56%	27%	56%	23%	23%	17%	68%	6%	49%	34%	50%	41%
INTEGRATED TEST TIME (TEST DAYS)	38	3	18	7	2	4	1	1	1	12	1	4	20	1	2
	5%	1%	3%	3%	5%	3%	1%	4%	2%	4%	3%	3%	6%	50%	6%

① Total 4 Processed

② Total 28 Processed

③ Total 58 Processed

④ Total 18 Processed

⑤ Total 75 Processed

Table 3-2 Other Summary Data

PARAMETERS	SPACELAB PAYLOADS			SPACELAB CARRIERS			DEPLOYED SATELLITES			GAS			PARTIAL PAYLOADS			MIDDECK PAYLOADS		
	MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG
USER REQUIREMENTS (NUMBER)	1446	195	709	396	24	184	308	139	190	41	20	36	132	10	55	117	0	20
TEST PROCEDURES (NUMBER)	396	104	259	2404	158	921	68	27	49	3	1	1	128	2	38	25	0	5
MODS (NUMBER)	324	20	148	2898	805	1652	6	0	2	1	0	0	38	0	7	6	0	0
INTERIM PROBLEM REPORTS (NUMBER)	COMBINED WITH CARRIERS			467	72	284	39	0	10	2	1	1	49	1	12	6	0	1
PROBLEM REPORTS (NUMBER)	748	93	551	2120	130	904	16	0	4	0	0	0	144	0	24	11	0	1

Table 3-3 STS Launch Delays

Mission	Payload Problems	Days At VPF	Days At Pad	Delays Affecting Launch
STS-2		N/A	N/A	Orbiter tile problems delayed 1st & 2nd launches
STS-3	OFT pallet to GSFC for LV IV	N/A	N/A	
STS-4	(DOD)			1st launch with no delays
STS-5	CITE/MLP T-O wiring errors; PAM sequence control assembly failure at Pad	31	31	
STS-6	PL contamination in PCR; PGHM handling problem	64	78	Orbiter engine problems caused delay
STS-7	PAM connection investigation after closeout; hypergolic sensor failed during transport to Pad	45	27	
STS-8	PAM cradle-to-SIP cable misfit; changout at Pad in orbiter	20	29	
STS-9	SL-1	N/A	N/A	SRB suspect nozzle delay
STS-11	none	36	23	Manifest slip
STS-13	SMRM IVT & E-E Test required 30 working days in VPF	63	22	
STS-14	none	42	40	On pad engine shutdown
STS-14R	(Combining of PLs from 41-D & 41-F in payload bay)	25	24	Rollback, destacking, integration of new PLs
STS-17	ERBS command transmission problems during CITE,IVT, POCC, & E-E; JSC data dropouts	19	26	delay (PL)
STS-19	SYNCOM IV-1 MUX rework - 22 days in VPF; TELESAT IVT; wrong CITE T-O configuration	22	21	Manifest change to retrieve 2 satellites
STS-20	(DOD)			
STS-22	TDRS-B flunked E-E, battery problems, scrubbed launch; rollback from Pad & remanifest payloads	57	38	Payload caused delay
STS-23	none	34	18	Launch delay for weather
STS-24	SL-3 (originally STS-21)	N/A	N/A	Manifest slip
STS-25	Repair/replace ARABSAT gyro at Pad; MORELOS & TELSTAR antenna position mechanism R/R at Pad	29	17	
STS-26	SL-2	N/A	N/A	(14 days delay - manifest slip)
STS-27	Pad struck by lightning during IVT & E-E with orbiter; retest required	16	22	(3 days delay)
STS-28	(DOD)			
STS-30	SL-D1	N/A	N/A	Manifest slip of 1 month
STS-31		30	18	(1 day delay)
STS-32		7	37	Weather delay (twice); rescheduled after holidays
STS-33	PL to pad 2 days late due to contamination in PCR; IUS SCU R/R; PCR leak from rainstorm onto IUS/TDRS adapter	50	46	Orbiter balky hatch & weather delay

NOTES: 1 — Payload problems & days at VPF & Pad from R. Reyes' report
2 — Launch delay in parentheses, with numbers, reflects differences in scheduled launch date at PRR & actual.

3.2.1 PAYLOAD STAY TIMES. Stay times were measured in actual calendar days that the payload remained at KSC from arrival through launch or deintegration for non-deployed payloads. Holidays, manifest slips, and dwell periods are included; mission days are not. Figure 3-1 depicts the data for payload stay times.

Payload trends for Spacelab (SL) payloads were difficult to deduce; there were only four Spacelabs processed. SL-1, 2, and 3 experienced extended stay times due in part to manifest slips: SL-1, 2 months; SL-3, 7 months; and SL-2, 8 months.

The German Spacelab, D1, had a reduced time at KSC resulting from the normally lengthy experiment integration being performed in Germany by DFVLR and ERNO.

Deployed satellites ranged from a high for SYNCOM IV-1 (STS-19) of 230 calendar days to a low of 37 calendar days for TELESAT-H (STS-19). An average for all 28 processed satellites was 116 calendar days.

GAS payloads evidenced relatively small differences in stay times, ranging from a high of 102 to a low of 26, with an average of 54 calendar days for the 58 GAS payloads processed.

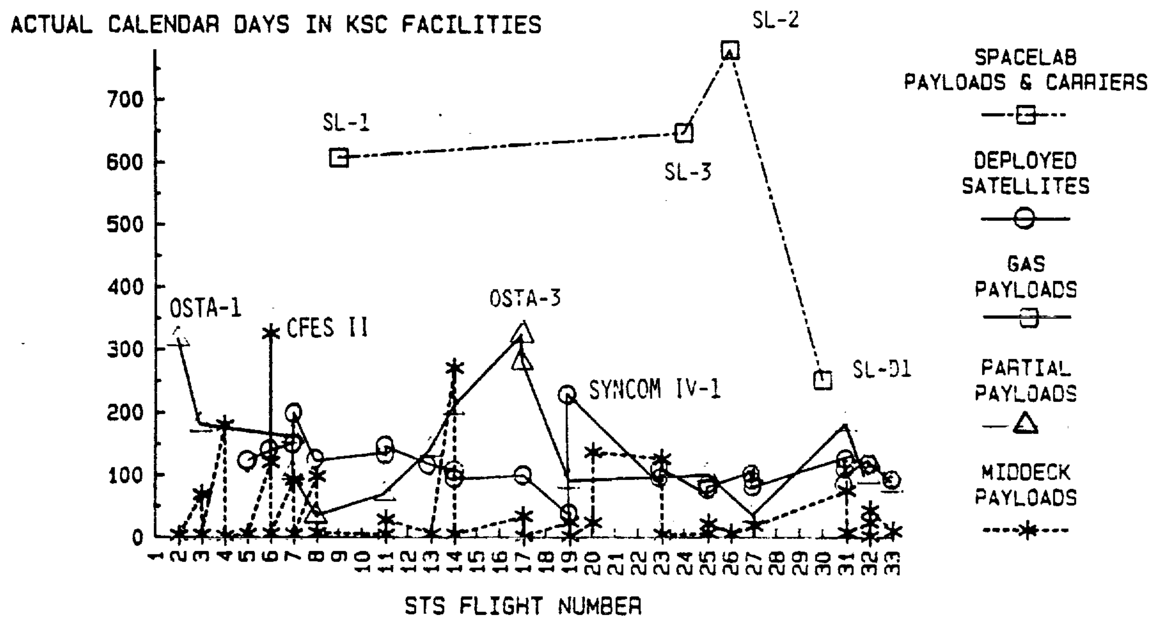
The average duration for the 18 partial payloads processed was 142 calendar days. OSTA-1 (STS-2) duration was 316 calendar days because it was the first payload processed in the STS program; OSTA-3 showed a 322-calendar day spike, which was caused by the extent of work necessary for this unusually complex payload.

Middeck payload stay times varied, with the Continuous Flow Electrophoresis System (CFES) being the most complex and requiring the most time in calendar days: STS-4, 180; STS-6, 326; STS-7, 93; STS-8, 99; STS-14, 271; STS-23, 127; and STS-31, 76. The STS-14 spike can be explained by the on-pad abort. The CFES average was 167 calendar days. The average stay time for all 75 middeck payloads was 32 calendar days.

3.2.2 ACTUAL PAYLOAD PROCESSING TIME LINES. Figure 3-2 shows the actual work days used to process each payload from arrival at KSC through launch or deintegration for non-deployed payloads. Holidays and dwell periods are excluded. Normal work periods for the facilities are as follows:

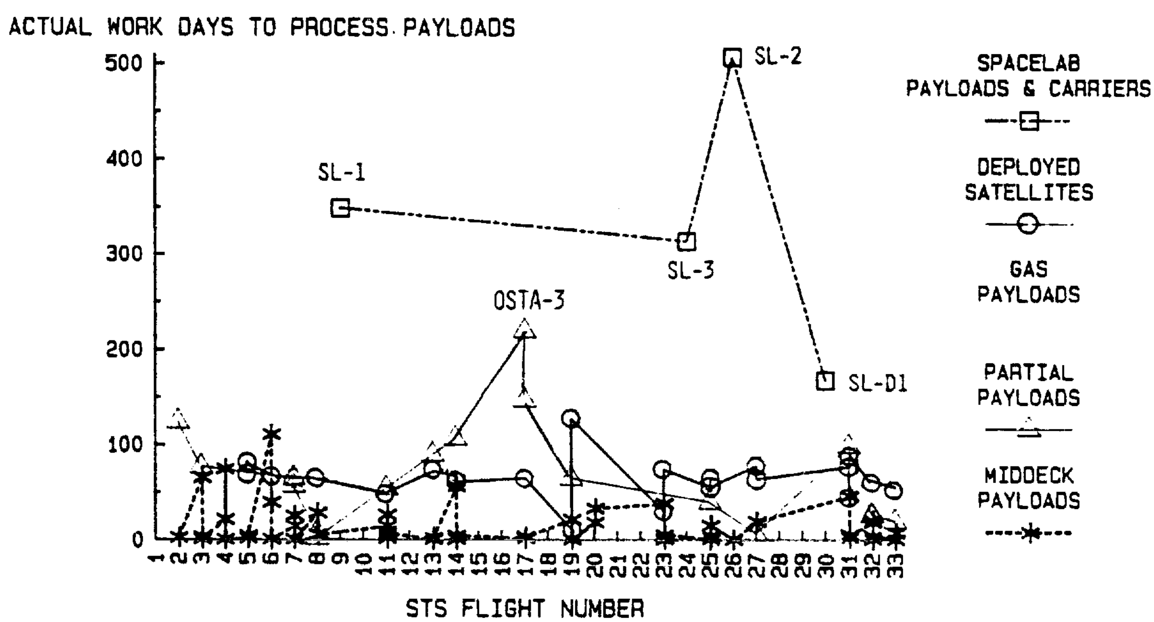
a. O&C Building - 5 days/week, 8 hours/day
b. OPF - 6 days/week, 16 hours/day
c. VAB and Pad - 7 days/week, 24 hours/day

There was a definite downward trend in actual work days associated with the similar long module configurations of SL-1 (349 days), SL-3 (314 days), and SL-D1 (168 days). Part of the reason for the decrease was the elimination of CITE testing for SL-3 and D1. In addition, experiment integration for SL-D1 was performed in Germany, not at KSC. SL-2 actual processing time peaked (507 work days) because this was the first and only Spacelab pallet-igloo-IPS configuration processed.



* MISSIONS 14, 22, 23, & 24 WERE AFFECTED BY REMANIFESTING ACTIVITIES.

Figure 3-1 Payload Stay Times



* MISSIONS 14, 22, 23, & 24 WERE AFFECTED BY REMANIFESTING ACTIVITY.

* EXCLUDED ARE DWELL PERIODS. LIGHT WORK PERIODS ARE CONSIDERED.

Figure 3-2 Actual Payload Processing Time Lines

Deployed satellite processing times varied from a high for SYNCOM IV-1 (STS-19), which was processed twice, of 128 work days to a low for TELESAT-H (STS-19) of 10 work days. Average processing for 28 deployed satellites was 65 work days.

GAS payloads showed no significant trend, with average processing time less than 10 days.

Actual processing times for the 18 partial payloads averaged 69 work days. As shown earlier, OSTA-1 and OSTA-3 showed the highs of 124 and 220 work days, respectively.

Middeck payloads fluctuated as a function of payload complexity. CFES, the most complex, averaged 45 work days. The average for all 75 middeck payloads was 13 days.

3.2.3 INTEGRATED TEST TIME SPENT. Figure 3-3 shows the measurements of the actual integrated test days for KSC processing. This includes tests conducted with an orbiter simulator (CITE) or with the orbiter itself. Specific tests include mission sequence, CITE, end-to-end, orbiter integrated, and closed-loop and payload operations control center (POCC) tests.

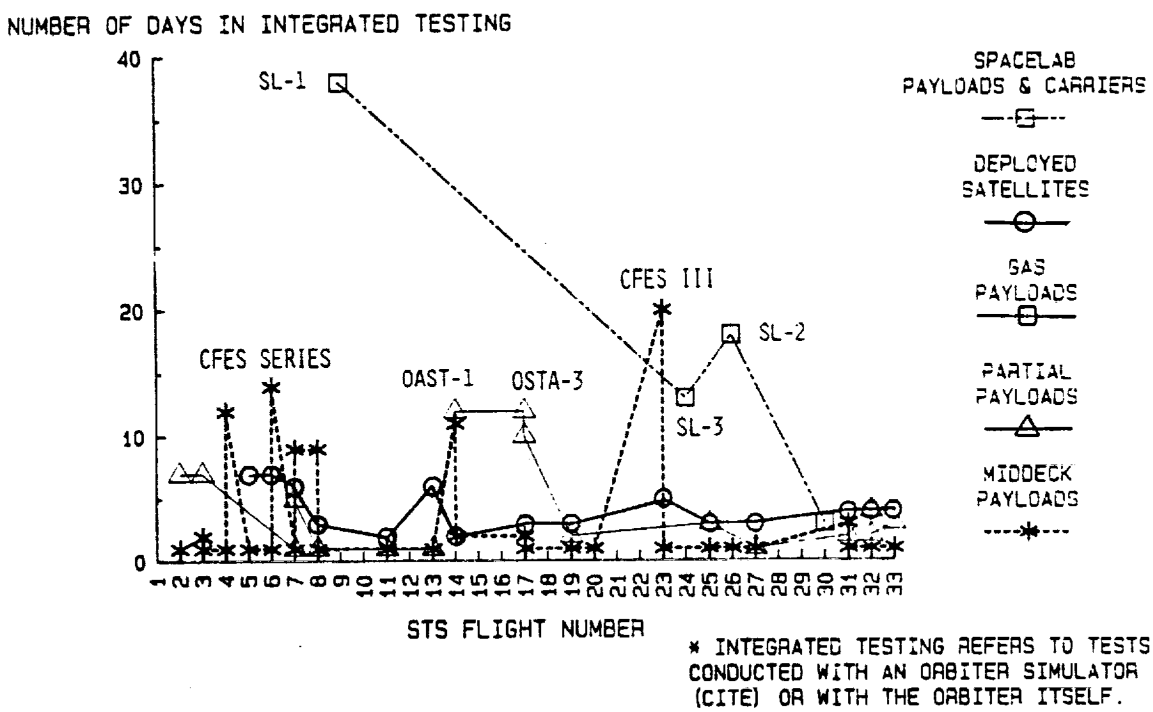


Figure 3-3 Integrated Test Times For Payloads

Following SL-1, which required 38 days, there was a drastically reduced number of Spacelab (integrated payload and carrier) integrated test days. The main reasons were fewer experiments to test, less Spacelab subsystem testing, elimination of CITE testing for SL-3 and SL-D1, and a reduction in mission sequence testing. Integrated testing averaged 18 days for Spacelab payloads.

Deployed satellites averaged 4 days of integrated testing for the 28 satellites processed. STS-5 and 6 showed the highest number, 7; several satellites showed a low of 2 days.

GAS payloads had no significant trend; only 1 day of testing was required for each.

Partial payloads showed a high of 12 days for OAST-1 (STS-14) and OSTA-3 (STS-17) to a low of 1 for a number of them. There were 4 average integrated test days for the 18 partial payloads.

Middecks fluctuated, with an average of 11 test days for the complex CFES to an average for all 75 middecks of approximately 2 test days.

3.2.4 CUSTOMER REQUIREMENTS. The number of requirements identified by the customers to be performed at KSC were tabulated for these measurements. Various customers specify their payload requirements; George C. Marshall Space Flight Center's (MSFC) Spacelab Program Office identifies Spacelab carrier requirements.

3.2.4.1 Spacelab Payloads. Downward trends are seen in Figure 3-4 for both Spacelab payloads and carriers. For the payloads, the primary decrease in the customers' requirements is due to the vastly reduced level of detail included in the Ground Integration Requirements Documents (GIRDs). Specific requirements for payloads were SL-1 (STS-9), 1446; SL-3 (STS-24), 703; SL-2 (STS-26), 490; and SL-D1 (STS-30), 195.

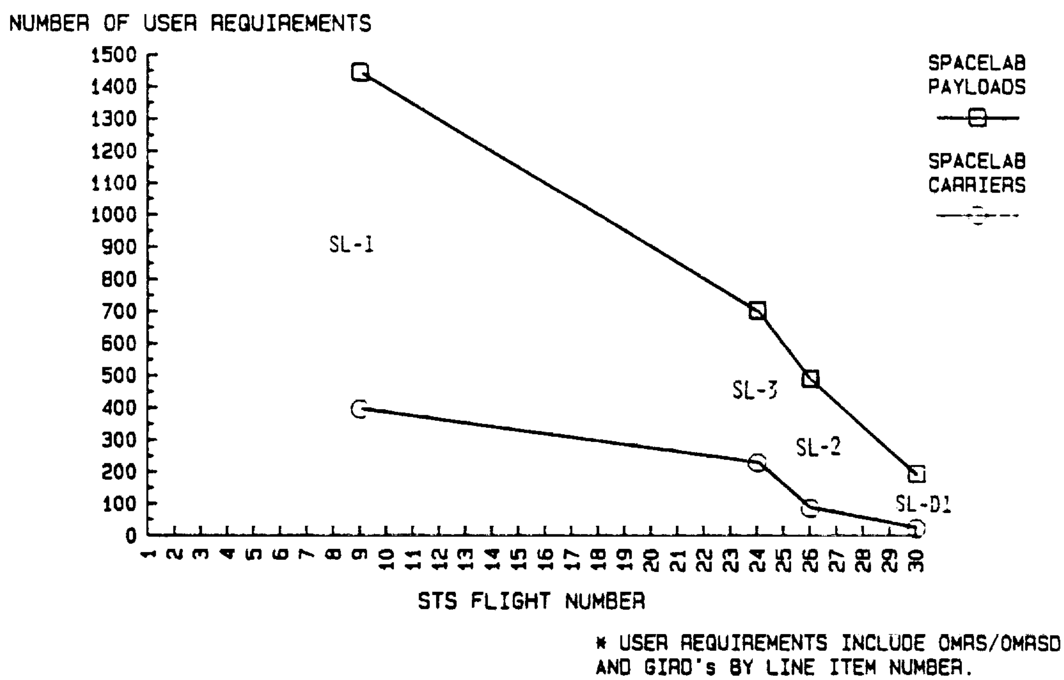


Figure 3-4 Customer Requirements for Spacelab Payloads and Carriers

Carrier requirements came from MSFC and showed significant decrease from similar long module configurations (SL-1 and SL-3). There was a 42 percent reduction in carrier requirements--from 396 to 229.

3.2.4.2 Other Payloads. Figure 3-5 shows the measurement of the number of requirements identified for accomplishment at KSC. Customers include commercial, scientific, NASA, and other Government and industry organizations.

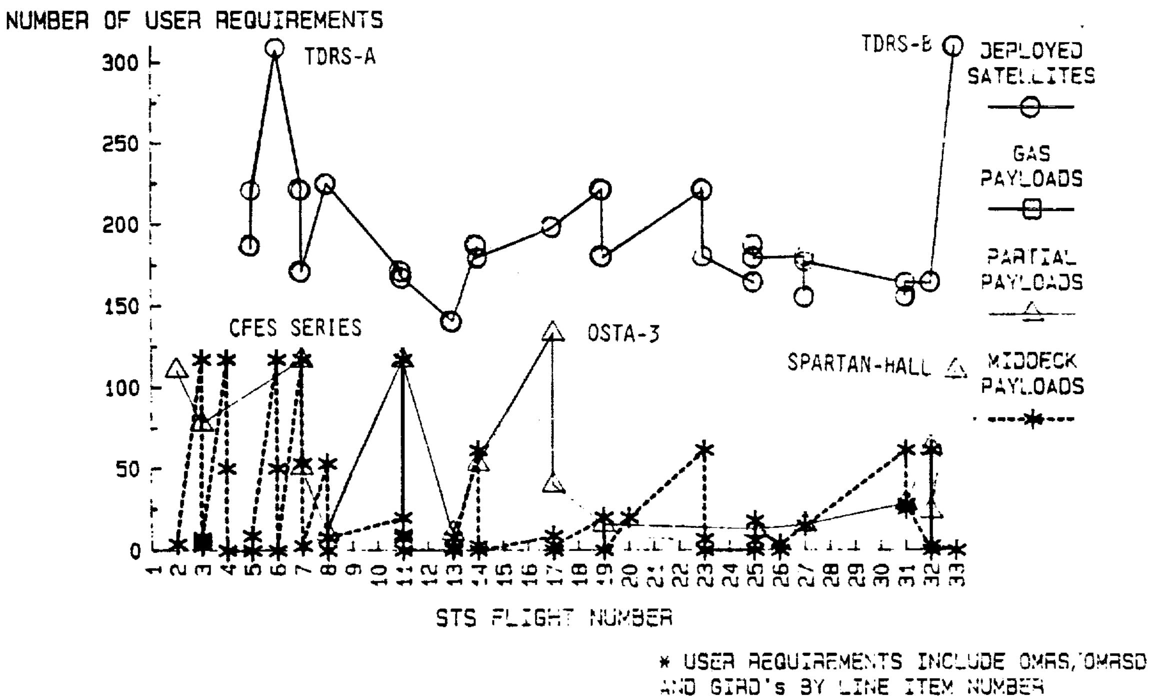


Figure 3-5 Customer Requirements for Payloads Other Than Spacelab

Deployed satellites showed a wide range, with a maximum identified of 308 for TDRS-B on STS-33 to the minimum of 139 for LDEF (STS-13). On the average, 190 customer requirements for each STS flight were recorded. Not included in the deployed satellite data are carrier requirements for the IUS (437); Payload Assist Module-Delta Class, or PAM-D, (126); and PAM-Delta Class II, or PAM-D2, (127).

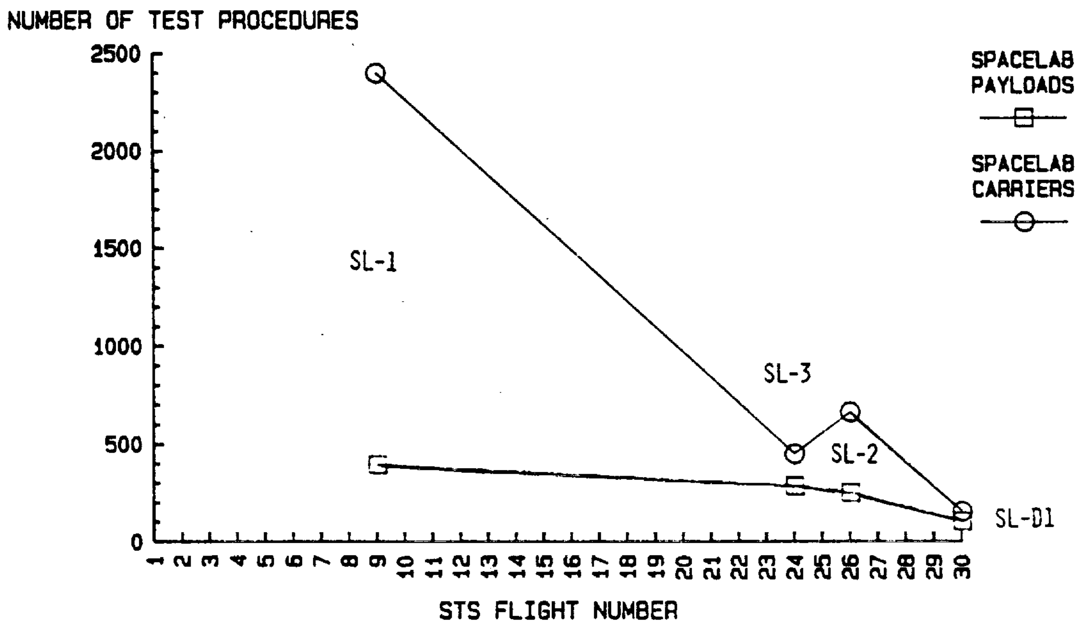
GAS payloads showed no significant trend or changes.

Partial payloads showed the high for OSTA-3 of 132 requirements; simpler partials such as the Large Format Camera/Orbital Refueling System (LFC/ORS) and SPARTAN-1 reported only 39 and 12, respectively. The simplest, which flew on STS-8 and STS-13, had the least requirements, 10 each. The average for the partial payloads in this parameter was 55.

Middeck payload customer requirements fluctuated, again, as a function of payload complexity. CFES required the most with an average of 56. The largest number of requirements was 117, recorded for the MLR payloads flown on STS-3 and 4. On the average, only 20 customer requirements were identified for all middeck payloads.

3.2.5 TEST PROCEDURES REQUIRED. This measurement included the count of test procedures needed for assembly, installation, alignment, calibration, and testing for all phases of KSC activities, from receipt of hardware through flight or deintegration for non-deployed payloads.

3.2.5.1 Spacelab Payloads. Figure 3-6 shows the reduction in long module test procedures; this correlates directly with the decrease in KSC testing required for subsequent Spacelab missions, the elimination of Verification Flight Instrumentation (VFI) requirements for SL-3, and expanded efficiencies of operations. A significant reduction of 81 percent (from 2404 to 454) occurred for test procedures associated with the carriers.



* TEST PROCEDURES CONSIST OF OMI's, TAP's, AND TPS's.

Figure 3-6 Test Procedures Required for Spacelab Payloads and Carriers

However, an increase shows in the number of payload and carrier test procedures for SL-2 (after SL-3). Again, this is due to the first time the pallet-igloo-IPS configuration flew and the carrier VFI requirements. VFI carrier requirements account for approximately 30 percent of the test preparation sheets for SL-1 and SL-2. The overall reduction in KSC integration testing for Spacelab payloads and carriers, primarily the elimination of CITE for SL-3 and SL-D1, resulted in a reduction of test procedures.

3.2.5.2 Other Payloads. Deployed satellite test procedures reflect the payload complexity and range from 68 each for TELESAT-F and PALAPA B-1 on STS-7 to 27 for LDEF-1 (STS-13). An average of 49 test procedures were required for the 28 deployed satellites. See Figure 3-7.

GAS payloads, again, showed no significant requirement for test procedures, and only one procedure is required for each payload.

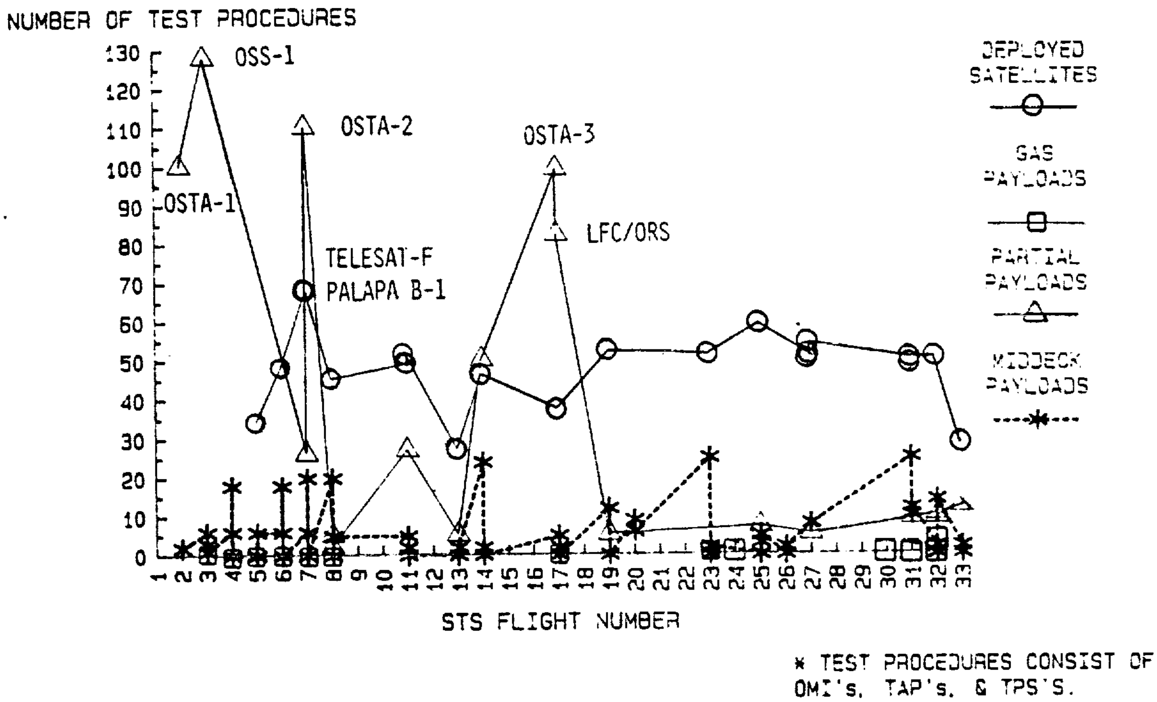


Figure 3-7 Test Procedures Required for Payloads Other Than Spacelab

Test procedures for the partial payloads again reflect the payload complexity. The number required ranged from 128 (OSS-1) to 2 for the PDRS/PFTA. Average number for partial payloads was 38.

For the middeck payloads, CFES had an average of 21; the average of test procedure requirements for all middeck payloads was only 5.

3.2.6 MODIFICATIONS PERFORMED. In this parameter are considered the total number of modifications made to the payloads and their flight carriers during KSC processing. The need for the modifications was generated by the customers for the payloads and by MSFC for the Spacelab and some partial payload carriers.

3.2.6.1 Spacelab Payloads. Spacelab payload modifications showed a downward trend, which can be attributed in part to a reduced number of experiments flown on each mission after SL-1 and some learning efficiencies gained by experimenters who refly certain experiments.

The significant downward trend in carrier modifications for Spacelab can be explained by the fact that while much open work was performed at KSC after delivery of the first Spacelab, SL-3 was a reflight. Carrier modifications for SL-2 were lower than for SL-1 because the majority of the IPS modifications were performed in Germany by Dornier, while modifications to parts of the module for SL-D1 were done in Germany by ERNO.

Reduction in total Spacelab payload modifications was 62 percent (from 324 to 123); in carrier modifications, 72 percent (from 2898 to 805). Modifications for SL-D1 were not included in the Spacelab payload data. SL-1 and SL-2 VFI modifications were included in the carrier data. See Figure 3-8.

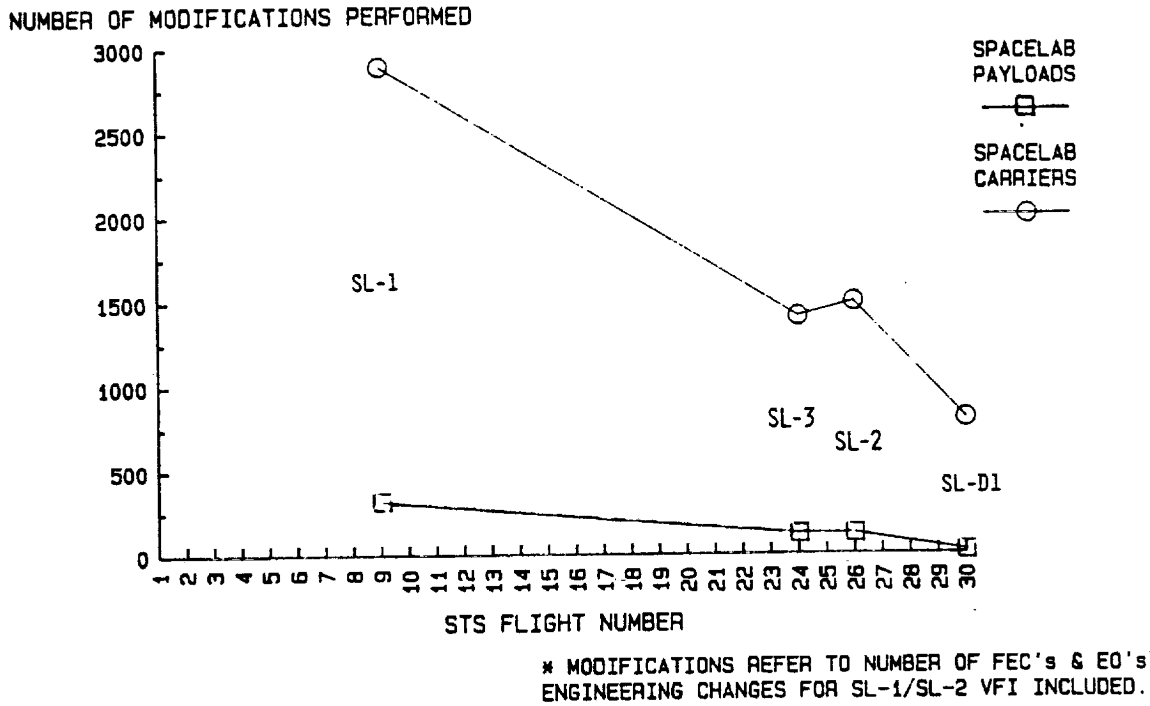


Figure 3-8 Modifications Performed to Spacelab Payloads and Carriers

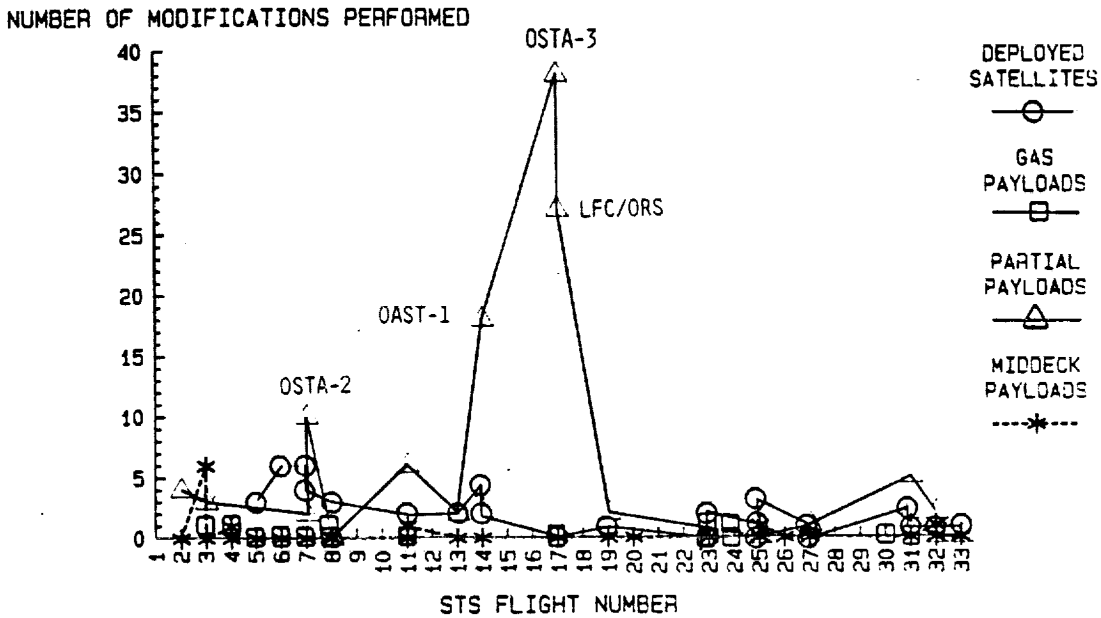
3.2.6.2 Other Payloads. Figure 3-9 shows the data for modifications to the other payloads. Developed satellites showed no significant trends or changes. However, all payload modifications are made by the customers outside the KSC work control system.

GAS payloads also showed no significant trends or changes.

Partial payloads showed a spike for OSTA-3 (STS-17), represented by 38 modifications. This spike was caused by the extent of work required for carrier buildup and the experiment integration associated with an unusually complex payload.

Middeck payloads showed no significant trends or changes.

3.2.7 INTERIM PROBLEM REPORTS (IPRs). IPRs are generated during KSC test activities when problems occur and troubleshooting is needed. If hardware or software changes are identified, IPRs are upgraded to problem reports (PRs). IPRs are not tracked for Spacelab payloads during experiment integration but are included with Spacelab carrier IPRs for subsequent processing. Figure 3-10 depicts the measurements for this parameter.



* MODIFICATIONS REFER TO NUMBER OF FEC's.

Figure 3-9 Modifications Performed to Payloads Other Than Spacelab

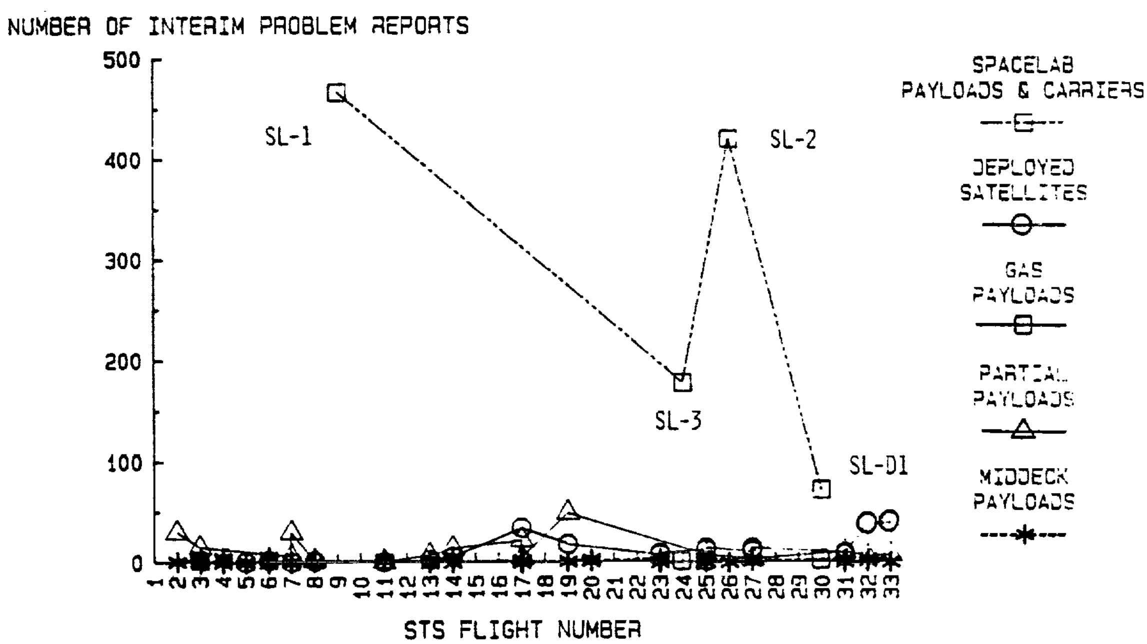


Figure 3-10 Interim Problem Reports Generated

Only Spacelab IPRs showed significant trends or changes. The number of IPRs significantly reduced from SL-1 to SL-3, approximately 62 percent (from 467 to 178). There was a definite increase in the number of IPRs for SL-2 (420), occurring after SL-3, because this payload was the first and only pallet-igloo-IPS configuration processed during this time period. IPRs for the SL-D1 were greatly reduced because experiment integration was performed in Germany by DFVLR/ERNO. In general, the overall reduction in number of IPRs can be attributed to the elimination of CITE testing for SL-3 and SL-D1.

3.2.8 PROBLEM REPORTS (PRs). PRs are written as the result of anomalies requiring hardware or software correction discovered during payload processing activities.

3.2.8.1 Spacelab Payloads. Figure 3-11 shows the data on PRs generated for Spacelab payloads and carriers. Long module PRs showed a reduction, which correlates directly with the decrease in KSC testing required for subsequent missions. The actual number of PRs required for carrier activities significantly reduced from 2120 to 393 between SL-1 and SL-3, approximately 81 percent. Those PRs for the Spacelab payloads decreased only 11 percent (from 720 to 642) between SL-1 and SL-3.

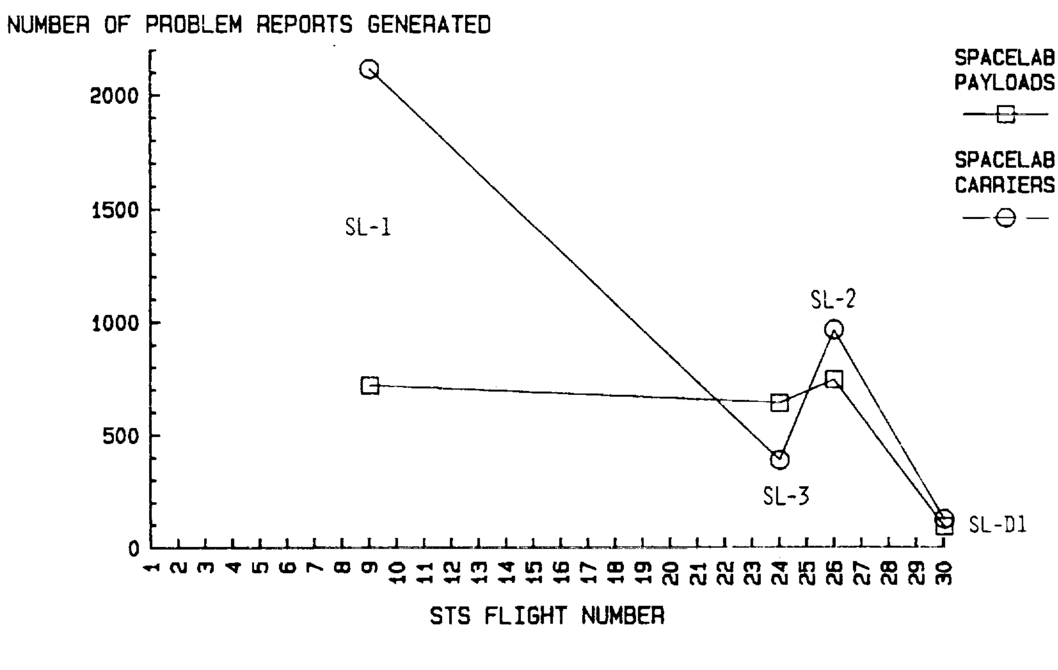


Figure 3-11 Problem Reports Generated for Spacelab Payloads and Carriers

SL-2 payload and carrier PRs increased, again, as a result of the new configuration of pallet-igloo-IPS. SL-D1 PRs were also reduced because experiment integration was performed in Germany, not at KSC.

Overall reduction in KSC integration testing, primarily the elimination of CITE testing for SL-3 and SL-D1, resulted in a reduction in PRs for Spacelab carriers and payloads.

3.2.8.2 **Other Payloads.** Figure 3-12 charts the PRs generated for payloads other than Spacelab. Deployed satellites, GAS, and middeck payloads evidenced no significant trends or changes. Only the partial payloads, particularly the LFC/ORS (STS-17), experienced PR generation of note. On the average, 24 PRs resulted for each partial payload.

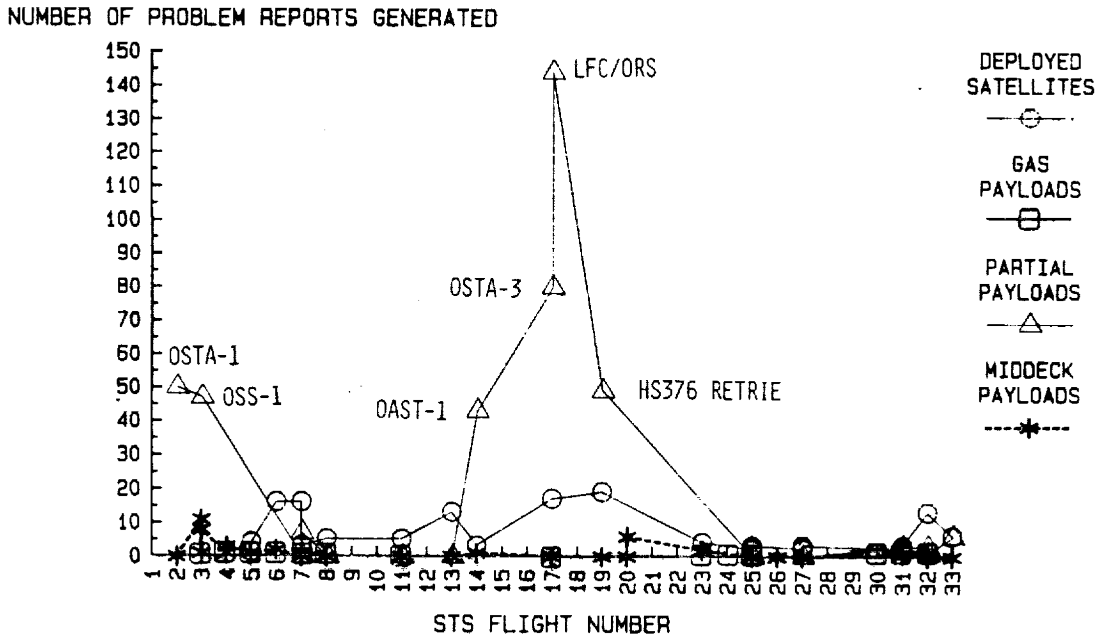


Figure 3-12 Problem Reports Generated for Payloads Other Than Spacelab

SECTION IV

KSC PROCESSING OPTIONS

Five options were identified from the operational drivers and the analysis of processing parameter data. The criteria for these options represent the full spectrum of payload processing possibilities, from the simplest or minimum KSC involvement to the most complex. The criteria have been identified in two forms: quantitative and qualitative. Quantitative criteria represent data-derived processing considerations, while qualitative criteria delineate customer (payload element) and KSC responsibilities. Table 4-1 identifies the KSC payload processing criteria.

Table 4-1 Payload Processing Criteria

KSC PERFORMED TASKS	#1 MIN. KSC INVOLVEMENT	#2 HOST MODE	#3 MIN. KSC TESTING	#4 JOINT PARTICIPATION	#5 MAX. KSC INVOLVEMENT
CARRIER SUBSYSTEM TESTING REQUIRED AT KSC	YES *	YES *	YES	YES	YES
PAYLOAD HARDWARE DEVELOPMENT & ASSEMBLY REQUIRED AT KSC	NO	NO	YES	YES	YES
EXPERIMENT INTEGRATION AND INTERFACE VERIFICATION AT KSC	NO	YES	YES	YES	YES
SINGLE ELEMENT POWER-UP FUNCTIONAL TEST AT KSC	NO	YES *	YES	YES	YES
PAYLOAD-ORBITER INTERFACES VERIFICATION	NO	YES	YES	YES	YES
POWER-UP SERVICING/ MAINTENANCE AT KSC	YES *	YES *	YES *	YES *	YES
LATE ACCESS/STOWAGE AT KSC	YES *	YES *	YES *	YES *	YES

* DEPENDS ON USER REQUIREMENTS

4.1 OPTION 1 - MINIMUM KSC INVOLVEMENT

Data-derived processing considerations for this option involve delivery to KSC occurring 2 to 50 days before launch--essentially ready for launch, with no time-critical installation of the payload required. The payload must be capable of remaining in the orbiter 4 to 6 weeks without servicing or special work access. Interface testing with the orbiter requires power only, except for mechanical attachments. The payload requirement for testing includes only a 15-minute check of the interface once installed in the orbiter. All modifications are performed before delivery to KSC, and the payload is tolerant to remanifesting.

Under this option, the customer has the primary responsibility of providing a fully assembled and serviced payload essentially ready for launch. After transporting his payload to the launch site, the customer ensures that no payload modifications, testing, or software validations are required at KSC. Documentation is submitted for orbiter installation only. During all KSC launch and landing activities, the customer maintains hardware ownership.

KSC, on the other hand, provides a flight carrier, if required and available, and provides support for time-critical OPF and launch pad servicing only.

Payloads that have been processed under this option are the pre-packaged middeck experiments and Spacelab stowage lockers.

4.2 OPTION 2 - KSC HOST MODE

Like option 1, the payload processed with KSC in the "host mode" is delivered to KSC 2 to 50 days before launch; however, there is an understanding that the customer will perform some functional preparation and testing on site. It is expected that the payload may require some servicing or integrated testing once installed in the orbiter, which is normally accomplished in parallel with orbiter processing lasting between 1 and 5 days, maximum. There are no requirements for testing with KSC simulators for facility systems, except for orbiter power simulation. Under this option, the customer may perform a small number of modifications, three to seven, on payload hardware as long as the KSC processing schedule is not impacted. This payload is tolerant to remanifesting.

The KSC host mode option allows payload assembly at the customer integration facility or at KSC. However, the customer provides the transportation to KSC and participates in the KSC ground safety reviews. Some software validation may be required. The customer provides the needed payload documentation, identifying KSC requirements, including installation and intracenter transportation. During KSC activities, the customer maintains hardware ownership. KSC, in support of customer requirements, provides required facilities, supporting services, software development and validation, and supports payload servicing.

Payloads that have been processed under this option are most of the middeck payloads, the SSIP experiments, and the GAS payloads.

4.3 OPTION 3 - MINIMUM KSC TESTING

Under option 3, the customer delivers the payload to KSC 30 to 50 days before launch, ready for launch, except for customer on-site functional buildup and checkout. Payload activity remains in a KSC off-line processing facility for 2 to 6 weeks before installation into the orbiter, with one integrated test required after installation and with not more than 1 day of orbiter processing impact anticipated. No modifications are planned to be performed at KSC; however, this payload may be sensitive to restrictive manifesting such as co-passengers, launch windows, orbiter assignment, and crew requirements.

The customer provides to KSC a special flight carrier, if needed, and identifies processing requirements and needed documentation and software. The customer participates in KSC safety reviews, supports KSC activities as required (including 7-day-per-week and multiple-shift support during certain high activity periods), and maintains hardware ownership. Under these considerations, KSC outfits carrier support systems, performs experiment integration with payload element support after delivery, and performs subsystem software development and validation. In addition, KSC is responsible for subsystem, system, and reduced integrated testing with customer support; assembly of the payload to a launch-ready condition; performance of all KSC servicing; and intracenter transportation.

Payloads processed under minimum KSC testing are a few partial payloads and a few commercial deployed satellites.

4.4 OPTION 4 - JOINT CUSTOMER AND KSC PARTICIPATION

This option anticipates the delivery of the payload to KSC 50 to 300 days before launch. After delivery, all major subassemblies are capable of buildup in off-line processing areas in 2 to 15 weeks maximum. No more than two to four milestone integrated tests are performed in KSC test stands, simulators, or the orbiter. Some generic KSC procedures for payload processing are expected; however, customer support is necessary for some multi-shift and weekend work, if required. Up to 25 percent of the payloads in this category may have on-site modification work performed, and approximately 15 to 20 percent of these payloads may cause manifest changes due to restrictive launch constraints, mandatory modifications, or other prelaunch problems.

As with option 3, the customer provides to KSC a special flight carrier, processing requirements and needed documentation, and payload software if needed. The customer participates in safety reviews, performs all payload modifications, supports KSC testing activities, and maintains hardware ownership. KSC outfits subsystems, performs experiment integration, and does subsystem software development and validation. In addition, the KSC processing team (including customers) is responsible for assembling the payload and carrier; performing subsystem, system, and integrated testing; providing all KSC servicing; and accomplishing intracenter transportation.

Most partial payloads, deployed satellites, and Spacelab payloads were processed under this option.

4.5 OPTION 5 - MAXIMUM KSC INVOLVEMENT

The final option requires that all payload flight experiments and component hardware be delivered to KSC 75 to 365 days before launch for on-site integration and test. KSC becomes a "factory," performing operation and maintenance of frequently reused flight hardware and carriers (modules, flight structures, and pallets) and performs integration tasks for experiments and payloads, except for unique skill activities. With appropriate customer participation and observation, KSC performs complete functional verification of the flight element, unit by unit. Integrated testing with KSC simulators and in the orbiter is performed by KSC to the customers' specifications, for a period of time varying from 10 to 40 days total, depending on element complexity. Extensive modification to flight hardware (anywhere from 100 to 1000 modifications) is performed at KSC as needed to assure flight readiness. Payloads processed under these criteria are normally very sensitive to manifesting.

With this option, customer responsibilities are greatly simplified: providing a carrier, if needed; identifying total requirements and completed documentation; participating in KSC safety reviews; and supporting processing and test activities as needed. KSC accepts hardware ownership upon payload arrival at KSC; outfits carrier subsystems; performs experiment integration and data analysis, modifications, complete software development and validation, and subsystem, system, and integration testing; assembles the payload to a launch-ready condition; and performs all launch site servicing and intracenter transportation.

The early Spacelab payload (SL-1) and Spacelab carrier hardware were processed under this option.

KSC processing experience derived from collected data is summarized in Table 4-2. Of significance is the skewed emphasis toward more involved processing (option 4) for the great majority of payload types. Obviously, payload processing has not yet achieved a "ship and shoot" reality; however, that processing mode remains a goal.

Table 4-2 KSC Processing Experience

PROCESSING OPTIONS	NAME	PAYLOADS
1	MINIMUM KSC INVOLVEMENT	• PRE-PACKAGED MIDDECK PAYLOADS • SPACELAB STOWAGE LOCKERS
2	KSC HOST MODE	• MOST MIDDECK PAYLOADS, INCLUDING SSIPs* • GAS
3	MINIMUM KSC TESTING	• FEW PARTIAL PAYLOADS • FEW COMMERCIAL DEPLOYED SATELLITES
4	JOINT CUSTOMER AND KSC PARTICIPATION	• MOST PARTIAL PAYLOADS • MOST DEPLOYED SATELLITES • SPACELAB PAYLOADS
5	MAXIMUM KSC INVOLVEMENT	• SPACELAB CARRIER HARDWARE • EARLY SPACELAB PAYLOADS

*SSIP = SPACE SCIENCE STUDENT INVOLVEMENT PROJECT

SECTION V

SUMMARY AND CONCLUSIONS

5.1 SUMMARY

5.1.1 OPERATIONAL DRIVERS. Operational drivers were invaluable in the identification of selected parameters and data abstractions. A variety of drivers affect KSC payload processing activities. More than half (6 of 11) of the drivers were found not to be under KSC control.

5.1.2 PROCESSING PARAMETERS. Three of the eight parameters measured are specified by the customer and are not totally under KSC control. These customer-derived parameters were integrated test time, customer requirements, and modifications performed. Customer requirements greatly affect KSC processing efforts. Over time, a significant reduction in all measured parameters was observed, which can be attributed to increased experience obtained by KSC and customer personnel, especially for those payloads that flew two or more times. Reduction can also be explained by deliberate improvements in processing policies, procedures, and methods.

For Spacelab, it was found that the elimination of CITE testing and the reduction of mission sequence testing significantly reduced KSC processing of the third Spacelab (SL-3) and the West German SL-D1, as did experiment integration processing in Europe for SL-D1.

The unique configuration of the SL-2 payload caused an increase in processing time. Early STS manifest slips caused extensions of the actual length of time payloads remained at KSC. As indicated in Tables 3-1 and 3-2, on the average, actual processing time amounted to 59 percent of stay time at KSC, while actual test time was only 3 percent. Average calendar days and work days were high (571 and 335, respectively) with test days low (18). It was found that when the customer provided extensive detailed requirements for the method of conducting the tests, it complicated the development of KSC test procedures. On the other hand, reduced level of detail in customer requirements caused a decrease in absolute numbers, and also improved prelaunch processing operations. Spacelab carrier procedures can be substantially reduced, combined, or eliminated as experience levels increase and testing requirements are reduced. IPRs and PRs will reduce as a function of the number of experiments and the amount of testing required.

Processing of deployed satellites is not as "ship and shoot" as is commonly believed. On the average, 116 calendar days were counted with 65 work days required, most by the customer performing their functional tests. An average of 4 days (3 percent) of integrated testing with CITE or the orbiter was required. For the most part, a substantial improvement in processing activities was observed. Customer requirements and the number of test procedures are very much a function of payload complexity.

For GAS payloads, relatively short KSC stay times were observed (54 calendar days on the average) because of their simplicity. Very short processing and integrated test times were needed (9 and 1 work day, respectively) for the same reason. A downward trend was not noted, and this should be the norm. Customer requirements, test procedures, modifications, IPRs, and PRs are almost non-existent.

For partial payloads, stay times and processing times were found to be similar to deployed satellites in magnitude, and they are also very much a function of payload complexity. Integrated test time is identical to that for deployed payloads, on the average (4 days). While customer requirements are substantially less than for Spacelab and deployed payloads, the number of test procedures is about the same as for deployed payloads. Modifications, IPRs, and PRs are substantially less than for Spacelab payloads but are greater than for deployed payloads, as might be expected.

Middeck payloads tended to fall into three categories: CFES, those which are pre-packed, and all others. CFES payloads have the greatest impact on operations when all parameters were measured. Pre-packed payloads have very little impact. The majority of all other payloads of this type requires KSC support directly as a function of their complexity.

5.1.3 KSC PROCESSING OPTIONS. The majority of payloads processed by KSC fall into the Joint Customer and KSC Participation category (option 4). The smallest number is consistent with Minimum KSC Involvement (option 1). Spacelab carriers (modules and pallets) fall into the Maximum KSC Involvement category (option 5). There has been a trend toward Minimum KSC Testing (option 3) operations by Spacelab, commercial satellite, and partial payload customers, and it is reflected in their reduced requirements.

5.2 CONCLUSIONS

Results of this study should be of value for a variety of purposes: a better understanding of present processing activities, trend analysis, facility use and forecasting, mission costing, and an improved customer expectation of KSC processing. Space Station applications are varied:

a. Identification of Space Station implications derived from STS payload processing experiences
b. Development of Space Station processing criteria
c. Suggested methods of optimizing overall program costs and schedules for Space Station operations at KSC
d. Performance of program trade-off analyses

The need for an historical data retrieval study and the report of its results should be obvious to STS customers who have flown or are contemplating future mission activities. Equipped with this information, STS customers and those planning for Space Station should be better prepared in their planning activities. Also, KSC should be able to satisfy customer requirements more efficiently as a result of a more comprehensive understanding of operations and processing sensitivities.

Finally, it must be realized that each payload has individual requirements. Even payloads flying on the STS more than once and those with the same configuration may have different supporting needs for a variety of good reasons. KSC, working with the customers as part of the processing team, will continue to strive for the minimum processing that will assure orbiter safety and successful on-orbit payload operation.

APPENDIX A

STS PAYLOAD DESCRIPTIONS

3AAL	3-Axis Acoustic Levitator
3M	Minnesota Mining and Manufacturing Company
ACCESS	Assembly Concept for Construction of Erectable Space Structures
ACES	Acoustic Containerless Experiment System
ACOMEX	Advanced Composite Materials Exposure
ACS	Attitude Control System
ADSF	Automated Directional Solidification Furnace
AFE	American Flight Echocardiograph
AIAA	American Institute of Aeronautics and Astronautics
AKM	apogee kick motor
APE	Aurora Photography Experiment
ARABSAT	Arabian communication satellite
ARC	Aggregation of Red Blood Cells
ASC	American Satellite Company satellite
ASE	airborne support equipment
ATM	Apollo Telescope Mount
AUSSAT	Australian communication satellite
BDCF	Baseline Data Collection Facility
C/O	checkout
C360	Cinema 360 camera - middeck and payload bay
CANEX	Canadian Experiments
CBDE	Carbonated Beverage Development Experiment
CCAFS	Cape Canaveral Air Force Station
CDDT	countdown demonstration test
CFES	Continuous Flow Electrophoresis System, models I, II, III
CG	center of gravity
CHAMP	Comet Halley Active Monitoring Program
CITE	cargo integration test equipment
CLOUDS	Clouds experiment
CPL	capillary pump loop
DAE	Dynamic Augmentation Experiment
DFI	Developmental Flight Instrumentation
DFRF	Dryden Flight Research Facility
DFVLR	Deutsche Forschungs-und Versuchsanstalt Fur Luft-und Raumfahrt
DMOS	Diffuse Mixing of Organic Solutions
DOD	Department of Defense (payload)
DSTF	Delta Spin Test Facility
E-E	End-to-End (test)
EASE	Experiment Assembly of Structures in Extravehicular Activity
EASE/ACCESS	Extravehicular (EVA) Structural Assembly Concepts for Construction of Erectable Structures
EEVT	Electrophoresis Experiment Verification Test
EML	Electromechanical Levitator furnace
EOS	Electrophoresis Operations in Space
ERBS	Earth Radiation Budget Satellite
ESA	European Space Agency
ESA-60A	Explosive Safe Area-60A
EVA	extravehicular activity
FAA	Federal Aviation Administration
FDE	Fluid Dynamic Experiment

FEE	French Echocardiograph Experiment
FILE	Feature Identification and Location Experiment
FLT	flight
FPE	French Postural Experiment
FSS	Flight Support Structure
GAS	Getaway Special
GLOMR	Global Low-Orbiting Message Relay satellite
GLOW	Earth Glow (experiment)
GN_2	gaseous nitrogen
GSA	gas supply assembly
GSFC	Robert H. Goddard Space Flight Center
HBT	Heflex Bioengineering Test
HG-1	First GSFC-sponsored Hitchhiker payload
HMF	Hazardous Maintenance Facility
HPF	hazardous processing facility
HPTE	High-Precision Tracking Experiment
HQ	headquarters
HS376	Hughes Satellite - 376 series
I/F	interface
IBSE	Initial Blood Storage Experiment
IEF	Isoelectric Focusing experiment
IMAX	IMAX, Canada camera (middeck)
INSAT	Indian communication satellite
IPBC	IMAX Payload Bay Camera
IPS	Instrument Pointing System (on Spacelab)
IR-IE	Infrared Imaging Experiment
IRT	Integrated Rendezvous Target
IUS	Inertial Upper Stage
IVT	Interface Verification Test
JSC	Lyndon B. Johnson Space Center
KSC	John F. Kennedy Space Center
LaRC	Langley Research Center
LDEF	Long Duration Exposure Facility
LFC	Large Format Camera
LM	long module
LRT	Launch Readiness Test
LRV	Launch Readiness Verification
LSSF	Life Science Support Facility
MAPS	Measurements of Air Pollution from Satellites
MAUS	Material Wissenschaftliche Autonome Experimente Unter Schwerelosigkeit
MDAC	McDonnell Douglas Astronautics Company
MDM	multiplexer-demultiplexer
MEA	Material Experiment Assembly
MLR	Monodisperse Latex Reactor
MMC	Mission Control Center
MMH	monomethyl hydrazine
MORELOS	Mexican communication satellite
MPESS	Mission-Peculiar Experiment Support Structure
MPSE	Mexican Payload Specialist Experiments
MRTB	Missile Research and Test Building
MSL	Material Science Laboratory
MST	mission sequence test

N2O4	nitrogen tetroxide
NASA	National Aeronautics and Space Administration
NDTL	Non-Destructive Test Laboratory
NOAA	National Oceanographic and Atmospheric Administration
NOSL	Night-Day Optical Survey of Thunderstorm Lightning
NRCC	National Research Council of Canada
NRL	Naval Research Laboratory
NUSAT	Northern Utah Satellite
O&C	Operations and Checkout (Building)
OAST-1	Office of Aeronautics and Space Technology, NASA Headquarters - first payload
OCE	Ocean Color Experiment
OGLOW	Orbiter Glow experiment
OIM	Orbiter Instrumentation Monitoring experiment
OIT	Orbiter integrated test
OPF	Orbiter Processing Facility
ORS	Orbital Refueling System
OSS-1	First payload sponsored by Office of Space Science, NASA Headquarters
OSTA-1, 2, 3	First, second, and third flight of payloads sponsored by the Office of Space and Terrestrial Applications, NASA Headquarters
PACS	Particle Analysis Camera for Shuttle
PALAPA	Communication satellite for Republic of Indonesia
PAM-D	Payload Assist Module - Delta Class
PAM-D2	Payload Assist Module - Delta II Class
PCOC	Plant Carry-On Container
PDP	Plasma Diagnostics Package
PDRS/PFTA	Payload Deployment and Retrieval System/Payload Flight Test Article
PGU	Plant Growth Unit
PL	payload
POCC	Payload Operations Control Center
PPE	Phase Partitioning Experiment
PPF	payload processing facility
PS	Payload Specialist
PSIG	pound(s) per square inch
PVTOS	Physical Vapor Transport of Organic Solids experiment
RCS	Reaction Control Subsystem
REM	release-engage mechanism
RME	Radiation Monitoring Experiment
RMS	Remote Manipulating System
RSS	Rotating Service Structure
S/C	spacecraft
SAE	Solar Array Experiment
SAEF	Spacecraft Assembly and Encapsulation Facility
SAREX	Shuttle Amateur Radio Experiment
SAS	Space Adaptation Syndrome experiment
SASSE	Space Adaptation Syndrome Supplementary Experiments
SATCOM-Ku	AMERICOM satellite (RCA American Communications)
SBS	Satellite Business Systems
SCA	Shuttle Carrier Aircraft
SCCF	Solar Cell Calibration Facility

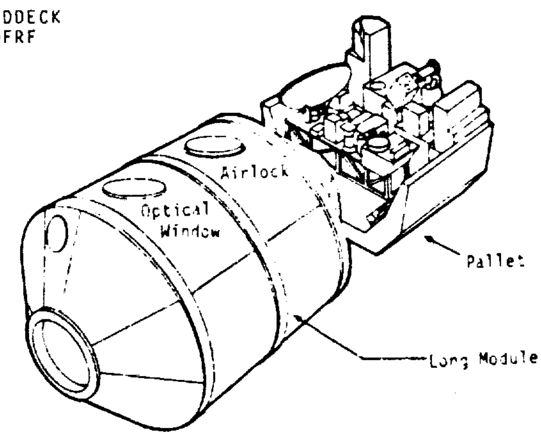
SEP	separation
SFMD	Storable Fluid Management Demonstration
SFSS	Spartan Fixed Support Structure
SFXP	Solar Flare X-Ray Polarimeter
SIR	Shuttle Imaging Radar
SL-1, 2, 3	Spacelabs 1, 2, and 3
SL-D1	First German Spacelab Mission
SMM	Solar Maximum Mission
SMRM	Solar Maximum Repair Mission
SPARTAN	Shuttle-Pointed Autonomous Research Tool for Astronomy
SPARTAN-HALLEY	SPARTAN satellite to study Halley's Comet
SPAS-01, -01A	Shuttle Pallet Satellites
SPEAM	Sun Photometer Earth Atmosphere Measurements
SPIF	Shuttle Payload Integration Facility
SPOC	Shuttle Payload of Opportunity Carrier
SRM	solid rocket motor
SS	special structure
SSIA	Shuttle-Spacelab Induced Atmosphere Experiment
SSIP	Space Science Student Involvement Project
STDN	Spacecraft Tracking and Data Network
STS	Space Transportation System
STTP	Life Science Space Technology Training Program experiment
SUSIM	Solar Ultraviolet Spectral Irradiance Monitor
SYNCOM	LEASAT communication satellite
TCE	Thermal Canister Experiment
TDRS	Tracking and Data Relay Satellite
TELESAT	Communication satellite owned by Telesat, Canada - also called Anik
TELSTAR	Comsat General Corp. communication satellite
TIS	Teacher in Space experiments
TISP	Teacher in Space Project
TLD	Thermoluminescent Dosimeter
USAF	United States Air Force
USDA	United States Department of Agriculture
USS	unique support structure
UVX	far ultraviolet
VAB	Vehicle Assembly Building
VCAP	Vehicle Charging and Potential
VFI	Verification Flight Instrumentation
VISET	Space Vision System Experiment Development Test
VPF	Vertical Processing Facility
VPHD	vertical payload handling device
WESTAR	Western Union communication satellite
WSGT	White Sands Ground Terminal

SPACELAB PAYLOADS

SPACELAB 1 - STS-9:

- FIRST DEDICATED SPACELAB MISSION
- LONG MODULE, PALLET, & LONG TUNNEL
- JOINTLY SPONSORED BY NASA & ESA
- CONTAINED 72 SCIENTIFIC INVESTIGATIONS REPRESENTING 8 DISCIPLINES:
    - ATMOSPHERIC PHYSICS
    - PLASMA PHYSICS
    - ASTRONOMY
    - SOLAR PHYSICS
    - MATERIAL SCIENCES
    - TECHNOLOGY
    - LIFE SCIENCES
    - EARTH OBSERVATIONS

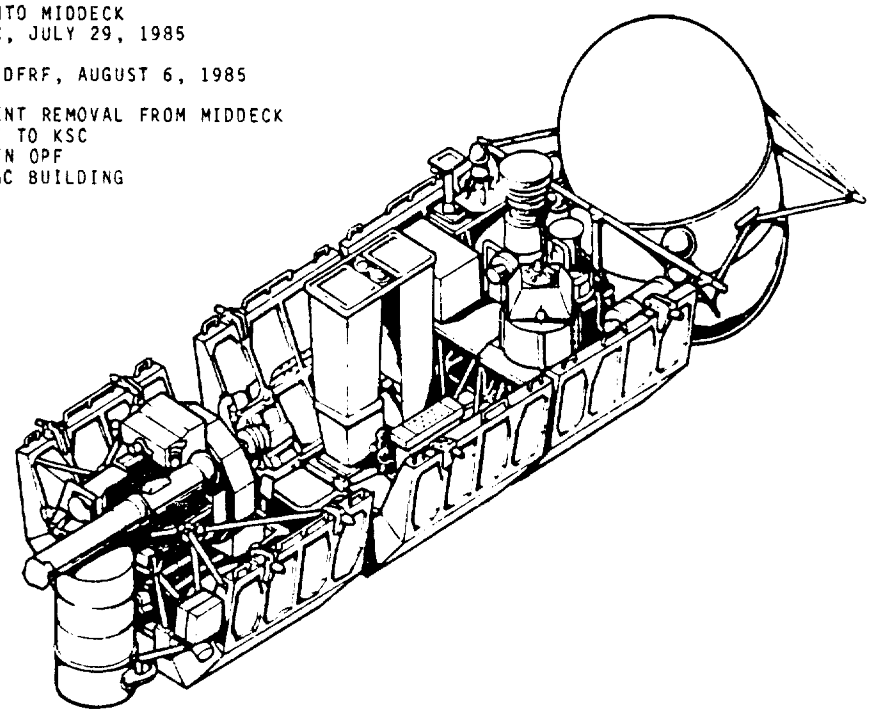
  [EXPERIMENT INSTRUMENTS INSTALLED BOTH IN MODULE & ON PALLET]
- VERIFICATION FLIGHT INSTRUMENTATION (VFI) ON BOARD TO VERIFY SPACELAB CAPABILITIES IN SPACE ENVIRONMENT
- GROUND PROCESSING - PREFLIGHT
    - O&C BUILDING
        - SUBSYSTEMS INSTALLED ON CARRIERS
        - EXPERIMENT INTEGRATION, INCLUDING MST
        - SPACELAB INTEGRATION (TEST STAND 2), INCLUDING MST
        - SL-TO-TUNNEL INTERFACE CHECK
        - CARGO INTEGRATION TEST EQUIPMENT (CITE) OPERATIONS (TEST STAND 4 = CITE STAND) WITH SL/MCC/POCC CLOSED-LOOP TEST
    - ORBITER PROCESSING FACILITY (OPF)
        - INSTALLATION INTO ORBITER
        - OIT
        - END-TO-END TEST
    - VEHICLE ASSEMBLY BUILDING (VAB) - ROTATION & STACKING
    - LAUNCH PAD 39A - SPECIMEN & SAMPLE INSTALLATION IN MIDDECK
      - LAUNCH--STS-9, KSC, NOVEMBER 28, 1983
- POSTLANDING ACTIVITIES - DRYDEN FLIGHT RESEARCH FACILITY (DFRF) DECEMBER 8, 1983
    - REMOVAL OF TIME-CRITICAL SAMPLES & SPECIMENS FROM MIDDECK
    - USE OF BASELINE DATA COLLECTION FACILITY (BDCF) AT DFRF
    - MATE WITH SCA & TRANSPORT TO KSC
    - SL-1 REMOVED FROM ORBITER IN OPF
    - DEINTEGRATION IN O&C BUILDING



SPACELAB 2 - STS-26 (51-F):

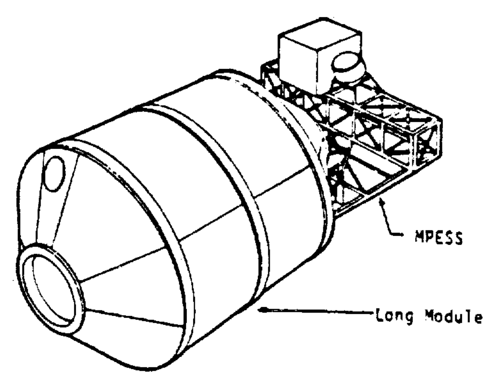
- FIRST ALL-PALLET CONFIGURATION OF SL PAYLOADS
- THIRD DEDICATED SPACELAB MISSION
- FIRST USE OF INSTRUMENT POINTING SYSTEM (IPS) & IGLOO
- CONTAINED 13 U.S. & ENGLISH EXPERIMENTS REPRESENTING 7 SCIENTIFIC DISCIPLINES
    - LIFE SCIENCES
    - PLASMA PHYSICS
    - INFRARED ASTRONOMY
    - TECHNOLOGY
    - HIGH ENERGY PHYSICS
    - SOLAR PHYSICS
    - ATMOSPHERIC PHYSICS
- CARRIERS - 1 + 2-PALLET TRAIN WITH IGLOO & IPS
- VFI USED TO VERIFY SPACELAB SYSTEMS & SUBSYSTEMS
- GROUND PROCESSING - PREFLIGHT
    - O&C BUILDING
        - OFF-LINE LAB SUPPORT, PALLET & IGLOO STAGING, VFI INSTALLATION
        - EXPERIMENT INTEGRATION, WITH MST
        - SL INTEGRATION, WITH MATING OF SYSTEM I/Fs & MISSION COMPATIBILITY TESTING
        - CITE TESTING, WITH CLOSED LOOP TEST & WEIGHT & CG

        [LSSF (HGR "L") USED FOR PLANT GROWTH UNIT (PGU) PREPARATION]
    - ORBITER PROCESSING FACILITY (OPF)
        - INSTALLATION INTO ORBITER
        - OIT
        - END-TO-END TEST WITH POCC
    - VAB - ROTATION & STACKING
    - LAUNCH PAD 39A
        - FINAL SERVICING
        - PGU INSTALLATION INTO MIDDECK
        - LAUNCH--STS-26, KSC, JULY 29, 1985
- POSTLANDING ACTIVITIES - DFRF, AUGUST 6, 1985
    - TIME-CRITICAL EXPERIMENT REMOVAL FROM MIDDECK
    - MATE TO SCA, TRANSPORT TO KSC
    - REMOVAL FROM ORBITER IN OPF
    - SL DEINTEGRATION IN O&C BUILDING



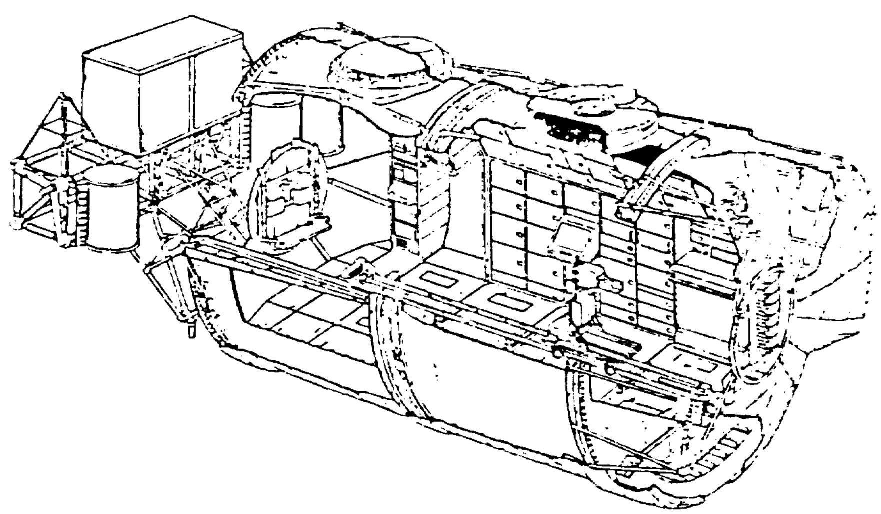
SPACELAB 3 - STS-24 (51-B):

- SECOND DEDICATED SPACELAB MISSION; FIRST OPERATIONAL FLIGHT OF SPACELAB
- NASA & ESA-SPONSORED PAYLOAD
- CARRIERS - LONG MODULE & EXPERIMENT SUPPORT STRUCTURE
- CONTAINED 15 SCIENTIFIC EXPERIMENTS IN 5 DISCIPLINES
  - LIFE SCIENCES
  - ASTRONOMY
  - MATERIALS PROCESSING
  - TECHNOLOGY
  - ENVIRONMENTAL OBSERVATIONS
- FIRST ACCESS TO SL MODULE IN VERTICAL POSITION AT PAD (USED MODULE VERTICAL ACCESS KIT, MVAK, TO INSTALL LIVE SPECIMENS 24 HOURS BEFORE LAUNCH)
- GROUND PROCESSING - PREFLIGHT
  - LIFE SCIENCE SUPPORT FACILITY, CCAFS - SPECIMEN PREPARATION
  - O&C BUILDING
    - EXPERIMENT INTEGRATION (FUNCTIONAL TESTS & ALIGNMENT)
    - SPACELAB INTEGRATION, WITH SYSTEM LEVEL & MST [NO CITE]
  - OPF
    - INSTALLATION IN ORBITER
    - INTERFACE VERIFICATION
    - END-TO-END CHECK WITH POCC
  - VAB - ROTATION & STACKING
  - LAUNCH PAD 39A
    - LIFE SCIENCE LATE ACCESS
    - LAUNCH - STS-24, KSC, APRIL 29, 1985
- POSTLANDING ACTIVITIES - DFRF, MAY 6, 1985
  - REMOVAL FROM MODULE OF LIFE SCIENCE SPECIMEN (MONKEYS & RATS)
  - REMOVAL OF OTHER TIME-CRITICAL ITEMS
  - MATE TO SCA, TRANSPORT TO KSC
  - SL REMOVAL FROM ORBITER IN OPF
  - SL DEINTEGRATION IN O&C BUILDING



SPACELAB D1 - STS-30 (61-A):

- FIRST GERMAN SPACELAB MISSION
- EXPERIMENTS PROVIDED BY GERMAN & OTHER EUROPEAN INVESTIGATORS
- DEDICATED TO EXPERIMENTAL SCIENTIFIC & TECHNOLOGICAL RESEARCH & DEVELOPMENT
- EXPERIMENTAL FACILITIES ARRANGED ACCORDING TO ELEMENTS REPRESENTING
  - MEDICINE
  - BIOLOGY
  - NAVIGATION
  - MATERIAL SCIENCE & SPACE PROCESSING
- CARRIERS - LONG MODULE & UNIQUE SUPPORT STRUCTURE (USS)
- GROUND PROCESSING - PREFLIGHT
  - BREMEN, GERMANY
    - RACK EXPERIMENT INTEGRATION
    - TESTING
  - O&C BUILDING, KSC
    - SL INTEGRATION
    - SYSTEM LEVEL TESTS
    - MST
    - WEIGHT & CG
  - OPF
    - INSTALLATION IN ORBITER
    - INTERFACE VERIFICATION
  - VAB - ROTATION & STACKING
  - LAUNCH PAD 39A
    - CDDT
    - LATE ACCESS STOWAGE - BIORACK LOCKERS, PGU, FROG STATOLITH, FLT DATA FILE, CRYOSTATE LOCKER
    - LAUNCH--STS-30, KSC, OCTOBER 30, 1985
- POSTLANDING ACTIVITIES - DFRF, NOVEMBER 6, 1985
  - REMOVAL OF TIME-CRITICAL ITEMS FROM MIDDECK
  - MATE TO SCA, TRANSPORT TO KSC
  - REMOVAL FROM ORBITER IN OPF
  - DEINTEGRATION IN O&C BUILDING

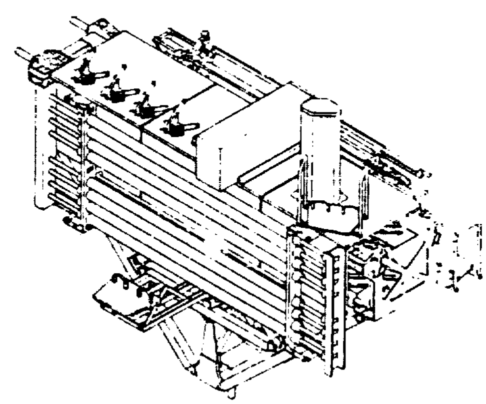


PARTIAL PAYLOADS

- EASE/ACCESS
- GAS BRIDGE
- HG-1
- HS-376 SRM
- IR-IE
- LFC
- MSL-1
- MSL-2
- OAST-1
- OSS-1
- OSTA-1
- OSTA-2
- OSTA-3 (SRL-1)
- ORS
- OIM
- PDRS/PFTA
- SPAS-01 & SPAS-01A
- SMRM
- SPARTAN-1
- SPARTAN HALLEY
- SYNCOM SALVAGE

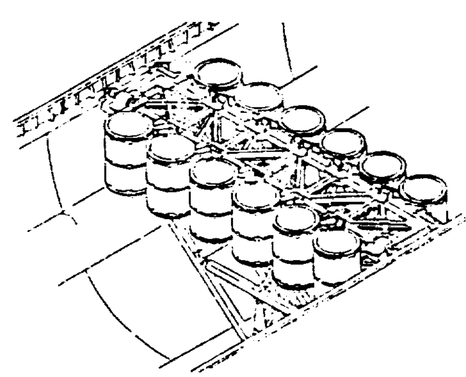
EVA STRUCTURAL ASSEMBLY CONCEPTS FOR CONSTRUCTION OF ERECTABLE STRUCTURES (EASE/ACCESS) - STS-31 (61-B):

- FLIGHT DEMONSTRATION OF EVA STRUCTURAL ASSEMBLY TECHNIQUES IN SPACE
- CONSISTED OF 2 EXPERIMENTS MOUNTED ON MPESS
  - EXPERIMENT ASSEMBLY OF STRUCTURES IN EXTRAVEHICULAR ACTIVITY (EASE)
  - ASSEMBLY CONCEPT FOR CONSTRUCTION OF ERECTABLE SPACE STRUCTURES (ACCESS)
- VALIDATION OF GROUND-BASED & NEUTRAL-BUOYANCY SIMULATOR ASSEMBLY TIME LINES
- GROUND PROCESSING - PREFLIGHT
  - O&C BUILDING - MPESS STAGING; EXPERIMENT INTEGRATION
  - VPF - INTEGRATION WITH OTHER PAYLOADS
  - LAUNCH PAD 39A - INSTALLATION INTO ORBITER
- LAUNCH NOVEMBER 26, 1985
- POSTLANDING ACTIVITIES
  - LANDING DFRF, DECEMBER 3, 1985
  - ORBITER MATED TO SCA; TRANSPORTED TO KSC
  - EASE/ACCESS REMOVED FROM ORBITER IN OPF
  - DEINTEGRATION IN O&C BUILDING



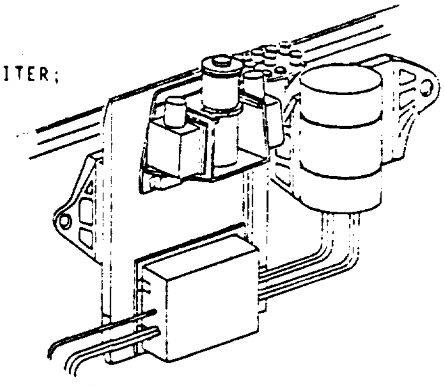
[GAS BRIDGE] - STS-32 (61-C):

- MPESS-TYPE STRUCTURE MODIFIED TO HOLD 12 STANDARD 5-CUBIC-FOOT GETAWAY SPECIAL (GAS) CANISTERS
- GAS BRIDGE CAN HOLD AS MANY AS 6 STANDARD GAS CANS WITH OPENING LIDS & AS MANY AS 6 STANDARD CANS WITHOUT OPENING LIDS
- GROUND PROCESSING - PREFLIGHT
  - GAS CANS INSTALLED ON BRIDGE IN PPF (DSTF FOR STS-32)
  - TRANSPORTED TO O&C BUILDING
  - BRIDGE WITH GAS CANS INSTALLED IN CANISTER HORIZONTALLY (STS-32)
  - VAB - ROTATION OF CANISTER
  - LAUNCH PAD 39A - INSTALLATION OF GAS BRIDGE IN ORBITER BAY
- IVT
- LAUNCH JANUARY 12, 1986
- POSTLANDING ACTIVITIES
  - LANDING DFRF, JANUARY 18, 1985
  - MATE ORBITER TO SCA: TRANSPORT TO KSC
  - REMOVE GAS BRIDGE FROM ORBITER IN OPF
  - TRANSPORT TO VPF: REMOVE FROM CANISTER
  - GAS BRIDGE DEINTEGRATION IN PPF, CCAFS (DSTF, STS-32)



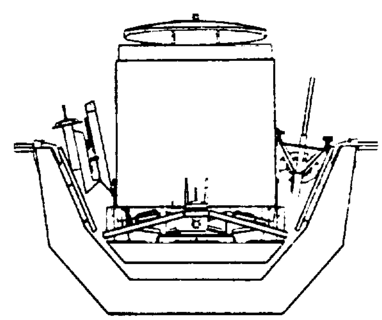
HITCHHIKER GSFC-1 (HG-1) - STS-32 (61-C):

- FIRST OF PAYLOADS TO USE SHUTTLE PAYLOAD OF OPPORTUNITY CARRIER (SPOC)
- SPOC MOUNTED IN PAYLOAD BAY USING EXISTING GAS ATTACH FITTINGS
- HG-1 TO PROVIDE FILM IMAGES OF ANY PARTICLE CONTAMINATION AROUND ORBITER; SPONSORED BY GSFC
- 2 EXPERIMENTS:
  - PARTICLE ANALYSIS CAMERAS FOR SHUTTLE (PACS) [ON SPOC PLATE]
  - CAPILLARY PUMP LOOP (CPL) [IN SEALED GAS CAN]
- GROUND PROCESSING - PREFLIGHT
  - O&C BUILDING - OFF-LINE LAB CHECKOUT
  - OPF - INSTALL IN ORBITER BAY
  - LAUNCH PAD 39A - LAUNCH JANUARY 12, 1986
- POSTLANDING ACTIVITIES
  - LANDING DFRF, JANUARY 18, 1986
  - MATE ORBITER TO SCA; TRANSPORT TO KSC
  - REMOVE HG-1 FROM ORBITER BAY IN OPF



HS-376 SATELLITE RETRIEVAL MISSION (SRM) - STS-19 (51-A):

- RETRIEVAL OF WESTAR & PALAPA HUGHES 376 SATELLITES RELEASED INTO ORBIT ON STS-11 (41-B) MISSION; SATELLITES WERE NOT BOOSTED TO HIGHER ORBITS ON INITIAL FLIGHT.
- CARRIER - SPACELAB PALLET (ONE EACH) WITHOUT SUBSYSTEMS, WITH STRUCTURAL PROVISIONS FOR MOUNTING PAYLOAD PLATFORM & WIRING HARNESS WITH 3 PL RETENTION LATCH ASSEMBLIES
- GROUND PROCESSING - PREFLIGHT
  - O&C BUILDING - INTEGRATION OF FLT HARDWARE ONTO PALLETS IN CITE STAND
  - VPF - INTEGRATION WITH VERTICAL PAYLOADS
  - LAUNCH PAD 39A - ORBITER INTEGRATION
- LAUNCH NOVEMBER 8, 1984
- POSTLANDING ACTIVITIES
  - LANDING KSC NOVEMBER 16, 1984
  - REMOVAL OF PALLETS WITH SATELLITES IN OPF
  - REMOVAL OF DEPLOYABLE HARDWARE IN VPF



INFRARED IMAGING EXPERIMENT (IR-IE) - STS-32 (61-C):

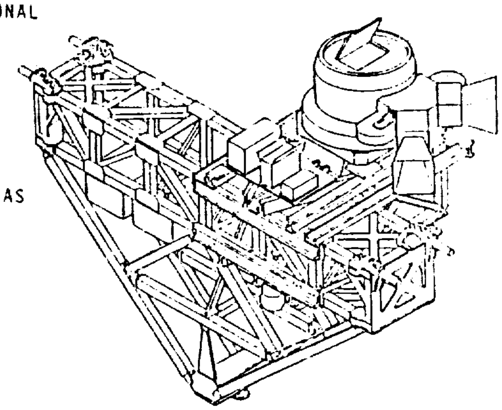
- INFRARED TV CAMERA MOUNTED IN ORBITER BAY; DESIGNED TO REPLACE OPERATIONAL TV CAMERA INSTALLATION WITHOUT REQUIRING ANY SHUTTLE MODIFICATIONS
- CARRIER - ORBITER CCTV PAN & TILT UNIT IN BAY
- BUILT BY RCA
- GROUND PROCESSING - PREFLIGHT
  - O&C BUILDING - FUNCTIONAL TESTING IN OFF-LINE LAB
  - OPF - TESTS OF EQUIPMENT IN ORBITER BAY
  - LAUNCH PAD 39A - INSTALLED IN ORBITER BAY
- LAUNCH JANUARY 12, 1986
- POSTFLIGHT OPERATIONS
  - LANDING DFRF, JANUARY 18, 1986
  - TRANSPORT ORBITER TO KSC
  - REMOVAL OF IR-IE FROM ORBITER BAY IN OPF

(NO DRAWING AVAILABLE)

ORIGINAL PAGE IS
OF POOR QUALITY

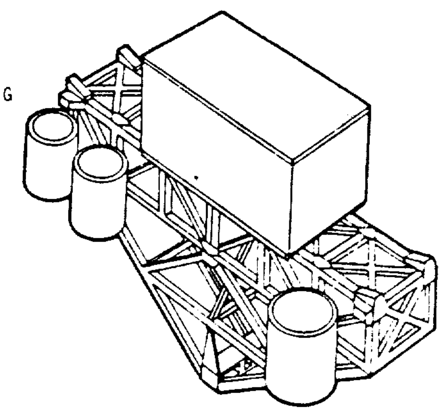
LARGE FORMAT CAMERA (LFC) - STS-17 (41-G):

- TAKE OVERLAPPING HIGH-RESOLUTION PHOTOGRAPHS OF EARTH'S SURFACE FROM SPACE
- CONTAINS STELLAR CAMERA ARRAY TO PHOTOGRAPH STARFIELDS FOR POSITIONAL INFORMATION
- CARRIER - MPESS (FLEW WITH ORBITAL REFUELING SYSTEM ON STS-17)
- GROUND PROCESSING - PREFLIGHT
  - O&C BUILDING - OFF-LINE LAB PREPARATION
    - EXPERIMENT INTEGRATION
    - ALIGNMENT, CALIBRATION, & PRESSURIZATION OF GAS SUPPLY ASSY (GSA)
    - WEIGHT & CG
  - VPF - JOINED BY VERTICAL PAYLOADS IN CANISTER
  - LAUNCH PAD 39A - INSTALLATION INTO ORBITER
    - IVT
    - TOP-OFF OF GAS
    - LAUNCH OCTOBER 5, 1984
- POSTLANDING ACTIVITIES
  - LANDING KSC, OCTOBER 13, 1984
  - SAFING OF SYSTEMS; REMOVAL FROM ORBITER BAY IN OPF
  - DEINTEGRATION IN O&C BUILDING



MATERIAL SCIENCE LAB-1 (MSL-1, FORMERLY MEA-1)*:

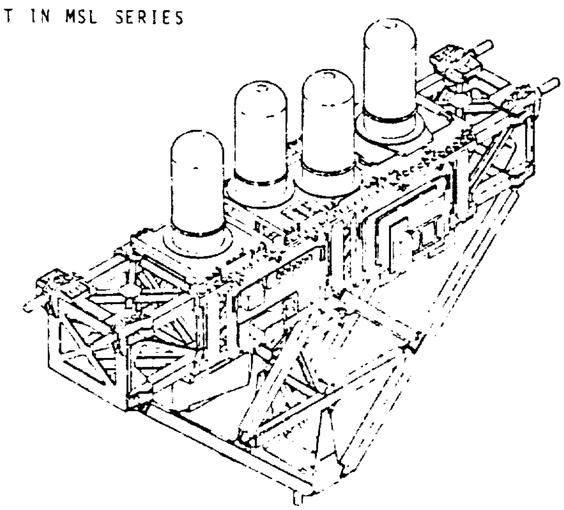
- EVALUATED MATERIAL PROCESSING EXPERIMENTS IN MICROGRAVITY; SPONSORED BY MSFC
- CARRIER - MPESS
- CONTAINED MATERIAL EXPERIMENT ASSEMBLY (MEA) & 3 GAS CONTAINERS SUPPORTING 4 EXPERIMENTS
  - SOLID ELECTROLYTES
  - LIQUID PHASE MISCIBILITY
  - VAPOR GROWTH OF ALLOYS
  - CONTAINERLESS PREPARATION OF ADVANCED OPTICAL GLASSES
- GROUND PROCESSING - PREFLIGHT
  - O&C BUILDING - MPESS PREPARATION & EXPERIMENT INTEGRATION
    - PAYLOAD DISASSEMBLED



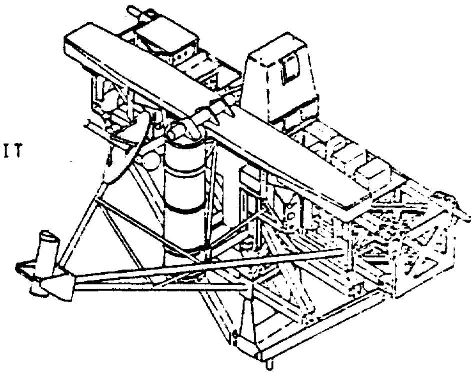
* MSL-1 ORIGINALLY SCHEDULED FOR STS-19 (51-A); MANIFEST CHANGED TO PERMIT HS-376 SRM ON STS-19; MSL-1 ASSEMBLED AND CHECKED OUT FOR FLIGHT; PAYLOAD DISASSEMBLED AFTER MANIFEST CHANGE.

MATERIAL SCIENCE LAB-2 (MSL-2) - STS-32 (61-C):

- DEMONSTRATION OF MATERIALS PROCESSING IN ZERO-G; FIRST FLIGHT IN MSL SERIES
- CONTAINED 3 EXPERIMENTS
  - 3-AXIS ACOUSTIC LEVITATOR (3AAL)
  - AUTOMATIC DIRECTIONAL SOLIDIFICATION FURNACE (ADSF)
  - ELECTROMECHANICAL LEVITATOR FURNACE (EML)
- CARRIER - MPESS
- GROUND PROCESSING - PREFLIGHT
  - O&C BUILDING - OFF-LINE LAB PREPARATION
    - EXPERIMENT INTEGRATION
  - VPF - JOINED BY REMAINING PAYLOADS IN CANISTER
  - LAUNCH PAD 39A - SERVICING
    - INSTALL IN ORBITER BAY
    - IVT
    - LAUNCH JANUARY 12, 1986
- POSTLANDING ACTIVITIES
  - LANDING DFRF, JANUARY 18, 1986
  - MATING ORBITER TO SCA: TRANSPORT TO KSC
  - SAFING OF SYSTEMS & REMOVAL OF MSL-2 FROM ORBITER IN OPF
  - DEINTEGRATION IN O&C BUILDING

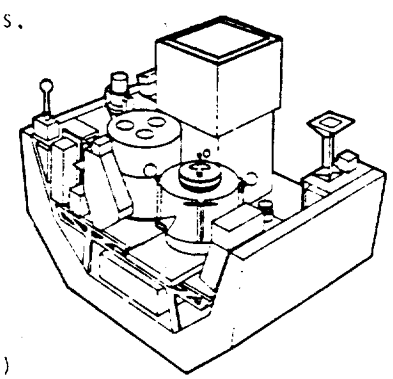


OFFICE OF AERONAUTICS & SPACE TECHNOLOGY-1 (OAST-1) - STS-14 (41-D):



- FIRST PAYLOAD SPONSORED BY OAST AT NASA HQ
- DEMONSTRATED LIGHTWEIGHT SOLAR ARRAY TECHNOLOGY
- CONTAINED 3 EXPERIMENTS
  - SOLAR ARRAY EXPERIMENT (SAE) - EXTENDED 105 FT OUT OF BAY ON ORBIT
  - SOLAR CELL CALIBRATION FACILITY (SCCF)
  - DYNAMIC AUGMENTATION EXPERIMENT (DAE)
- CARRIER - MPESS
- GROUND PROCESSING - PREFLIGHT
  - O&C BUILDING - OFF-LINE LAB SUPPORT
    - EXPERIMENT INTEGRATION & FUNCTIONAL TESTING
    - ALIGNMENT & CALIBRATION
    - MISSION SIMULATION
    - ORDNANCE INSTALLATION & CONNECTION (BY SAFETY WAIVER)
  - VPF - JOINED BY OTHER PAYLOADS IN CANISTER
  - LAUNCH PAD 39A - INSTALLATION IN ORBITER BAY
    - IVT
    - FINAL ORDNANCE CONNECTION
    - LAUNCH AUGUST 30, 1984
- POSTLANDING ACTIVITIES
  - LANDING DFRF SEPTEMBER 5, 1984
  - MATE TO SCA & TRANSPORT TO KSC
  - REMOVAL FROM ORBITER BAY IN OPF
  - DEINTEGRATION IN O&C BUILDING

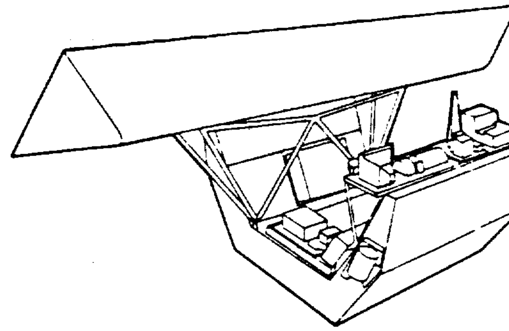
OFFICE OF SPACE SCIENCE-1 (OSS-1) - STS-3:



- FIRST PAYLOAD SPONSORED BY OSS, NASA HQ; MISSION MANAGEMENT - GSFC
- PERFORMED TECHNOLOGY EVALUATION IN SOLAR PHYSICS, ASTRONOMY, LIFE SCIENCES, & MEASURED ORBITER'S ENVIRONMENT
- 6 EXPERIMENTS CARRIED ON OFT PALLET:
  - PLASMA DIAGNOSTICS PACKAGE (PDP) - TO TEST RMS HANDLING
  - VEHICLE CHARGING & POTENTIAL (VCAP)
  - THERMAL CANISTER EXPERIMENT (TCE)
  - SHUTTLE-SPACELAB INDUCED ATMOSPHERE (SSIA) EXPERIMENT
  - SOLAR UV SPECTRAL IRRADIANCE MONITOR (SUSIM)
  - SOLAR FLARE X-RAY POLARIMETER (SFXP)
- GROUND PROCESSING - PREFLIGHT
  - O&C BUILDING - PALLET STAGING; SHIPMENT TO GSFC
  - GSFC - EXPERIMENT INTEGRATION
  - O&C BUILDING - PRE-CITE & CITE TESTING
  - OPF - INTEGRATION INTO ORBITER (INSTALLATION & INTERFACE VERIFICATION)
  - VAB - ROTATION & STACKING WITH ORBITER
  - LAUNCH PAD 39A - LAUNCH MARCH 22, 1982
- POSTLANDING ACTIVITIES
  - LANDING DFRF, MARCH 30, 1982
  - ORBITER MATED TO SCA; TRANSPORTED TO KSC
  - OSS-1 REMOVED FROM BAY IN OPF
  - DEINTEGRATION IN O&C BUILDING

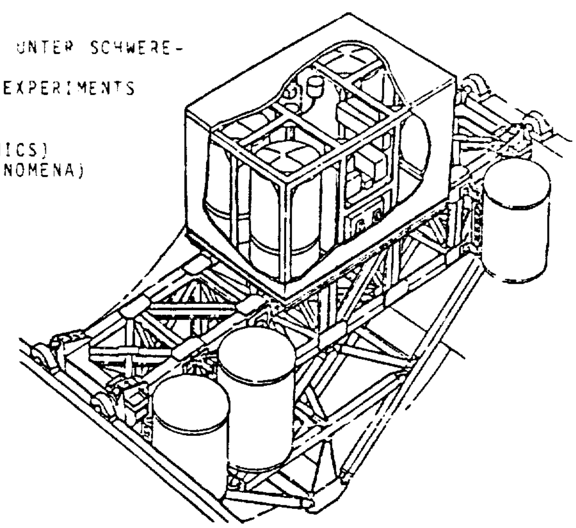
OFFICE OF SPACE & TERRESTRIAL APPLICATIONS-1 (OSTA-1) - STS-2:

- FIRST PAYLOAD SPONSORED BY OSTA, NASA HQ
- CONTAINED 4 EXPERIMENTS ADDRESSING EARTH RESOURCES, ENVIRONMENTAL OBSERVATIONS, LIFE SCIENCES, & ADVANCED TECHNOLOGY DISCIPLINES
    - SHUTTLE IMAGING RADAR A (SIR-A)
    - FEATURE IDENTIFICATION & LOCATION EQUIPMENT
    - OCEAN COLOR EQUIPMENT (OCE)
    - MEASUREMENTS OF AIR POLLUTION FROM SATELLITES (MAPS)
- CARRIER - OFT PALLET
- GROUND PROCESSING - PREFLIGHT
    - O&C BUILDING - PALLET STAGING & EXPERIMENT INTEGRATION
      - ATM CLEAN ROOM STORAGE (STS-2 DELAYS)
      - PRE-CITE & CITE TESTING
    - OPF - INSTALLATION INTO ORBITER & INTERFACE VERIFICATION
    - VAB - ROTATION & STACKING WITH ORBITER
    - LAUNCH PAD 39A - LAUNCH NOVEMBER 12, 1981
- POSTLANDING ACTIVITIES
    - LANDING DFRF, NOVEMBER 14, 1981
    - MATE TO SCA & TRANSPORT TO KSC
    - REMOVAL FROM ORBITER IN OPF
    - DEINTEGRATION IN O&C BUILDING



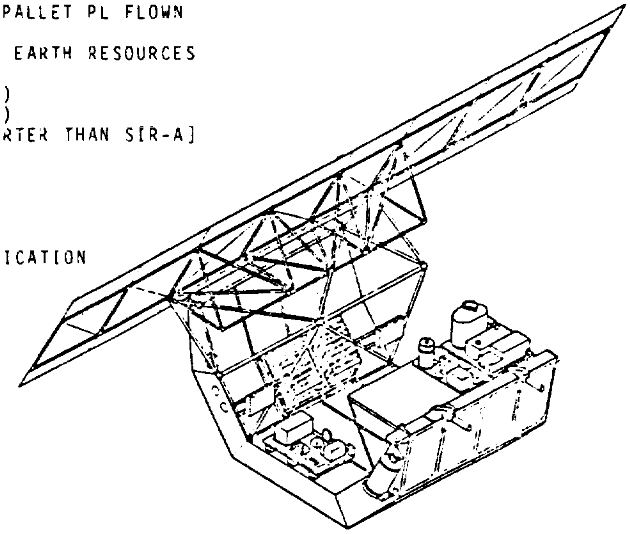
OFFICE OF SPACE & TERRESTRIAL APPLICATIONS-2 (OSTA-2) - STS-7:

- COOPERATIVE MISSION BETWEEN FEDERAL REPUBLIC OF GERMANY & NASA
- STUDIED MATERIALS PROCESSING IN LOW GRAVITY
- CARRIER - MPESS
- EXPERIMENTS
    - GERMAN - MATERIAL WISSENSCHAFTLICHE AUTONOME EXPERIMENTE UNTER SCHWERELOSIGKEIT (MAUS), IN 3 MODIFIED GAS CANS
    - U.S. (NASA) - MATERIAL EXPERIMENT ASSEMBLY (MEA) WITH 3 EXPERIMENTS
      - ACOUSTIC LEVITATOR (METALLURGY)
      - GRADIENT GENERAL-PURPOSE ROCKET FURNACE (FLUID DYNAMICS)
      - ISOTHERMAL-GENERAL SPECIAL CONTAINERS (TRANSPORT PHENOMENA)
- GROUND PROCESSING - PREFLIGHT
    - O&C BUILDING - MPESS STAGING
      - OFF-LINE LAB EXPERIMENT PREPARATION
      - EXPERIMENT INTEGRATION
    - VPF - OTHER PAYLOADS JOIN OSTA-2 IN CANISTER
    - LAUNCH PAD 39A - INSTALLATION IN ORBITER BAY
      - CHECKOUT
      - LAUNCH JUNE 18, 1983
- POSTLANDING ACTIVITIES
    - LANDING DFRF, JUNE 24, 1983
    - MATE ORBITER TO SCA; TRANSPORT TO KSC
    - REMOVE FROM ORBITER IN OPF
    - DEINTEGRATION IN O&C BUILDING



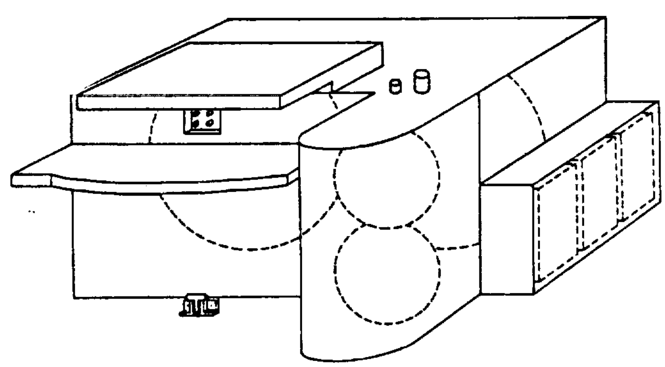
OFFICE OF SPACE & TERRESTRIAL APPLICATIONS-3 (OSTA-3) [ALSO KNOWN AS SHUTTLE RADAR LABORATORY-1 (SRL-1)] - STS-17 (41-G):

- THIRD PAYLOAD SPONSORED BY OSTA, NASA HQ: SECOND OSTA PALLET PL FLOWN
- CONTAINED 3 EXPERIMENTS MOUNTED ON MDM PALLET STUDYING EARTH RESOURCES
  - FEATURE IDENTIFICATION & LOCATION EXPERIMENT (FILE)
  - MEASUREMENT OF AIR POLLUTION FROM SATELLITES (MAPS)
  - SHUTTLE IMAGING RADAR-B (SIR-B) [SIR-B ANTENNA SHORTER THAN SIR-A]
- GROUND PROCESSING - PREFLIGHT
  - O&B BUILDING - OFF-LINE LAB PREPARATION
    - EXPERIMENT INTEGRATION
  - OPF - INSTALLATION IN ORBITER BAY: INTERFACE VERIFICATION
  - VAB - ROTATION & STACKING WITH ORBITER
  - LAUNCH PAD 39A - END-TO-END TESTING
    - LAUNCH OCTOBER 5, 1984
- POSTLANDING ACTIVITIES
  - LANDING KSC OCTOBER 13, 1984
  - REMOVAL FROM ORBITER BAY IN OPF
  - DEINTEGRATION IN O&C BUILDING



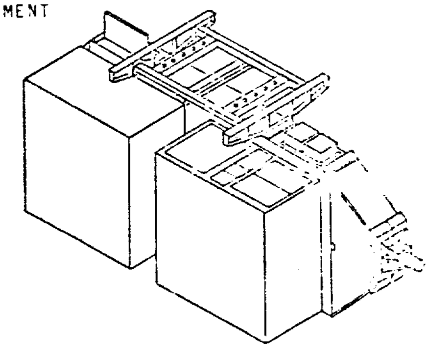
ORBITAL REFUELING SYSTEM (ORS) - STS-17 (41-G):

- DEMONSTRATE SYSTEM PLANNED TO BE AVAILABLE TO STS CUSTOMERS
- SYSTEM CAPABILITIES
  - ON-ORBIT SATELLITE REFUELING
  - EVA TOOL/VALVE INTERFACE TO SERVICE EXISTING SATELLITES
  - ULLAGE RECOMPRESSION FOR PROPELLANT RESERVICING
  - CONTROL OF PROPELLANTS FROM AFD THROUGH ORBITER-SATELLITE DATA ACQUISITION & FLUID CONTROL SYSTEM
- CARRIER - MPESS WITH FLEX MDM
- GROUND PROCESSING - PREFLIGHT
  - HMF - PRE-INTEGRATION LEAK CHECK
  - O&C BUILDING - EXPERIMENT INTEGRATION
    - ALIGNMENT & FUNCTIONAL TEST
    - LOADING GN2 BOTTLES TO 3000 PSIG
    - WEIGHT & CG
  - VPF - OTHER PAYLOADS INSTALLED INTO CANISTER WITH ORS (& LARGE FORMAT CAMERA, WHICH FLEW ON SAME MPESS)
  - OPF - INSTALLATION & INTERFACE VERIFICATION
  - LAUNCH PAD 39A - GN2 & HYDRAZINE LOADING
    - INSTALLATION IN PAYLOAD BAY
    - LRV
    - LAUNCH OCTOBER 5, 1984
- POSTLANDING ACTIVITIES
  - LANDING KSC OCTOBER 13, 1984
  - SAFING OF ORS & REMOVAL FROM ORBITER IN OPF
  - DEINTEGRATION IN O&C BUILDING



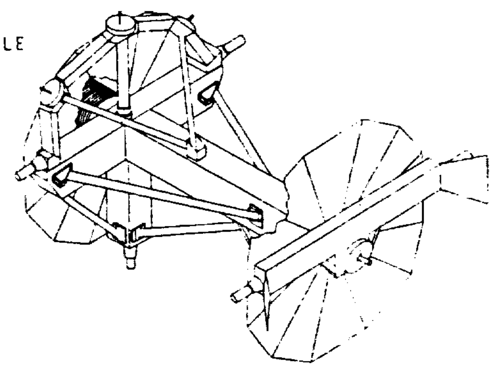
OXYGEN INTERACTION WITH MATERIALS/ORBITER INSTRUMENTATION MONITORING (OIM) - STS-8:

- FIRST OPERATIONAL FLIGHT OF DEVELOPMENTAL FLIGHT INSTRUMENTATION (DFI) EQUIPMENT, WHICH FLEW ON FIRST 4 MISSIONS
- TEST EFFECT OF ATOMIC OXYGEN BOMBARDMENT ON MATERIALS; HEAT PIPE EXPERIMENT ADDED TO THIS FLIGHT (STS-8)
- CARRIER - PALLET STRUCTURE
- GROUND PROCESSING - PREFLIGHT
  - SHIPPED FROM JSC
  - OPF - INSTALLATION IN ORBITER; FUNCTIONAL TESTING
  - VAB - ROTATION & STACKING WITH ORBITER
  - LAUNCH PAD 39A - INSTALLATION OF 2 OXYGEN & HEAT PIPE EXPERIMENTS
    - LAUNCH AUGUST 30, 1983
- POSTLANDING ACTIVITIES
  - LANDING DFRF, SEPTEMBER 5, 1983
  - MATING ORBITER TO SCA; TRANSPORT TO KSC
  - REMOVAL OF OIM FROM ORBITER IN OPF



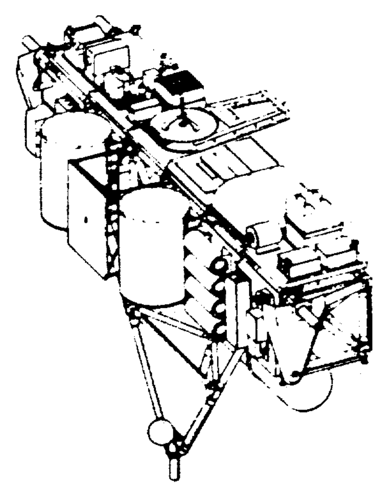
PAYLOAD DEPLOYMENT & RETRIEVAL SYSTEM/PAYLOAD FLIGHT TEST ARTICLE (PDRS/PFTA) - STS-8:

- 8500-POUND TEST ARTICLE FOR THE RMS'S ABILITY TO HANDLE HEAVIER OBJECTS, SUCH AS THE LONG-DURATION EXPOSURE FACILITY (LDEF)
- ALUMINUM & STAINLESS STEEL STRUCTURE 15 FT BY 13 FT WITH 2 GRAPPLE FIXTURES; DUMBELL-SHAPED, PASSIVE PAYLOAD
- GROUND PROCESSING - PREFLIGHT
  - RECEIVED FROM JSC
  - INSTALLED IN ORBITER IN OPF (NO INTEGRATED TESTING)
  - LAUNCH AUGUST 30, 1983
- POSTLANDING ACTIVITIES
  - LANDING DFRF, SEPTEMBER 5, 1983
  - MATING OF ORBITER TO SCA; TRANSPORT TO KSC
  - REMOVAL OF PDRS/PFTA FROM BAY IN OPF

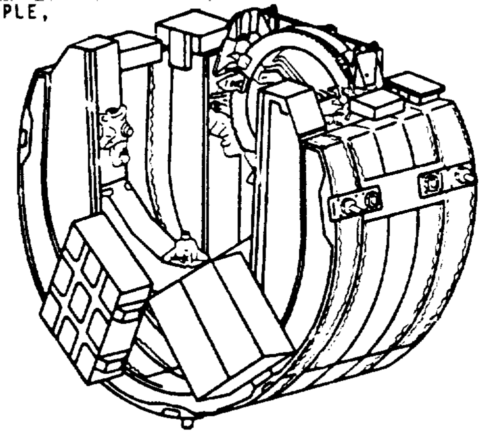


SHUTTLE PALLET SATELLITE-01 (SPAS-01) - STS-7
SHUTTLE PALLET SATELLITE-01A (SPAS-01A) - STS-11 (41-B):

- DEMONSTRATE GERMAN-BUILT PLATFORM & SYSTEMS AS CARRIER FOR SCIENCE EXPERIMENTS; DEPLOYED AS TEST ARTICLE FOR RMS IN PREPARATION FOR SMM SATELLITE REPAIR; TOOK FIRST PICTURES OF ORBITER FROM SPACE ON STS-7
- 10 EXPERIMENTS: 7 SPONSORED BY GERMAN NATIONAL MINISTRY FOR RESEARCH & TECHNOLOGY & 3 NASA EXPERIMENTS
- CARRIER - SPECIAL GERMAN-BUILT PLATFORM SIMILAR IN SHAPE TO NASA MPESS
- GROUND PROCESSING - PREFLIGHT
  - O&C BUILDING - MAUS CANS PREPARED IN OFF-LINE LAB
  - HANGAR S, CCAFS - PAYLOAD PREPARATION & GERMAN EXPERIMENTS MOUNTED ON STRUCTURE
  - VPF - ATTACHMENT OF KEEL & TRUNNION FITTINGS
    - SPAS PAYLOAD INSTALLATION IN VPHD
    - CITE TESTING (SPAS-01 ONLY)
    - BATTERY CHARGING
    - INSTALLATION OF NASA CAMERAS
- LAUNCH PAD 39A - INSTALL IN ORBITER BAY
  - LAUNCHES--STS-7, SPAS-01, JUNE 18, 1983;
    STS-11, SPAS-01A, FEBRUARY 3, 1984
- POSTLANDING ACTIVITIES
  - LANDINGS--STS-7, DFRF, JUNE 24, 1983;
    STS-11, KSC, FEBRUARY 11, 1984
  - REMOVAL OF SPAS FROM ORBITER IN OPF; KEEL FITTING REMOVED
  - DEINTEGRATION IN HANGAR S; MAUS CANS TO O&C BUILDING
  - MAUS DEINTEGRATION IN O&C BUILDING

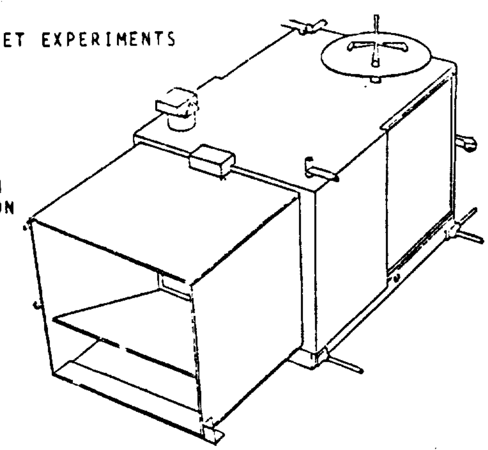


SOLAR MAXIMUM SATELLITE REPAIR MISSION (SMRM) - STS-13 (41-C):



- SOLAR MAXIMUM MISSION (SMM) S/C ACS FAILED & 3 EXPERIMENTS MALFUNCTIONED 10 MONTHS AFTER LAUNCH; REPAIR MISSION DESIGNED TO STABILIZE, GRAPPLE, BERTH, REPAIR, & RE-DEPLOY S/C
- FIRST PRACTICAL DEMONSTRATION OF STS REPAIR CAPABILITY
- CARRIER - FLIGHT SUPPORT STRUCTURE (FSS) (SUPPLIED BY GSFC)
- GROUND PROCESSING - PREFLIGHT
  - O&C BUILDING - PREPARATION OF FSS
    - CITE STAND TESTING
    - INSTALLATION IN CANISTER
  - VAB - ROTATION TO VERTICAL
  - LAUNCH PAD 39A - INSTALLATION INTO ORBITER
    - LAUNCH APRIL 6, 1984
- POSTLANDING ACTIVITIES
  - LANDING DFRF, APRIL 13, 1984
  - MATING OF ORBITER TO SCA; TRANSPORT TO KSC
  - REMOVAL OF FSS FROM ORBITER IN OPF
  - DEINTEGRATION OF FSS IN O&C BUILDING; RETURN OF FSS TO GSFC

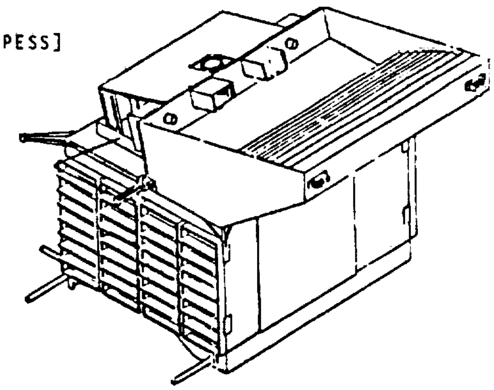
SPARTAN-1 - STS-25 (51-G):



- FIRST SHUTTLE-POINTED AUTONOMOUS RESEARCH TOOL FOR ASTRONOMY (SPARTAN)
- DEPLOYED FROM BAY BY RMS; RETURNED TO BAY BEFORE RE-ENTRY
- TELESCOPE WAS FLOWN PREVIOUSLY ABOARD NASA SOUNDING ROCKETS
- PURPOSE: TO PROVIDE MEANS FOR FLYING EXISTING SOUNDING ROCKET EXPERIMENTS ON BOARD STS
- CARRIER - MPESS
- GROUND PROCESSING - PREFLIGHT
  - HANGAR S, CCAFS - MPESS STAGING & EXPERIMENT INTEGRATION
  - OPF - INSTALLATION IN ORBITER BAY; INTERFACE VERIFICATION
  - VAB - ROTATION & STACKING WITH ORBITER
  - LAUNCH PAD 39A - DETECTOR GAS SUPPLY TOP-OFF
    - LAUNCH JUNE 17, 1985
- POSTLANDING ACTIVITIES
  - LANDING DFRF, JUNE 24, 1985
  - MATING OF ORBITER WITH SCA; TRANSPORT TO KSC
  - REMOVE SPARTAN-1 FROM ORBITER BAY IN OPF
  - DEINTEGRATION IN HANGAR S

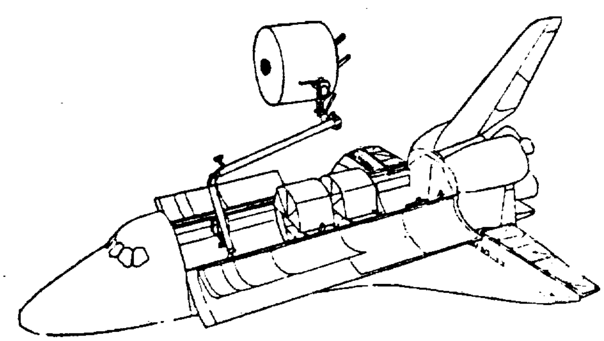
SPARTAN-HALLEY - STS-33 (51-L):

- SECOND PAYLOAD FLOWN IN SPARTAN PROGRAM
- DESIGNED TO BE DEPLOYED FROM BAY BY RMS; PAYLOAD RETRIEVED BEFORE RE-ENTRY & RETURNED TO ORBITER BAY
- EXPERIMENT ON BOARD TO VIEW HALLEY'S COMET
- CARRIER - SFSS - SPARTAN FIXED SUPPORT STRUCTURE [SIMILAR TO MPESS]
- GROUND PROCESSING - PREFLIGHT
  - BUILDING AM - EXPERIMENT INTEGRATION
    - RELEASE MECHANISM FUNCTIONAL TEST
  - OPF - INSTALLATION OF PAYLOAD IN ORBITER BAY
    - INTERFACE VERIFICATION
    - REM LATCH FUNCTIONAL TEST
  - LAUNCH PAD 39B - LAUNCH JANUARY 28, 1986



SYNCOM SALVAGE - STS-27 (51-I):

- SALVAGE PLAN TO RENDEZVOUS & MODIFY SYNCOM IV-3 TO PERMIT GROUND COMMAND OF SATELLITE
- SPONSORED BY HUGHES COMMUNICATIONS, INC.
- SALVAGE EQUIPMENT - CAPTURE BAR, HANDLING BAR, GRAPPLE BAR, AVIONICS EQUIPMENT, TOOLS, TRASH BAG, FOOT RESTRAINTS
- CARRIER - 6 TOOLBOARDS MOUNTED ON SIDES OF FORWARD ORBITER BAY
- GROUND PROCESSING - PREFLIGHT
  - EQUIPMENT AND MOUNTING BOARDS SHIPPED FROM JSC
  - OPF - INSTALLATION IN ORBITER
  - VAB - ROTATION & STACKING WITH ORBITER
  - LAUNCH PAD 39A - LAUNCH AUGUST 27, 1985
- POSTLANDING ACTIVITIES
  - LANDING DFRF, SEPTEMBER 3, 1985
  - MATING OF ORBITER TO SCA; TRANSPORT TO KSC
  - SALVAGE EQUIPMENT REMOVAL FROM BAY IN OPF

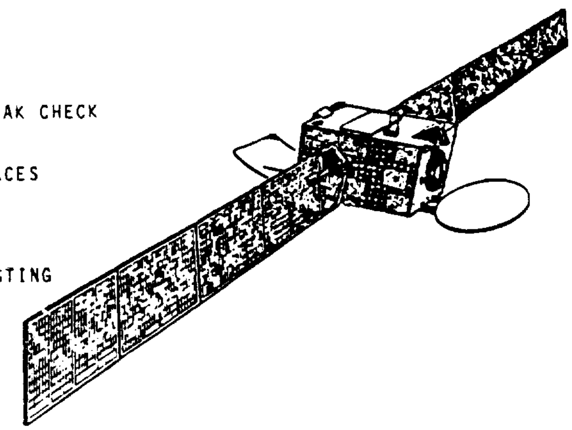


DEPLOYED SATELLITES

- COMMERCIAL SATELLITES
  - ASC-1
  - ARABSAT 1-B
  - AUSSAT 1 & 2
  - INSAT 1-B
  - MORELOS A & B
  - PALAPA B-1 & B-2
  - SATCOM Ku-1 & 2
  - SBS-C & D
  - SYNCOM IV-1,2,3,4
  - TDRS-A & B
  - TELESAT-E, F, H, I
  - TELSTAR 3-C & 3-D
  - WESTAR-6
- UPPER STAGES
  - IUS
  - PAM-D
  - PAM-D2
- SCIENTIFIC SATELLITES
  - ERBS
  - LDEF-1

AMERICAN SATELLITE COMPANY -1 (ASC-1) - STS-27 (51-I):

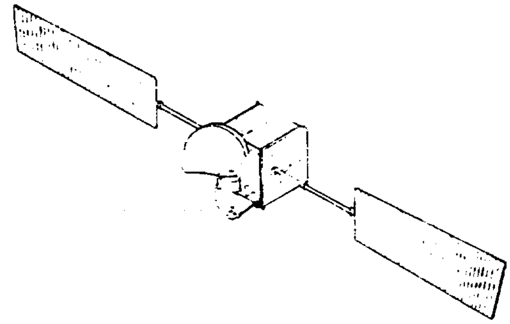
- FIRST OF TWO ASC SATELLITES; OPERATES IN C- & Ku-BANDS
- FIRST COMMERCIAL SPACECRAFT TO HAVE COMMAND LINKS PROTECTED BY ENCRYPTION
- HYBRID RECTANGULAR SATELLITE BUILT BY RCA TO SERVE 50 STATES & PUERTO RICO
- UPPER STAGE - PAM-D
- GROUND PROCESSING - PREFLIGHT
  - MRTB & NDTL, CCAFS - AKM COLD SOAK & X-RAY
  - ASTROTECH - RECEIVING & INSPECTION OF S/C; PRESSURE & LEAK CHECK
    - ORDNANCE INSTALLATION
    - AKM INSTALLATION; HYDRAZINE LOADING
    - MATING S/C TO PAM-D; VERIFICATION OF INTERFACES
  - VPF - INSTALLATION INTO VPHD
    - FUNCTIONAL TESTING; IVT & E-E TESTING
  - LAUNCH PAD 39A - INSTALLATION INTO RSS
    - FUNCTIONAL TESTING
    - INSTALLATION INTO ORBITER; IVT; E-E TESTING
    - LAUNCH--AUGUST 27, 1985



- POSTLANDING ACTIVITIES
  - LANDING AT DFRF, SEPTEMBER 3, 1985
  - MATING OF ORBITER & SCA; TRANSPORT TO KSC
  - REMOVAL OF ASE FROM ORBITER BAY IN OPF

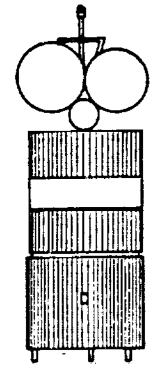
ARABIAN SATELLITE 1-B (ARABSAT 1-B) - STS-25 (51-G):

- FIRST GEOSYNCHRONOUS COMMUNICATION SATELLITE SPONSORED BY ARAB SATELLITE COMMUNICATIONS ORGANIZATION
- PROVIDES DOMESTIC & REGIONAL TELEVISION & TELECOMMUNICATION SERVICES TO 22 MEMBERS OF ARAB CONSORTIUM; BUILT BY AEROSPATIALE
- 3-AXIS STABILIZED S/C WITH RECTANGULAR MAIN BODY; C- & S-BAND TRANSMIT & RECEIVE CAPABILITY
- UPPER STAGE - PAM-D
- GROUND PROCESSING - PREFLIGHT
  - BUILDING AE, CCAFS - RECEIVING & INSPECTION
    - PRESSURE & LEAK CHECK
  - ESA-60A - MATING OF S/C & PAM-D
    - HYDRAZINE LOADING
    - INTERFACE VERIFICATION
  - VPF - INSTALLATION IN VPHD
  - - PL FUNCTIONAL TESTING
  - - CITE TESTING
  - - BATTERY CHARGE
  - LAUNCH PAD 39A - INSTALLATION INTO RSS: PL FUNCTIONAL TESTING
    - INSTALLATION INTO ORBITER
    - IVT
    - FINAL ORDNANCE CONNECTION
    - LAUNCH--STS-27 AUGUST 27, 1985;
      STS-31 NOVEMBER 26, 1985



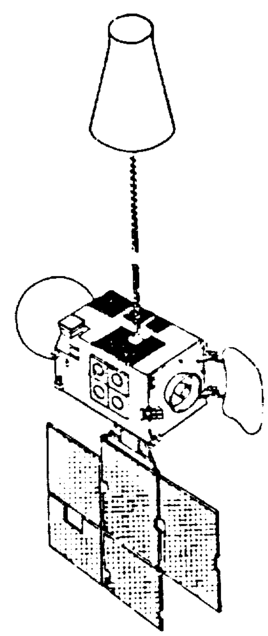
- POSTLANDING ACTIVITIES
  - LANDING AT DFRF, JUNE 24, 1985
  - MATING OF ORBITER TO SCA; TRANSPORT TO KSC
  - REMOVAL OF ASE FROM ORBITER BAY IN OPF FOR REFURBISHMENT IN PPF, CCAFS

AUSTRALIAN SATELLITES - AUSSAT-1, STS-27 (51-I) & AUSSAT-2, STS-31 (61-B):



- OWNED BY AUSTRALIAN NATIONAL SATELLITE COMMUNICATION SYSTEM; PROVIDES WIDE RANGE OF COMMUNICATION SERVICES TO CONTINENT & OFF-SHORE ISLANDS
- HUGHES 376 SERIES WITH SPOT BEAM ANTENNAS
- UPPER STAGE - PAM-D
- GROUND PROCESSING - PREFLIGHT
  - PPF, ASTROTECH - RECEIVING & INSPECTION; PRESSURE & LEAK CHECK
  - - ORDNANCE INSTALLATION
  - MRTB & NDTL, CCAFS - AKM COLD SOAK & X-RAY
  - PPF, ASTROTECH - AKM INSTALLATION
    - HYDRAZINE LOADING
    - S/C & PAM-D MATING
    - INTERFACE VERIFICATION
  - VPF - INSTALLATION INTO VPHD; PL FUNCTIONAL TESTING
  - LAUNCH PAD 39A - INSTALLATION INTO RSS; PL FUNCTIONAL TESTING
    - INSTALLATION INTO ORBITER
    - IVT
    - FINAL ORDNANCE CONNECTION
    - LAUNCH--STS-27 AUGUST 27, 1985;
      --STS-31 NOVEMBER 26, 1985
- POSTLANDING OPERATIONS
  - LANDING--STS-27 DFRF, SEPTEMBER 3, 1985; STS-31 DFRF, DECEMBER 3, 1985
  - MATE ORBITER TO SCA; TRANSPORT TO KSC
  - REMOVE ASE FROM ORBITER BAY IN OPF; TRANSPORT TO CCAFS PPF FOR REFURBISHMENT

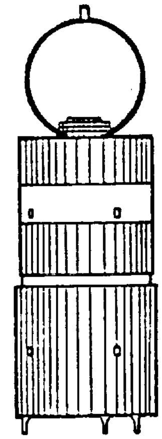
INDIAN SATELLITE 1-B (INSAT 1-B) - STS-8:



- SPONSORED BY INDIA'S DEPARTMENT OF SPACE TO PROVIDE INDIA WITH METEOROLOGICAL, TELECOMMUNICATIONS, & DIRECT BROADCAST TELEVISION SERVICES
- BUILT BY FORD AEROSPACE
- CONTAINS AKM, TELECOMMUNICATION ELECTRONICS, C- & S-BAND ANTENNAS, SOLAR ARRAY & SOLAR SAIL, & RCS; 3-AXIS STABILIZED S/C
- UPPER STAGE - PAM-D
- GROUND PROCESSING - PREFLIGHT
  - HANGAR AO, CCAFS - SATELLITE PREPARATION
  - ESA-60A, CCAFS - RCS FUELING WITH MMH & N204; LEAK TEST & SOLAR ARRAY TEST
    - MATING TO PAM-D; INTERFACE VERIFICATION
  - VPF - INSTALLED IN VPHD
    - CITE TESTING (IVT, END-TO-END TEST, MST)
  - LAUNCH PAD 39A - INSTALLED INTO ORBITER BAY
    - IVT
    - END-TO-END TEST
    - LAUNCH--AUGUST 30, 1983
- POSTLANDING ACTIVITIES
  - LANDING AT DFRF, SEPTEMBER 5, 1983
  - ORBITER MATED TO SCA; TRANSPORTED TO KSC
  - AIRBORNE SUPPORT EQUIPMENT REMOVED FROM BAY IN OPF
  - TRANSPORTED TO ESA-60A FOR REFURBISHMENT (PAM-D)
  - INSAT EQUIPMENT TO HANGAR AO

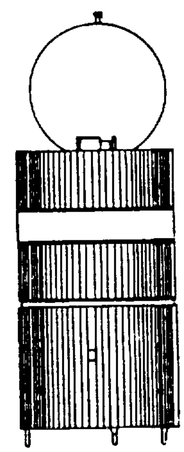
MORELOS-A - STS-25 (51-G)
MORELOS-B - STS-31 (61-B):

- HUGHES 376 SATELLITES OPERATING IN C- & Ku-BANDS SIMULTANEOUSLY
- OWNED BY MEXICO'S SECRETARIAT OF COMMUNICATIONS & TRANSPORTATION
- TO TRANSMIT EDUCATIONAL & COMMERCIAL TV PROGRAMS, TELEPHONE & FACSIMILE TRANSMISSIONS TO REMOTE AREAS; ALSO ALLOWS LIVE TV PROGRAMMING
- USED FIRST PLANAR ARRAY ON HS376 SATELLITE
- UPPER STAGE - PAM-D
- GROUND PROCESSING - PREFLIGHT
    - ASTROTECH - PRESSURE & LEAK CHECK
      - ORDNANCE INSTALLATION
      - AKM INSTALLATION
      - HYDRAZINE LOADING
      - S/C TO PAM-D MATE
      - INTERFACE VERIFICATION
    - VPF - INSTALLATION IN VPHD
      - FUNCTIONAL TESTING
    - LAUNCH PAD 39A - INSTALLATION INTO RSS; FUNCTIONAL TESTING
      - INSTALLATION INTO ORBITER; IVT; FINAL ORDNANCE CONNECTION
      - LAUNCHES--STS-25 JUNE 17, 1985;
STS-31 NOVEMBER 26, 1985
- POSTLANDING ACTIVITIES
    - LANDINGS - STS-25 AT DFRF, JUNE 24, 1985;
STS-31 AT DFRF, DECEMBER 3, 1985
    - REMOVE CRADLE & ASE FROM ORBITER IN OPF



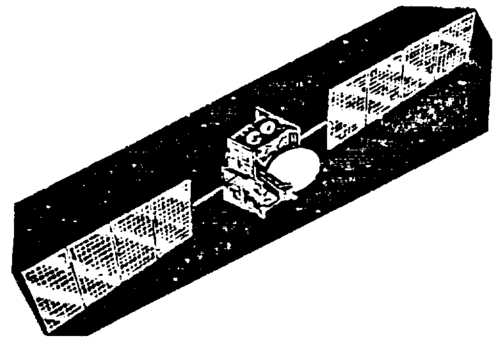
PALAPA - B-1 STS-7; B-2 STS-11 (41-B):

- HUGHES 376 SYNCHRONOUS COMMUNICATION SATELLITE FOR REPUBLIC OF INDONESIA, REPRESENTED BY PERUMTEL; SECOND GENERATION OF COMMUNICATION SATELLITES
- DESIGNED TO DELIVER VOICE, VIDEO, TELEPHONE & HIGH-SPEED DATA SERVICES TO INDONESIA, PHILIPPINES, THAILAND, MALAYSIA, SINGAPORE
- UPPER STAGE - PAM-D
- GROUND PROCESSING - PREFLIGHT
    - BUILDING AM, CCAFS - PRESSURE & LEAK CHECK
      - ORDNANCE INSTALLATION
    - ESA-60A, CCAFS - AKM INSTALLATION
      - ORDNANCE INSTALLATION
      - S/C & PAM-D MATING
      - INTERFACE VERIFICATION
    - VPF - INSTALLATION IN VPHD
      - BATTERY CHARGE
    - LAUNCH PAD 39A - INSTALLATION INTO ORBITER
      - IVT & E-E TESTING
      - LAUNCH--STS-7 JUNE 18, 1983;
STS-11 FEBRUARY 3, 1984
- POSTLANDING ACTIVITIES
    - LANDING--STS-7 AT DFRF, JUNE 24, 1983;
STS-11 AT KSC, FEBRUARY 11, 1984
    - REMOVAL OF ASE & CRADLE FROM ORBITER IN OPF
    - CRADLE REFURBISHMENT IN PPF, CCAFS



SATCOM Ku - SATCOM Ku-2 STS-31 (61-B); SATCOM Ku-1 STS-32 (61-C):

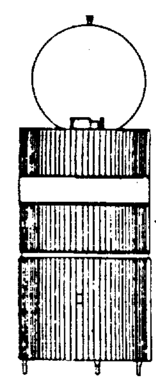
- PART OF SATELLITE SYSTEM OWNED & OPERATED BY RCA AMERICAN COMMUNICATIONS (AMERICOM)
- SATELLITE VERSION OF RCA 4000 SERIES, SIMILAR IN DESIGN TO ASC-1
- CARRIED 75-POUNDS EXTRA RCS PROPELLANT
- UPPER STAGE - PAM-D2 (FIRST USE WITH SATCOM Ku-2)
- GROUND PROCESSING - PREFLIGHT
  - MRTB & NDTL, CCAFS - AKM COLD SOAK & X-RAY
  - ASTROTECH - S/C RECEIVING & INSPECTION
- PRESSURE & LEAK CHECK; ORDNANCE INSTALLATION
- AKM INSTALLATION; HYDRAZINE LOADING
- S/C & PAM-D2 MATING; INTERFACE VERIFICATION
  - VPF - INSTALLATION IN VPHD
- PL FUNCTIONAL TESTING; IVT
  - LAUNCH PAD 39A - INSTALLATION INTO RSS
- FUNCTIONAL TESTING
- INSTALLATION INTO ORBITER BAY; IVT
- FINAL ORDNANCE CONNECTION & C/O
- LAUNCH--STS-31 NOVEMBER 26, 1985;
STS-32 JANUARY 12, 1986



- POSTLANDING ACTIVITIES
  - LANDINGS--STS-31 AT DFRF, DECEMBER 3, 1985;
STS-32 AT DFRF JANUARY 18, 1986
  - MATE ORBITER TO SCA; TRANSPORT TO KSC
  - REMOVE ASE FROM ORBITER BAY IN OPF

SATELLITE BUSINESS SYSTEMS SATELLITES - SBS-C (STS-5) & SBS-D (STS-14 [41-B]):

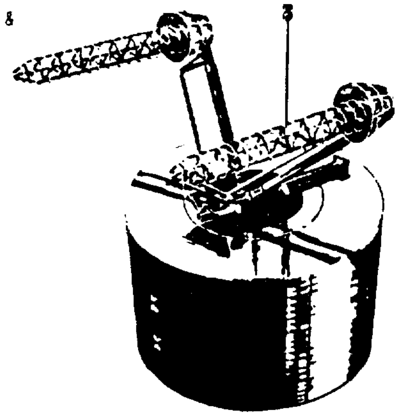
- HUGHES 376 COMMUNICATION SATELLITES SERVING BOTH PRIVATE INDUSTRY & GOVERNMENT USERS
- UPPER STAGE - PAM-D
- PROVIDE DOMESTIC DIGITAL COMMUNICATIONS FROM GEOSYNCHRONOUS ORBIT
- GROUND PROCESSING - PREFLIGHT
  - BUILDING AM, CCAFS - S/C LEAK CHECK & ORDNANCE INSTALLATION
  - SOLID MOTOR AREA (NDTL & MRTB) - C/O & COLD SOAK AKM & X-RAY
  - ESA-60A, CCAFS - AKM INSTALLATION
- ORDNANCE INSTALLATION
- MATE S/C TO PAM-D
- VERIFY INTERFACES
  - VPF - INSTALLATION IN VPHD
- P/L FUNCTIONAL CHECK
- CITE TEST
- BATTERY CHARGE
  - LAUNCH PAD 39A - INSTALLATION IN ORBITER
- PL COMPLEMENT IVT & E-E TEST
- LAUNCHES--STS-5 NOVEMBER 11, 1982;
STS-14 AUGUST 30, 1984



- POSTLANDING ACTIVITIES
  - LANDINGS--STS-5 AT DFRF NOVEMBER 15, 1983;
STS-14 AT DFRF SEPTEMBER 5, 1984
  - ORBITER MATE TO SCA; TRANSPORT TO KSC
  - REMOVE CRADLE & ASE FROM ORBITER IN OPF
  - TRANSPORT TO VPF FOR DEINTEGRATION

SYNCOM IV - "2" STS-14 (41-D), "1" STS-19 (51-A), "3" STS-23 (51-D), "4" STS-27 (51-I):

- ALSO CALLED "LEASAT" - SATELLITES TO REPLACE FLEETSATCOM SERIES TO PROVIDE WORLDWIDE COMMUNICATIONS FOR SHIPS & SUBMARINES FOR DOD
- HUGHES 381 SATELLITE EJECTED FROM ORBITER BAY IN FRISBEE-LIKE MANEUVER
- PERIGEE KICK MOTOR - MINUTEMAN III SOLID (ON BOARD S/C);
  APOGEE KICK MOTOR - LIQUID MOTOR USED TO GAIN ADDITIONAL ALTITUDE & CIRCULARIZE ORBIT

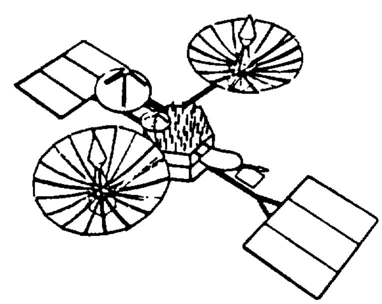


- GROUND PROCESSING - PREFLIGHT
  - SPIF (SNYCOM IV-2 & IV-1), SAEF-2 (SYNCOM IV-3 & IV-4)
    - S/C ASSEMBLY & PERFORMANCE TESTING
    - LIQUID APOGEE MOTOR & RCS SERVICING
    - PL FUNCTIONAL TESTING; SRM INSTALLATION
  - VPF - PL FUNCTIONAL TESTING (IV-2 & IV-1)
    - LRT (IV-2, IV-3, IV-4); IVT
  - LAUNCH PAD 39A - PL FUNCTIONAL TEST (IV-2 & IV-1)
    - LRT (IV-2, IV-3, & IV-4); IVT
    - ORDNANCE OPERATIONS; LAUNCH
- POSTLANDING ACTIVITIES - REMOVE CRADLE FROM ORBITER IN OPF
  - DEINTEGRATE IN VPF
  - RETURN TO HUGHES

LAUNCHES	LANDINGS
STS-14 AUGUST 30, 1984	DFRF SEPTEMBER 5, 1984
STS-19 NOVEMBER 8, 1984	KSC NOVEMBER 16, 1984
STS-23 APRIL 12, 1985	KSC APRIL 19, 1985
STS-27 AUGUST 27, 1985	DFRF SEPTEMBER 3, 1985

TRACKING & DATA RELAY SATELLITES - TDRS-A, STS-6
TDRS-B, STS-33 (51-L):

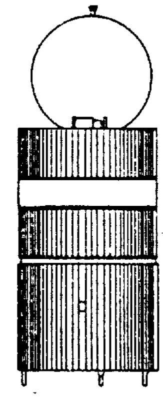
- PROVIDE ORBIT DETERMINATION & DATA ACQUISITION SUPPORT TO SCIENTIFIC & APPLICATIONS SATELLITES IN NEAR-EARTH ORBIT & TO SHUTTLE; BUILT BY TRW
- DESIGNED TO REPLACE MANY OF GROUND STATIONS IN NASA'S STDN & EXTEND CAPABILITIES; TWO TDRSs CAN PROVIDE REAL-TIME COVERAGE OF 85% OF EACH ORBIT OF USER S/C
- CONSISTS OF PL EQUIPMENT MODULE, S/C EQUIPMENT MODULE, RCS TANK ASSEMBLY, SOLAR ARRAY, & 4 ANTENNAS
  - 2 DEPLOYABLE PARABOLIC ANTENNAS (S- & Ku-BANDS)
  - PHASED ARRAY OF 30 HELICAL S-BAND RADIATORS
  - PARABOLIC REFLECTOR FOR Ku-BAND SIGNAL RELAY



- UPPER STAGE - INERTIAL UPPER STAGE (IUS)
- GROUND PROCESSING - PREFLIGHT
  - VPF - RECEIVING INSPECTION & PREPARATION
    - IUS & TDRS MATING (USER GSE IN BLDG. AO)
    - S/C FUNCTIONAL TEST; S/C/STDN/WSGT COMPATIBILITY TEST
    - INTERFACE CHECKS
    - CITE TESTING
  - LAUNCH PAD (STS-6, 39A; STS-33, 39B)
    - INSTALL IN RSS; IUS & TDRS C/O
    - TDRS HYDRAZINE LOADING
    - MATING WITH ORBITER; IVT & E-E TESTING
    - ORDNANCE INSTALLATION & CONNECTION
    - LAUNCH--STS-6 APRIL 4, 1983;
      STS-33 JANUARY 28, 1986
- POSTLANDING ACTIVITIES - STS-6 AT DFRF APRIL 9, 1983
  - TRANSPORT ORBITER TO KSC
  - REMOVE ASE FROM ORBITER IN OPF

TELESAT - "E" STS-5, "F" STS-7, "H" STS-19 (51-A), "I" STS-23 (51-D):

- HUGHES 376 SATELLITE SERIES CALLED ANIK C/D; COMPATIBLE WITH DELTA LAUNCH VEHICLE & SPACE SHUTTLE
- OWNED BY TELESAT CANADA, LTD; FIRST COMMUNICATION SATELLITES FOR CANADA
- UPPER STAGE - PAM-D
- GROUND PROCESSING - PREFLIGHT
  - BUILDING AM, CCAFS - RECEIVING, INSPECTION, PRESSURE & LEAK CHECK
    - ORDNANCE INSTALLATION
  - MRTB & NDTL, CCAFS - APOGEE KICK MOTOR (AKM) COLD SOAK & X-RAY
  - ESA-60A, CCAFS - AKM INSTALLATION; ORDNANCE INSTALLATION
    - MATING OF S/C & PAM-D; INTERFACE VERIFICATION
  - VPF - INSTALLATION INTO VPHD; PL FUNCTIONAL TEST
    - CITE TESTING
    - BATTERY CHARGE
  - LAUNCH PAD 39A - INSTALLATION INTO RSS; PL FUNCTIONAL TESTING
    - INSTALLATION INTO ORBITER
    - IVT & E-E TESTING; LAUNCH

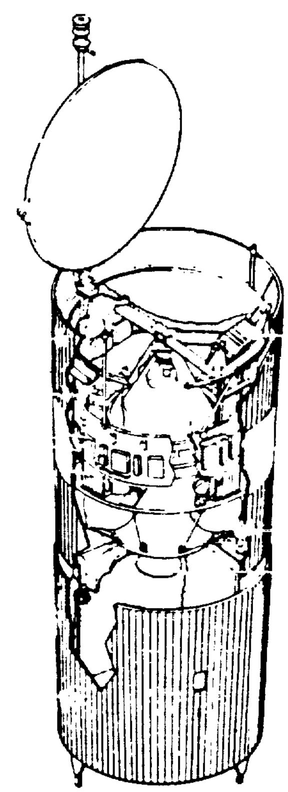


- POSTLANDING ACTIVITIES
  - TRANSPORT TO OPF
  - REMOVE ASE FROM ORBITER BAY IN OPF
  - TRANSPORT TO PPF FOR REFURBISHMENT

	LAUNCHES	LANDINGS
STS-5	NOVEMBER 11, 1982	DFRF NOVEMBER 16, 1982
STS-7	JUNE 18, 1983	DFRF JUNE 24, 1983
STS-19	NOVEMBER 8, 1984	KSC NOVEMBER 16, 1984
STS-23	APRIL 12, 1985	KSC APRIL 19, 1985

TELSTAR 3 - "C" STS-14 (41-D), "D" STS-25 (51-G):

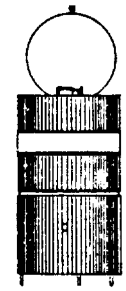
- HUGHES 376 COMMUNICATION SATELLITES OWNED BY AMERICAN TELEPHONE & TELEGRAPH COMPANY
- REPLACE CURRENT SATELLITES LEASED FROM COMSAT GENERAL CORP.
- TELSTAR 3-C, SECOND IN SERIES; TELSTAR 3-D, THIRD IN SERIES
- UPPER STAGE - PAM-D
- GROUND PROCESSING - PREFLIGHT
  - HPF, CCAFS (MRTB & NDTL) - AKM COLD SOAK & X-RAY
  - PPF (BLDG AM FOR TELSTAR 3-C; ASTROTECH FOR TELSTAR 3-D)
    - RECEIVING & INSPECTION
    - PRESSURE & LEAK CHECK
    - ORDNANCE INSTALLATION
  - HPF (ESA-60A FOR TELSTAR 3-C; ASTROTECH FOR TELSTAR 3-D)
    - AKM INSTALLATION
    - HYDRAZINE LOADING
    - MATING OF S/C & PAM-D
    - VERIFICATION OF INTERFACES
  - VPF - INSTALLATION INTO VPHD
    - PL FUNCTIONAL TEST & CITE TESTING (TELSTAR 3-C ONLY)
    - BATTERY CHARGE
  - LAUNCH PAD 39A - INSTALLATION INTO RSS
    - FUNCTIONAL TESTING
    - INSTALLATION INTO ORBITER; IVT
    - FINAL ORDNANCE CONNECTION
    - LAUNCHES--STS-14 AUGUST 30, 1984;
      STS-25 JUNE 17, 1985



- POSTLANDING ACTIVITIES
  - LANDINGS--STS-14 AT DFRF, SEPTEMBER 5, 1984;
    STS-25 AT DFRF, JUNE 24, 1985
  - MATE ORBITER TO SCA; TRANSPORT TO KSC
  - REMOVE ASE FROM ORBITER BAY IN OPF

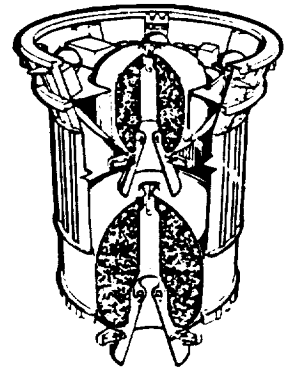
WESTAR-6 - STS-11 (41-B):

- HUGHES 376 COMMUNICATION SATELLITE TO RELAY VOICE, DATA, VIDEO, & FACSIMILE COMMUNICATIONS TO CONTINENTAL U.S., HAWAII, ALASKA, PUERTO RICO, & VIRGIN ISLANDS
- OWNED BY WESTERN UNION TELEGRAPH COMPANY
- UPPER STAGE - PAM-D
- GROUND PROCESSING - PREFLIGHT
  - BUILDING AM, CCAFS PPF OPERATIONS - PRESSURE & LEAK CHECK,
    - ORDNANCE INSTALLATION
  - ESA-60A (HPF) - INSTALL AKM
    - INSTALL ORDNANCE
    - MATE S/C TO PAM-D
    - VERIFY INTERFACES
  - VPF - INSTALL IN VPHD
    - CHARGE BATTERY
  - LAUNCH PAD 39A - INSTALL IN ORBITER
    - CONDUCT PL IVT & E-E TESTING
    - LAUNCH--FEBRUARY 3, 1984
- POSTLANDING ACTIVITIES
  - LANDING--KSC, FEBRUARY 11, 1984
  - REMOVE ASE & CRADLE FROM ORBITER IN OPF
  - ASE & CRADLE TO PPF FOR REFURBISHMENT

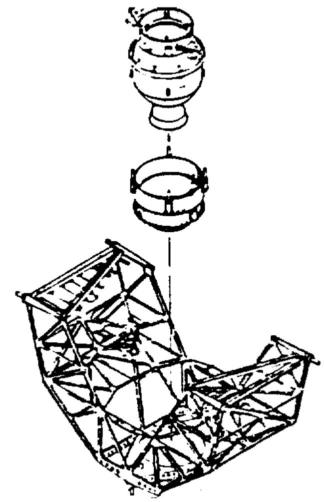


INERTIAL UPPER STAGE (IUS) - STS-6 & STS-33 (51-L):

- TWO-STAGE SOLID PROPELLANT BOOSTER CAPABLE OF PLACING 5000-POUND PAYLOAD INTO WIDE RANGE OF EARTH ORBITS; BUILT BY BOEING
- COMPATIBLE WITH STS ORBITER & TITAN LAUNCH VEHICLE
- CARRIER - CRADLE ASSEMBLY WITH DEPLOYABLE PAYLOAD ATTACH FITTING & ASSOCIATED AVIONICS
- GROUND PROCESSING - PREFLIGHT
  - SMAB - SOLID MOTOR BUILDUP
  - VPF - IUS & S/C MATE
    - TDRS C/O
    - CITE TESTING
    - INSTALLATION INTO CANISTER
  - LAUNCH PAD - 39A FOR STS-6; 39B FOR STS-33
    - IUS CHECKOUT IN RSS
    - INSTALLATION INTO ORBITER
    - IVT & END-TO-END TESTING
    - ORDNANCE INSTALLATION & CONNECTION
    - LAUNCH--STS-6 APRIL 4, 1983;
      STS-33 JANUARY 28, 1986
- POSTLANDING ACTIVITIES
  - LANDING - STS-6 DFRF APRIL 9, 1983;
    STS-33 NONE
  - REMOVAL OF ASE IN OPF



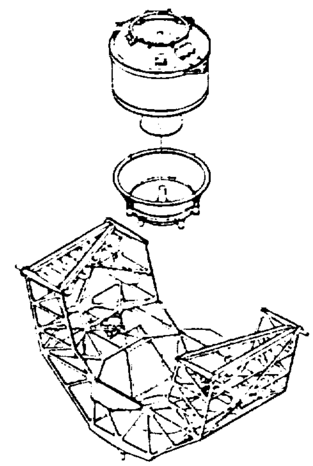
PAYLOAD ASSIST MODULE - DELTA CLASS (PAM-D) - STS-5, 7, 8, 11 (41-B), 14 (41-D), 19 (51-A), 23 (51-D), 25 (51-G), 27 (51-I), 31 (61-B), 32 (61-C):



- UPPER STAGE BUILT BY MDAC
- SOLID SPINNING STAGE CAPABLE OF BOOSTING 2750-POUND PAYLOAD INTO EARTH ORBIT WITH APOGEE OF MORE THAN 22,000 MILES
- COMPATIBLE WITH BOTH STS ORBITER & DELTA LAUNCH VEHICLE
- CARRIER - REUSABLE CRADLE WITH ATTACH FITTINGS & FUNCTIONAL SUBSYSTEMS
- GROUND PROCESSING - PREFLIGHT
  - NDTL, CCAFS - X-RAY SOLID MOTOR: COLD SOAK MOTOR (OPTIONAL)
  - HAZARDOUS PROCESSING FAC. (HPF) [DSTF OR ESA-60A, CCAFS OR ASTROTECH]
    - LEAK CHECK MOTOR & MATE TO ATTACH FITTING
    - INSTALL ORDNANCE; SPIN BALANCE EXPENDABLE STAGE (ESA-60 OR DSTF OR ASTROTECH)
    - VERIFY CONNECTIONS & INTERFACES
    - CHECK OUT CRADLE & ASE; MATE MOTOR & CRADLE
  - ESA-60A OR ASTROTECH - MATE S/C & PAM-D & CHECK OUT
  - VPF - INSTALL IN VPHD; PERFORM CITE (OPTIONAL)
  - LAUNCH PAD - INSTALL IN ORBITER
    - S/C IVT, E-E TEST, ORDNANCE CONNECTION
- POSTLANDING ACTIVITIES - REMOVE FROM ORBITER IN OPF; CRADLES & ASE TO HPF (CCAFS) OR ASTROTECH FOR REFURBISHMENT

LAUNCHES		LANDINGS	
STS-5	NOV 11, 1982	DFRF	NOV 16, 1982
STS-7	JUN 18, 1983	DFRF	JUN 24, 1983
STS-8	AUG 30, 1983	DFRF	SEP 5, 1983
STS-11	FEB 3, 1984	KSC	FEB 11, 1984
STS-14	AUG 30, 1984	DFRF	SEP 5, 1984
STS-19	NOV 8, 1984	KSC	NOV 16, 1984
STS-23	APR 12, 1985	KSC	APR 19, 1985
STS-25	JUN 17, 1985	DFRF	JUN 24, 1985
STS-27	AUG 27, 1985	DFRF	SEP 3, 1985
STS-31	NOV 26, 1985	DFRF	DEC 3, 1985
STS-32	JAN 12, 1986	DFRF	JAN 18, 1986

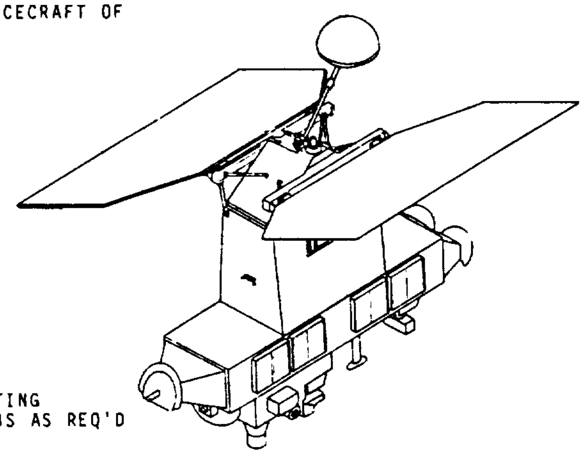
PAYLOAD ASSIST MODULE, DELTA CLASS II (PAM-D2) - STS-31 (61-B);
- STS-32 (61-C):



- UPPER STAGE BUILT BY MDAC
- CAPABLE OF BOOSTING 4160-POUND PAYLOAD INTO EARTH ORBIT
- LARGER SOLID MOTOR THAN PAM-D; DIFFERENT SPIN TABLE & SEP. SYSTEM
- LARGER SUNSHIELD THAN PAM-D
- CARRIER - SAME SIZE CRADLE AS FOR PAM-D
- GROUND PROCESSING - PREFLIGHT
  - NDTL, CCAFS - X-RAY MOTOR
  - HPF (CCAFS OR ASTROTECH) - LEAK CHECK MOTOR
    - MATE TO ATTACH FITTING
    - INSTALL ORDNANCE
    - SPIN BALANCE PAM-D2
    - VERIFY CONNECTIONS & INTERFACES
    - C/O ASE & CRADLE
    - MATE MOTOR & PAM-D2 CRADLE
    - MATE S/C TO PAM-D2
    - CHECK ELECTRICS; MAKE ASE CRADLE CONNECTIONS
  - VPF - INSTALL IN VPHD; CITE TESTING (OPTIONAL)
  - LAUNCH PAD 39A - INSTALL IN ORBITER; PL IVT & E-E TESTING
    - LAUNCH--STS-31, NOVEMBER 26, 1985;
      STS-32, JANUARY 12, 1986
- POSTLANDING ACTIVITES
  - LANDINGS--STS-31 AT DFRF, DECEMBER 3, 1985;
    STS-32 AT DFRF JANUARY 18, 1986
  - REMOVE ASE & CRADLE FROM ORBITER IN OPF AFTER TRANSPORT FROM DFRF

EARTH RADIATION BUDGET SATELLITE (ERBS) - STS-17 (41-G):

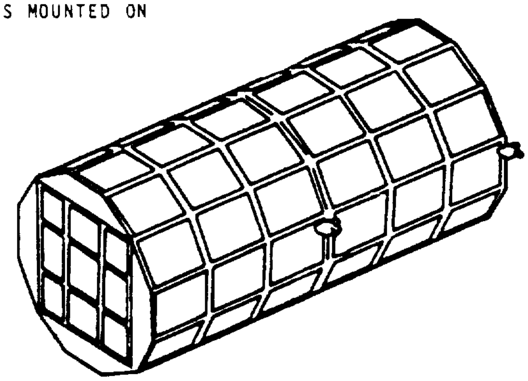
- SCIENTIFIC MONITORING OF EARTH RADIATION BUDGET; FIRST SPACECRAFT OF LONG-RANGE PROGRAM
- COOPERATIVE VENTURE BETWEEN NOAA & NASA
- S/C DEPLOYED FROM ORBITER BY RMS TO LOW-EARTH ORBIT
- S/C 3-AXIS MOMENTUM BIASED
- GROUND PROCESSING - PREFLIGHT
    - BUILDING AE - RECEIVING, INSPECTION, & C/O
        - POCC INTERFACE TEST
    - DSTF - PROPELLANT SERVICING
        - MOVE TO VPF IN PETS
    - VPF - INSTALLATION INTO VPHD
        - INTERFACE CHECKOUT
        - CITE & E-E TESTING
        - INSTALLATION INTO CANISTER
    - OPF - ASE INSTALLATION INTO ORBITER; SIMULATED TESTING
    - LAUNCH PAD 39A - INSTALLATION INTO RSS; SERVICING ERBS AS REQ'D
        - INSTALLATION INTO ORBITER BAY
        - INTERFACE TESTING; E-E TESTING
        - ORDNANCE INSTALLATION, ARMING, CONNECTING
        - BATTERY CHARGE THROUGH T-0
        - LAUNCH--OCTOBER 5, 1984



- POSTLANDING OPERATIONS
    - LANDING AT KSC, OCTOBER 13, 1984
    - REMOVE ASE FROM ORBITER IN OPF; TRANSPORT TO BUILDING AE

LONG DURATION EXPOSURE FACILITY-1 (LDEF-1) - STS-13 (41-C):

- STRUCTURE DESIGNED TO EXPOSE SCIENTIFIC EXPERIMENTS TO SPACE ENVIRONMENT FOR EXTENDED TIME; SPONSORED BY NASA HQ OFFICE OF AERONAUTICS & SPACE TECHNOLOGY (OAST) & LANGLEY RESEARCH CENTER (LaRC)
- 53 EXPERIMENTS FROM OVER 200 INVESTIGATORS ON BOARD IN 86 TRAYS MOUNTED ON LDEF; EXPERIMENTS TOTALLY SELF-CONTAINED
- DEPLOYED FROM ORBITER BAY BY RMS; DESIGNED FOR 1 YEAR IN SPACE
- GROUND PROCESSING - PREFLIGHT
    - SAEF-2 - EXPERIMENT C/O; INSTALLATION ONTO LDEF
        - WEIGHT & CG; PHOTOS
    - O&C BUILDING - INSTALL IN CANISTER
    - VAB - ROTATION TO VERTICAL
    - LAUNCH PAD 39A - INSTALLATION INTO RSS, THEN INTO ORBITER
        - LAUNCH--APRIL 6, 1984



- POSTLANDING ACTIVITIES
    - LANDING AT DFRF, APRIL 13, 1984
    - MATE ORBITER & SCA; TRANSPORT TO KSC
    - NO POSTLANDING ACTIVITIES FOR LDEF-1; ALL OF IT DEPLOYED

GETAWAY SPECIAL (GAS) PAYLOADS

- STANDARD
- DEPLOYED FROM BAY (GLOMR, IRT, NUSAT)
- NON-STANDARD (C360, IMAX PAYLOAD BAY CAMERA)

STANDARD GAS PAYLOADS

STS-3
--- GSFC FLIGHT VERIFICATION PAYLOAD (GAS TEST)

STS-4
G-001 GIL MOORE/UTAH STATE UNIVERSITY

STS-5
G-026 DFVLR (MAUS)

STS-6
G-381 PARK SEED CO.
G-049 USAF ACADEMY
G-005 ASAHI SHIMBUN, TOKYO, JAPAN

STS-7
G-012 RCA/CAMDEN NJ HIGH SCHOOL
G-033 CAL TECH
G-038 EDSYN INC.
G-009 PURDUE UNIVERSITY
G-002 KAYSER THREDE, W. GERMANY
G-345 GSFC/NAVAL RESEARCH LAB
G-305 AIR FORCE/NRL

STS-8
**G-347 GSFC NAVAL RESEARCH LAB.
G-346 GSFC/ADOLPHSON PROJECT CRUX
G-348 GSFC/McINTOSH
G-475 ASAHI SHIMBUN, TOKYO, JAPAN
----- 8 GAS CANS-ENVELOPES FOR U.S. POSTAL DEPT.

STS-11
**G-309 GSFC PROJECT CRUX, ADOLPHSON
G-051 GTE LABORATORIES, INC.
G-008 AIAA/UTAH STATE UNIVERSITY
G-004 UTAH STATE UNIVERSITY
G-349 GSFC/McINTOSH

STS-17 (41-G)
G-308 MARSHALL-MCSHANE, PRESCOTT, AZ
G-007 ALABAMA SPACE & ROCKET CENTER
G-306 USAF/NRL/ADAMS
G-032 ASAHI BROADCASTING, TOKYO, JAPAN
G-518 UTAH STATE UNIVERSITY
G-013 KAISER THREDE, W. GERMANY
G-074 MDAC, ST. LOUIS, MO
**G-469 ADOLPHSON (GSFC) PROJECT CRUX

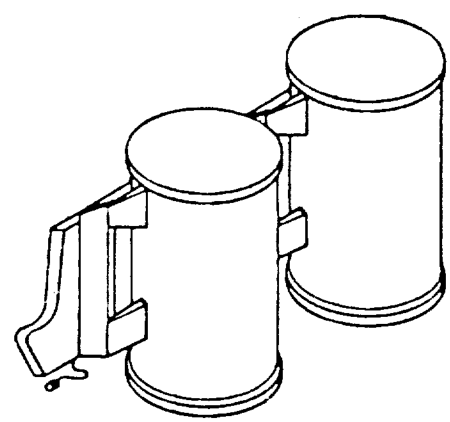
STS-23 (51-L)
G-471 GSFC/OLLENDORF
**G-035 TV ASAHI, TOKYO, JAPAN

STS-25 (51-G)
G-034 EL PASO/YSELTA SCHOOL DISTRICT
G-027 DFVLR (MAUS)
G-028 DFVLR (MAUS)
*G-471 GSFC/OLLENDORF
G-025 ERNO, W. GERMANY
G-314 USAF/NRL

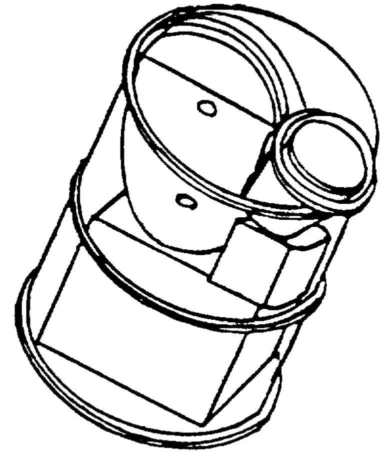
STS-31 (61B)
G-479 TELESAT, OTTAWA, CANADA

STS-32 (61-C)
G-464 NASA GSFC UVX
G-463 NASA GSFC UVX
G-462 NASA GSFC UVX
*G-007 ALABAMA SPACE & ROCKET CENTER
G-446 ALLTECH ASSOCIATES, DEERFIELD, IL
G-494 NRCC, ONTARIO, CANADA
G-EMP ENVIRONMENTAL MONITORING PACKAGE, GSFC
G-481 VERTICAL HORIZONS, FLUSHING, NY
G-062 PENN STATE/G.E. VALLEY FORGE, PA
G-449 ST. MARY'S HOSPITAL, MILWAUKEE, WI
G-332 BOOKER T. WASHINGTON, HOUSTON, TX
G-310 USAF ACADEMY, BOULDER CO
G-470 U.S. DEPT OF AGRICULTURE (USDA), GREENBELT, MD

*REFLIGHT AT NASA'S EXPENSE
**REFLIGHT AT OWNER'S EXPENSE

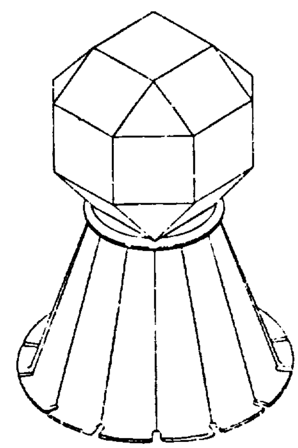


CINEMA 360° PAYLOAD BAY EXPERIMENT - STS-11 (41-B)



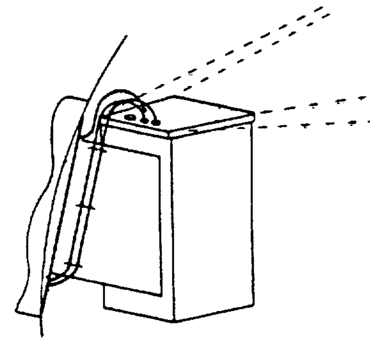
- CINEMA 360° CAMERA MOUNTED IN MODIFIED GAS CANISTER
- RECORDED ACTIVITIES IN PAYLOAD BAY DURING 2 MISSIONS
- GROUND PROCESSING - PREFLIGHT
  - PREPARED FOR FLIGHT IN O&C BUILDING OFF-LINE LAB
  - INSTALLED IN ORBITER IN OPF
  - ROTATED & STACKED WITH ORBITER IN VAB
  - LAUNCHED - STS-11, KSC, FEBRUARY 3, 1984
- POSTLANDING ACTIVITIES - STS-11 AT KSC, FEBRUARY 11, 1984
  - (NONE AT LANDING SITE)
  - PAYLOAD REMOVED FROM ORBITER IN OPF
  - DELIVERED TO PAYLOAD MISSION MANAGER

GLOBAL LOW-ORBITING MESSAGE RELAY (GLOMR) SATELLITE - STS-24 (51-B) & STS-30 (61-A):



- DEMONSTRATE ABILITY TO READ OUT & COMMAND OCEANOGRAPHIC SENSORS, LOCATING GROUND CUSTOMER EQUIPMENT, & COMMUNICATING BETWEEN THEM.
- MULTI-SIDED POLYHEDRON WITH BOTH SQUARE & TRIANGULAR SIDES & DI-POLE ANTENNAS
- CARRIER - GAS CANISTER WITH FULL-DIAMETER MOTORIZED DOOR ASSEMBLY LID
- GROUND PROCESSING - PREFLIGHT
  - GAS FACILITY, CCAFS - PREPARED FOR FLIGHT
  - OPF - INSTALLED IN ORBITER BAY; CHECKED OUT
  - VAB - ROTATED & STACKED WITH ORBITER
  - LAUNCH PAD 39A - LAUNCH--STS-24, APRIL 29, 1985;
STS-30, OCTOBER 30, 1985
- POSTLANDING ACTIVITIES - STS-24, MAY 6, 1985 AT DFRF;
STS-30, NOVEMBER 6, 1985 AT DFRF
  - ORBITER MATED TO SCA
  - TRANSPORTED TO KSC
  - REMOVED FROM ORBITER IN OPF
  - RETURNED TO PRINCIPAL INVESTIGATOR

IMAX PAYLOAD BAY CAMERA (IPBC) - STS-31 (61-B):

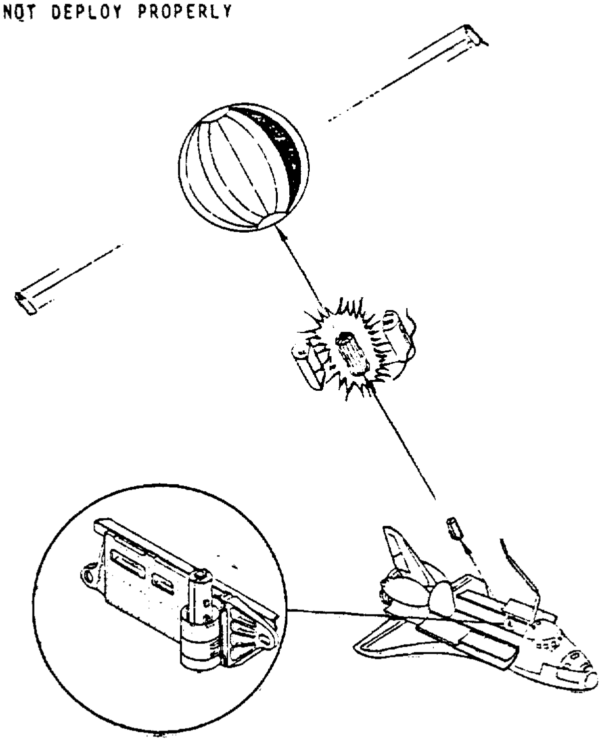


- IMAX CAMERA MOUNTED IN PRESSURE-SEALED CONTAINER WITH VIEWING WINDOW
- CONTAINER MOUNTED ON GAS ADAPTER BEAM ASSEMBLY
- USED TO FILM EASE/ACCESS EVA ON ORBIT
- GROUND PROCESSING - PREFLIGHT
  - PREPARED BY PI IN O&C BUILDING OFF-LINE LAB
  - INSTALLED ON GAS ADAPTER BEAM IN ORBITER BAY IN OPF
  - LAUNCHED FROM PAD 39A NOVEMBER 26, 1985
- POSTLANDING ACTIVITIES
  - LANDING AT DFRF DECEMBER 8, 1985
  - REMOVED FROM ORBITER BAY IN OPF
  - TRANSPORTED TO O&C BUILDING OFF-LINE LAB

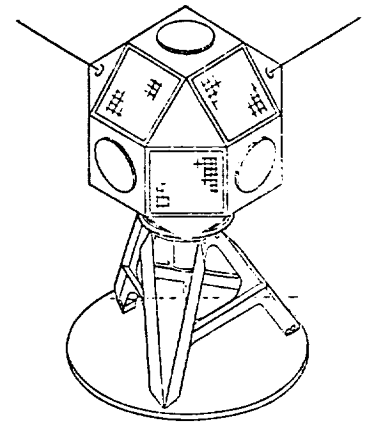
INTEGRATED RENDEZVOUS TARGET (IRT) - STS-11 (41-B):

- PAYLOAD EJECTED FROM ORBITER BAY; USED AS TARGET FOR RENDEZVOUS BY ORBITER
- CARRIER - CANISTER ASSEMBLY MOUNTED TO ORBITER BAY
- IRT EXERCISE TO SERVE AS TRAINING FOR SOLAR MAXIMUM MISSION (SMM) SATELLITE REPAIR SCHEDULED FOR STS-13
- GROUND PROCESSING - PREFLIGHT
  - O&C BUILDING - PREPARED FOR FLIGHT IN OFF-LINE LAB
  - OPF - INSTALLED INTO ORBITER BAY
  - VAB - ROTATED & STACKED WITH ORBITER
  - LAUNCH PAD 39A - LAUNCH FEBRUARY 3, 1984
- POSTLANDING ACTIVITIES - KSC, FEBRUARY 11, 1984
  - REMOVED FROM ORBITER BAY IN OPF
  - RETURNED TO O&C BUILDING LAB

NOTE: IRT DID NOT FUNCTION AS PLANNED ON ORBIT. IT DID NOT DEPLOY PROPERLY AFTER EJECTION FROM CANISTER.



NORTHERN UTAH SATELLITE (NUSAT) - STS-24 (51-B)

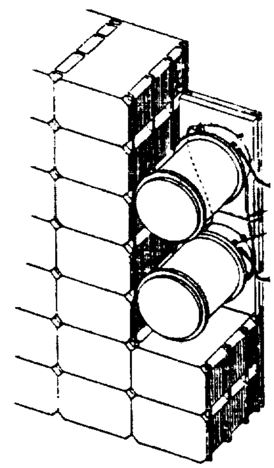


- DEMONSTRATE CAPABILITY FOR MEASURING ANTENNA PATTERNS OF AIR TRAFFIC CONTROL RADAR BEACONS USED IN GLOBAL NETWORK OPERATED BY FAA, U.S. MILITARY SERVICES, & FOREIGN GOVERNMENTS.
- MULTI-SIDED POLYHEDRON WITH BOTH SQUARE & TRIANGULAR SIDES THAT IS "EJECTED" FROM ITS CARRIER IN ORBITER BAY
- CARRIER - GAS CANISTER WITH FULL-DIAMETER MOTORIZED DOOR ASSEMBLY LID
- GROUND PROCESSING - PREFLIGHT
  - GAS FACILITY, CCAFS - PREPARED FOR FLIGHT
  - OPF - INSTALLED IN ORBITER BAY; CHECKED OUT
  - VAB - ROTATED & STACKED WITH ORBITER
  - LAUNCH PAD 39A - LAUNCHED AT KSC, APRIL 29, 1985
- POSTLANDING ACTIVITIES - MAY 6, 1985 DFRF
  - ORBITER MATED TO SCA
  - TRANSPORTED TO KSC
  - REMOVED FROM ORBITER IN OPF
  - RETURNED TO PRINCIPAL INVESTIGATOR

KSC-PROCESSED MIDDECK PAYLOADS

- ACES
- ARC
- ADSF
- CANEX
- C360
- CFES
- DMOS
- EEVT
- FEE
- IMAX
- IBSE
- IEF
- MLR
- MPSE
- PCOC
- PGU
- PVTOS
- SFMD

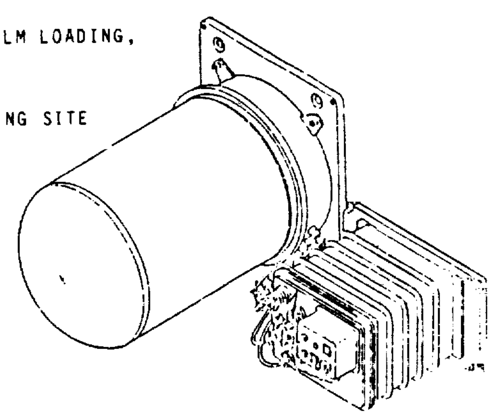
ACOUSTIC CONTAINERLESS EXPERIMENT SYSTEM (ACES) - STS-11 (41-B):



- 3-AXIS ACOUSTIC CONTAINMENT FURNACE WHICH PERFORMS PRE-PROGRAMMED SEQUENCE OF OPERATIONS ON MATERIAL SAMPLE
- CARRIER - TWO AIR-TIGHT CANISTERS OCCUPYING SPACE OF 4 MIDDECK LOCKERS
- GROUND PROCESSING - PREFLIGHT
    - O&C BUILDING - PREPARATION IN OFF-LINE LAB
    - OPF - INSTALLATION INTO ORBITER USING MLR HANDLING ADAPTER
    - LAUNCH - KSC, FEBRUARY 3, 1984
- POSTLANDING ACTIVITIES - LANDING KSC, FEBRUARY 11, 1984
    - REMOVAL FROM ORBITER IN OPF
    - RETURN TO PAYLOAD OWNER

AGGREGATION OF RED BLOOD CELLS (ARC) - STS-23 (51-D):*

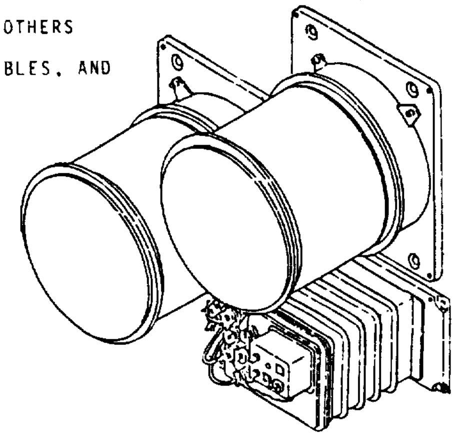
- AUSTRALIAN-DEVELOPED MIDDECK EXPERIMENT DESIGNED TO CONDUCT EXPERIMENTS TO SUPPLY INFORMATION ON KINETICS OF RED BLOOD CELL AGGREGATION, MORPHOLOGY, & VISCOSITY OF WHOLE BLOOD
- MOUNTED ON 3 ADAPTER PLATES IN PLACE OF 3 MIDDECK LOCKERS
- GROUND PROCESSING - PREFLIGHT
    - O&C BUILDING - OFF-LINE LAB SUPPORT FOR BLOOD GATHERING, FILM LOADING, & FINAL SERVICING
    - INSTALLATION INTO ORBITER AT LAUNCH PAD*
- DEINTEGRATION - REMOVAL OF TIME-CRITICAL BLOOD SAMPLES AT LANDING SITE



* PREPARED OFF-LINE AND READIED; NEVER INSTALLED IN ORBITER

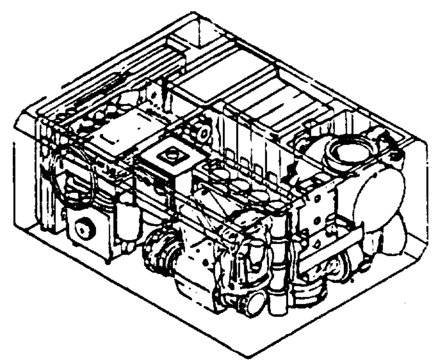
AUTOMATED DIRECTIONAL SOLIDIFICATION FURNACE (ADSF) - STS-25 (51-G):

- STORED IN SPACE OF 3 MIDDECK LOCKERS; REMAINDER OF SYSTEM TAKES 2 OTHERS
- PERFORMS DIRECTIONAL SOLIDIFICATION OF MAGNETIC MATERIALS, IMMISCIBLES, AND INFRARED DETECTORS; PERFORMS OFF-EUTECTIC GROWTH & SOLIDIFICATION (MATERIALS PROCESSING)
- GROUND PROCESSING - PREFLIGHT
  - KSC OFF-LINE PREPARATION IN O&C BUILDING
  - INSTALLATION IN MIDDECK IN OPF
  - LAUNCH PAD 39A - LAUNCH JUNE 17, 1985
- POSTLANDING ACTIVITIES
  - LANDING - DFRF, JUNE 24, 1985
  - REMOVE ADSF FROM MIDDECK IN OPF



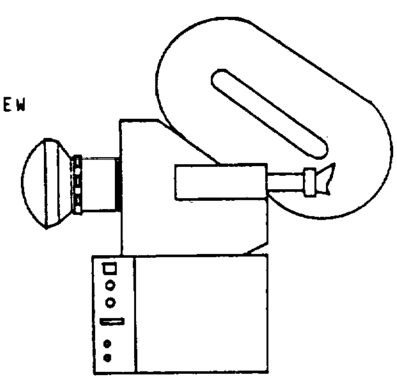
CANADIAN EXPERIMENTS (CANEX) - STS-17 (41-G)

- FIVE EXPERIMENTS PERFORMED BY CANADIAN PAYLOAD SPECIALIST
  - SPACE ADAPTATION SYNDROME SUPPLEMENTARY EXPERIMENTS (SASSE)
  - ORBITER GLOW (OGLOW)
  - ADVANCED COMPOSITE MATERIALS EXPOSURE (ACOMEX)
  - SPACE VISION SYSTEM EXPERIMENT DEVELOPMENT TEST (VISET)
  - SUN PHOTOMETER EARTH ATMOSPHERE MEASUREMENTS (SPEAM)
- CARRIER - ONE MIDDECK LOCKER VOLUME
- GROUND PROCESSING - PREFLIGHT
  - OPF - SPEAM IS CALIBRATED; ACOMEX SAMPLES MOUNTED ON RMS
  - LAUNCH PAD 39A - LOCKER INSTALLED INTO MIDDECK
    - LAUNCH OCTOBER 5, 1984
- POSTLANDING ACTIVITIES
  - LANDING - KSC, OCTOBER 13, 1984
  - REMOVED FROM MIDDECK IN OPF



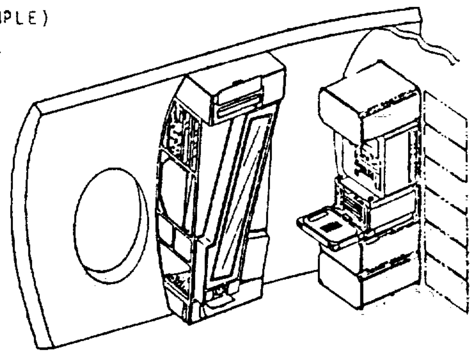
CINEMA 360° MIDDECK EXPERIMENT - STS-11 (14B):

- CINEMA 360° HANDHELD CAMERA FOR USE IN CREW COMPARTMENT TO RECORD CREW ACTIVITIES; STOWED IN MIDDECK LOCKER
- GROUND PROCESSING - PREFLIGHT
  - O&C BUILDING - PREPARED FOR MISSION IN OFF-LINE LAB
  - LAUNCH PAD - INSTALLED IN ORBITER MIDDECK LOCKER
    - LAUNCHED KSC, FEBRUARY 3, 1984
- POSTLANDING ACTIVITIES
  - LANDING - KSC, FEBRUARY 11, 1984
  - REMOVED FROM ORBITER MIDDECK IN OPF
  - RETURNED TO PAYLOAD MISSION MANAGER



CONTINUOUS FLOW ELECTROPHORESIS SYSTEM (CFES) - STS-4, 6, 7, 8, 14 (41-D), 23 (51-D), 31 (61-B):

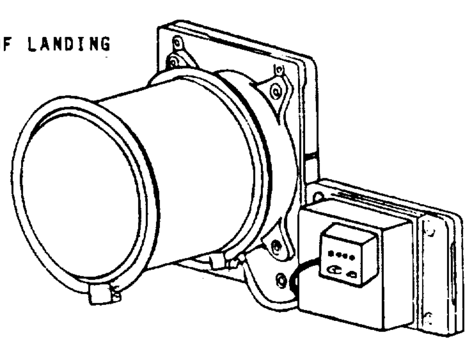
- JOINT VENTURE AMONG ORTHO PHARMACEUTICALS, MDAC, & NASA
- USES ELECTROPHORESIS PROCESS TO SEPARATE PHARMACEUTICAL SAMPLES IN MICRO-GRAVITY
- THREE DIFFERENT BLOCK MODULES OF CFES:
  - BLOCK I - STS-4 (AIR-COOLED; COLLECTED 6 SAMPLES)
  - BLOCK II - STS-6, 7 & 8 (WATER COOLED; COLLECTED 6 SAMPLES)
  - BLOCK III - STS-14 (41-D), STS-23 (51-D), STS-31 (61-B) (ONE LARGE SAMPLE; FIRST TRUE CONTINUOUS FLOW SAMPLE)
- FORERUNNER OF ELECTROPHORESIS OPERATIONS IN SPACE (EOS) ON PALLET
- GROUND PROCESSING - PREFLIGHT
  - O&C BUILDING & LSSF, CCAFS USED FOR OFF-LINE LAB SUPPORT
  - HARDWARE INSTALLED IN MIDDECK IN OPF
  - SAMPLES INSTALLED AS LATE ACCESS TO MIDDECK AT LAUNCH PAD
  - CFES SERVICED, AT PAD, 5 AND 2 DAYS BEFORE LAUNCH
- POSTLANDING
  - SAMPLES REMOVED AT LANDING SITE
  - HARDWARE REMOVED IN OPF



MISSION	LAUNCH	LANDING
STS-4	KSC, JUNE 27, 1982	DFRF, JULY 4, 1982
STS-6	KSC, APRIL 4, 1983	DFRF, APRIL 9, 1983
STS-7	KSC, JUNE 18, 1983	DFRF, JUNE 24, 1983
STS-8	KSC, AUGUST 30, 1983	DFRF, SEPTEMBER 5, 1983
STS-14	KSC, AUGUST 30, 1984	DFRF, SEPTEMBER 5, 1984
STS-23	KSC, APRIL 12, 1985	KSC, APRIL 19, 1985
STS-31	KSC, NOVEMBER 26, 1985	DFRF, DECEMBER 3, 1985

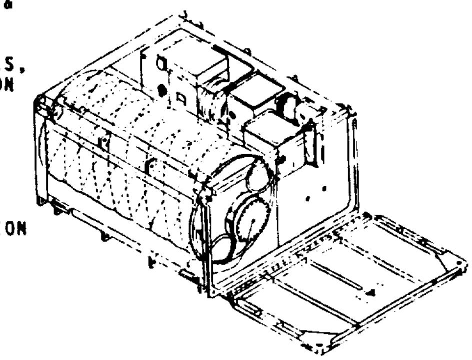
DIFFUSE MIXING OF ORGANIC SOLUTIONS (DMOS) - STS-19 (51-A) & STS-31 (61-B):

- 3M EXPERIMENT DESIGNED TO GROW CRYSTALS FROM COMBINATION OF ORGANIC SOLUTIONS
- CARRIER - APPARATUS THAT OCCUPIES SPACE OF 3 MIDDECK LOCKERS
- GROUND PROCESSING - PREFLIGHT
  - O&C BUILDING - OFF-LINE LABORATORY SUPPORT TO GAS CHROMATOGRAPHIC TEST & LEAK CHECK
  - LAUNCH PAD 39A - INSTALLATION INTO MIDDECK WITHIN 36 HOURS OF LAUNCH
    - LAUNCHES--STS-19, NOVEMBER 8, 1984;
      STS-31, NOVEMBER 26, 1985
- POSTLANDING ACTIVITIES - REMOVED FROM ORBITER WITHIN 24 HOURS OF LANDING
  - STS-19, KSC - NOVEMBER 16, 1984
  - STS-31, DFRF - DECEMBER 3, 1985



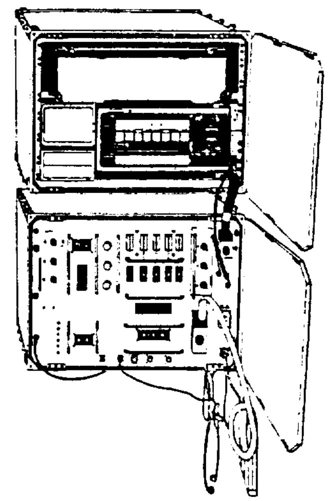
ELECTROPHORESIS EQUIPMENT VERIFICATION TEST (EEVT) - STS-3:

- JSC PAYLOAD INTENDED TO VERIFY ELECTROPHORESIS EQUIPMENT AS APPROPRIATE HARDWARE FOR USE IN SEPARATING INDIVIDUAL FUNCTIONING BIOLOGICAL CELLS & LARGE MOLECULES
- EQUIPMENT - ELECTROPHORESIS UNIT, CRYOGENIC FREEZER FOR BIOLOGICAL CELLS, CAMERA SYSTEM, & TAPE RECORDER FOR ON-ORBIT DATA COLLECTION
- CARRIER - LOCKER & ELECTROPHORESIS UNIT THAT TAKES PLACE OF ONE MIDDECK LOCKER
- GROUND PROCESSING - PREFLIGHT
  - O&C BUILDING - OFF-LINE LAB SUPPORT FOR HARDWARE & SAMPLE PREPARATION
  - OPF - INTERFACE VERIFICATION
  - O&C BUILDING - FINAL PREPARATION FOR FLIGHT
  - LAUNCH PAD 39A - FLIGHT HARDWARE STOWED IN MIDDECK AS LATE ACCESS (WITHIN 23 HOURS OF LAUNCH)
    - LAUNCH, MARCH 22, 1982
- POSTLANDING ACTIVITIES
  - LANDING - DFRF, MARCH 30, 1982
  - EEVT REMOVED FROM MIDDECK AT LANDING SITE WITHIN 23 HOURS OF LANDING
  - EEVT TURNED OVER TO PAYLOAD MISSION MANAGER



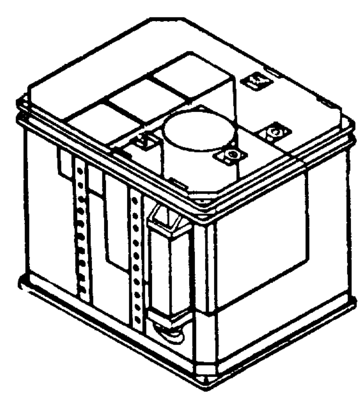
FRENCH ECHOCARDIOGRAPH EXPERIMENT (FEE) - STS-25 (51-G):

- ULTRASONIC EXPLORATION & DOPPLER AFFECT USED TO QUANTITATIVELY LOCATE POSITION & BLOOD FLOW MEASUREMENTS OF CARDIOVASCULAR SYSTEM
- SPONSORED BY CNES, FRANCE; TO BE PERFORMED BY FRENCH PAYLOAD SPECIALIST
- CARRIER - TWO DOUBLE MIDDECK LOCKERS; OCCUPIED SPACE OF 4 LOCKERS
- GROUND PROCESSING - PREFLIGHT
  - O&C BUILDING - OFF-LINE LAB FOR PREINSTALLATION PROCESSING
  - LAUNCH PAD 39A - INSTALLATION INTO ORBITER MIDDECK
    - LAUNCH JUNE 17, 1985
- POSTLANDING ACTIVITIES
  - LANDING AT DFRF, JUNE 24, 1985
  - REMOVAL OF FEE FROM ORBITER MIDDECK IN OPF



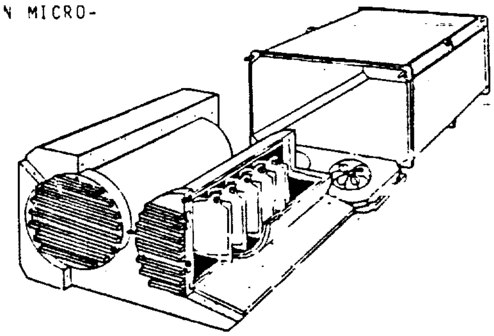
IMAX MIDDECK PAYLOAD - STS-13 (41-C), STS-14 (41-D), STS-17 (41G):

- COLOR MOTION PICTURE CAMERA USING SPECIAL 70 MM X 280 MM FILM
- STOWED IN MIDDECK LOCKER
- USED TO FILM IN-CABIN ACTIVITIES & ORBITER BAY ACTIVITIES THROUGH AFD WINDOW
- IMAX SPONSORED BY CANADIAN COMPANY BY SAME NAME
- GROUND PROCESSING - PREFLIGHT
  - PREPARED BY PRINCIPAL INVESTIGATOR (PI) OFF-LINE (JSC OR KSC LAB)
  - INSTALLED IN MIDDECK AT LAUNCH PAD
  - LAUNCHES FROM PAD 39A - STS-13, APRIL 6, 1984;
    - STS-14, AUGUST 30, 1984;
    - STS-17, OCTOBER 5, 1984
- POSTLANDING ACTIVITIES
  - LANDINGS - STS-13 AT DFRF, APRIL 13, 1984;
    - STS-14 AT DFRF, SEPTEMBER 5, 1984;
    - STS-17 AT DFRF, OCTOBER 13, 1984
  - REMOVE FROM MIDDECK IN OPF
  - RETURN FILM TO PI, HARDWARE TO JSC



INITIAL BLOOD STORAGE EXPERIMENT (IBSE) - STS-32 (61-C):

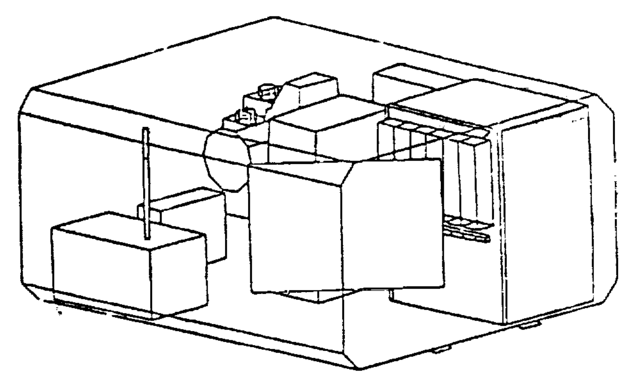
- STUDY STORAGE CHARACTERISTICS OF WHOLE BLOOD & BLOOD PLASMA IN MICRO-GRAVITY; STUDY SEDIMENTATION EFFECTS OF BOTH
- CARRIER - 2 MIDDECK LOCKERS
- GROUND PROCESSING - PREFLIGHT
  - O&C BUILDING - OFF-LINE LAB FOR PREFLIGHT C/O
  - LAUNCH PAD 39A - INSTALLATION IN ORBITER, L-9H, 20 MIN
    - LAUNCH JANUARY 12, 1986
- POSTLANDING ACTIVITIES
  - LANDING DFRF, JANUARY 18, 1986
  - REMOVAL FROM MIDDECK WITHIN 2 HOURS AFTER LANDING



NOTE: IBSE REQUIRES BLOOD SAMPLES DRAWN NO EARLIER THAN 24 HOURS BEFORE FLIGHT.

ISOELECTRIC FOCUSING EXPERIMENT (IEF) - STS-11 (41-B):

- GATHERS DATA ON ELECTRO-OSMOSIS IN SPACE, USING TECHNIQUE FOR SEPARATING COMPOUNDS BY USING DIFFERENCES IN ELECTRICAL & CHEMICAL PROPERTIES
- CARRIER - CONTAINER THAT REPLACES ONE ORBITER MIDDECK LOCKER
- GROUND PROCESSING - PREFLIGHT
  - O&C BUILDING - OFF-LINE LAB PREPARATION
  - LAUNCH PAD 39A - INSTALLATION INTO ORBITER MIDDECK WITHIN 24 HOURS OF LAUNCH
    - LAUNCH FEBRUARY 3, 1984
- POSTLANDING ACTIVITIES - KSC, FEBRUARY 11, 1984
  - REMOVED FROM MIDDECK IN OPF
  - DEINTEGRATION IN O&C BUILDING OFF-LINE LAB



MONODISPERSE LATEX REACTOR (MLR) - STS-3, 4, 6, 7, 11 (41-B):

- DESIGNED TO PRODUCE UNIFORMLY-SIZED, LARGE MONODISPERSE LATEX PARTICLES FOR USE IN CANCER RESEARCH, GLAUCOMA RESEARCH, DRUG DELIVERY MEDIUMS, CALIBRATION STANDARDS, CHROMATOGRAPHY, & ANTI-BLOCKING AGENTS IN PLASTIC MANUFACTURING

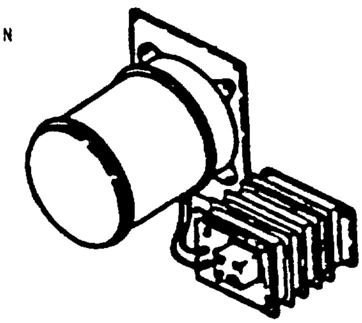
- CARRIER - CONTAINER WITH REACTOR & SUPPORT ELECTRONICS PACKAGE OCCUPYING SPACE OF 3 MIDDECK LOCKERS

- GROUND PROCESSING - PREFLIGHT

  - O&C BUILDING OFF-LINE LAB - PREFLIGHT SAMPLE & HARDWARE PREPARATION
  - LAUNCH PAD 39A - INSTALLED IN MIDDECK L-48 HOURS (OR LESS)

- POSTLANDING ACTIVITIES - REMOVED AT LANDING SITE USING MLR HORIZONTAL HANDLING DEVICE

MISSION	LAUNCHES	LANDINGS
STS-3	MARCH 22, 1982	DFRF, MARCH 30, 1982
STS-4	JUNE 27, 1982	DFRF, JULY 4, 1982
STS-6	APRIL 4, 1983	DFRF, APRIL 9, 1983
STS-7	JUNE 18, 1983	DFRF, JUNE 24, 1983
STS-11	FEBRUARY 3, 1984	KSC, FEBRUARY 11, 1984



MEXICAN PAYLOAD SPECIALIST EXPERIMENTS (MPSE) - STS-31 (61-B):

- 5 EXPERIMENTS OBSERVING PLANT GROWTH, BACTERIA REPRODUCTION & GROWTH, VITAL ENERGY BALANCE STATES OF PS, PHOTOGRAPHY OF MEXICO FOR EARTH RESOURCES PURPOSES

- CARRIER - ONE MIDDECK LOCKER

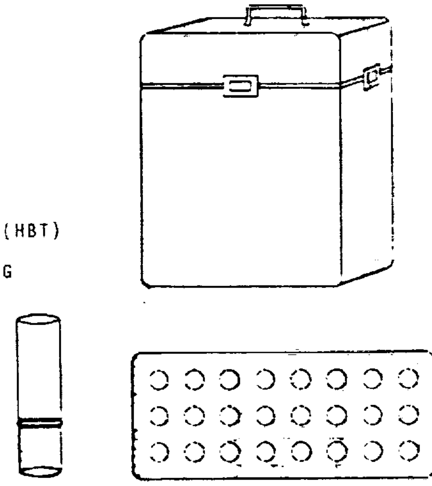
- GROUND PROCESSING - PREFLIGHT

  - O&C BUILDING - OFF-LINE LAB FOR PREFLIGHT C/O & PROCESSING
  - LAUNCH PAD 39A - INSTALLATION INTO ORBITER AS LATE ACCESS
    - LAUNCH NOVEMBER 26, 1985

- POSTLANDING ACTIVITIES

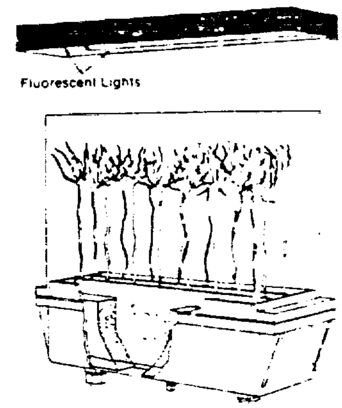
  - LANDING AT DFRF, DECEMBER 3, 1985
  - REMOVAL FROM MIDDECK AT LANDING SITE
  - RETURN TO PI WITHIN 2 HOURS OF LANDING

PLANT CARRY-ON CONTAINER (PCOC) - STS-2 & STS-3:



- STANDARD CARRIER FOR USE IN VARIETY OF PLANT GROWTH STUDIES
- TAKES PLACE OF MIDDECK LOCKER
- PREPARED & LOADED WITH SPECIMENS IN OFF-LINE LAB
- LATE ACCESS INSTALLATION IN ORBITER AT LAUNCH PAD 39A
- LAUNCHED ON STS-2, NOVEMBER 12, 1981 WITH HEFLEX BIOENGINEERING TEST (HBT) [SUNFLOWER SEEDS] TO DETERMINE NORMAL GROWTH CURVE RELATION TO SOIL MOISTURE; ON STS-3, MARCH 22, 1982 WITH SEEDS TO STUDY NUTATION DURING GROWTH
- REMOVED FROM ORBITER MIDDECK AS EARLY POSTLANDING ACCESS AT DFRF, NOVEMBER 14, 1981 & MARCH 30, 1982
- RETURNED TO PRINCIPAL INVESTIGATOR

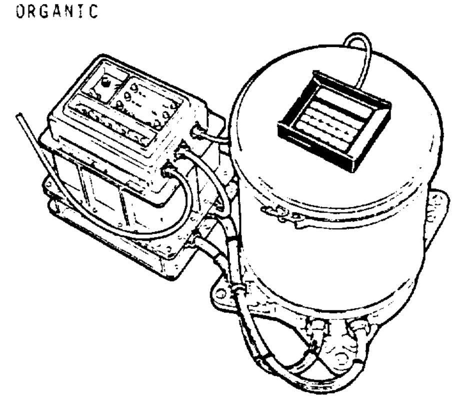
PLANT GROWTH UNIT (PGU) - STS-3:



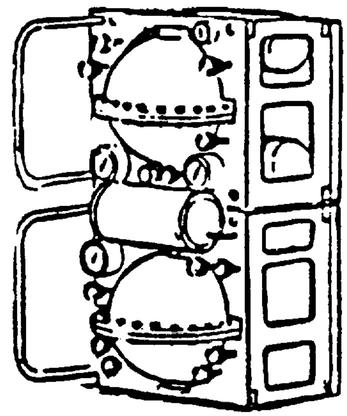
- STANDARD CARRIER FOR USE IN VARIETY OF PLANT GROWTH STUDIES
- TAKES PLACE OF MIDDECK LOCKER
- OFF-LINE FACILITY SUPPORT PROVIDED AT O&C BLDG (STS-3) OR LSSF, CCAFS
- TRANSPORTED IN KSC ISOPOD TO LAUNCH PAD 39A
- LATE ACCESS INSTALLATION IN ORBITER - MARCH 22, 1982
- REMOVED FROM MIDDECK AS EARLY POSTLANDING ACCESS - DFRF, MARCH 30, 1982

PHYSICAL VAPOR TRANSPORT OF ORGANIC SOLIDS (PVTOS) - STS-27 (51-I):

- ORGANIC MATERIALS PROCESSING EXPERIMENT SPONSORED BY 3M
- OCCUPIES SPACE OF 3 MIDDECK LOCKERS
- USES SAME APPARATUS AS DMOS; STUDIES PHYSICAL VAPOR TRANSPORT OF ORGANIC SOLIDS
- GROUND PROCESSING - PREFLIGHT
  - O&C BUILDING - OFF-LINE LAB PREPARATION
  - OPF - FIT CHECKS & VERIFICATION TESTING
  - LAUNCH PAD 39A - INSTALLED IN MIDDECK 5 DAYS BEFORE LAUNCH - LAUNCH AUGUST 27, 1985
- POSTLANDING ACTIVITIES
  - LANDING AT DFRF, SEPTEMBER 3, 1985
  - TRANSPORTED TO KSC
  - REMOVED FROM ORBITER MIDDECK IN OPF



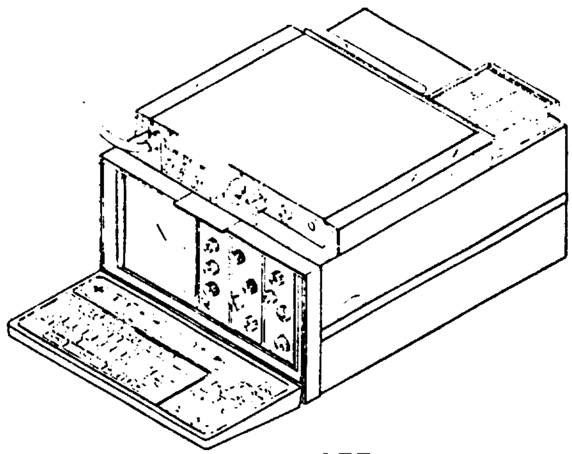
STORABLE FLUID MANAGEMENT DEMONSTRATION (SFMD) - STS-20 (51-C):



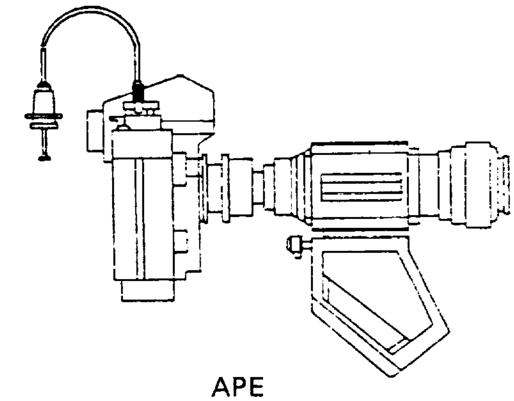
- DEMONSTRATES ON-ORBIT REFUELING PROCEDURES
- CARRIER - STRUCTURE MOUNTED ON TWO DOUBLE-ADAPTER PLATES; TAKE PLACE OF 4 MIDDECK LOCKERS
- GROUND PROCESSING - PREFLIGHT
  - O&C BUILDING - OFF-LINE LAB INSPECTION, TESTING, FLT PREPARATION
  - OPF - INSTALLATION INTO ORBITER MIDDECK, LEAK TESTS PERFORMED
  - VAB - ROTATION & STACKING WITH ORBITER
  - LAUNCH PAD 39A - LAUNCHED JANUARY 24, 1985
- POSTLANDING ACTIVITIES
  - LANDING KSC, JANUARY 27, 1985
  - EXPERIMENT HARDWARE SAFED AT SLF
  - REMOVAL OF SFMD FROM MIDDECK IN OPF

PRE-PACKED MIDDECK PAYLOADS REQUIRING NO KSC PROCESSING EXCEPT ORBITER INSTALLATION

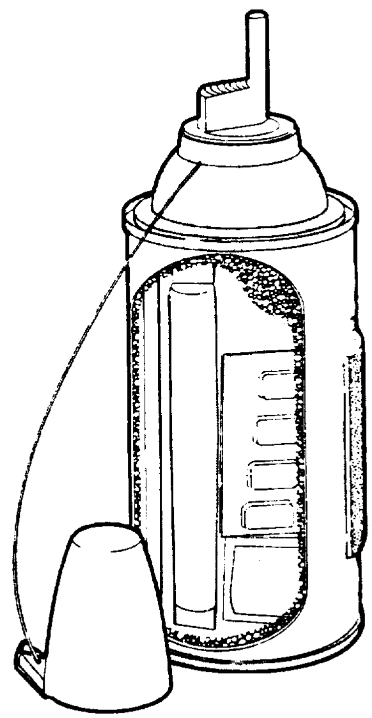
Pre-Packed Payload	Title	Major Objectives	Flown On STS Mission
AFE	American Flight Echocardiograph	Obtain clinical grade echocardiogram (with 4 views) as soon after orbital insertion as possible and prior to sleep on first day of flight.	51-D (STS-23)
APE	Aurora Photography Experiment	Photograph auroras at higher latitudes and view and photograph any effects on the orbiter.	41-G (STS-17)
CBDE	Carbonated Beverage Development Experiment	Determine best container for carbonated drink in space (Pepsi & Coca-Cola sponsored).	51-F (STS-26)
CHAMP	Comet Halley Active Monitoring Program	Obtain photographs and spectra of Halley's Comet on several flights so that both dynamic and morphological behavior as well as chemical structure of Comet Halley can be deduced.	61-C (STS-32) 51-L (STS-33)
CLOUDS	Clouds	Photograph broken clouds with a vertical structure over specific target areas.	41-D (STS-14)
FDE	Fluid Dynamic Experiment	Perform 6 distinct investigations designed to improve understanding of fluid dynamics under microgravity and orbiter-maneuvering conditions.	51-L (STS-33)
FPE	French Postural Experiment	Use sensors, tape recorders, and 16mm film film to record measurement of EMG activity of muscles, angular head movement, and eye movement to better understand adaptation of postural control in microgravity.	51-G (STS-25)
GLOW	Earth Glow	Study the Earth glow from low-Earth orbit.	STS-5
NOSL	Night/Day Optical Survey of Thunderstorm Lightning	Study through photographs lightning in cloud tops from space.	STS-4, 6
PPE	Phase Partitioning Experiment	Examine phase partitioning in the zero-g environment for comparison to one-g results (still and video filming used for recording).	51-D (STS-23) 51-L (STS-33)
RME	Radiation Monitoring Equipment	Actively measure the level of gamma radiation present at various times in the orbiter crew cabin.	STS-8, STS11 41-C (STS-13) 41-D (STS-14R) 41-G (STS-17) 51-A (STS-19)
SAREX	Shuttle Amateur Radio Experiment	Sponsored by Huntsville, AL Assn for Amateur Radio Operators.	51-F (STS-26)
SAS	Space Adaptation Syndrome	Examine the mechanisms that produce the symptoms of SAS.	STS-7, 51-D (STS-23)
STTP	Life Science Space Technology Training Program	Provide promising minority college students an opportunity to conduct a Shuttle experiment.	51-F (STS-26)
TISP	Teacher in Space Project	Demonstrate effects of microgravity on hydroponics, magnetism, Newton's laws, effervescence, chromatography, and operation of simple machines.	51-L (STS-33)
TLD	Thermoluminescent Dosimeter	Measure gamma radiation exposure doses in flight.	41-G (STS-17)



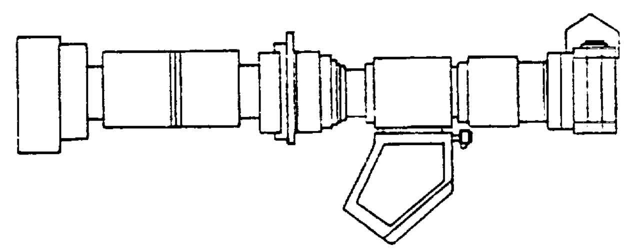
AFE



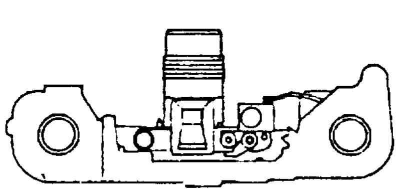
APE



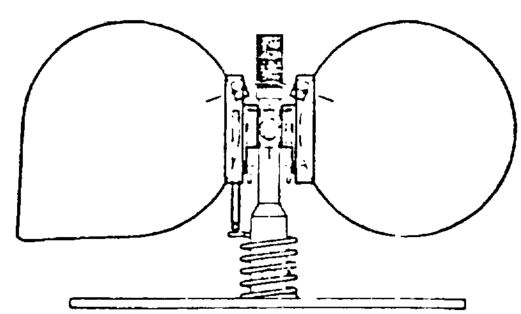
CBDE



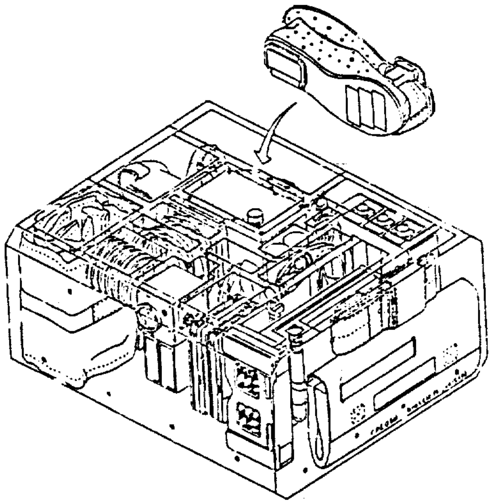
CHAMP



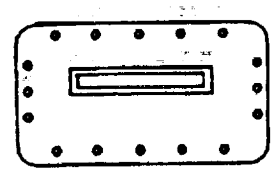
CLOUDS



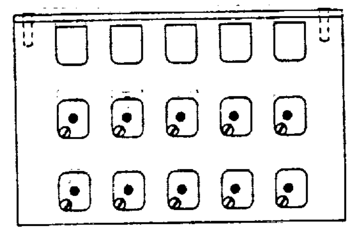
FDE



FPE

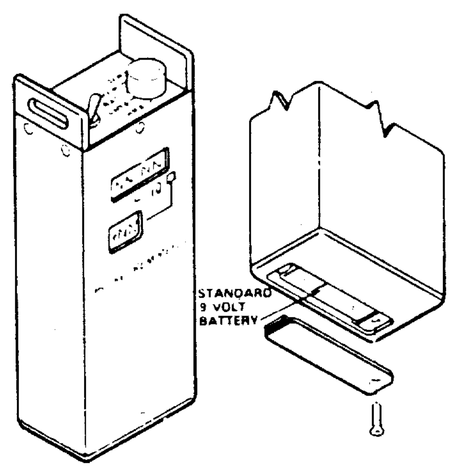


GLOW

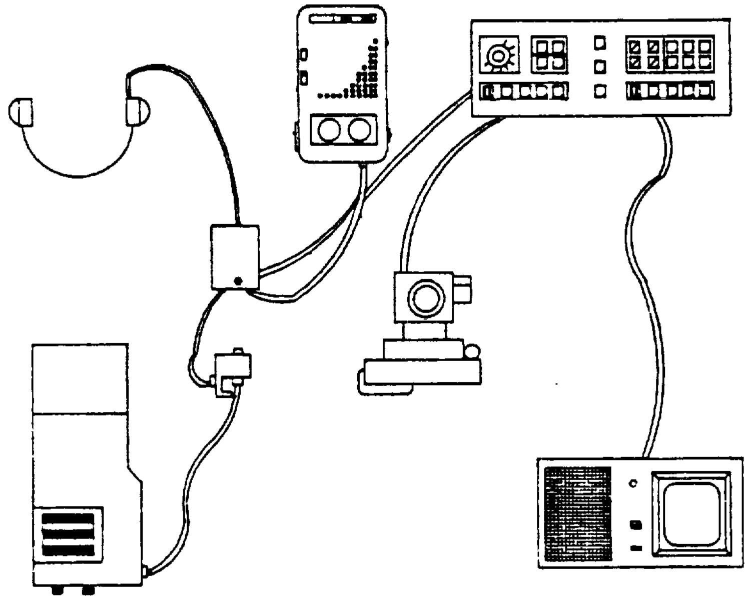


PPE

NOSL

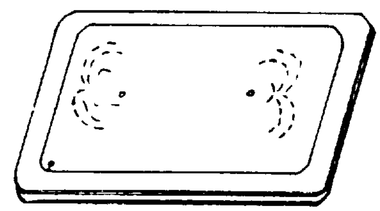


RME
(Pocket Meter)

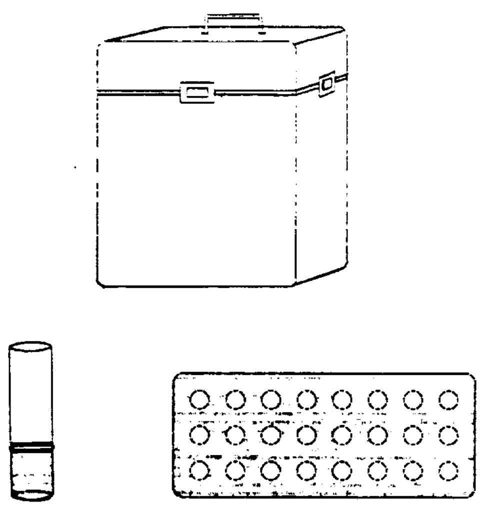


SAREX

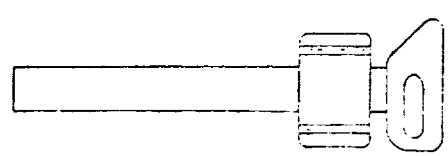
SAS
(1 locker)



TISP
(Magnetic Demonstration)



STTP
(PCOC used on STS-26)



TLD

APPENDIX B

PRIMARY STUDY DATA

ABBREVIATIONS AND ACRONYMS

ACES	Acoustic Containerless Experiment System
ADSF	Automated Directional Solidification Furnace
AFE	American Flight Echocardiograph
APE	Aurora Photography Experiment
ARABSAT	Arabian communication satellite
ARC	Aggregation of Red Blood Cells
ASC	American Satellite Company satellite
AUSSAT	Australian communication satellite
AVE	average
C	calendar days at KSC
C360	Cinema 360 camera - middeck and payload bay
CANEX	Canadian Experiments
CBDE	Carbonated Beverage Development Experiment
CFES	Continuous Flow Electrophoresis System, models I, II, III
CHAMP	Comet Halley Active Monitoring Program
CLOUDS	Clouds experiment
DMOS	Diffuse Mixing of Organic Solutions
DOD	Department of Defense (payload)
EASE/ACCESS	Extravehicular (EVA) Structural Assembly Concepts for Construction of Erectable Structures
EEVT	Electrophoresis Experiment Verification Test
ERBS	Earth Radiation Budget Satellite
FDE	Fluid Dynamic Experiment
FEE	French Echocardiograph Experiment
FLT	flight
FPE	French Postural Experiment
FSS	Flight Support Structure
GAS	Getaway Special
GLOMR	Global Low-Orbiting Message Relay satellite
GLOW	Earth Glow (experiment)
HG-1	First GSFC-sponsored Hitchhiker payload
HI	high
HPTE	High-Precision Tracking Experiment
HS376	Hughes Satellite - 376 series
IBSE	Initial Blood Storage Experiment
IEF	Isoelectric Focusing experiment
IMAX	IMAX, Canada camera (middeck)
INSAT	Indian communication satellite
IPBC	IMAX Payload Bay Camera
IR-IE	Infrared Imaging Experiment
IRT	Integrated Rendezvous Target
IUS	Inertial Upper Stage
LDEF	Long Duration Exposure Facility
LFC	Large Format Camera
LM	long module
LO	low
MAX	maximum
MIN	minimum
MLR	Monodisperse Latex Reactor
MORELOS	Mexican communication satellite
MPESS	Mission Peculiar Experiment Support Structure
MPSE	Mexican Payload Specialist Experiments
MSL	Material Science Laboratory

NOSL	Night-Day Optical Survey of Thunderstorm Lightning
NUSAT	Northern Utah Satellite
O&C	Operations and Checkout
OAST-1	Office of Aeronautics and Space Technology, NASA Headquarters - first payload
OIM	Orbiter Instrumentation Monitoring experiment
OPF	Orbiter Processing Facility
ORS	Orbital Refueling System
OSS-1	First payload sponsored by Office of Space Science, NASA Headquarters
OSTA-1, 2, 3	First, second, and third flight of payloads sponsored by the Office of Space and Terrestrial Applications, NASA Headquarters
PALAPA	Communication satellite for Republic of Indonesia
PAM-D	Payload Assist Module - Delta Class
PAM-D2	Payload Assist Module - Delta II Class
PCOC	Plant Carry-On Container
PDRS/PFTA	Payload Deployment and Retrieval System/Payload Flight Test Article
PGU	Plant Growth Unit
PPE	Phase Partitioning Experiment
PPF	payload processing facility
PVTOS	Physical Vapor Transport of Organic Solids experiment
REFLT	reflight
RME	Radiation Monitoring Experiment
SAREX	Shuttle Amateur Radio Experiment
SAS	Space Adaptation Syndrome experiment
SATCOM-Ku	Americom satellite
SBS	Satellite Business Systems
SFMD	Storable Fluid Management Demonstration
SL-1, 2, 3	Spacelabs 1, 2, and 3
SL-D1	First German Spacelab Mission
SMM	Solar Maximum Mission
SPARTAN	Shuttle-Pointed Autonomous Research Tool for Astronomy
SPARTAN-HALLEY	SPARTAN satellite to study Halley's Comet
SPAS-01, -01A	Shuttle Pallet Satellites
SPOC	Shuttle Payload of Opportunity Carrier
SS	special structure
SSIP	Space Science Student Involvement Project
STS	Space Transportation System
STTP	Life Science Space Technology Training Program experiment
SYNCOM	LEASAT communication satellite
TDRS	Tracking and Data Relay Satellite
TELESAT	Communication satellite owned by Telesat, Canada - also called Anik
TELSTAR	Comsat General Corp. communication satellite
TIS	Teacher in Space experiments
TLD	Thermoluminescent Dosimeter
VAB	Vehicle Assembly Building
VPF	Vertical Processing Facility
W	actual work days at KSC
WESTAR	Western Union communication satellite

PRIMARY STUDY DATA

PAYLOAD FACILITY STAY TIME IN CALENDAR (C) AND WORK (W) DAYS
(SHEET 1 OF 7)

STS FLT	PAYLOAD	PPF (C)	PPF (W)	O & C (C)	O & C (W)	VPF (C)	VPF (W)	OPF (C)	OPF (W)	VAB/PAD (C)	VAB/PAD (W)	TOTALS (C)	TOTALS (W)
2	OSTA-1			181	88			40	31	95	5	316	124
	PCOC			3	2					1	0.2	4	2.2
3	OSS-1			115	70			18	6	47	1	180	77
	MLR			68	65					1	0.2	69	65.2
	EEVT			60	3					1	0.2	61	3.2
	PCOC			3	2					1	0.2	4	2.2
	PGU			4	3					1	0.2	5	3.2
	SSIP (1)			2	0					1	0.2	3	0.2
	GAS TEST (1)	21	11					21	1	45	0	87	12
4	MLR			23	21					1	0.2	24	21.2
	CFES I	180	64					7	3	37	8	224	75
	(NOSL)			3	0					3	0.2	6	0.2
	GAS (1)	14	8					16	1	32	0	62	9
	(SSIP (2))			2	0					1	0.2	3	0.2
5	SBS-C	69	41			21	15			31	14	121	70
(31-A)	TELESAT-E	63	51			31	16			31	14	125	81
	(GLOW)			1	1					1	0.5	2	1.5
	SSIP (3)	5	4							1	0.2	6	4.2
	GAS (1)	15	12					14	1	31	0	60	13

PPF = PAYLOAD PROCESSING FACILITY
O & C = OPERATIONS & CHECKOUT BLDG.
VPF = VERTICAL PROCESSING FACILITY
OPF = ORBITER PROCESSING FACILITY
VAB = VEHICLE ASSEMBLY BLDG.

PAD = LAUNCH PAD
(C) = CALENDAR DAYS AT KSC
(W) = ACTUAL WORK DAYS AT KSC
(PAYLOAD) = A PRE-PACKED PAYLOAD

PAYLOAD FACILITY STAY TIME IN CALENDAR (C) AND WORK (W) DAYS
(SHEET 2 OF 7)

STS FLT	PAYLOAD	PPF (C)	PPF (W)	O & C (C)	O & C (W)	VPF (C)	VPF (W)	OPF (C)	OPF (W)	VAB/PAD (C)	VAB/PAD (W)	TOTALS (C)	TOTALS (W)
6	TDRS-A					64	22			78	45	142	67
(31-B)	MLR	88	86	32	25					1	0.2	121	111
	CFES II	180	29					15	3	131	8	326	40
	(NOSL)			5	0					2	0.2	7	0.2
	GAS (3)	14	7					12	1	78	1	104	9
7	SPAS-01	108	50			27	9			27	6	162	65
(31-C)	OSTA-2			71	51	5	0			27	6	103	57
	TELESAT-F	93	43			32	11			27	11	152	65
	PALAPA B-1	129	41			45	13			27	11	201	65
	MLR			15	14					1	0.2	16	14.2
	CFES II	60	17					5	2	28	7	93	26
	(SAS)			4	0					2	0.2	6	0.2
	GAS (7)	21	14					14	2	37	0	72	16
8	OIM							10	5	23	3	33	8
(31-D)	PDRS/PFTA							12	2	23	0	35	2
	INSAT 1-B	80	49			20	8			23	9	123	66
	CFES II	63	20					8	3	28	6	99	29
	(RME)			3	0					1	0.2	4	0.2
	SSIP (1)	4	4	3	1					1	0.2	8	5.2
	GAS (4)	20	9					14	1	23	0	57	10
9 (41-A)	SL-1			497	311			44	35	66	3	607	349
10	CANCELLED												

PAYLOAD FACILITY STAY TIME IN CALENDAR (C) AND WORK (W) DAYS
(SHEET 3 OF 7)

STS FLT	PAYLOAD	PPF (C)	PPF (W)	O & C (C)	O & C (W)	VPF (C)	VPF (W)	OPF (C)	OPF (W)	VAB/PAD (C)	VAB/PAD (W)	TOTALS (C)	TOTALS (W)
11	SPAS-01A	45	43			25	5				7	70	55
(41-B)	PALAPA B-2	78	38			36	4			23	8	137	50
	WESTAR-6	102	38			22	4			23	8	147	50
	ACES			15	14			1	0.5	1	0.2	17	14.7
	IEF			14	8			0	0	1	0.2	15	8.2
	C360b			3	1.5					3	0.2	6	1.7
	C360c			3	1.5					3	0.2	6	1.7
	MLR			28	26					1	0.2	29	26.2
	(RME)			2	0					1	0.2	3	0.2
	SSIP (1)	14	6							1	0.2	15	6.2
	IRT			14	9			7	3	23	1	44	13
	GAS (5)	16	7					16	1	23	1	55	9
12	CANCELLED												
13	SMM REPAIR	56	56	63	30					22	4	141	90
(41-C)	LDEF-1	85	69	10	1					22	5	117	75
	(RME)			2	0					1	0.2	3	0.2
	IMAX			4	1.5			1	0.5	3	0.2	8	2.2
	SSIP (1)			2	2					1	0.5	3	2.5

PAYLOAD FACILITY STAY TIME IN CALENDAR (C) AND WORK (W) DAYS
(SHEET 4 OF 7)

STS FLT	PAYLOAD	PPF (C)	PPF (W)	O & C (C)	O & C (W)	VPF (C)	VPF (W)	OPF (C)	OPF (W)	VAB/PAD (C)	VAB/PAD (W)	TOTALS (C)	TOTALS (W)
14	LFC-1			147	105	5	0			40	4	192	109
(ABORT)	OAST-1			127	91	5	0			40	5	172	96
	SYNCOM IV-1	56	56			42	12			40	6	138	74
14	OAST-1			7	5	5	0			24	6	36	11
(41-D)	SBS-D	76	61			9	5			24	6	109	72
	TELESTAR 3-C	64	51			19	5			24	7	107	63
	SYNCOM IV-2	47	47			25	8			24	6	96	61
	CFES III	158	33					32	6	81	18	271	57
	IMAX			3	1			1	0.5	1	0.5	5	2
	(RME)			3	0					1	0.2	4	0.2
	(CLOUDS)			4	0					1	0.2	5	0.2
	SSIP (1)	5	4							1	0.2	6	4.2
15 & 16	CANCELLED												
17	OSTA-3			287	207			30	29	26	1	343	237
(41-G)	LFC/ORS			52	37	9	0			26	1	87	38
	ERBS	56	46			19	11			26	9	101	66
	IMAX			3	1			31	0.5	1	0.5	35	2
	(RME)			2	0					1	0.2	3	0.2
	(TLD)			2	0					1	0.2	3	0.2
	(APE)			2	0					1	0.2	3	0.2
	CANEX			0	0			5	3	26	0.2	31	3.2
	GAS (8)	42	3					32	1	26	0	100	4
18	CANCELLED												

PAYLOAD FACILITY STAY TIME IN CALENDAR (C) AND WORK (W) DAYS
(SHEET 5 OF 7)

STS FLT	PAYLOAD	PPF		O & C		VPF		OPF		VAB/PAD		TOTALS	
		(C)	(W)	(C)	(W)	(C)	(W)	(C)	(W)	(C)	(W)	(C)	(W)
19	HS376 RETRIE			84	60	6	0				5	90	65
(51-A)	TELESAT-H					16	3			21	7	37	10
	SYNCOM IV-1	54	44			17	3			21	7	92	54
	DMOS			23	21			1	0.5	2	0.5	26	22
	(RME)			2	0					1	0.2	3	0.2
20	ARC			23	18			1	0.5	1	0.5	25	19
(51-C)	SFMD			42	30			71	3	25	0.2	138	33.2
21 & 22	CANCELLED												
23	TELESAT-I					27	11			56	20	83	31
(51-D)	SYNCOM IV-3	55	55			34	13			18	7	107	75
	CFES III	77	27					30	4	20	8	127	39
	(AFE)			2	2			0	0	5	0.2	7	2.2
	(PPE/SAS)			4	0					1	0	5	0
	SSIP (2)	5	5							1	0.2	6	5.2
	GAS (2)	10	5					13	1	18	0	41	6
24	SL-3			609	295			19	16	19	3	647	314
(51-B)	NUSAT	31	6					1	1	20	0	52	7
	GLOMR	31	6					1	1	20	0	52	7

PAYLOAD FACILITY STAY TIME IN CALENDAR (C) AND WORK (W) DAYS
(SHEET 6 OF 7)

STS FLT	PAYLOAD	PPF		O & C		VPF		OPF		VAB/PAD		TOTALS	
		(C)	(W)	(C)	(W)	(C)	(W)	(C)	(W)	(C)	(W)	(C)	(W)
25	SPARTAN-1	65	36					14	3	22	1	101	40
(51-G)	MORELOS-A	51	42			12	7			17	8	80	57
	ARABSAT-1B	39	34			23	17			17	12	79	63
	TELESTAR 3-D	43	36			29	12			17	8	89	56
	(FPE)			5	0					3	0.2	8	0.2
	FEE			3	2			1	0.5	3	2	7	4.5
	ADSF			18	15					5	0.5	23	15.5
	GAS (6)	27	8					16	2	17	0	60	10
26	SL-2			712	450			32	30	36	27	780	507
(51-F)	(SAREX)			4	0					2	0.2	6	0.2
	(STTP)			5	0					3	0.2	8	0.2
	(CBDE)			3	0					1	0.2	4	0.2
27	SYN SALVAGE							14	7	22	0	36	7
(51-I)	SYNCOM IV-4	81	67			16	6			22	6	119	79
	AUSSAT-1	73	57			1	0			22	8	96	65
	ASC-1	49	49			14	7			22	8	85	64
	PVTOS			25	19			1	0.5	1	0.5	27	20
28 (51-J)	DOD												
29	CANCELLED												

PAYLOAD FACILITY STAY TIME IN CALENDAR (C) AND WORK (W) DAYS
(SHEET 7 OF 7)

STS FLT	PAYLOAD	PPF		O & C		VPF		OPF		VAB/PAD		TOTALS	
		(C)	(W)	(C)	(W)	(C)	(W)	(C)	(W)	(C)	(W)	(C)	(W)
30	SL-D1			204	140			28	26	19	2	251	168
(61-A)	GLOMR REFLT	20	6					1	1	18	0	39	7
31	EASE/ACCESS			161	93	4	3			17	3	182	99
(61-B)	SATCOM KU-2	89	67			11	4			18	7	118	78
	AUSSAT-2	43	33			30	9			18	4	91	46
	MORELOS-B	106	84			3	1			18	4	127	89
	CFES III	47	36					6	3	23	8	76	47
	MPSE	2	2							1	0.2	3	2.2
	DMOS	8	5							1	0.2	9	5.2
	IPBC			6	5			2	1	18	0	26	6
	GAS (1)	11	7					10	1	18	0	39	8
32	MSL-2			47	22	9	1			42	3	98	26
(61-C)	HH-G1	14	10	45	26			40	2	42	2	141	40
	IR-IE	3	3					8	6	14	10	25	19
	SATCOM KU-1	70	52			7	6			42	4	119	62
	(CHAMP)			2	0					1	0.2	3	0.2
	IBSE	43	20							1	0.2	44	20.2
	SSIP (3)	30	5							2	0.6	32	5.6
	GAS BRG (12)	30	21	4	2	5	0			42	0	81	23
	GAS (1)	11	7					41	1	42	0	94	8
33	SPARTAN-HALL	19	16					13	3	52	1	84	20
(51-L)	TDRS-B					50	32			47	23	97	55
	(TIS)	4	4							1	0.2	5	4.2
	(FDE)			3	0					1	0.2	4	0.2
	(RME)			3	0					1	0.2	4	0.2
	(CHAMP)			2	0					1	0.2	3	0.2
	SSIP	7	7	3	0					1	0.4	11	7.4
	(PPE)			4	0					1	0	5	0

* * * PRIMARY STUDY DATA * * *
(CHART 1)

* * STAY TIMES BY PAYLOAD CATEGORY * *
UNITS: CALENDAR DAYS
SHEET 1 OF 3

* SPACELAB *
PAYLOADS & CARRIERS

STS	P/L	DAYS
9	SL-1	607
24	SL-3	647
26	SL-2	780
30	SL-D1	251

SPACELAB SUMMARY

MAX:	780
MIN:	251
AVE:	571
NUMBER:	4

* DEPLOYED SATELLITES *

STS	P/L	DAYS	STS	P/L	DAYS
5	SBS-C	121	19	SYNCOM IV-1	230 #
5	TELESAT-E	125	23	TELESAT-I	83
6	TDRS-A	142	23	SYNCOM IV-3	107
7	TELESAT-F	152	25	MORELOS-A	80
7	PALAPA B-1	201	25	ARABSAT-1B	79
8	INSAT 1-B	123	25	TELSTAR 3-D	89
11	PALAPA B-2	137	27	SYNCOM IV-4	119
11	WESTAR-6	147	27	AUSSAT-1	96
13	LDEF-1	117	27	ASC-1	85
14	SBS-D	109	31	SATCOM KU-2	118
14	TELESTAR 3-C	107	31	AUSSAT-2	91
14	SYNCOM IV-2	96	31	MORELOS-B	127
17	ERBS	101	32	SATCOM KU-1	119
19	TELESAT-H	37	33	TDRS-B	97

PROCESSED TWICE

DEPLOYED SUMMARY

MAX:	230
MIN:	37
AVE:	116
NUMBER:	28

*** * STAY TIMES BY PAYLOAD CATEGORY * ***

UNITS: CALENDAR DAYS

SHEET 2 OF 3

* GAS PAYLOADS *

STS	P/L	DAYS
3	TEST	87
4	G-001	63
5	G-026	60
6	G-381	102
6	G-049	102
6	G-005	70
7	G-012	70
7	G-033	70
7	G-088	71
7	G-009	71
7	G-002	71
7	G-345	72
7	G-305	72
8	G-347	56
8	G-346	56
8	G-348	56
8	G-475	57
11	IRT	44
11	G-309	42
11	G-051	42
11	G-008	42
11	G-004	43
11	G-349	43
11	C360b	43
17	G-038	98
17	G-007	98
17	G-306	98
17	G-032	96
17	G-518	96
17	G-013	96
17	G-074	100
17	G-469	100
23	G-471	41
23	G-035	41
24	NUSAT	52
24	GLOMR	52
25	G-034	59
25	G-027	59
25	G-028	59
25	G-471	60
25	G-025	60
25	G-314	60
30	GLOMR-R	39
31	IPBC	26
31	G-479	39
32	BRIDGE (12)	81
32	G-470	94

GAS SUMMARY

MAX:	102
MIN:	26
AVE:	54
NUMBER:	58

* PARTIAL PAYLOADS *

STS	P/L	DAYS
2	OSTA-1	316
3	OSS-1	180
7	SPAS-01	162
7	OSTA-2	103
8	OIM	33
8	PDRS/PFTA	35
11	SPAS-01A	70
13	SMM REPAIR	141
14	OAST-1	208 #
17	OSTA-3	322
17	LFC/ORS	279 #
19	HS376 RETRIE	90
25	SPARTAN-1	101
27	SYN SALVAGE	36
31	EASE/ACCESS	182
32	MSL-2	98
32	HH-G1	124
33	SPARTAN-HALL	84

PARTIAL SUMMARY

MAX:	322
MIN:	33
AVE:	142
NUMBER:	18

PROCESSED TWICE

* * STAY TIMES BY PAYLOAD CATEGORY * *
UNITS: CALENDAR DAYS
SHEET 3 OF 3

* MIDDECK PAYLOADS *

c.2

STS	P/L	DAYS
2	PCOC	4
3	MLR	69
3	EEVT	61
3	PCOC	4
3	PGU	5
3	SSIP	3
4	MLR	24
4	CFES I	180
4	(NOSL)	6
4	(SSIP (2))	3
5	(GLOW)	2
5	SSIP (3)	6
6	MLR	121
6	CFES II	326
6	(NOSL)	7
7	MLR	16
7	CFES II	93
7	(SAS)	6
8	CFES II	99
8	(RME)	4
8	SSIP	8
11	ACES	17
11	IEF	15
11	C360c	6
11	MLR	29
11	(RME)	3
11	SSIP	15

STS	P/L	DAYS
13	(RME)	3
13	IMAX	7
13	SSIP	3
14	CFES III	271
14	IMAX	5
14	(RME)	4
14	(CLOUDS)	5
14	SSIP	6
17	IMAX	35
17	(RME)	3
17	(TLD)	3
17	(APE)	3
17	CANEX	31
19	DMOS	26
19	(RME)	3
20	ARC	25
20	SFMD	138
23	CFES III	127
23	(AFE)	5
23	(PPE/SAS)	5

STS	P/L	DAYS
23	SSIP (2)	6
25	(FPE)	8
25	FEE	7
25	ADSF	23
26	(SAREX)	6
26	(STTP)	8
26	(CBDE)	4
27	PVTOS	20
31	CFES III	76
31	MPSE	3
31	DMOS	9
32	IR-IE	25 #
32	(CHAMP)	3
32	IBSE	44
32	SSIP (3)	9
33	(TIS)	5
33	(FDE)	4
33	(RME)	4
33	(CHAMP)	3
33	SSIP	11
33	(PPE)	5

CFES SUMMARY

MAX:	326
MIN:	76
AVE:	167
NUMBER:	7

MIDDECK SUMMARY

MAX:	326
MIN:	2
AVE:	32
NUMBER:	75

PROCESSED LIKE A MIDDECK PAYLOAD

* * * PRIMARY STUDY DATA * * *
(CHART 2)

* * ACTUAL PAYLOAD PROCESSING TIME LINES BY PAYLOAD CATEGORY * *
UNITS: WORK DAYS
SHEET 1 OF 3

* SPACELAB *
PAYLOADS & CARRIERS

STS	P/L	DAYS
9	SL-1	349
24	SL-3	314
26	SL-2	507
30	SL-D1	168

SPACELAB SUM

MAX:	507
MIN:	168
AVE:	335
NUMBER:	4

* DEPLOYED SATELLITES *

STS	P/L	DAYS	STS	P/L	DAYS
5	SBS-C	70	19	SYNCOM IV-1	128 #
5	TELESAT-E	81	23	TELESAT-I	31
6	TDRS-A	67	23	SYNCOM IV-3	75
7	TELESAT-F	65	25	MORELOS-A	57
7	PALAPA B-1	65	25	ARABSAT-1B	63
8	INSAT 1-B	66	25	TELSTAR 3-D	56
11	PALAPA B-2	50	27	SYNCOM IV-4	79
11	WESTAR-6	50	27	AUSSAT-1	65
13	LDEF-1	75	27	ASC-1	64
14	SBS-D	72	31	SATCOM KU-2	78
14	TELESTAR 3-C	63	31	AUSSAT-2	46
14	SYNCOM IV-2	61	31	MORELOS-B	89
17	ERBS	66	32	SATCOM KU-1	62
19	TELESAT-H	10	33	TDRS-B	55

DEPLOYED SUMMARY

MAX:	128
MIN:	10
AVE:	65
NUMBER:	28

PROCESSED TWICE

* * ACTUAL PAYLOAD PROCESSING TIME LINES BY PAYLOAD CATEGORY * *
UNITS: WORK DAYS
SHEET 2 OF 3

* GAS PAYLOADS *

STS	P/L	DAYS	STS	P/L	DAYS
3	TEST	11	17	G-306	8
4	G-001	9	17	G-032	9
5	G-026	13	17	G-518	9
6	G-381	9	17	G-013	9
6	G-049	9	17	G-074	10
6	G-005	9	17	G-469	10
7	G-012	14	23	G-471	6
7	G-033	14	23	G-035	6
7	G-088	15	24	NUSAT	7
7	G-009	15	24	GLOMR	7
7	G-002	15	25	G-034	9
7	G-345	16	25	G-027	9
7	G-305	16	25	G-028	9
8	G-347	10	25	G-471	10
8	G-346	10	25	G-025	10
8	G-348	10	25	G-314	10
8	G-475	11	30	GLOMR-R	7
11	IRT	13	31	IPBC	6
11	G-309	11	31	G-479	8
11	G-051	11	32	BRIDGE (12)	23
11	G-008	11	32	G-470	8
11	G-004	12			
11	G-349	12			
11	C360b	12			
17	G-038	8			
17	G-007	8			

GAS SUMMARY

MAX:	23
MIN:	6
AVE:	9
NUMBER:	58

* PARTIAL PAYLOADS *

STS	P/L	DAYS
2	OSTA-1	124
3	OSS-1	77
7	SPAS-01	65
7	OSTA-2	57
8	OIM	8
8	PDRS/PFTA	2
11	SPAS-01A	55
13	SMM REPAIR	90
14	OAST-1	107 #
17	OSTA-3	220
17	LFC/ORS	147 #
19	HS376 RETRIE	65
25	SPARTAN-1	40
27	SYN SALVAGE	7
31	EASE/ACCESS	99
32	MSL-2	26
32	HH-G1	27
33	SPARTAN-HALL	20

PARTIAL SUMMARY

MAX:	220
MIN:	2
AVE:	69
NUMBER:	18

PROCESSED TWICE

* * ACTUAL PAYLOAD PROCESSING TIME LINES BY PAYLOAD CATEGORY * *
UNITS: WORK DAYS
SHEET 3 OF 3

* MIDDECK PAYLOADS *

STS	P/L	DAYS
2	PCOC	3
3	MLR	66
3	EEVT	4
3	PCOC	3
3	PGU	4
3	SSIP	1
4	MLR	22
4	CFES I	75
4	(NOSL)	1
4	(SSIP (2))	1
5	(GLOW)	2
5	SSIP (3)	5
6	MLR	111
6	CFES II	40
6	(NOSL)	1
7	MLR	15
7	CFES II	26
7	(SAS)	1
8	CFES II	29
8	(RME)	1
8	SSIP	6
11	ACES	15
11	IEF	9
11	C360c	2
11	MLR	27
11	(RME)	1
11	SSIP	7

STS	P/L	DAYS
13	(RME)	1
13	IMAX	3
13	SSIP	3
14	CFES III	57
14	IMAX	2
14	(RME)	1
14	(CLOUDS)	1
14	SSIP	5
17	IMAX	2
17	(RME)	1
17	(TLD)	1
17	(APE)	1
17	CANEX	4
19	DMOS	22
19	(RME)	1
20	ARC	19
20	SFMD	34
23	CFES III	39
23	(AFE)	3
23	(PPE/SAS)	1

STS	P/L	DAYS
23	SSIP (2)	6
25	(FPE)	1
25	FEE	5
25	ADSF	16
26	(SAREX)	1
26	(STTP)	1
26	(CBDE)	1
27	PVTOS	20
31	CFES III	47
31	MPSE	3
31	DMOS	6
32	IR-IE	19 #
32	(CHAMP)	1
32	IBSE	21
32	SSIP (3)	5
33	(TIS)	5
33	(FDE)	1
33	(RME)	1
33	(CHAMP)	1
33	SSIP	8
33	(PPE)	1

CFES SUMMARY

MAX:	75
MIN:	26
AVE:	45
NUMBER:	7

MIDDECK SUMMARY

MAX:	111
MIN:	1
AVE:	13
NUMBER:	75

PROCESSED LIKE A MIDDECK PAYLOAD

* * * PRIMARY STUDY DATA * * *
(CHART 3)

* * INTEGRATED TEST TIME SPENT FOR PAYLOADS * *
UNITS: TEST DAYS
SHEET 1 OF 3

* SPACELAB *
PAYLOADS & CARRIERS

STS	P/L	DAYS
9	SL-1	38
24	SL-3	13
26	SL-2	18
30	SL-D1	3

SPACELAB SUMMARY

MAX:	38
MIN:	3
AVE:	18
NUMBER:	4

* DEPLOYED SATELLITES *

STS	P/L	DAYS	STS	P/L	DAYS
5	SBS-C	7	19	SYNCOM IV-1	3
5	TELESAT-E	7	23	TELESAT-I	5
6	TDRS-A	7	23	SYNCOM IV-3	5
7	TELESAT-F	6	25	MORELOS-A	3
7	PALAPA B-1	6	25	ARABSAT-1B	3
8	INSAT 1-B	3	25	TELSTAR 3-D	3
11	PALAPA B-2	2	27	SYNCOM IV-4	3
11	WESTAR-6	2	27	AUSSAT-1	3
13	LDEF-1	6	27	ASC-1	3
14	SBS-D	2	31	SATCOM KU-2	4
14	TELESTAR 3-C	2	31	AUSSAT-2	4
14	SYNCOM IV-2	2	31	MORELOS-B	4
17	ERBS	3	32	SATCOM KU-1	4
19	TELESAT-H	3	33	TDRS-B	4

DEPLOYED SUMMARY

MAX:	7
MIN:	2
AVE:	4
NUMBER:	28

*** * INTEGRATED TEST TIME SPENT FOR PAYLOADS * ***
UNITS: TEST DAYS
SHEET 2 OF 3

*** GAS PAYLOADS ***

STS	P/L	DAYS
3	TEST	1
4	G-001	1
5	G-026	1
6	G-381	1
6	G-049	1
6	G-005	1
7	G-012	1
7	G-033	1
7	G-088	1
7	G-009	1
7	G-002	1
7	G-345	1
7	G-305	1
8	G-347	1
8	G-346	1
8	G-348	1
8	G-475	1
11	IRT	1
11	G-309	1
11	G-051	1
11	G-008	1
11	G-004	1
11	G-349	1
11	C360b	1
17	G-038	1
17	G-007	1
17	G-306	1
17	G-032	1
17	G-518	1
17	G-013	1
17	G-074	1
17	G-469	1
23	G-471	1
23	G-035	1
24	NUSAT	1
24	GLOMR	1
25	G-034	1
25	G-027	1
25	G-028	1
25	G-471	1
25	G-025	1
25	G-314	1
30	GLOMR-R	1
31	IPBC	1
31	G-479	1
32	BRIDGE (12)	1
32	G-470	1

GAS SUMMARY

MAX:	1
MIN:	1
AVE:	1
NUMBER:	58

*** PARTIAL PAYLOADS ***

STS	P/L	DAYS
2	OSTA-1	7
3	OSS-1	7
7	SPAS-01	1
7	OSTA-2	5
8	OIM	1
8	PDRS/PFTA	1
11	SPAS-01A	1
13	SMM REPAIR	1
14	OAST-1	12
17	OSTA-3	12
17	LFC/ORS	10
19	HS376 RETRIE	2
25	SPARTAN-1	3
27	SYN SALVAGE	1
31	EASE/ACCESS	2
32	MSL-2	4
32	HH-G1	2
33	SPARTAN-HALL	3

PARTIAL SUMMARY

MAX:	12
MIN:	1
AVE:	4
NUMBER:	18

*** * INTEGRATED TEST TIME SPENT FOR PAYLOADS * ***
UNITS: TEST DAYS
SHEET 3 OF 3

*** MIDDECK PAYLOADS ***

STS	P/L	DAYS
2	PCOC	1
3	MLR	2
3	EEVT	1
3	PCOC	1
3	PGU	1
3	SSIP	1
4	MLR	1
4	CFES I	12
4	(NOSL)	1
5	(GLOW)	1
5	SSIP (3)	1
6	MLR	1
6	CFES II	14
6	(NOSL)	1
7	MLR	1
7	CFES II	9
7	(SAS)	1
8	CFES II	9
8	(RME)	1
8	SSIP	1
11	ACES	1
11	IEF	1
11	C360c	1
11	MLR	1
11	(RME)	1
11	SSIP	1

STS	P/L	DAYS
13	(RME)	1
13	IMAX	1
13	SSIP	1
14	CFES III	11
14	IMAX	2
14	(RME)	1
14	(CLOUDS)	1
14	SSIP	1
17	IMAX	2
17	(RME)	1
17	(TLD)	1
17	(APE)	1
17	CANEX	1
19	DMOS	1
19	(RME)	1
20	ARC	1
20	SFMD	1
23	CFES III	20
23	(AFE)	1
23	(PPE/SAS)	1

STS	P/L	DAYS	
23	SSIP (2)	1	
25	(FPE)	1	
25	FEE	1	
25	ADSF	1	
26	(SAREX)	1	
26	(STTP)	1	
26	(CBDE)	1	
27	PVTOS	1	
31	CFES III	3	
31	MPSE	1	
31	DMOS	1	
32	IR-IE	1	#
32	(CHAMP)	1	
32	IBSE	1	
32	SSIP (3)	1	
33	(TIS)	1	
33	(FDE)	1	
33	(RME)	1	
33	(CHAMP)	1	
33	SSIP	1	
33	(PPE)	1	

CFES SUMMARY

MAX:	20
MIN:	3
AVE:	11
NUMBER:	7

MIDDECK SUMMARY

MAX:	20
MIN:	1
AVE:	2
NUMBER:	75

PROCESSED LIKE A MIDDECK PAYLOAD

* * * PRIMARY STUDY DATA * * *
(CHART 4)

* * USER REQUIREMENTS FOR SPACELAB PAYLOADS & SPACELAB CARRIERS * *
UNITS: NUMBER OF REQUIREMENTS

* SPACELAB PAYLOADS *

STS	P/L	NO.
9	SL-1	1446
24	SL-3	703
26	SL-2	490
30	SL-D1	195

PAYLOAD SUMMARY

MAX:	1446
MIN:	195
AVE:	709
NUMB:	4

SL-1/3 CHANGE: -51%
HI-LO CHANGE: -87%

* SPACELAB CARRIERS *

STS	P/L	NO.
9	SL-1	396
24	SL-3	229
26	SL-2	86
30	SL-D1	24

CARRIER SUMMARY

MAX:	396
MIN:	24
AVE:	184
NUMB:	4

SL-1/3 CHANGE: -42%
HI-LO CHANGE: -94%

* * * PRIMARY STUDY DATA * * *
(CHART 5)

* * USER REQUIREMENTS FOR STS PAYLOADS OTHER THAN SPACELAB * *
UNITS: NUMBER OF REQUIREMENTS
SHEET 1 OF 3

* DEPLOYED SATELLITES *

STS	P/L	NO.	STS	P/L	NO.
5	SBS-C	186	19	SYNCOM IV-1	179
5	TELESAT-E	220	23	TELESAT-I	220
6	TDRS-A	308	23	SYNCOM IV-3	179
7	TELESAT-F	220	25	MORELOS-A	163
7	PALAPA B-1	170	25	ARABSAT-1B	186
8	INSAT 1-B	224	25	TELSTAR 3-D	178
11	PALAPA B-2	170	27	SYNCOM IV-4	179
11	WESTAR-6	166	27	AUSSAT-1	154
13	LDEF-1	139	27	ASC-1	176
14	SBS-D	186	31	SATCOM KU-2	163
14	TELESTAR 3-C	178	31	AUSSAT-2	154
14	SYNCOM IV-2	179	31	MORELOS-B	163
17	ERBS	197	32	SATCOM KU-1	163
19	TELESAT-H	220	33	TDRS-B	308

DEPLOYED SUMMARY

MAX:	308
MIN:	139
AVE:	190
NUMBER:	28

* * USER REQUIREMENTS FOR STS PAYLOADS OTHER THAN SPACELAB * *
UNITS: NUMBER OF REQUIREMENTS
SHEET 2 OF 3

* GAS PAYLOADS *

STS	P/L	NO.	STS	P/L	NO.
3	TEST	36	17	G-306	36
4	G-001	36	17	G-032	36
5	G-026	36	17	G-518	36
6	G-381	36	17	G-013	36
6	G-049	36	17	G-074	36
6	G-005	36	17	G-469	36
7	G-012	36	23	G-471	36
7	G-033	36	23	G-035	36
7	G-088	36	24	NUSAT	36
7	G-009	36	24	GLOMR	36
7	G-002	36	25	G-034	36
7	G-345	36	25	G-027	36
7	G-305	36	25	G-028	36
8	G-347	36	25	G-471	36
8	G-346	36	25	G-025	36
8	G-348	36	25	G-314	36
8	G-475	36	30	GLOMR-R	36
11	IRT	36	31	IPBC	20
11	G-309	36	31	G-479	36
11	G-051	36	32	BRIDGE (12)	41
11	G-008	36	32	G-470	36
11	G-004	36			
11	G-349	36			
11	C360b	36			
17	G-038	36			
17	G-007	36			

GAS SUMMARY

MAX:	41
MIN:	20
AVE:	36
NUMBER:	58

* PARTIAL PAYLOADS *

STS	P/L	NO.
2	OSTA-1	110
3	OSS-1	77
7	SPAS-01	116
7	OSTA-2	50
8	OIM	10
8	PDRS/PFTA	10
11	SPAS-01A	116
13	SMM REPAIR	10
14	OAST-1	52
17	OSTA-3	132
17	LFC/ORS	39
19	HS376 RETRIE	15
25	SPARTAN-1	12
27	SYN SALVAGE	15
31	EASE/ACCESS	28
32	MSL-2	62
32	HH-G1	23
33	SPARTAN-HALL	109

PARTIAL SUMMARY

MAX:	132
MIN:	10
AVE:	55
NUMBER:	18

* * USER REQUIREMENTS FOR STS PAYLOADS OTHER THAN SPACELAB * *
UNITS: NUMBER OF REQUIREMENTS
SHEET 3 OF 3

* MIDDECK PAYLOADS *

STS	P/L	NO.
2	PCOC	4
3	MLR	117
3	EEVT	8
3	PCOC	4
3	PGU	6
3	SSIP	3
4	MLR	117
4	CFES I	50
4	(NOSL)	0
4	(SSIP (2))	0
5	(GLOW)	0
5	SSIP (3)	9
6	MLR	117
6	CFES II	50
6	(NOSL)	0
7	MLR	117
7	CFES II	53
7	(SAS)	3
8	CFES II	53
8	(RME)	0
8	SSIP	8
11	ACES	20
11	IEF	10
11	C360c	8
11	MLR	117
11	(RME)	0
11	SSIP	8

STS	P/L	NO.
13	(RME)	0
13	IMAX	8
13	SSIP	2
14	CFES III	61
14	IMAX	3
14	(RME)	0
14	(CLOUDS)	0
14	SSIP	4
17	IMAX	9
17	(RME)	0
17	(TLD)	0
17	(APE)	0
17	CANEX	3
19	DMOS	20
19	(RME)	0
20	ARC	20
20	SFMD	20
23	CFES III	61
23	(AFE)	7
23	(PPE/SAS)	0

CFES SUMMARY

MAX:	61
MIN:	50
AVE:	56
NUMBER:	7

STS	P/L	NO.	
23	SSIP (2)	0	
25	(FPE)	0	
25	FEE	6	
25	ADSF	18	
26	(SAREX)	0	
26	(STTP)	4	
26	(CBDE)	0	
27	PVTOS	15	
31	CFES III	61	
31	MPSE	25	
31	DMOS	28	
32	IR-IE	0	#
32	(CHAMP)	0	
32	IBSE	61	
32	SSIP (3)	3	
33	(TIS)	0	
33	(FDE)	0	
33	(RME)	0	
33	(CHAMP)	0	
33	SSIP	0	
33	(PPE)	0	

MIDDECK SUMMARY

MAX:	117
MIN:	0
AVE:	20
NUMBER:	75

PROCESSED LIKE A MIDDECK PAYLOAD

* * * PRIMARY STUDY DATA * * *
(CHART 6)

* * TEST PROCEDURES REQUIRED FOR SPACELAB PAYLOADS & SPACELAB CARRIERS * *
UNITS: NUMBER OF TEST PROCEDURES

* SPACELAB PAYLOADS *

STS	P/L	NO.
9	SL-1	396
24	SL-3	284
26	SL-2	250
30	SL-D1	104

PAYLOAD SUMMARY

MAX:	396
MIN:	104
AVE:	259
NUMB:	4

SL-1/3 CHANGE: -28%
HI-LO CHANGE: -74%

* SPACELAB CARRIERS *

STS	P/L	NO.
9	SL-1	2404
24	SL-3	454
26	SL-2	667
30	SL-D1	158

CARRIER SUMMARY

MAX:	2404
MIN:	158
AVE:	921
NUMB:	4

SL-1/3 CHANGE: -81%
HI-LO CHANGE: -93%

* * * PRIMARY STUDY DATA * * *
(CHART 7)

* * TEST PROCEDURES REQUIRED FOR PAYLOADS OTHER THAN SPACELAB * *
UNITS: NUMBER OF TEST PROCEDURES
SHEET 1 OF 3

* DEPLOYED SATELLITES *

STS	P/L	NO.	STS	P/L	NO.
5	SBS-C	34	19	SYNCOM IV-1	52
5	TELESAT-E	34	23	TELESAT-I	51
6	TDRS-A	48	23	SYNCOM IV-3	51
7	TELESAT-F	68	25	MORELOS-A	59
7	PALAPA B-1	68	25	ARABSAT-1B	59
8	INSAT 1-B	45	25	TELSTAR 3-D	59
11	PALAPA B-2	49	27	SYNCOM IV-4	51
11	WESTAR-6	51	27	AUSSAT-1	50
13	LDEF-1	27	27	ASC-1	54
14	SBS-D	46	31	SATCOM KU-2	50
14	TELESTAR 3-C	46	31	AUSSAT-2	49
14	SYNCOM IV-2	46	31	MORELOS-B	49
17	ERBS	37	32	SATCOM KU-1	50
19	TELESAT-H	52	33	TDRS-B	28

DEPLOYED SUMMARY	
MAX:	68
MIN:	27
AVE:	49
NUMBER:	28

* * TEST PROCEDURES REQUIRED FOR PAYLOADS OTHER THAN SPACELAB * *
UNITS: NUMBER OF TEST PROCEDURES
SHEET 2 OF 3

* GAS PAYLOADS *

STS	P/L	NO.
3	TEST	1
4	G-001	1
5	G-026	1
6	G-381	1
6	G-049	1
6	G-005	1
7	G-012	1
7	G-033	1
7	G-088	1
7	G-009	1
7	G-002	1
7	G-345	1
7	G-305	1
8	G-347	1
8	G-346	1
8	G-348	1
8	G-475	1
11	IRT	1
11	G-309	1
11	G-051	1
11	G-008	1
11	G-004	1
11	G-349	1
11	C360b	1
17	G-038	1
17	G-007	1
17	G-306	1
17	G-032	1
17	G-518	1
17	G-013	1
17	G-074	1
17	G-469	1
23	G-471	1
23	G-035	1
24	NUSAT	1
24	GLOMR	1
25	G-034	1
25	G-027	1
25	G-028	1
25	G-471	1
25	G-025	1
25	G-314	1
30	GLOMR-R	1
31	IPBC	1
31	G-479	1
32	BRIDGE (12)	3
32	G-470	1

GAS SUMMARY

MAX:	3
MIN:	1
AVE:	1
NUMBER:	58

* PARTIAL PAYLOADS *

STS	P/L	NO.
2	OSTA-1	100
3	OSS-1	128
7	SPAS-01	26
7	OSTA-2	110
8	OIM	5
8	PDRS/PFTA	2
11	SPAS-01A	27
13	SMM REPAIR	5
14	OAST-1	50
17	OSTA-3	99
17	LFC/ORS	82
19	HS376 RETRIE	5
25	SPARTAN-1	7
27	SYN SALVAGE	5
31	EASE/ACCESS	9
32	MSL-2	10
32	HH-G1	9
33	SPARTAN-HALL	12

PARTIAL SUMMARY

MAX:	128
MIN:	2
AVE:	38
NUMBER:	18

* * TEST PROCEDURES REQUIRED FOR PAYLOADS OTHER THAN SPACELAB * *
UNITS: NUMBER OF TEST PROCEDURES
SHEET 3 OF 3

* MIDDECK PAYLOADS *

STS	P/L	NO.
2	PCOC	2
3	MLR	6
3	EEVT	3
3	PCOC	1
3	PGU	2
3	SSIP	3
4	MLR	6
4	CFES I	18
4	(NOSL)	0
4	(SSIP (2))	0
5	(GLOW)	0
5	SSIP (3)	6
6	MLR	6
6	CFES II	18
6	(NOSL)	0
7	MLR	6
7	CFES II	20
7	(SAS)	0
8	CFES II	20
8	(RME)	0
8	SSIP	5
11	ACES	5
11	IEF	5
11	C360c	2
11	MLR	6
11	(RME)	0
11	SSIP	5

STS	P/L	NO.
13	(RME)	0
13	IMAX	2
13	SSIP	2
14	CFES III	24
14	IMAX	2
14	(RME)	0
14	(CLOUDS)	0
14	SSIP	2
17	IMAX	5
17	(RME)	2
17	(TLD)	0
17	(APE)	0
17	CANEX	5
19	DMOS	12
19	(RME)	0
20	ARC	9
20	SFMD	6
23	CFES III	25
23	(AFE)	0
23	(PPE/SAS)	2

STS	P/L	NO.
23	SSIP (2)	0
25	(FPE)	0
25	FEE	3
25	ADSF	5
26	(SAREX)	0
26	(STTP)	2
26	(CBDE)	0
27	PVTOS	8
31	CFES III	25
31	MPSE	10
31	DMOS	12
32	IR-IE	2 #
32	(CHAMP)	0
32	IBSE	14
32	SSIP (3)	3
33	(TIS)	2
33	(FDE)	0
33	(RME)	0
33	(CHAMP)	0
33	SSIP	3
33	(PPE)	2

CFES SUMMARY	
MAX:	25
MIN:	18
AVE:	21
NUMBER:	7

MIDDECK SUMMARY	
MAX:	25
MIN:	0
AVE:	5
NUMBER:	75

PROCESSED LIKE A MIDDECK PALYLOAD

* * * PRIMARY STUDY DATA * * *
(CHART 8)

* * MODIFICATIONS PERFORMED TO SPACELAB PAYLOADS & SPACELAB CARRIERS * *
UNITS: NUMBER OF MODIFICATIONS

* SPACELAB PAYLOADS *

STS	P/L	NO.
9	SL-1	324
24	SL-3	123
26	SL-2	125
30	SL-D1	20

PAYLOAD SUMMARY

MAX:	324
MIN:	20
AVE:	148
NUMB:	4

SL-1/3 CHANGE: -62%
HI-LO CHANGE: -94%

* SPACELAB CARRIERS *

STS	P/L	NO.
9	SL-1	2898
24	SL-3	1410
26	SL-2	1496
30	SL-D1	805

CARRIER SUMMARY

MAX:	2898
MIN:	805
AVE:	1652
NUMB:	4

SL-1/3 CHANGE: -51%
HI-LO CHANGE: -72%

* * * PRIMARY STUDY DATA * * *
(CHART 9)

* * MODIFICATIONS PERFORMED TO PAYLOADS OTHER THAN SPACELAB * *
UNITS: NUMBER OF MODIFICATIONS
SHEET 1 OF 3

* DEPLOYED SATELLITES *

STS	P/L	NO.	STS	P/L	NO.
5	SBS-C	2	19	SYNCOM IV-1	2
5	TELESAT-E	3	23	TELESAT-I	0
6	TDRS-A	6	23	SYNCOM IV-3	2
7	TELESAT-F	6	25	MORELOS-A	1
7	PALAPA B-1	4	25	ARABSAT-1B	3
8	INSAT 1-B	3	25	TELSTAR 3-D	1
11	PALAPA B-2	2	27	SYNCOM IV-4	1
11	WESTAR-6	2	27	AUSSAT-1	0
13	LDEF-1	2	27	ASC-1	0
14	SBS-D	4	31	SATCOM KU-2	2
14	TELESTAR 3-C	2	31	AUSSAT-2	1
14	SYNCOM IV-2	2	31	MORELOS-B	2
17	ERBS	0	32	SATCOM KU-1	1
19	TELESAT-H	1	33	TDRS-B	1

DEPLOYED SUMMARY

MAX:	6
MIN:	0
AVE:	2
NUMBER:	28

* * MODIFICATIONS PERFORMED TO PAYLOADS OTHER THAN SPACELAB * *
UNITS: NUMBER OF MODIFICATIONS
SHEET 2 OF 3

* GAS PAYLOADS *

STS	P/L	NO.
3	TEST	1
4	G-001	1
5	G-026	0
6	G-381	0
6	G-049	0
6	G-005	0
7	G-012	0
7	G-033	0
7	G-088	0
7	G-009	0
7	G-002	0
7	G-345	0
7	G-305	0
8	G-347	1
8	G-346	0
8	G-348	0
8	G-475	0
11	IRT	0
11	G-309	0
11	G-051	0
11	G-008	0
11	G-004	0
11	G-349	0
11	C360b	0
17	G-038	0
17	G-007	0
17	G-306	0
17	G-032	0
17	G-518	0
17	G-013	0
17	G-074	0
17	G-469	0
23	G-471	1
23	G-035	0
24	NUSAT	1
24	GLOMR	0
25	G-034	0
25	G-027	0
25	G-028	0
25	G-471	0
25	G-025	0
25	G-314	0
30	GLOMR-R	0
31	IPBC	0
31	G-479	0
32	BRIDGE (12)	0
32	G-470	0

GAS SUMMARY

MAX:	1
MIN:	0
AVE:	0
NUMBER:	58

* PARTIAL PAYLOADS *

STS	P/L	NO.
2	OSTA-1	4
3	OSS-1	3
7	SPAS-01	2
7	OSTA-2	10
8	OIM	0
8	PDRS/PFTA	0
11	SPAS-01A	6
13	SMM REPAIR	2
14	OAST-1	18
17	OSTA-3	38
17	LFC/ORS	27
19	HS376 RETRIE	2
25	SPARTAN-1	0
27	SYN SALVAGE	1
31	EASE/ACCESS	5
32	MSL-2	2
32	HH-G1	0
33	SPARTAN-HALL	0

PARTIAL SUMMARY

MAX:	38
MIN:	0
AVE:	7
NUMBER:	18

* * MODIFICATIONS PERFORMED TO PAYLOADS OTHER THAN SPACELAB * *
UNITS: NUMBER OF MODIFICATIONS
SHEET 3 OF 3

* MIDDECK PAYLOADS *

STS	P/L	NO.
2	PCOC	0
3	MLR	6
3	EEVT	0
3	PCOC	0
3	PGU	0
3	SSIP	0
4	MLR	1
4	CFES I	0
4	(NOSL)	0
4	(SSIP (2))	0
5	(GLOW)	0
5	SSIP (3)	0
6	MLR	0
6	CFES II	0
6	(NOSL)	0
7	MLR	0
7	CFES II	0
7	(SAS)	0
8	CFES II	0
8	(RME)	0
8	SSIP	0
11	ACES	0
11	IEF	1
11	C360c	0
11	MLR	0
11	(RME)	0
11	SSIP	0

STS	P/L	NO.
13	(RME)	0
13	IMAX	0
13	SSIP	0
14	CFES III	0
14	IMAX	0
14	(RME)	0
14	(CLOUDS)	0
14	SSIP	0
17	IMAX	0
17	(RME)	0
17	(TLD)	0
17	(APE)	0
17	CANEX	0
19	DMOS	0
19	(RME)	0
20	ARC	0
20	SFMD	0
23	CFES III	0
23	(AFE)	0
23	(PPE/SAS)	0

STS	P/L	NO.	
23	SSIP (2)	0	
25	(FPE)	0	
25	FEE	0	
25	ADSF	1	
26	(SAREX)	0	
26	(STTP)	0	
26	(CBDE)	0	
27	PVTOS	0	
31	CFES III	0	
31	MPSE	0	
31	DMOS	0	
32	IR-IE	1	#
32	(CHAMP)	0	
32	IBSE	0	
32	SSIP (3)	0	
33	(TIS)	0	
33	(FDE)	0	
33	(RME)	0	
33	(CHAMP)	0	
33	SSIP	0	
33	(PPE)	0	

CFES SUMMARY

MAX:	0
MIN:	0
AVE:	0
NUMBER:	7

MIDDECK SUMMARY

MAX:	6
MIN:	0
AVE:	0
NUMBER:	75

\# PROCESSED LIKE A MIDDECK PAYLOAD

* * * PRIMARY STUDY DATA * * *
(CHART 10)

* * INTERIM PROBLEM REPORTS * *
UNITS: NUMBER OF IPR's
SHEET 1 OF 3

* SPACELAB *
PAYLOADS & CARRIERS

STS	P/L	NO.
9	SL-1	467
24	SL-3	178
26	SL-2	420
30	SL-D1	72

SPACELAB SUMMARY

MAX:	467
MIN:	72
AVE:	284
NUMBER:	4

* DEPLOYED SATELLITES *

STS	P/L	NO.	STS	P/L	NO.
5	SBS-C	0	19	SYNCOM IV-1	17
5	TELESAT-E	0	23	TELESAT-I	7
6	TDRS-A	2	23	SYNCOM IV-3	9
7	TELESAT-F	0	25	MORELOS-A	12
7	PALAPA B-1	0	25	ARABSAT-1B	13
8	INSAT 1-B	1	25	TELSTAR 3-D	14
11	PALAPA B-2	0	27	SYNCOM IV-4	10
11	WESTAR-6	0	27	AUSSAT-1	12
13	LDEF-1	2	27	ASC-1	14
14	SBS-D	5	31	SATCOM KU-2	9
14	TELESTAR 3-C	4	31	AUSSAT-2	8
14	SYNCOM IV-2	5	31	MORELOS-B	7
17	ERBS	34	32	SATCOM KU-1	38
19	TELESAT-H	18	33	TDRS-B	39

DEPLOYED SUMMARY

MAX:	39
MIN:	0
AVE:	10
NUMBER:	28

*** * INTERIM PROBLEM REPORTS * ***
UNITS: NUMBER OF IPR's
SHEET 2 OF 3

*** GAS PAYLOADS ***

STS	P/L	NO.
3	TEST	2
4	G-001	1
5	G-026	1
6	G-381	1
6	G-049	1
6	G-005	1
7	G-012	1
7	G-033	1
7	G-088	1
7	G-009	1
7	G-002	1
7	G-345	1
7	G-305	1
8	G-347	1
8	G-346	1
8	G-348	1
8	G-475	1
11	IRT	1
11	G-309	1
11	G-051	1
11	G-008	1
11	G-004	1
11	G-349	1
11	C360b	1
17	G-038	1
17	G-007	1
17	G-306	1
17	G-032	1
17	G-518	1
17	G-013	1
17	G-074	1
17	G-469	1
23	G-471	1
23	G-035	1
24	NUSAT	1
24	GLOMR	1
25	G-034	1
25	G-027	1
25	G-028	1
25	G-471	1
25	G-025	1
25	G-314	1
30	GLOMR-R	1
31	IPBC	1
31	G-479	1
32	BRIDGE (12)	1
32	G-470	1

GAS SUMMARY

MAX:	2
MIN:	1
AVE:	1
NUMBER:	58

*** PARTIAL PAYLOADS ***

STS	P/L	NO.
2	OSTA-1	30
3	OSS-1	15
7	SPAS-01	6
7	OSTA-2	30
8	OIM	2
8	PDRS/PFTA	2
11	SPAS-01A	1
13	SMM REPAIR	7
14	OAST-1	14
17	OSTA-3	22
17	LFC/ORS	4
19	HS376 RETRIE	49
25	SPARTAN-1	7
27	SYN SALVAGE	3
31	EASE/ACCESS	10
32	MSL-2	5
32	HH-G1	5
33	SPARTAN-HALL	7

PARTIAL SUMMARY

MAX:	49
MIN:	1
AVE:	12
NUMBER:	18

*** * INTERIM PROBLEM REPORTS * ***
UNITS: NUMBER OF IPR's
SHEET 3 OF 3

*** MIDDECK PAYLOADS ***

STS	P/L	NO.	STS	P/L	NO.	STS	P/L	NO.	
2	PCOC	1	13	(RME)	0	23	SSIP (2)	1	
3	MLR	4	13	IMAX	3	25	(FPE)	0	
3	EEVT	3	13	SSIP	0	25	FEE	1	
3	PCOC	0	14	CFES III	5	25	ADSF	1	
3	PGU	0	14	IMAX	3	26	(SAREX)	0	
3	SSIP	0	14	(RME)	0	26	(STTP)	0	
4	MLR	3	14	(CLOUDS)	0	26	(CBDE)	0	
4	CFES I	5	14	SSIP	0	27	PVTOS	1	
4	(NOSL)	0	17	IMAX	2	31	CFES III	3	
4	(SSIP (2))	0	17	(RME)	0	31	MPSE	0	
5	(GLOW)	1	17	(TLD)	0	31	DMOS	1	
5	SSIP (3)	0	17	(APE)	0	32	IR-IE	1	#
6	MLR	2	17	CANEX	1	32	(CHAMP)	0	
6	CFES II	6	19	DMOS	1	32	IBSE	3	
6	(NOSL)	0	19	(RME)	0	32	SSIP (3)	0	
7	MLR	1	20	ARC	3	33	(TIS)	0	
7	CFES II	1	20	SFMD	1	33	(FDE)	0	
7	(SAS)	0	23	CFES III	4	33	(RME)	0	
8	CFES II	1	23	(AFE)	0	33	(CHAMP)	0	
8	(RME)	0	23	(PPE/SAS)	0	33	SSIP	0	
8	SSIP	0				33	(PPE)	0	
11	ACES	2							
11	IEF	2							
11	C360c	1							
11	MLR	3							
11	(RME)	0							
11	SSIP	1							

CFES SUMMARY

MAX:	6
MIN:	1
AVE:	4
NUMBER:	7

MIDDECK SUMMARY

MAX:	6
MIN:	0
AVE:	1
NUMBER:	75

PROCESSED LIKE A MIDDECK PAYLOAD

* * * PRIMARY STUDY DATA * * *
(CHART 11)

* * PROBLEM REPORTS GENERATED FOR SPACELAB PAYLOADS & SPACELAB CARRIERS * *
UNITS: NUMBER OF PROBLEM REPORTS

* SPACELAB PAYLOADS *

STS	P/L	NO.
9	SL-1	720
24	SL-3	642
26	SL-2	748
30	SL-D1	93

PAYLOAD SUMMARY

MAX:	748
MIN:	93
AVE:	551
NUMB:	4

SL-1/3 CHANGE: -11%
HI-LO CHANGE: -88%

* SPACELAB CARRIERS *

STS	P/L	NO.
9	SL-1	2120
24	SL-3	393
26	SL-2	972
30	SL-D1	130

CARRIER SUMMARY

MAX:	2120
MIN:	130
AVE:	904
NUMB:	4

SL-1/3 CHANGE: -81%
HI-LO CHANGE: -94%

* * * PRIMARY STUDY DATA * * *
(CHART 12)

* * PROBLEM REPORTS GENERATED FOR PAYLOADS OTHER THAN SPACELAB * *
UNITS: NUMBER OF PROBLEM REPORTS
SHEET 1 OF 3

* DEPLOYED SATELLITES *

STS	P/L	NO.	STS	P/L	NO.
5	SBS-C	1	19	SYNCOM IV-1	0
5	TELESAT-E	4	23	TELESAT-I	3
6	TDRS-A	16	23	SYNCOM IV-3	4
7	TELESAT-F	16	25	MORELOS-A	2
7	PALAPA B-1	3	25	ARABSAT-1B	3
8	INSAT 1-B	5	25	TELSTAR 3-D	2
11	PALAPA B-2	5	27	SYNCOM IV-4	2
11	WESTAR-6	5	27	AUSSAT-1	3
13	LDEF-1	13	27	ASC-1	2
14	SBS-D	3	31	SATCOM KU-2	2
14	TELESTAR 3-C	3	31	AUSSAT-2	3
14	SYNCOM IV-2	3	31	MORELOS-B	2
17	ERBS	1	32	SATCOM KU-1	13
19	TELESAT-H	0	33	TDRS-B	6

DEPLOYED SUMMARY

MAX:	16
MIN:	0
AVE:	4
NUMBER:	28

* * PROBLEM REPORTS GENERATED FOR PAYLOADS OTHER THAN SPACELAB * *

UNITS: NUMBER OF PROBLEM REPORTS

SHEET 2 OF 3

* GAS PAYLOADS *

STS	P/L	NO.
3	TEST	0
4	G-001	0
5	G-026	0
6	G-381	0
6	G-049	0
6	G-005	0
7	G-012	0
7	G-033	0
7	G-088	0
7	G-009	0
7	G-002	0
7	G-345	0
7	G-305	0
8	G-347	0
8	G-346	0
8	G-348	0
8	G-475	0
11	IRT	0
11	G-309	0
11	G-051	0
11	G-008	0
11	G-004	0
11	G-349	0
11	C360b	0
17	G-038	0
17	G-007	0

STS	P/L	NO.
17	G-306	0
17	G-032	0
17	G-518	0
17	G-013	0
17	G-074	0
17	G-469	0
23	G-471	0
23	G-035	0
24	NUSAT	0
24	GLOMR	0
25	G-034	0
25	G-027	0
25	G-028	0
25	G-471	0
25	G-025	0
25	G-314	0
30	GLOMR-R	0
31	IPBC	0
31	G-479	0
32	BRIDGE (12)	0
32	G-470	0

GAS SUMMARY

MAX:	0
MIN:	0
AVE:	0
NUMBER:	58

* PARTIAL PAYLOADS *

STS	P/L	NO.
2	OSTA-1	50
3	OSS-1	47
7	SPAS-01	0
7	OSTA-2	7
8	OIM	0
8	PDRS/PFTA	0
11	SPAS-01A	0
13	SMM REPAIR	0
14	OAST-1	43
17	OSTA-3	80
17	LFC/ORS	144
19	HS376 RETRIE	49
25	SPARTAN-1	0
27	SYN SALVAGE	0
31	EASE/ACCESS	3
32	MSL-2	3
32	HH-G1	1
33	SPARTAN-HALL	6

PARTIAL SUMMARY

MAX:	144
MIN:	0
AVE:	24
NUMBER:	18

*** * PROBLEM REPORTS GENERATED FOR PAYLOADS OTHER THAN SPACELAB * ***

UNITS: NUMBER OF PROBLEM REPORTS

SHEET 3 OF 3

* MIDDECK PAYLOADS *

STS	P/L	NO.	STS	P/L	NO.	STS	P/L	NO.	
2	PCOC	0	13	(RME)	0	23	SSIP (2)	1	
3	MLR	11	13	IMAX	0	25	(FPE)	0	
3	EEVT	1	13	SSIP	0	25	FEE	0	
3	PCOC	8	14	CFES III	1	25	ADSF	1	
3	PGU	0	14	IMAX	0	26	(SAREX)	0	
3	SSIP	0	14	(RME)	0	26	(STTP)	0	
4	MLR	1	14	(CLOUDS)	0	26	(CBDE)	0	
4	CFES I	3	14	SSIP	0	27	PVTOS	0	
4	(NOSL)	0	17	IMAX	0	31	CFES III	1	
4	(SSIP (2))	0	17	(RME)	0	31	MPSE	0	
5	(GLOW)	1	17	(TLD)	0	31	DMOS	0	
5	SSIP (3)	0	17	(APE)	0	32	IR-IE	0	#
6	MLR	2	17	CANEX	0	32	(CHAMP)	0	
6	CFES II	2	19	DMOS	0	32	IBSE	0	
6	(NOSL)	0	19	(RME)	0	32	SSIP (3)	0	
7	MLR	0	20	ARC	0	33	(TIS)	0	
7	CFES II	1	20	SFMD	6	33	(FDE)	0	
7	(SAS)	0	23	CFES III	2	33	(RME)	0	
8	CFES II	0	23	(AFE)	0	33	(CHAMP)	0	
8	(RME)	0	23	(PPE/SAS)	0	33	SSIP	0	
8	SSIP	0				33	(PPE)	0	
11	ACES	0							
11	IEF	0							
11	C360c	0							
11	MLR	1							
11	(RME)	0							
11	SSIP	0							

CFES SUMMARY	
MAX:	3
MIN:	0
AVE:	1
NUMBER:	7

MIDDECK SUMMARY	
MAX:	11
MIN:	0
AVE:	1
NUMBER:	75

PROCESSED LIKE A MIDDECK PAYLOAD

STANDARD TITLE PAGE

1. Report No. NASA TM 83105	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle Historical Data and Analysis for the First Five Years of KSC STS Payload Processing		5. Report Date September 1, 1986
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15. Abstract General and specific quantitative and qualitative results were identified from a study of actual operational experience while processing 186 science, applications, and commercial payloads for the first 5 years of Space Transportation System (STS) operations at the National Aeronautics and Space Administration's (NASA) John F. Kennedy Space Center (KSC). All non-Department of Defense payloads from STS-2 through STS-33 were part of the study.

Historical data and cumulative program experiences from key personnel were used extensively. Emphasis was placed on various program planning and events that affected KSC processing, payload experiences and improvements, payload hardware condition after arrival, services to customers, and the impact of STS operations and delays. From these initial considerations, operational drivers were identified, data for selected processing parameters collected and analyzed, processing criteria and options determined, and STS payload results and conclusions reached.

The study showed a significant reduction in time and effort needed by STS customers and KSC to process a wide variety of payload configurations. Also of significance is the fact that even the simplest payloads required more processing resources than were initially assumed. The success to date of payload integration, testing, and mission operations, however, indicates the soundness of the approach taken and the methods used.

16. Key Words

Payload processing	Historical data	Processing parameters
STS missions	Trend analysis	
KSC processing options	Operational considerations	

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