

# **STS-7 Space Shuttle Program Mission Report**

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July 1983



National Aeronautics and  
Space Administration

**Lyndon B. Johnson Space Center**  
Houston, Texas

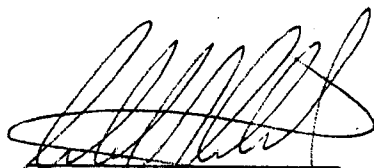
SPACE SHUTTLE PROGRAM

STS-7

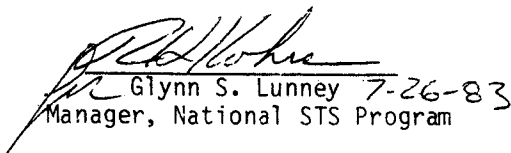
MISSION REPORT



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## INTRODUCTION AND MISSION OBJECTIVES

The STS-7 Space Shuttle Program Mission Report provides an overview of the major activities, accomplishments, and findings of the third operational flight and the second flight of vehicle OV-099, the Challenger. The vehicle has been returned to Kennedy Space Center where preparations are continuing for STS-8, scheduled for late August 1983.

The primary mission objective of STS-7 was to deploy the ANIK and PALAPA satellites and to accomplish the functions of SPAS-01, OSTA-2, MLR, and CFES payloads.

### STS-7 MISSION SUMMARY

The STS-7 flight was launched on June 18, 1983, at 11:33:00.033 G.m.t (7:33:00.033 a.m.e.d.t.) from Kennedy Space Center, Florida, and landed at Edwards AFB, CA. The sequence of events for this seventh flight is listed in Table I. The crew for this flight, the largest number ever flown, were Captain R. L. Crippen, Commander; Captain F. H. Hauck, Pilot; and Colonel J. M. Fabian and S. K. Ride, Phd., Mission Specialists; and N. E. Thagard, M.D., Medical Specialist.

The ascent phase was normal with all systems operating near predicted levels. All SRB (solid rocket booster), ET (external tank), SSME (Space Shuttle Main Engine), and MPS (main propulsion system) systems performed as designed. The SRB's separated within 2.0 seconds of the planned time and all recovery systems operated satisfactorily, resulting in the recovery of both SRB's and all parachutes.

All ET systems operated properly and the ET impact point was within 12 nmi downrange of the predicted point.

The main propulsion system operated normally. The main engine cutoff occurred after 8 minutes 20.24 seconds of powered flight, followed by ET separation 18 seconds later. Approximately 2 minutes after MECO, the first of two OMS (orbital maneuvering system) maneuvers that occurred during the first revolution was initiated. Following the completion of the second OMS maneuver at 169:12:19:28.05 G.m.t. (38 minutes after MECO), the vehicle was in essentially a 160 nmi. circular orbit.

The first day's activities were all conducted in accordance with the flight plan including the on-time deployment of the ANIK-C (Telesat) satellite at 169:21:02:00 G.m.t. The OMS-3 separation maneuver followed the deployment by about 14.5 minutes. The ANIK-C satellite later performed the necessary maneuvers to achieve the desired geosynchronous orbit. No significant anomalies occurred during day 1 activities.

The major activity of the second day was the successful deployment of the PALAPA satellite followed by the OMS-4 separation maneuver. The satellite later performed the required maneuvers to place it in a geosynchronous orbit. The RMS (remote manipulator system) and SPAS (Shuttle Pallet Satellite) payload were checked out, and all systems were operating properly. OSTA-2 experiment activities were also initiated during day 2.

Early on day 3, two detailed test objectives were successfully performed and these were the KU-band communications link performance test and S-band/TDRS communications link performance test. The OMS-5 and OMS-6 orbit adjust maneuvers were also performed. Major events for the remainder of the day included the SPAS attached operations, OSTA-2 activities, and experiment (GAS and MLR) activities. The 30-hour 10.2-psia cabin pressurization test was initiated the third day. All systems operated satisfactorily during this 30-hour period.

TABLE I.- STS-7 SEQUENCE OF EVENTS

| Event   | Actual<br>G.m.t. |
|---|------------------|
| APU activation (1)                            | 169:11:28:08     |
| (2)   | 169:11:28:09     |
| (3)   | 169:11:28:10     |
| SRB HPU activation command (4)                | 169:11:32:32.23  |
| MPS start command (Engine 3)                  | 169:11:32:53.43  |
| SRB ignition command from GPC (lift-off)      | 169:11:33:00.03  |
| Main engine throttledown to 81-percent thrust | 169:11:33:27.92  |
| MPS throttleup to 104-percent thrust          | 169:11:34:01.40  |
| Maximum dynamic pressure                      | 169:11:34:03     |
| SRB separation command                        | 169:11:35:06.12  |
| MPS throttledown for 3g acceleration          | 169:11:40:23     |
| 3g acceleration                               | 169:11:40:23.60  |
| Main engine cutoff (MECO) command             | 169:11:41:20.24  |
| External tank separation                      | 169:11:41:38.24  |
| OMS-1 ignition                                | 169:11:43:20.36  |
| OMS-1 cutoff                                  | 169:11:45:39.81  |
| APU deactivation                              | 169:11:46:13     |
| OMS-2 ignition                                | 169:12:17:30.53  |
| OMS-2 cutoff                                  | 169:12:19:28.05  |
| Telesat (ANIK-C) deployment                   | 169:21:02:00     |
| OMS-3 ignition                                | 169:21:16:29.41  |
| OMS-3 cutoff                                  | 169:21:16:34.41  |
| PALAPA deployment                             | 170:13:33:00     |
| OMS-4 ignition                                | 170:13:51:10.45  |
| OMS-4 cutoff                                  | 170:13:51:15.37  |
| OMS-5 ignition                                | 171:14:50:10.97  |
| OMS-5 cutoff                                  | 171:14:50:14.09  |
| OMS-6 ignition                                | 171:15:35:33.41  |
| OMS-6 cutoff                                  | 171:15:35:46.37  |
| OPS-8 checkout attempt                        | 174:07:23:52     |
| OPS-8 checkout accomplished                   | 174:14:51:03     |
| Deorbit maneuver ignition                     | 175:12:56:00.21  |
| Deorbit maneuver cutoff                       | 175:12:58:46.21  |
| APU 1 activation                              | 175:12:51:01     |
| APU 2 and 3 activation                        | 175:13:13:04     |
| Entry interface (400,000 ft)                  | 175:13:25:58     |
| End blackout                                  | 175:13:42:59     |
| Terminal area energy management               | 175:13:50:31     |
| Main landing gear contact                     | 175:13:56:59     |
| Nose landing gear contact                     | 175:13:57:19     |
| Wheels stop                                   | 175:13:58:14     |
| APU deactivation completion                   | 175:14:08:17     |

The significant events of the fourth day were the completion of the first three runs of the CFES (continuous flow electrophoresis system) experiment and the SPAS attached activities during which the SPAS was released from its latches and moved outside the payload bay by the RMS (remote manipulator system) arm.

A highly active fifth day began with the unberthing and release of the SPAS-01 payload using the RMS. The SPAS-01 experiments were conducted during the long range (1000 ft) station keeping activity. The SPAS-mounted cameras (16-mm, 70-mm, and TV) were used to photograph the Orbiter during detached operations. A V-bar approach (rendezvous) was performed and SPAS-01 grapple and release operations were again performed. Short range (up to 200 ft) station keeping operations then followed, after which an inertial approach was made by the Orbiter to the SPAS-01. Grapple operations were again performed by the RMS with the SPAS-01, followed by berthing the SPAS-01 in the Orbiter cargo bay.

During the sixth day, the final RMS tests were performed, the KU-band antenna was stowed, and cabin stowage was begun in preparation for entry the following day. The flight control system checkout was also performed. One of the most significant anomalies of the flight occurred during this checkout when APU (auxiliary power unit) 3 shut down because of a turbine underspeed condition during the start operations of the APU. The data from this failure were analyzed and 7 hours later a successful second attempt was made of the flight control system checkout using APU 3.

On day 7, the OSTA-2 experiments were powered down and the payload bay doors were closed in anticipation of entry on revolution 96 with a landing at KSC (Kennedy Space Center). Poor weather conditions at KSC resulted in a decision to delay entry until revolution 97, and still land at KSC. However, weather conditions did not improve adequately to allow a landing at KSC; consequently, the entry was delayed until revolution 98 with landing at Edwards AFB, CA. The deorbit maneuver was performed at 175:12:56 G.m.t., and after a satisfactory entry and blackout phase, the Orbiter was landed at Edwards AFB at 175:13:56:59 G.m.t on the lake bed runway.

All other systems operated satisfactorily throughout entry and landing, however, during towing operations, noises and chattering came from the right wheel. It was necessary to jack up the Orbiter and remove the wheel, take out the brake assembly, and remount the wheel before towing could be completed.

## VEHICLE ASSESSMENT

### SOLID ROCKET BOOSTERS

The thrust time history for the SRMs (solid rocket motors) was well within the specification limits. The evaluation shows that head pressures were higher than predicted by approximately 0.7 percent for the left-hand and 1.2 percent for the right-hand motor between 5 and 20 seconds. The propellant burn rate on both SRMs was approximately 1.0-percent higher than predicted. The action time was short by approximately 2.35 seconds for the left-hand motor and 2.08 seconds for the right-hand motor resulting in an earlier than predicted separation by approximately 2.0 seconds.

The deceleration subsystems on both SRBs performed normally and all parachutes were recovered. As on previous flights, the parachutes suffered burn damage. Performance of all location aids was good, and recovery operations went smoothly.

### EXTERNAL TANK

During prelaunch, the ET LH<sub>2</sub> loading operation was halted momentarily due to a leak in the T-zero umbilical that exceeded the 3.6 percent red line value. The leak was isolated to the 1.5-inch MPS high-point bleed disconnect. As LH<sub>2</sub> loading continued, the leak was kept below the red line value and there were no problems during launch.

The ET (external tank) systems met all launch requirements. During flight, the liquid hydrogen ullage pressure transducer no. 2 apparently failed to function properly from 120 seconds to 390 seconds after lift-off. This resulted in the LH<sub>2</sub> flow control valve not opening which allowed the liquid hydrogen ullage pressure to drop below 32 psia. There was no impact to the flight.

The prelaunch thermal environment was as expected with no launch commit criteria violations. The TPS (thermal protection system) acreage experienced only minor ice/frost buildup in areas for which waivers had been granted. During loading, one of two inboard LH<sub>2</sub> feedline bracket heater circuits failed. For STS-7, one heater failure was allowable at T-2 hours. The heater circuit was deenergized and loading proceeded with no impact. The failure has been attributed to a short in a facility junction box.

The ET separation, entry, and disposal were as predicted. The ET impact point was within approximately 12 nmi (downrange) of the predicted point.

### MAIN PROPULSION SYSTEM

The liquid oxygen and liquid hydrogen propellant loading was completed satisfactorily. Flight mass was maintained for both fluids during the terminal count. ET ullage pressures during loading met requirements for both fluids.

The engine start buildups and transitions to mainstage were normal. Engine operation and performance during mainstage appeared satisfactory. Mixture ratio and thrust values from the flight indicate repeatable engine performance. Power level throttling operation appeared normal. The system specific impulse was 452.97 seconds or 0.43 seconds above the assessment tag values. Engine shutdown was satisfactory. Actual MECO occurred approximately 0.5 second later than predicted. During ascent, the Orbiter GH<sub>2</sub> pressurant pressure sensors for engine 2 and engine 3 failed. Neither of these failures impaired the successful performance of the pressurization system.

Initiation of L02 and LH2 propellant dump performance appeared to be normal. MPS helium storage bottle pressures and temperatures were within limits during prelaunch and boost as were ORB/SSME helium interface pressures and temperatures.

#### ORBITER

All systems performed nominally except for the discrepancies discussed in the following paragraphs.

#### ARPCS High Oxygen Flow

High oxygen flow rates were experienced in the automatic mode on ARPCS system 1 when switching from nitrogen to oxygen and occurred again on system 2. The automatic system was deactivated and the manual mode was used to control the cabin O<sub>2</sub> and N<sub>2</sub> levels for the remainder of the flight.

#### APU Heater Failures

Three APU system heaters failed. APU 2 fuel service line B heater failed off at 169:15:53 G.m.t. System A was activated and maintained temperatures for the remainder of the mission.

APU 3 water injector cooling line A heater failed at 173:16:46 G.m.t. APU 3 drain line system B heater failed off at 174:02:24 G.m.t. Since the APU drain line and water injector cooling line are on the same switch, both A and B systems were turned on to maintain temperatures for the rest of the mission.

#### Hydraulic Accumulator

The prelaunch hydraulic system 2 bootstrap accumulator pressure indicated a slow decay. On day 1 of the flight, the accumulator pressure indicated that a rapid pressure decay was occurring. Pressure was maintained by a combination of manual- and timer-mode circulation pump operation. This provided sufficient suction pressure for the APU and main pump start up, thus resulting in normal system operation during entry, landing, and rollout.

#### IMU Bite

Shortly after ANIK-C deployment, several Bite/T messages were observed on IMU 1. Investigation revealed that the messages were caused by the method used in the software algorithm to perform the resolver limit test for the outer roll axis. A software G MEM change was implemented which changed the limit threshold to avoid the BITE messages. This technique cleared the problem for the remainder of the flight.

#### CRT 3 Failed

On day three of the mission at about 171:19:37 G.m.t., CRT 3 failed and would not respond to on-orbit testing. Cycling the power input switch did not produce positive results. Also the stand-alone self test on-orbit could not isolate the problem to an LRU. The crew successfully used the other two forward CRT's for the entry phase.



### Wireless Crew Communications System

Midway through the mission, the crew reported that the wireless crew communications system A, B, and C leg units and system C and E wall units had failed.

### UHF Constant Key On Middeck ATU

Constant UHF transmitter keying was heard and subsequent trouble shooting isolated the problem to the middeck audio control panel air-to-air (A/A) loop which was selected in the transmit/receive (T/R) mode. The problem was cleared by selecting A/A in the receive-only mode.

### Text And Graphics System (TAGS) Failure

The TAGS failed after the first sheet of paper was transmitted. The paper failed to move through the developer in the hard copier. This same problem occurred during qualification testing and a modification was subsequently developed to prevent the problem. There was insufficient time to incorporate the modification on this unit before flight.

### Right RCS Fuel Isolation Valve Miscompare

At 173:10:11 G.m.t., about 4 hours after initiating the OMS/RCS interconnect mode, an open and a closed indication were both noted on the right RCS system B fuel manifold 3/4/5B isolation valve. The valve could not be commanded open with the open indication present. Thus one of three parallel fuel flow paths to manifolds 3, 4, and 5 of the right RCS pod was lost.

The mission was not affected by this failure.

### OMS Right-Hand Quantity Gage Loss

At 173:15:40:12 G.m.t., both fuel and oxygen aft propellant gage quantities of the right-hand OMS indicated off-scale high and the total gage quantities for fuel and oxygen dropped by 7 percent. During the next 25 minutes, all four quantity indications fluctuated and then read zero.

### APU Shutdown

During the startup for on-orbit checkout, the APU 3 ramped up to normal pressure (~1000 psi), but the second pulse was only about 550 psi. At the degraded pressure, the APU was able to hold the load of pressurizing the hydraulic pump, but shutdown when the load was applied during the on-orbit checkout procedure.

During the second on-orbit checkout attempt 7 hours later, the APU started in 5 1/2 seconds and ran at 550 psi for about 8 pulses (hydraulic pump depressurized). The pressure then ramped up to about 950 psi over 4 pulses and remained at that level or higher for the remainder of the mission.

### Display Driver Unit Failed Bite Message

During deorbit preparations, a failed Bite message was observed on the right DDU (display driver unit). At the same time, the crew reported that the right ADI (attitude direction indicator) and other active hardware powered and driven by the DDU was working properly. The remaining dedicated displays also operated normally when they were activated during entry and landing.

### Water Spray Boiler 3 Water Depletion

After post-entry blackout at about 175:13:43 G.m.t. there was an indication that WSB (water spray boiler) 3 water quantity was rapidly depleting. Control was switched from system A to system B and the GN<sub>2</sub> pressure decay was stopped for a period of 5 minutes after which the decay continued. Although the rapid depletion resulted in a depleted WSB tank, sufficient cooling was maintained through landing and rollout.

### Left ADTA System A Did Not Indicate Deploy

At 175:13:49 G.m.t., the left Air Data Transducer Assembly (ADTA) System A did not indicate deploy. The crew recycled the deploy switch and received the system A deployed indication. All four channels of the ADTA were then operable.

### Right Braking System

During initial Orbiter towing operations postflight, a noticeable crunching and grinding noise emanated from the right main landing gear. Also there was strut chattering. Investigation revealed that the right inboard brake had major structural damage of two rotors including the beryllium heat sink and carbon lining segments. The right outboard brake had two loose carbon pads with retainer washers missing. Cracked retaining washers were found in all brake assemblies.

### Waste Management System Failure

During day five, the WMS slinger failed and the urine system flow became erratic.

### Windshield Damage

The right center windshield (window 5) sustained a 0.2-inch diameter pit in the upper center portion. The pit had a pulverized center about 0.1-inch deep. The crew reported that the pit was first noticed on day 3.

### Thermal Protection System Damage

More debris damage was noted to the lower TPS (thermal protection system) surfaces on this flight when compared with previous flights. This damage was primarily to the left chine area, and the damage definitely occurred during ascent. The Orbiter had more FRSI (felt reusable surface insulation) discoloration than on STS-6, primarily along the side fuselage at the FRSI-to-tile interface. Five tile corners were broken on the rudder speed

brake along with heavy fraying of the right-hand split line thermal barrier. A portion of one tile on the left main landing gear door fractured at door opening as also occurred on STS-6. Also, the nose landing gear door thermal barrier sustained slight damage. The AFRSI (advanced felt reusable insulation) was damaged on 15 of the right-hand pod blankets and on 3 of the left-hand pod blankets. Also, tile slumping was noted on 4 tiles of the LESS (leading edge structural system) lower access panel, and on 4 tiles on the elevon leading edge carrier panel.

#### CCTV Monitor Bracket Debonded

The CCTV monitor bracket on the aft flight deck debonded from the cabin port sidewall.

#### Radar Altimeter Unit 1 Intermittent

Radar altimeter unit 1 momentarily locked and provided data for about 1 second, then lost lock and attempted to reacquire from 4000 feet altitude down to approximately 1000 feet. Acquisition of the ground return was then obtained and performance was nominal from 1000 feet through rollout.

#### Left OMS GN<sub>2</sub> Regulator Leak

During the deorbit maneuver, a leak occurred through the Left OMS GN<sub>2</sub> Regulator. This was indicated by a 1 psi/10-second pressure increase downstream of the regulator.

#### Payload Interrogator Loss of Lock

During proximity operations with the SPAS-01, the payload interrogator (PI) occasionally lost the return link lock. Several unsuccessful attempts were made to reacquire lock by sweeping the PI transmitter. The crew restored normal operation by switching to system 2.

#### Locker and Cabin Door Misalignment Problems

The crew continued to have misalignment problems with about one third of the locker doors. Deformation of the door frame for the waste management compartment prevented door closure. The Text and Graphic System access door was jammed. Red marks were incised on a number of locker door frames for postflight evaluation of the deformation. Cross threading of the latching mechanism contributed to the door closure problem.

### ACTIVITIES

#### ANIK-C DEPLOYMENT

The TELESAT Canada Satellite (ANIK-C) was successfully deployed from the Orbiter exactly at the planned time of 09:28:42 mission elapsed time on June 18, 1983. The deployment from the Orbiter was within 0.15 degree of the planned, as compared with 2.0 degrees specification allowable from the Orbiter. The PAM engine was fired 45 minutes after deployment, placing the ANIK into its planned transfer orbit. The PAM apogee firing was accomplished by TELESAT on June 21, 1983. The ANIK-C has been fully checked out and is on station.

The only anomaly evident on the ANIK-C flight was a slight hesitation of the sunshield during its initial closing and to a lesser extent during subsequent operations.

## PALAPA-B DEPLOYMENT

The Indonesian Satellite PALAPA-B was successfully deployed from the Orbiter within 1 second of the planned time of 02:18:04:00 mission elapsed time on June 19, 1983. The PAM engine was fired 45 minutes later, placing the PALAPA in an accurate transfer orbit. The PAM apogee firing was accomplished by the Indonesian station at Jakarta on June 21, 1983. The PALAPA-B has been fully configured and checked out and is currently on station and in operation.

The deployment from the Orbiter was within 0.15-degree of the planned as compared with the Orbiter specification of 2.0 degrees.

## SPAS-01 AND PROXIMITY OPERATIONS

All scheduled detailed test objectives (DTO's) concerning SPAS-01 and the associated operations (DTO-0504 and -0802) were accomplished as planned. The handling characteristics were good and the unberthing and berthing of the SPAS-01 were smooth and easily accomplished. Release of the SPAS-01 showed no appreciable motion imparted to the payload due to end effector operation or arm dynamics. Capture of the payload, both in the stable attitude and rotating at 0.1 deg/sec relative to the Orbiter was easily accomplished. The proximity operations were performed as planned and simulated and the propellant consumption was less than planned.

The SPAS-01 Plume Impingement Test (DTO-0505) showed that the SPAS-01 was perturbed by the plume from the RCS thrusters. All thrusters except the aft ones perturbed the SPAS.

## MONODISPERSE LATEX REACTOR

The MLR (monodisperse latex reactor) experiments were operated in accordance with timeline on STS-7. No anomalies were noted in the hardware or the latex spheres. Preliminary observations of the spheres indicate a growth wall in all four MLR reactors. The MLR engineering data were collected and are currently being reviewed.

## CONTINUOUS FLOW ELECTROPHORESIS SYSTEM

All six CFES (continuous flow electrophoresis system) samples were processed according to the timeline and all samples appear to have separated very well. The NASA samples have been forwarded to the PI's (Principal Investigators) and none of the NASA or MDAC (McDonnell-Douglas Aircraft Corporation) samples show any off-nominal characteristics.

## GET-AWAY SPECIAL EXPERIMENTS

Seven get-away special experiments were flown on STS-7. Results of these experiments may be obtained from the principle investigators.

## REDUCED CABIN PRESSURE DEMONSTRATION

The evaluation of the 10.2-psia manual cabin pressure and oxygen partial pressure (PPO<sub>2</sub>) control procedures was satisfactorily demonstrated.

With the established procedures, the crew was able to adjust the cabin pressure and PP0<sub>2</sub> into the target box requirements and to maintain cabin pressure and PP0<sub>2</sub> at acceptable levels. Repressurization to the 14.7-psia level was satisfactorily performed using the manual control procedures.

The oxygen bleed orifice sizing was adequate for 5 crew persons and was determined to be essential to the 10.2-psia manual pressure control procedure.

Thermally using the coolant loop configuration for the 10.2 psia operation, the air coolant outlet temperatures in the avionic bays remained about the same at 10.2-psia as those noted at the 14.7-psia cabin pressure conditions. The air-cooled avionics on the flight deck at 10.2-psia were estimated to be about 10° F warmer (117° F outlet) than that observed at the 14.7-psia levels.

#### BUS-TIE DEMONSTRATION

A DTO was performed postlanding to verify the ability to perform a bus-tie during ascent in the event of a bus loss.

All three main buses were exercised successfully without significant transients occurring. The main engine controllers were not affected by the bus tie or by the reactivation of the loaded static inverter. This demonstrated that an ascent bus tie is a viable option for future missions.

During the DTO performance, however, the right and left main landing gear uplock release pyrotechnics were fired. Inverted logic is used in one half of the redundant backup release circuits and this logic requires inhibit signals from the main gear door uplock proximity sensor. These signals were lost during the bus tie DTO, thus allowing the backup release logic to fire one set of the pyrotechnics. The pyrotechnics would not have fired using normal bus-tie procedures during ascent.

### TEST OBJECTIVES ACCOMPLISHMENTS

Fifty eight scheduled DTO/DSO (Detailed Test Objectives/Detailed Supplementary Objectives) activities comprising 17 DTO's and 18 DSO's were scheduled for the STS-7 flight. All were successfully completed except for the Y c.g. offset (DTO 0211). A summary of the DTO/DSO activities is shown in Table II.

TABLE II.- STS-7 DTO/DSO ACCOMPLISHMENTS  
(a) Flight day 1 thru 7

| DTO/DSO | Title   | Accomplished |
|---------|---|--------------|
| 0203/   | Entry Aero #3   | yes          |
| 0312/   | ET TPS Performance                                      | yes          |
| /0401   | Medical Report  | yes          |
| /0402   | Cardiovascular Deconditioning Countermeasure Assessment | yes          |
| /0403   | Ascent Head and Eye Tracking                            | yes          |
| /0404   | On-Orbit Head and Eye Tracking                          | yes          |
| 0407/   | Postlanding Bus Tie                                     | yes          |
| /0408   | Near Vision Acuity                                      | yes          |
| /0409   | Microbiology Screening                                  | yes          |
| 0504/   | PDRS Performance  | yes          |
| 0505/   | Plume Impingement                                       | yes          |
| 0602/   | Cabin Atmosphere  | yes          |
| 0620/   | 10.2 Cabin P. C. Demonstration                          | yes          |
| 0725/   | Ku-Band Functional Test                                 | yes          |
| 0762/   | Orbiter-RMS Dynamic Interaction                         | yes          |
| 0766/   | VRCS Plume Impingement                                  | yes          |
| 0801/   | RR/Sensors Performance                                  | yes          |
| 0802/   | Proximity Operations                                    | yes          |

TABLE II.- STS-7 DTO/DSO ACCOMPLISHMENTS - Continued  
(b) Data only DTO's

| DTO/DSO | Title                        | Accomplished |
|---------|------------------------------|--------------|
| 0211/   | Entry with Lateral Offset #3 | no           |
| 0217/   | Ascent Aero                  | yes          |
| 0219/   | ET and SRB Ascent Heating    | yes          |
| 0303/   | TPS Entry Heating            | yes          |
| 0313/   | SRB Recovery                 | yes          |

TABLE II.- STS-7 DTO/DSO ACCOMPLISHMENTS - Concluded  
(c) Unscheduled

| DTO/DSO | Title                  | Accomplished |
|---------|------------------------|--------------|
| 0406/   | Kinesthetic Ability    | yes          |
| 0407/   | Leg Volume Photos      | yes          |
| 0412/   | Treadmill Photos       | yes          |
| 0413/   | Cell Attachment        | yes          |
| 0414/   | Ophthalmoscopy         | yes          |
| 0415/   | Tissue Press-Tonometer | yes          |
| 0416/   | Ambulatory Monitoring  | yes          |
| 0417/   | SAS Countermeasures    | yes          |
| 0418/   | Eye-Hand Conditions    | yes          |
| 0901/   | TV                     | yes          |
| 0902/   | 16mm Photos            | yes          |
| 0903/   | Still Photos           | yes          |