# STS-41B <br> National Space <br> Transportation Systems <br> Program Mission Report 

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## INTRODUCTION AND MISSION OBJECTIVES

The STS-41B National Space Transportation Systems Program Mission Report contains a summary of the major activities and accomplishments of the sixth operational Shuttle flight and fourth flight of the OV-099 vehicle, Challenger. Since this flight was the first to land at Kennedy Space Center, the vehicle was towed directly to the OPF (Orbiter Processing Facility) where preparations for flight STS-41C, scheduled for early April 1984, began immediately. This report also summarizes the significant problems that occurred during STS-41B, and provides a problem tracking list that is a complete list of all problems that occurred during the flight. None of the problems will affect the STS-A1C flight.

The major objectives of flight STS-41B were to successfully deploy the Westar satellite and the Indonesian Communications Satellite-B2 (PALAPA-B2); to evaluate the MMU (Manned Maneuvering Unit) support for EVA (Extravehicular Activities); to exercise the MFR (Manipulator Foot Restraint); to demonstrate a closed-loop rendezvous; and to operate the MLR (Monodisperse Latex Reactor), the ACES (Acoustic Containerless Experiment System) and the IEF (Isoelectric Focusing) in-cabin experiments; and to obtain photographs with the Cinema 360 Cameras.

The as-flown timeline for the STS-41B flight is shown in figure 1 at the end of the report. The sequence of events for this flight is shown in table I. The problem tracking lists for the MSFC (Marshall Space Flight Center) elements and Orbiter are shown in tables II and III, respectively, also at the end of the report.

## MISSION SUMMARY

The STS-41B flight was launched from Launch Complex 39 at KSC (Kennedy Space Center) on February 3, 1984, at 034:12:59:59.998 G.m.t. (06:59:59.998 a.m. e.s.t.), and landed at the KSC Shuttle Landing Facility at 07:16 a.m. e.s.t. on February 11, 1984. This flight ended with the completion of one of the last major test objectives of the program, that of landing at the Kennedy Space Center. The precision with which this objective was accomplished showed that all areas of the National Space Transportation System Progran were at their peak of readiness for completing this objective.

The crew for this flight was Vance D. Brand, Commander; Lt. Commander Robert L. Gibson, Pilot; and Capt. Bruce McCandless II, Ronald E. McNair, Phd., and Lt. Col. Robert L. Stewart, Mission Specialists. Of the 32 DTO's (development test objectives) and DSO's (detailed supplementary objectives), 29 were completed for a 91 percent completion rate. The failure of the IRT (integrated rendezvous target) to inflate after deployment resulted in one and one-half of the three DTO's not being accomplished; thus resulting in the cancellation of the rendezvous exercise. Also one-half of the DTO concerning MMU operations with the deployed SPAS (Shuttle pallet satellite) could not be accomplished because the RMS (remote manipulator system) failure prevented the SPAS deployment. The third DTO not completed was the closed circuit television laser ranging test which was also to be completed using the inflated IRT.

The ascent phase was normal in all respects, as was the ET (external tank) separation and the two OMS (orbital maneuvering system) maneuvers that placed the vehicle in the planned $165-n m i$. circular orbit. The SRB's (solid rocket boosters) were recovered along with their parachutes. The ET impacted within the planned footprint.

TABLE 1. - STS-41B SEQUENCE OF EVENTS

| EVENT | Actual <br> G.m.t. |
| :---: | :---: |
| APU activation (1) | 034:12:55:10 |
| (2) | 034:12:55:12 |
| (3) | 034:12:55:13 |
| SRB HPU activation command (RH-B2) | 034:12:59:32.7 |
| MPS start command sequence (engine 3) | 034:12:59:53.4 |
| SRB ignition command from GPC (1ift-off) | 034:12:59:59.998 |
| MPS throttledown to 73 percent thrust (engine 3) | 034:13:00:29.4 |
| MPS throttleup to 100-percent thrust (engine 3) | 034:13:01:00.8 |
| Maximum dynamic pressure | 034:13:01:07.0 |
| SRB separation command | 034:13:02:08.6 |
| MPS throttledown for 3g acceleration (engine 3) | 034:13:07:50.1 |
| Main engine cutoff (MECO) | 034:13:08:41.76 |
| External tank separation | 034:13:09:00 |
| OMS-1 ignition | 034:13:10:41.8 |
| OMS-1 cutoff | 034:13:13:12.0 |
| APU deactivation (APU 3) | 034:13:14:43 |
| OMS-2 ignition | 034:13:45:24.8 : |
| OMS-2 cutoff | 034:13:47:29.8 |
| Westar/PAM satellite deployment | 034:20:59:00 |
| OMS-3 ignition (separation firing) | 034:21:13:53.2? |
| OMS-3 cutoff | 034:21:14:06.2 |
| OMS-4 ignition (orbit adjust firing) | 036:10:23:23.2 |
| OMS-4 cutoff | 036:10:23:54.4 |
| Integrated rendezvous target deployed/failed | 036:11:51 |
| PALAPA/PAM satellite deployment | 037:15:13:16 |
| OMS-5 ignition (separation firing) | 037:15:28:16.2? |
| OMS-5 cutoff | 037:15:28:28.6; 12 |
| Start first extravehicular activity | 038:12:10 |
| End first extravehicular activity | 038:18:05 |
| Start second extravehicular activity | 040:10:24 |
| End second extravehicular activity | 040:16:41 |
| OPS-8 (flight control system) checkout | 041:08:58:59 |
| APU 2 activation | 042:11:11:19 |
| Deorbit maneuver ignition | 042:11:16:15.2 |
| Deorbit maneuver cutoff | 042:11:19:03.4 $\}$ |
| APU 1 and 3 activation | 042:11:32:27 |
| Entry interface ( $400,000 \mathrm{ft}$ ) | 042:11:45:12 |
| End blackout | 042:12:01:29 |
| Terminal area energy management | 042:12:09:30.2 |
| Main landing gear contact | 042:12:15:55 |
| Nose landing gear contact | 042:12:16:06 |
| Wheels stop | 042:12:17:02 |
| APU deactivation complete | 042:12:31:08 |

The first day of the STS-41B flight progressed satisfactorily with data being obtained on all seven planned DTO/DSO's. Dnly minor anomalies occurred, none of which had any impact on the successful completion of the flight. In addition, the Westar Communications Satellite was deployed as planned at 34:20:59:00 G.m.t. The Orbiter was separated from the satellite and the Westar perigee burn was performed. The Westar satellite did not achieve the planned geosynchronous orbit. It is now in a 162-by $656-n \mathrm{mi}$. orbit. As a result, the PALAPA-B Indonesian satellite deployment was delayed 2 days in an effort to understand the Westar situation.

On the second day, the IRT balloon did not inflate after deployment. As a result, the rendezvous exercises were cancelled. Even though the balloon did not inflate, the crew was able to track the target to a range greater than $30,000 \mathrm{ft}$. and good short-range sensor data (Ku-Band radar, star tracker, and crewman optical alignnent sight) were obtained which partially fulfilled the planned short-range DTO. The long-range-rendezvous objective, the atmospheric drag profile of the balloon as it slowed and entered, and the CCTV laser ranging test could not be accomplished because of the IRT failure.

On the second day, the cabin pressure was lowered to 10.2 psia in preparation for the two EVA's. Lowering the cabin pressure reduced the required prebreathing time prior to the two EVA's from 3 hours, as on a previous mission with 14.7-psia cabin pressure, to 1 hour. All subsystems in the cabin area functioned satisfactorily during the 72 -hour period of lower pressure.

The third day was devoted primarily to conducting experiments, both those in the cabin and in the payload bay, and preparing for the first EVA. DTO 0705, the Shuttle Launch Configuration Communications Test that involved encrypting and decrypting voice and data, was performed smoothly.

The decision was made by the Indonesians to deploy their satellite (PALAPA-B) on the fourth day of the mission. The satellite was deployed on time and at the proper attitude. The PALAPA-B also did not achieve its desired orbit and is in approximately the same orbit ( 639 by 148 nmi .) as the Westar.

The fifth day was highlighted by the completion of a very ambitious EVA during which man, for the first time, separated from the orbiting vehicle without tethers, and, using the MMU, traversed to distances as far as 320 feet from the Orbiter. The two crewmen were able to perform the planned tasks during the EVA plus remove CCTV camera D for inflight maintenance within the cabin and subsequent reinstallation during the second EVA. Operations with the MMU were successful. Some difficulty was experienced by one of the crewmen in locking himself in the various foot restraints. Another difficulty occurred during EVA communications when the crewmen had to speak louder than normal to energize the VOX (voice-operated) microphone. All objectives associated with the first EVA were accomplished.

The sixth day was devoted to in-cabin operations, obtaining data from various experiments, and preparing equipment for the EVA planned for the seventh day. Various experiments on the SPAS-01 in the payload bay were also performed and data obtained. All planned DTO's and DSO's were completed on the sixth day.

A significant problem of the STS-41B mission developed on the morning of the seventh day during checkout of the RMS prior to EVA. The arm operated properly except for the wrist joint. The joint would not move when commanded, although it had operated properly during the first EVA. The crew attempted to recover use of the arm by performing groundsuggested procedures, but all attempts failed to activate the wrist joint. The arm was recradled and all RMS and deployed SPAS operations planned for the second EVA were cancelled.

The second EVA, although replanned because of the above activities being cancelled, was still successful. The crew performed MM N docking operations with the SPAS, even though the SPAS was not deployed. The crew also retrieved a foot restraint that had come loose, repaired the slide wire linkage that was also loose, and reinstalled CCTV camera D.

The crew spent the final full day in orbit completing three DTO/DSO's plus parts of the experiment data gathering still required. The crew also stowed the vehicle for entry the next morning. The crew completed all preparations for entry on the final day and at 042:11:16:15 G.m.t., the 168-second deorbit maneuver was performed as planned. The entry was normal in all respects and all scheduled PTI (programmed test input) maneuvers were performed. After completing the HAC (heading alignment circle) turn angle of 301 degrees, the Orbiter was guided to the KSC Shuttle Landing Facility for the first time. The Orbiter landed on runway 15 approximately 2000 feet from the beginning of the runway. Rollout required approximately 10,800 feet with the Orbiter stopped approximately 2,200 feet from the end of the runway.

The left OMS pod TPS received damage during entry such that a burn-through occurred. other TPS tile damage was consistent with previous flights.

## VEHICLE ASSESSMENT

SOLID ROCKET BOOSTERS
The performance of the SRM's (solid rocket motors) was well within the specification limits. Quick-look evaluation shows that head pressures and propellant burn rates were very close to those predicted for both motors. The separation times for both SRM's were as predicted. Operation of both SRB TVC (thrust vector control) systems was satisfactory and no anomalies were experienced. Postflight inspection showed that no hydrazine leaks occurred.

Review of data shows that all SRB power from the Orbiter was within specification. The rate gyro performance was also within specification. Rate gyro C (serial number 29) had a slight deviation in tracking compared with the other rate gyros, but this deviation was well within specification.

The decelerator subsystems on both SRB's performed normally with the exception of one main parachute on each SRB that failed to inflate. An investigation team has been established. Table II contains a current anomaly list for the SRB's.

EXTERNAL TANK
All prelaunch requirements were met with no LCC (launch commit criteria) violations. ET separation and entry were as predicted, tumble was confirmed, and impact was within the footprint.

The prelaunch thermal environment was as expected. The TPS (thermal protection system) experienced only minor ice/frost buildup in areas that had approved waivers prior to flight.

## MAIN PROPULSION SYSTEM

Liquid oxygen and liquid hydrogen propellant loading for the MPS (main propulsion system) was completed satisfactorily. Purge requirements prior to and during loading were met. Aft compartment hazardous gas concentrations were well within limits. Propellant preconditioning was satisfactory; all interface pressures and temperatures were net and all SSME (Space Shuttle Main Engine) prestart requirements were satisfied.

The engine start buildups and transitions to mainstage were normal. Engine operation and performance during mainstage appeared satisfactory. During steady-state performance, ET/Orbiter pressures and temperatures and Orbiter/SSME pressures and temperatures satisfied interface requirements. Quick-look mixture ratio and thrust values from the flight indicate repeatable engine performance. Power level throttling operation appeared normal. Engine shutdown was satisfactory. MECO (main engine cutoff) occurred approximately 0.1 second later than predicted.

Table II contains a current listing of anomalies that occurred within the SSME/MPS subsystems.

## ORBITER

The overall performance of the Orbiter was satisfactory. A brief discussion of the significant anomalies is contained in the following paragraphs. A complete list of the Orbiter flight anomalies is contained in table III.

## Auxiliary Power Unit

The APU (auxiliary power unit) gas generator water cooling system A failed off at 34:13:15:46 G.m.t. and system B was used successfully for the remainder of the mission.

The APU 1 gas generator injector temperature (V46T0174A) readout was erratic prelaunch and read 600 psia $10 w$ at $T$ plus 2 minutes - all other APU 1 parameters were normal. The lower limit was set to zero prior to entry and there was no impact on the mission.

APU 2 gas generator/fuel pump valve system A heater failed during prelaunch operations. System B heater was used for the entire flight with no impact to the mission.

## Intercommunication Loop Noise

At 034:21:00 G.m.t., the crew reported continuous static noise on both the hardwired and wireless communication systems $A$ and $B$. The crew isolated the problem to the WCCU (wireless crew communications unit) wall unit. There was no further mission impact.

## Right RCS Thruster R3D Driver Discrete Failed

At 038:11:49 G.m.t., the R3D thruster (jet) driver discrete failed during a hot-fire test prior to the first EVA. The thruster was still usable without mission impact.

Supply Water Dump Valve Failed To Open
At approximately 039:08:35 G.m.t., the supply water dump valve failed to open when commanded. The excess water was disposed of by operating the flash evaporator system. Later, during thermal conditioning using the dump nozzle heaters and after one revolution of Orbiter side sun, the valve was opened at 40:05:39 G.m.t. The supply water continued to fail to dump, thus indicating line freeze up. Postflight, the water line was found ruptured upstream of the dump valve. Discoloration of the TPS indicated ice formation on both potable and waste water nozzles.
Ku-Band System

Two problems occurred within the Ku-Band system. The RF (radio frequency) power output went to zero during a crew sleep period. After the crew sleep period, the Ku-Band power was cycled to off, then back to on. This action reset the fault sensing logic. The RF power output was recovered and remained nominal for the remainder of the mission.

Second, the Ku-Band failed the self-test initially and would not lock up on extravehicular crewman 1 during the initial activities of the first EVA. A manual search mode was used during the second EVA and a successful lock-on of extravehicular crewman 2 was completed with subsequent nominal performance.

## Right RCS Vernier Thrusters R5R And R5D Failed Off

On two occasions (039:21:36:41 G.m.t. and 040:10:56:58 G.m.t.), RCS vernier thrusters R5R and R5D both failed off. The thrusters were turned off for the remainder of the mission after the second failure.

## RMS Wrist Yaw Joint Failed In Primary System

At 040:09:23:33 G.m.t., the RMS wrist yaw joint failed in the primary system. During maneuvering to grapple the SPAS, a command was sent to the wrist yaw joint (Orbiter unloaded - RMS mode). The joint failed to move and the comm scan failure alarm was annunciated by the BITE (built-in test equipment). The crew verified the failure. The ground directed the crew to cycle power to the RMS to clear the failure indication. When power was reapplied to the arm, the failure indication reappeared, thus indicating a hard failure. As the joint was in position to be cradled, the crew was directed to cradle it. All RMS-SPAS operations for the EVA were cancelled.

## EMU TV Failed

At 040:10:56 G.m.t., the battery-powered EMU TV camera failed to come on. The crew substituted verbal comments in cases where TV recording was planned for the MMU thruster firings and for the Freon transfer experiment.

TV Camera Failures
At 040:14:08 G.m.t., the RMS elbow TV camera lost focus and a loose object was observed in the lens. Payload bay cameras $A$ and $C$ were used for the MMU evaluation tests. Also, CCTV camera D lost the tilt function and was slow to pan. In addition, the color wheel was stuck. Inflight maintenance was performed, substituting a cabin TV for payload bay camera D. The color wheel problem was resolved; however, the pan and tilt functions were not recovered.

## EXTRAVEHICULAR ACTIVITY

SUMMARY
The EVA's were completely successful with all summary objectives met. Two of the DTO's were modified due to the failure in the RMS and the EMU TV. The EMU experienced five sublimator high-pressure messages, three on the EMU-2 suit and two on the EMU-1 suit. These conditions were corrected by standard flight procedures. The SESA (special equipment stowage assembly) foot restraints came loose from their clamp. They were installed at KSC prior to launch and torqued to the required specifications. Why they came loose, is not known, but the crew was requested to safety-tether them prior to entry. The hydrazine transfer demonstration experiment was successfully performed, but a commercial QD (quick disconnect) appeared to be frozen. The experiment was essentially completed and a postflight inspection will determine if any internal leaks exist.

## FIRST EVA

An ambitious first EVA was successfully accomplished. The EMU and EVA hardware worked satisfactorily. The crew were able to concern themselves with the task at hand without having to concern themselves with EMU operation. Some nuisance-level anomalies were noted as follows.

During the preparation for EVA in the airlock, static was noted on the communication channels while in the RF mode. This distraction was alleviated by going to hardline mode.

During EVA preparations, the crew experienced difficulty attaching the EVA checklist to the EMU arm. An inflight repair was accomplished to lock the restraining screw and no further difficulties were noted.

Just prior to egress, Astronaut Stewart received a sublimator pressure caution-and-warning message. The pressure rose to 4.0 psi at which point the warning alarm was tripped. The sublimator was turned off and restarted per flight procedures. After this restart, proper operation was observed during the rest of the EVA. All EMU operations were nominal.

The MMU system performance was nominal. The crew reported a "chatter" during $+X$ translations. Since there is an offset of approximately 0.6 -inch between MMU geometric center-of-thrust and the MMU system center-of-mass, a positive pitch motion while translating in the $+X$ direction is induced. If attitude hold is on during translations, the attitude-hold logic is working to maintain very low pitch rates by cutting off two of the four thrusters which fire to produce $+X$ translation. The control electronics assembly is cycling between commanding 4 and 2 thrusters extremely rapidly, hence the chatter.

> SECOND EVA

System performance during the second EVA was nominal. Docking with the rotating SPAS was not achieved due to RMS problems. Failure of the EMU TV required substitution of verbal comments from crewman for thruster firings in lieu of visual cues during MMU engineering evaluation tests. Stewart had foot restraint problems similar to those experienced on the first EVA. Again, the problems did not deter the crew from keeping to the timeline.

As a result of the failure of the IRT to inflate, the rendezvous was cancelled, on the day of the target release, the target was tracked, and good sensor data was received from distances beyond 30,000 feet using the Ku-Band rendezvous radar, the crewman optical alignment sight, and the star tracker. These data were used to make manuever calculations, but the maneuvers were not performed. The short-range DTO was scored as 50 percent accomplished, based on the data collected.

Attempts to track the target on the day after release were totally unsuccessful and the long-range DTO was scored as zero accomplished.

The postflight processing of the downlinked relative vehicle tracking data may be significantly impacted because of multiple objects in the sensor field-of-view and unknown target characteristics caused by the IRT failure, and also because of downlink data transmission problems.

## CREW EQUIPMENT

The crew equipment operated satisfactorily in performing the required functions. The galley and personal hygiene station were operated satisfactorily and enabled the crew to complete their eating and personal hygiene functions more efficiently. One problem, still very prevalent as it has been on previous missions, is trash management. The crew suggested that incorporating trash exercises in long-duration simulations may be helpful in resolving the problem. The crew also suggested that more jettison stowage bags be supplied. Also, difficulty was experienced when opening and closing stowage lockers on the middeck. The crew suggested that various design fixes be flown in an effort to find one that will resolve this problem.

## PAYLOADS AND EXPERIMENTS

WESTAR SATELLITE
The Westar satellite was deployed at 034:20:59:00 G.m.t. (within 1 second of the planned time). The deployment was nominal in all respects with CCTV video covering the deployment. The Orbiter performed a nominal separation maneuver and the Westar PAM-D perigee motor ignited on time 45 minutes after deployment. The Westar satellite achieved a 656-by $162-\mathrm{nmi}$. orbit instead of its planned geosynchronous orbit. The cause of this situation is being investigated by the Westar contractors. All aspects of the Orbiter operation for this deployment were normal.

## INDONESIAN (PALAPA-B) SATELLITE

The deployment of the PALAPA-B satellite was delayed until the fourth day so that preliminary analysis of the Westar situation could be made prior to committing the PALAPA-B to deployment.

The PALAPA-B was deployed at 037:15:13:16 G.m.t. (within 1 second of the planned time). $V i d e o$ coverage showed the deployment to be nominal in all respects. The PALAPA-B achieved approximately the same orbit ( 639 by 148 nmi .) as the Westar. An investigation of both situations is being conducted. All aspects of the Orbiter operation for this deployment were nominal.

## integrated rendezvous target

The IRT deployment occurred as planned at 036:11:51 G.m.t. However, shortly after deployment, the crew reported that it appeared that the staves which held the balloon in a compact manner had not separated as planned. Because the staves did not separate, the balloon could not inflate properly and instead of becoming spherical, took on the appearance of a two-sided (black and silver) piece of cloth. The crew also reported that the 200-pound weight may have separated from the cloth; however, later reports indicated the weight and material were still intact as one piece. As a result of the debris potential during the final phases of rendezvous and proximity operations, the rendezvous was cancelled.

The IRT was developed to provide a radar and visual target of known characteristics for use in calibrating the Ku-band rendezvous radar, developing STS rendezvous techniques, and determining drag characteristics at orbital altitudes.

ISOELECTRIC FOCUSING
The preliminary postflight data from the IEF (Isoelectric Focusing) payload indicated that product-separation did occur, but not to the extent expected by the Principal Investigator. Photography internal to the IEF was excellent and was equivalent to ground-based data collected preflight. No inflight anomalies occurred.

## MONODISPERSE LATEX REACTOR

The latex spheres in one of the four internal reactors of the MLR (Monodisperse Latex Reactor) payload coagulated, thus losing the sample in that reactor. There were no inflight anomalies that indicated this product failed inside the reactor. The monodisperse latex spheres in the other three reactors did grow and are considered acceptable.

## ACOUSTIC CONTAINERLESS EXPERIMENT

The ACES (acoustic containerless experiment system) had a damaged glass sample when the ACES was disassembled after the flight. A review of the video data indicates that the sample probably had escaped from the cage during launch. Video tape indicates the presence of the samples several times and that they were acoustically controlled for some time during the melted phase. Several other phenomena occurred internal to the ACES that will require further investigation before future ACES flights. One of these is the outgassing of a vapor product inside the oven chamber onto the video camera lens system. Another is that the rate of increase in the chamber and sample temperature inflight was less than expected. The last phenomenon is that during the time the sample was in the melted phase, it received additional energy from an unknown source which excited the sample and caused it to exit from the low-pressure well in the center of the acoustic chamber.

## AUTONOMOUS PAYLOAD CONTROLLER

This modified APC (autonomous payload controller) worked extremely well in providing commands to the GAS (getaway special) experiments and Cinema 360 camera in the payload bay. The standard controller was not used.

The five GAS (getaway special) experiments flown on STS 41 were:

1. $\mathrm{r}_{3}-051$ - sponsored by General Telephone (modified optical and electrical properties of arc discharge)
2. G-349 - sponsored by Goddard Space Flight Center and R. MacIntosh (atomic oxygen
erosion)
3. G-309 - sponsored by the United States Air Force and J.Adolphson (comic ray upset
experiment)
4. G-004 - sponsored by Utah State University (thermocapillary flow in liquid columns, capillary waves on water, and spore growth experiment)
5. G-008 - sponsored by AIAA and Utah State University (soldering experiment, protein crystallization, and seed germination)

The initial reports indicate that experiments G-051, G-399, and G-309 operated properly. No report has been received on $\mathrm{G}-004$ and G-088.

## CINEMA 360 CAMERA

The Cinema 360 Camera System was successfully flown in the cabin and in the payload bay. Both cameras operated flawlessly and produced excellent film.

The in-cabin version was a specially adapted Arriflex 35 mm Model III camera to which was mounted a Nikon $8 \mathrm{~mm} / \mathrm{f} 2.8$ fisheye lens and a 400 -foot film magazine. The fisheye lens enabled the camera to film activity within a field of view that was 180 by 360 degrees. The camera recorded the crewmen engaged in performing daily routines associated with flying the spacecraft, payload handling and deployment, and other in-cabin housekeeping
activities.

The payload bay camera was identical to the in-cabin camera except that it used a 1000 -foot magazine and was mounted in a modified GAS canister. The modified GAS canister had a precision-machined lid that housed a quartz dome for the fisheye lens to look through, and electronics that allowed the crew to remotely change f-stop, frame rate, plus operate the camera. This camera was used to capture footage of EVA's, payload deployment, and RMS deployment.

## SHUTTLE PALLET SATELLITE

The SPAS (Shuttle pallet satellite) experiments, for the most part, performed very well. The SPAS mass spectrometer swivel-frame microswitch failed and the swivel frame would not stay in the $+X$ position when commanded. A microswitch adjustment was made during EVA 1 and partial capability was restored. However, control of the swivel was from the ground with visual verification of mass spectrometer frame position verified each time via ground-controlled live TV. The mass spectrometer status readout was invalid.

At approximately 05:19:40 MET, the SPAS was taken off Orbiter power and reactivated for RF functioning with the mass spectrometer react ivated at 05:20:00 MET. This action was in preparation for RMS operations. Longeron trunnion temperatures at that time were 3.6 deg $C$ on the starboard trunnion and $4.6 \mathrm{deg} C$ for the port trunnion. On RMS checkout, the RMS wrist yaw joint experienced a hard failure and the RMS operations were aborted. The SPAS was left in the RF mode with the mass spectrometer on unt il the EVA was completed. Trunnion temperatures at EVA completion (06:03:35 MET) were -6.2 deg $C$ and -1.5 deg $C$ for the starboard and port SPAS trunnions, respectively. SPAS was returned to Orbiter electrical power at 06:03:49 MET and the heat pipe was turned on.

The ACIP/HiRAP (Aerodynamic Coefficient Identification Package/High Resolution Accelerometer Package) experiment is part of the Orbiter experiments supporting aerodynamic research programs in the flight environment.

The experiment was located beneath the rear payload bay liner in the wing carry-through structure, and was mounted on a special shelf to the left of the vehicle's centerline. The ACIP experiment hardware consisted of triaxial linear and angular accelerometers and rate gyros aligned to the Orbiter axes. Hi RAP consisted of a triad of 1 -micro accelerometers aligned to the ACIP accelerometers and combined with the ACIP data stream. These instruments sense the dynamic attitudes and vehicle performance during the launch, orbit, entry, and descent phases of flight, and provided an accurate determination of the aerodynamic coefficients for the Orbiter.

Preliminary investigation of ACIP/HiRAP data from STS-41B showed that all scientific sensors were active and operated nominally. The data indicated the occurrence of specific flight events; e.g., ascent, payload deployment, thruster-firings, entry maneuvers and touchdown.

High concentrations of data anomalies occurred in all channels during the warmup period following ACIP turnon before the deorbit maneuver. Further investigation will reveal if this presents a problem or if any action is required.
TABLE II.- SKB, ET, AND SSME ANOMALY LIST

TABLE II.- SkB, ET, AND SSME ANOMALY LIST (Concluded)

TABLE III.- OkBITEF AND GFE PROBLEM TKACKING LIST

|  | JSC OV-099 STS-41B PROBLEM TRACKING |  |  | MARCH 13, 1984 |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| NO. 1 | title | 1 TIME, G.M.t. |  | COMMENTS | RESP. MGR. |
|  |  |  |  |  |  |
| 1.1 | APU GGVM H2O COOLING SYSTEM A | 1 34:13:15:46 |  | after ascent cooldown, apu cooling is not manda- | R. LANCE |
|  | FAILED OFF. |  |  | TORY UNLESS FCS CHECKOUT OCCURS WITHIN ONE REV OFI | Car 11 F009 |
| 1 |  |  |  | deorbit. isolation valve stuck. r\&r. Suspect i | I Closed |
| 1 |  | 1 |  | contamination. | 03/07/84 |
| 2 |  |  |  |  | 仿 |
| 2.1 | instrumentation failures: |  | I |  | Closed |
| 1 |  |  | 1 |  | 03/07/84 |
| A) | SSME 2 GH2 Pressurization outlet | 1 34:13:02:44 | 1 | SEnSor failed off SCale high about t+164 Seconds. 1 | S. baird |
| I | PRESSURE SENSOR (V41P1260A) FAILED. |  | 1 | also occurred on Sts-6, 7 AND 3. R\& R. | Car 11 FOO 1 |
|  |  |  | I |  |  |
| B1 | APU 1 Gas generator injector temper-1 | Prelaunch | 1 | temperature erratic prelaunch and dropped 600 | r. lance |
| 1 | ATURE (V46T0174A) 600 deg F LOW. |  | 1 | deg F Low at about t+2 minutes. read erratic | Car 11 F010 |
| 1 |  | 34:13:02 | 1 | during entry. Suspect thermocouple. r\&R. |  |
| 1 |  |  | 1 |  |  |
| Cl | APU 3 gas generator pressure | 34:12:55:12 | 1 | Stayed high all during ascent and entry. | R. LANCE |
|  | ( $4^{46 P 0320 A \text { ) } 100 ~ P S I A ~ H I G H . ~}$ |  | 1 | REPLACED WITH NEW APU FOR STS-41C. | CAR $11 \mathrm{F0} 07$ |
| -1 |  |  | 1 |  |  |
| 3.1 | Payload bay tv camera d did not | 34:14:45:45 | 1 | Crew report. video downlink indicated color | b. embrey |
|  | tilt, was slow to pan and the color I |  | 1 | Wheel stuck. Cycled power switch but no effect. I | FIAR RCATVA |
| 1 | Wheel stuck. I |  |  | removed on eva 1. replaced on eva 2. Still slowi | 2765F\&2548F |
| 1 | 1 |  | 1 | pan and no tilt. R\&R pan \& tilt assy and camera.l | closure |
| 1 | 1 |  | 1 |  | in process |
| I |  |  | 1 |  |  |
| 4. 1 | WCS FAN SEParatur 1 did not Spin 1 | 34:16:22 | 1 | fan separator 2 operating properly. t/s at ksc. | E. Winkler |
| 1 | UP TO Full speed and stall Current I |  | 1 | remove and replace wcs. Cb opened at l | Car 11 FOO 2 |
|  | was observed. slinger cb opened. I |  | 1 | 39:17:10 G.m.t. repeated at 1000 rpy postflight. ${ }^{\text {a }}$ | clusure |
| 1 | 1 |  | 1 |  | in Process |
| 5 | 1 |  | 1 | cen 1 |  |
| 5. 1 | INTERCOM VOICE LOOP NOISE. I | 34:21 | 1 | Creld reportel Continuous static on both hardwiredi | o. schmidt |
| 1 | I |  | 1 | and Wireless systems a and b. Crew isolated 1 | R. armstrong |
| 1 | , |  | 1 | Probley to mid jeck audio terminal unit. no l | fiar ee0577f |
| 1 | 1 |  | 1 | probley on hard line later in mission. t/s at i |  |
| 1 | I |  | + | Ksc. |  |
| 1 |  |  | , |  |  |

TABLE III.- ORBITEF AND GFE PKOBLEM ThACKING LIST (Continued)

| JSC OV-099 STS-418 PROBLEM TRACKING LIST |  |  | MARCH 13, 1984 |  |
| :---: | :---: | :---: | :---: | :---: |
| 1 NO. | 1 Title | 1 TIME, G.M.t. | 1 COMMENTS | 1 RESP. MGR. |
| 16. | I LRCS FUEL PRIMARY REGULATOR A | 1 PRELAUNCH | 1 LEAKED 8000 SCCH. PREFLIGHT WAIVER. SECONDARY | 1 D. BLEVINS |
| 1 | I INTERNAL LEAK. | I \& | 1 STAGE FUNCTIONED NORMALLY. PROBABLE PARTICLE | 1 CAR AC6471F |
| 1 | 1 | ON-ORBIT | I CONTAMINATION. T/S AT KSC. | - ClOSEd |
| 1 | 1 | 1 | 1 | 1 03/07/84 |
| 1 | 1 | 1 | 1 | 1 |
| 17. | I L OMS POD OX TANK AFt and total | \| 36:10:23:38 | \| FAILED TO 0.7\% AND 4.8\% RESPECTIVELY DURING 0.SS-5 | 51 C. HUMPHRIES |
| 11 | QUANTITIES (V43Q4232C) \& (V43Q4231C)। |  | I BURN. READ 0.4\% AND 1.4\% AFTER OMS-6. USE FUEL | 1 DR 11 F004 |
| 11 | I FAILED. |  | I GAGE AND/OR BURN TIME FOR OX QUANTITY. T/S IN | 1 CLOSURE |
| 11 | I I | I | 1 hMF AT KSC. | I IN PROCESS |
| 11 | I | 1 |  | 1 |
| 18. | InTEGRATED RENDEZVOUS TARGET (IRT I | 36:11:51 | 1 IRT deployed but staves did not separate. | 1 C. LE Blanc |
| 11 | BALLOON) FAILED. I | 1 | I BALLOON FABRIC APPEARED SEPARATED FROM CANNISTER. | . 1 FIAR HEN |
| 11 |  | 1 | I REMOVED JETTISON ASSY AND RETURNED TO JSC. | \| 0039F |
| 11 | 1 | 1 | I IMPROPER CRIMP CONNECTION FAILED. | 1 Closure |
| 11 | 1 | 1 | I | I IN PROCESS |
| 11 | 1 | 1 | 1 |  |
| 9.1 | EMU 2 LIGHT PROTECTIVE LENS CRACKED. 1 | 35:19:49 | I CREW REPORT. LENS ON HELMET NOT AN ENVIRON- | 1 R. MARAK |
| 11 | , |  | 1 MENTAL SEAL. NO IMPACT ON MISSION. R\&R. | I Closure |
| 11 | 1 | I | 1 FIAR ILC-H-0060F. | I IN PROCESS |
| , | 1 | - | 1 |  |
| 10.1 | KU-BAND RF POWER OUTPUT WENT TO | 36:21:38 | I TWT TURNED OFF by fault sensing logic circuitry | R. FENNER |
|  | ZERO. I |  | I IN DEA. CYCLED POWER FROM "ON" TO "OFF" TO "ON" | I CAR 11FO03 |
| 1 | 1 |  | I AND KU-BAND POWER RECOVERED WITH NOMINAL | Closure |
| I | ( |  | 1 PERFORMANCE. FLY AS IS FOR STS-41C. | IN PROCESS |
| 11. | CNC DOWNLIST DATA INCORRECT IN LOW |  | 1 l |  |
| 11. 1 | GNC DOWNLIST DATA INCORRECT IN LOW data Rate. | 35:06:08 |  | I H. HERNANDEZ |
|  | data Rate. |  | I (ENTRY) PLUS 3 IN FORMAT 32 (ON-ORBIT CHECKOUT) | 1 P. DUFFIN |
| 1 | I |  | 1 MAY BE INCORRECT IN LDR DOWNLIST. PCMMU TIMING | I N. HARDEE |
| 1 | 1 |  | AFFECTS LAST 8 BITS OF GNC DOWNLIST LDR FRAME. | Closure |
| 1 | 1 |  | NO Constraints for StS-41C. JSC Evaluation. | IN PROCESS |
| 12. 1 | RRCS R3A DRIVER OUTPUT DISCRETE | 38:11:49 | I JET DRIVER INDICATION FAILED during hot fire | R. EGUSQUIZA |
| 1 | FAILED. |  | 1 TEST PRIOR TO FIRST EVA. FOUND RECESSED PIN. | CLOSED |
| 1 | 1 |  | 1 REPAIRED AND RETESTED CONNEGTOR. | 03/07/84 |
| 1 | I |  | 1 | 寿 |

TABLE III.- OkBITER AND GFE PKOBLEM TKACKING LIST (Continued)

TABLE III.- OkBITEk AND GFE PROBLEM TKACKING LIST (Continued)

TABLE III.- OKBITER AND GFE PkOBLEM TKACKING LIST (Continued)

TABLE III.- ORBITER AND GFE PkOBLEM TRACKING LIST (Concluded)

| JSC ov-099 Sts-41b PROBLEM TRACKING LIST |  |  | MARCH 13, 1984 |  |
| :---: | :---: | :---: | :---: | :---: |
| 1 No. 1 | title 1 | । TIME, G.M.t. | 1 COMMENTS | 1 RESP. MGR. |
| 131.1 | ssme 3 helium panel a isolation 1 | I BEFORE ENTRY | after SSme hydraulic repress by sys b at ei-13, | P. COTA |
|  | Check valve leaked. I |  | 1 SYS A PRESSURE INCREASED 600 PSIA IN 40 minutes. | 1 Car 11 F019 |
|  | 1 |  | 1 postflight leakage acceptable for flight. | I Closure |
| 11 | 1 | 1 | 1 l | I in process |
|  |  | I | 1 |  |
| 32. | mlg all 4 tires had a flat spot. I | landing | \| high spin up friction on grooved ksc runway. | I C. Campbell |
| 1 |  |  | \| all 4 mlg tires and 1 of 2 nlg tires removed | 1 DR 11 F015 |
| ! | I |  | 1 FROM SERVICE. | \| Closure |
| 1 | I |  | 1 | 1 IN Process |
| 33. | nu-band mendezuous radar did not 1 |  | 1 |  |
| 33. | KU-band rendezvous radar did not | EVA-1 | 1 failed self test before eva-1 and one time post- | \| R. fenner |
| 11 | LOCK ON during first eva. |  | 1 Flight. Locked on as expected during eva-2. | \| DR 1 F021 |
| 1 | I |  | 1 deployed assembly returned to vendor for | I Closure |
| 1 | - |  | I CAPACITOR MOD. RETURNED TO KSC On 3/9. | 1 in process |
|  |  |  |  | 1 |
|  | AFT LATCH LOST ONE PHASE ON MOTOR 2 I | ON ORBIT | postflight data evaluation. Confirmed during GROUND DOOR OPERATIONS. RECESSED CONNECTOR PIN | I R. balciunas |
|  | during opening and closing. \| |  | REPAIRED AND RETESTED. RECSSED CONNECTOR PIN | in process |
| 1 | - 1 |  | 1 l | in process |


Figure 1.- Continued.

Figure 1.- Continued.




Figure 1.- Continued.

Figure 1.- Continued.



Figure 1.- Continued.



Figure 1.- Continued.

