Tracking No	Time	Classification		Documentation	Subsystem
MER - 0	**MET:** Prelaunch	Problem	**FIAR**	**IFA** STS-4-V-01	TPS
	GMT: Prelaunch		**SPR**	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: TPS (Thermal Protection System) Tile Damaged by Prelaunch Hail Storm. (ORB)

Summary: DISCUSSION: The night before the STS-4 launch, a rain and hail storm occurred in the area of Launch Pad A. The hail extensively damaged the Orbiter surface TPS tiles. Some of the damage on the right wing was repaired with a densification slurry prior to launch. The severity of the rain storm accompanying the hail resulted in significant amounts of water being absorbed by the hail-damaged tiles plus possibly other tiles. During the on-orbit phase of the STS-4 mission, the vehicle was oriented with the bottom toward the sun to successfully dry out the wet tiles. This was required to preclude coldsoak damage to the tiles as occurred on the right wing glove during STS-2. Postflight inspection showed no indication of tile ice damage.

CONCLUSION: While on the pad, the Orbiter is susceptible to significant surface damage from hail storms and water absorption from rain storms. The on-orbit dry-out of the tiles is effective in preventing tile ice damage. However, the attitude constraint of bottom-to-sun does have a significant impact on payload operations.
CORRECTIVE_ACTION: The hail-damaged tiles have been repaired for STS-5 using standard repair techniques. The RSS Roll back from the vehicle has been delayed. Modifications to the RSS are being made that will provide additional protection to the Orbiter. For STS-5, a witness panel consisting of 20 HRSI tiles will be exposed beside the Orbiter on the mobile launch platform. Tile weight of the witness panel before launch will be used along with DFI data to make a bottom-to-sun drying decision. The response of the tile to ascent heating and the cooling effects of ice sublimation on the tile, will be used to determine the amount of water in the tiles. Ascent and on-orbit DFI data will be used to make this determination. Analysis indicates that the -ZLV attitude will not allow the tiles to get cold enough to cause fracture problems.However, in the starboard sun attitude, tile temperatures as low as -70? F to -80? F can be expected. Should analysis of DFI data indicate that the water remaining in the tiles at initiation of starboard sun could cause fracturing, then some period of bottom of sun will be required to bake out the water.
EFFECTS_ON_SUBSEQUENT_MISSIONS: Excessive rain storms and/or hail storms may impact on-orbit operations for drying the tiles. Also, water absorbtion by the tiles will result in unknown lift-off weights, and may require additional turnaround time to repair hail-damaged tiles or dry out water-soaked tiles.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** Prelaunch	Problem	**FIAR**	**IFA** STS-4-V-02	MPS
	GMT: Prelaunch		**SPR**	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: MPS LO2 Overboard Bleed Valve Close Position Indicator Switch "B" Failed. (ORB)

Summary: DISCUSSION: During STS-3, the MPS LO2 bleed valve (PV-19) close switch "A" (V41X1580X) was slow in closing. This is a redundant switch, which can cause a launch scrub if both switches "A" and "B" fail. The valve was changed out for STS-4 and was checked during the tanking test. The "B" switch (V41X1581X) did not work. The switches were adjusted and tested again at T-3 hours during tanking for flight. The "A" switch worked, but the "B" switch required 77 seconds to close. It was decided that the valve worked; consequently both switches were masked out in OPS-1 at T-11 minutes to preclude a launch scrub. The KSC data indicated, at launch, that both switches were closed in approximately 1.3 seconds. Because of the tolerance of the telemetry data, the switch actuation may or may not have been in the required time of less than 1 second when the RSLS (redundant set launch sequencer) checked at T-7 seconds for LO2 bleed valve closure.

The valve position indicator can be affected by cryogenic temperatures. The probable cause of the failure is a malfunctioning position indicator. For STS-5, the MPS LO2 bleed valve close position indicator check has been masked out in the GPC mass memory. A new LO2 bleed valve will be installed in OV-102 during the major modification period. CONCLUSION: The probable cause of the failure is a malfunctioning valve position indicator. CORRECTIVE_ACTION: For STS-5, the MPS LO2 bleed valve close position indicator check has been masked out in the GPC mass memory. A new LO2 valve will be installed in OV-102 during the major modification period. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** Prelaunch	Problem	**FIAR**	**IFA** STS-4-V-03	FCP
	GMT: Prelaunch		**SPR**	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Fuel Cell 1 Condenser exit temperature was 12?-15? F below normal control range throughout the flight. (ORB)

Summary: DISCUSSION: When the STS-4 prelaunch conditioning loads were applied to the fuel cells at T-20 minutes, the TCE control point shifted downward 8? to 133?-134?. Analysis showed an acceptable margin of an additional 8? and a decision was made to proceed with the launch. The fuel cell 1 TCE continued to operated in the 133? control range and did not impact the STS-4 mission.

Postflight the subcontractor verified the 133-134? control point for the actuator. During disassembly of the actuator, a small amount of FC-40 coolant was collected from the boot when the actuator piston was removed. Entrapment of fluid in this region has caused TCE control calibration shifts in the past; the fix was to provide a relief slot along the length of the piston to enable any fluid that was trapped to flow out as the copper/wax compound expanded and pushed the piston outward. On this particular unit, however, the slot was very shallow with rounded edges near the end of the piston allowing the viton boot to conform to the shallow groove and block the flow of fluid through the groove. Inspection records showed that this unit was one of the three TCE cartridges that were polished and assembled by the production department and apparently was overpolished after the groove was machined. The other two actuator assemblies processed by the production department were screened out by normal fuel cell ATPs. The vendor had no formal specifications or inspection procedures that might have caught the defect prior to assembly in the affected units. The viton boot thickness was checked and found to be within tolerance. A calibration check showed TCE control identical to the original ATP, thus confirming the fluid entrapment scenario. A total of 12 thermal control valve cartridges were inspected and all were acceptable with nominal tolerances for the machined groove. CONCLUSION: The machined slot on the actuator piston was overpolished by the thermal control valve cartridge vendor. The shallow region of the slot was blocked by the viton boot as the copper/wax compound expanded, resulting in premature piston motion and creating the resultant temperature control band shift. CORRECTIVE_ACTION: The vendor has implemented formal cross-sectional tolerance limits on the groove machining and polishing operations and established a new mandatory inspection point to assure proper configuration of the piston prior to final assembly and calibration. A change to prelaunch fuel cell procedures has been initiated to operate the fuel cells at high power for approximately 10 minutes as soon as possible after fuel cell activation. This will provide early visibility into steady-state fuel cell thermal performance on all flights. The OV-099 fuel cells wil be operated during the FRF test, providing early assessment of fuel cell performance for that vehicle. A future change will provide two more relief slots along the length of the piston, equidistant from the original slot. This change is effective for the 3-substack fuel cells which will be added after STS-5. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	**Time**	**Classification**	**Documentation**		**Subsystem**
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-4-V-04	RCS
	GMT: 178:15:16		**SPR**	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Reaction Control System (RCS) Engine F1L Oxidizer Leak Indication (ORB)

Summary: DISCUSSION: Just after the OMS-1 maneuver, RCS thruster F1L developed an oxidizer leak that reduced the leak detector temperature measurement from 79? F to 30? F in 30 seconds. RCS thruster F1L was automatically deselected at 178:15:16:38 G.m.t. because of the low oxidizer-injector leak-detector temperature. The crew went through the malfunction procedures and determined that the leak was not large enough to warrant closing the manifold 1 isolation valves. The leak apparently stopped shortly after the thruster was deselected as indicated by increasing leak-detector temperatures. Approximately 3 hours later, the flight controllers instructed the crew to close manifold 1 which then deselected the other manifold 1 engines (F1F, F1D, annd F1U). On day 3, the manifold was repressurized. Manifold 1 pressures indicated that the manifold had stopped leaking and there was no indication of leakage on the leak detector. Thruster F1L was test fired and then used for the remainder of the mission without any further indication of leakage. However, the first night after the flight, the thruster cooled to 59?F and began leaking again as the heaters had not been turned on.

A helium leak check at the vendor indicated very low leakage at both ambient and cold temperatures. A detailed inspection found three small dark particles of iron nitrate and a small sliver of nylon on the valve seat. The size and shape of the nylon particle corresponded with the depression on the teflon seal. The nylon particle, which appears to be a sliver from a nylon parts bag was most probably introduced during the manufacturing process. The procedures for purging, flushing, and drying during testing at the vendor were improved to eliminate iron nitrate formation. Multiple cutting of nylon parts bags along the same line may produce slivers and will be eliminated. CONCLUSION: Thruster F1L leaked oxidizer during the flight and the leak detector deselected it. The leakage was caused by contamination that showed up when the engine was fired since F1L was a new engine for this flight. The nylon particle probably was embedded in the teflon seal and allowed the leakage to stop; however the leakage started again after the flight when the cooler temperatures cause the seal to shrink. CORRECTIVE_ACTION: The F1L engine was replaced for STS-5. Valve processing procedures have been improved to eliminate contamination during assembly and testing. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-4-V-05	APU
	GMT: 178:14:56		**SPR**	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: APU (Auxilary Propulsion Unit) 3 High Lubrication Oil Pressure (ORB)

Summary: DISCUSSION: Prior to STS-4, the gearbox seal on APU 3 was known to be leaking. The decision to fly with this condition was made because it was believed that a small amount of contaminant on the rotating seal would clear after APU startup, and if it did not, the leak would not be of sufficient size to cause an APU malfunction during ascent.

The APU experienced high lubrication oil pressure accompanied by low flow during most of the STS-4 mission. During ascent when the filter clogged, the pressure reached 100 psid, then dropped to 50 psid for a short interval after which the pressure returned to 100 psid. The pressure drop to 50 psid was the result of the filter bypass valve sticking temporarily in the open position. This has been verified during postflight testing. The lubrication oil and filter were analyzed for contaminants that would have caused the filter to plug. The lubrication oil sample had the highest total filterable solids ever detected after a flight. The filter was still plugged after the flight. A bench test of the filter showed that the filter developed a pressure of 150 psid at 2 gpm (normal filter flow is 5 psid maximum at 4.2 gpm). An analysis of the material found on the filter showed it to be 90-percent pentaerythritol, 1.6-percent carbon, and traces of several other elements. The pentaerythritol is a substance formed when hydrazine penetrates the gear box and reacts with the lubrication oil. In past cases of pentaerythritol contamination at about 200? F lubrication oil temperature, the pentaerythritol would go into solution and the pressure would be lowered. This time, the filter never cleared. Because the filter was so clogged with pentaerythritol, there was not enough lubrication oil flow through the filter to provide unsaturated oil for the pentaerythritol to go into solution.   CONCLUSION: The high lubrication oil pressure (low flow) during STS-4 was caused by hydrazine penetrating the gearbox and forming a crystalline substance which then clogged the filter. The filter never unplugged throughout the flight, therefore the pressures remained high.   CORRECTIVE_ACTION: The APU was removed and replaced with an uncontaminated APU with a good gearbox seal. In addition, KSC has revised their flushing and servicing timelines so that the gearbox is not empty for long periods of time. (The carbon nose piece seal is more likely to leak if allowed to dry.) Long term fixes include an improved seal design and the selection of an oil which will not percipitate undesireable contaminants when mixed with hydrazine.   EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification		Documentation	Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-4-V-06	INS
	GMT:		**SPR**	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Operational Instrumentation Failures (ORB)

Summary: DISCUSSION: Operational instrumentation failures include the following:

a) PRSD H2 tank 2 quantity shift (V45Q2205) - The indicated quantity was 42.2 percent should have been 94.4 percent. A similar problem occurred on STS-3. No problem was found in the vehicle wiring. After extensive troubleshooting the signal conditioner was replaced and returned to the vendor for failure analysis. Contingency loading procedures will be used if required. The quantity can be tracked using the other tank indications should a failure occur. b) MPS engine 3 LH2 inlet temperature measurement (V41T1301) failed off-scale high for 2 minutes from T+6 to T+8 minutes. The vibration environment exceeds the specification. The probe has been replaced with a new design. c) Main engine 2 GH2 pressurant temperature (V41T1261) shift. The measurement was on scale but read high for 3 minutes from T+5 to T+8. Data from this measurement is not essential. Fly as is for STS-5. d) RCS R5D Injector oxidizer (V42T3525) or fuel (V42T3526) temperature bias. A similar problem occurred on VRCS jet F5L on STS-3 and STS-4. Inaccessible. Fly as is. Should the temperature bias result in an RM deselect, a software patch is available. e) Flow out of LH2 CRYO tank 3 influences decay rate of midbody hydraulic line temperature (V58T1143). Insulation installation results in transducer responding to cryogenic flow. Fly as is for STS-5. f) RCS F1F injector temperatures (V42T1501) ox and V42T1502) fuel were slow to respond during ascnet. The problem is attributed to water intrusion from rain during prelaunch operations. Inspection did not reveal a leak source. Fly as is.   CONCLUSION: See above.   CORRECTIVE_ACTION: See above.
EFFECTS_ON_SUBSEQUENT_MISSIONS: None

Tracking No	Time	Classification		Documentation	Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-4-V-07	PRSD

	GMT: 179:18:08		**SPR**	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Hydrogen Tank 4 Heater "A" Failed. (ORB)

Summary: DISCUSSION: KSC postflight troubleshooting located an open circuit in Tank 4 heater "A" and the heater assembly was returned to the vendor for failure analysis.

Teardown and inspection of the heater assembly showed a 0.020 in. gap in the nickel wire within 1 inch of the nickel-to-nichrome weld joint. Metallurgical analysis of the fracture area indicates the failure was brittle and most probably due to a stress rupture in an area of large grain growth caused by the high temperatures during the manufacturing process. Failure history (i.e. 5 of 224 heater welds) shows that all failures occur early in heater life. The tank 4 heater failed during the 3rd cryo cycle. Two of the OV-102 tanks have 8 cryo cycles and one has 9 cycles. All five failures occurred in less than four cryo cycles. CONCLUSION: The open heater was most probably caused by a stress failure in the heater element that was initiated by the manufacturing process. Cryo tanks remaining in OV-102 have sufficient cryo loading cycles to be acceptable for STS-5. CORRECTIVE_ACTION: Hydrogen tank 4 is not required for STS-5. Additional cryo cycle screening of uninstalled tanks is planned and efforts to refine the heater element design fabrication process have been initiated. EFFECTS_ON_SUBSEQUENT_MISSIONS: None

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Tracking No	**Time**	**Classification**	**Documentation**		**Subsystem**
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-4-V-07A	
	GMT: 179:18:08		**SPR**	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Hydrogen tank heater "A" failed. (ORB)

Summary: DISCUSSION: KSC postflight troubleshooting located an open circuit in Tank 4 heater "A" and the heater assembly was returned to the vendor for failure analysis after STS-4. Hydrogen tank 4 was not required for STS-5.

Teardown and inspection of the heater assembly showed a 0.020 in. gap in the nickel wire within 1 inch of the nickel-to-nichrome weld joint. Metallurgical analysis of the fracture area indicates the failure was brittle and most probably due to a stress rupture in an area of large grain growth caused by the high temperatures during the manufacturing process. Failure history (i.e. 5 of 224 heater welds) shows that all failures occur early in heater life. Four of the flive failures have occured in less than two cryo cycles. The tank 4 heater failed during the 3rd cryo cycle. After STS-5 two of the OV-102 tanks have 9 cryo cycles and one has 10 cycles. The hydrogen tanks on OV-099 have been subjected to one cryo cycle during acceptance test and will experience the second cryo cycle during loading for the Flight Readiness Firing (FRF) prior to STS-6. The third cryo cycle will occur during loading for STS-6. CONCLUSION: The open heater was most probably caused by a stress failure in the heater element that was initiated by the manufacturing process. Cryo tanks remaining in OV-102 have sufficient cryo loading cycles to be acceptable for subsequent flights. After FRF the OV-099 cryo tanks will have sufficient cryo cycles to be acceptable for STS-6. CORRECTIVE_ACTION: All uninstalled hydrogen tanks, including hydrogen tank 4 removed from OV-102, will be subjected to 5 cryo cycles prior to installation in any Orbiter. During the STS-6 FRF, all hydrogen tanks on OV-099 will be subjected to a test to verify heater operation. Five spare heaters are being fabricated with efforts to eliminate unnecessary bends, limit hand brazing and a reduction in the temperature of the fabrication process. EFFECT ON SUBSEQUENT MISSIONS: none

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Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	MET:	Problem	FIAR	IFA STS-4-V-08	C&T
	GMT: 178:12:00		SPR	UA	Manager:
			IPR	PR	
					Engineer:

Title: VTR (Video Tape Recorder) Recorded Tape Frames Out of Synchronization During Playback on Monitor 2. (ORB)

Summary: DISCUSSION: The onboard-recorded video tapes cound not be properly syschronized with the console monitor no. 2 when playback in the "direct" source mode was attempted. Post-mission testing at KSC indicated that the "panel" mode worked properly.

Tests at the vendor isolated a failed CMOS (Complementary Metal Oxide Semiconductor) switching chip in the monitor input circuit. The chip failed to switch to the "direct" source mode. The failed chip was replaced and the monitor operated properly. Failure analysis on the CMOS chip is continuing. Failure of semiconductor chips has not been a generic problem during the flight test program. CONCLUSION: Tests at the vendor located a failed CMOS switching chip in the monitor input circuit. CORRECTIVE_ACTION: The monitor was replaced on OV-102. The failed CMOS switching chip was removed and replaced at the vendor. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	MET:	Problem	FIAR	IFA STS-4-V-09	PYLD
	GMT: 178:21:53		SPR	UA	Manager:
			IPR	PR	
					Engineer:

Title: Get Away Special (GAS) Activation Unsuccessful (ORB)

Summary: DISCUSSION: Planned activation of the GAS was unsucessful at 178:21:53 G.m.t. After inflight troubleshooting, the GAS was activated at 181:11:29 G.m.t. Deactivation was delayed until postflight. A broken wire was found at a crimp point of a pin in a jumper cable at the on-orbit station distribution panel located behind panel A12 on the aft flight deck.

The wire was probably broken during removal of a Data Processing System (DPS) camera bracket mounted near the wire. The camera is used to monitor DPS displays during ground checkout. The bracket was removed after successful completion of the GAS end-to-end functional checkout. CONCLUSION: A wire in a jumper cable at the on-orbit station was probably broken when checkout personnel removed a nearby DPS monitor camera bracket after completion of GAS Checkout. CORRECTIVE_ACTION: GAS checkout for STS-5 and subsequent will be done after closeout of panel A12. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-4-V-10	RMS
	GMT: 180:11:00		**SPR**	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: RMS End Effector Capture, Open and Close Flags Showed Incorrect Status (RMS)

Summary: DISCUSSION: During end effector operations on STS-4 the open and closed status flags from the end effector showed incorrect status intermittently. These flags (with 4 others) report the positional status of the end effector during RMS ops. It was determined from the flight data that the most probable cause of the unexpected flag operation was a broken wire in the E.E. carriage and no E.E. malfunction had occurred. RMS operations were continued. Postflight testing of the RMS at KSC confirmed that the failure was in the flat multiconductor cable connecting the carriage to the housing of the E.E. The E.E. was returned to SPAR for failure analysis and repair. Six of the 12 conductors in the cable were found to be broken. This condition was determined to be caused by an incorrectly installed ty-rap that stressed the cable during E.E. carriage operation.

CONCLUSION: During E.E. operations the design flexing of the multiconductor cable was distorted by interference with an incorrectly installed ty-rap. Continued operation with this constraint caused fatigue fractures of 6 of 12 conductors in the cable. When the conductors were broken, incorrect E.E. status was returned to system. CORRECTIVE_ACTION: Changes have been made to SPAR manufacturing drawings to detail proper installation of ty-raps in the area swept by the flat cable in the E.E. EFFECTS_ON_SUBSEQUENT_MISSIONS: None

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Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-4-V-11	EPD
	GMT: 180:20:34		**SPR**	**UA**	**Manager:**
			IPR	**PR**	

Engineer:

Title: Aft Starboard Forward Port and Forward Bulkhead Floodlights Failed. (ORB)

Summary: DISCUSSION: During STS-4, the crew reported that the aft starboard, forward port, and forward bulkhead floodlights in the payload bay were not operating. A review of the downlink bus current measurements confirmed the failures. Testing after the flight determined that two channels within the floodlight electronics assembly had failed and one lamp assembly (fwd bulkhead) had failed. Failure analysis by the light manufacturer confirmed that the failures were due to known problems with approved redesigns in progress. The electronics assembly had been redesigned because inadequate venting may have caused corona on STS-1. The lamp had been redesigned to reduce anode heating because thermal stress at high anode temperatures curtailed lamp life during qualification and extended life testing.

CONCLUSION: The electronic assembly failures were caused by inadequate venting of the box which resulted in corona. The corona caused electronic parts degradation which eventually resulted in a failure. The lamp assembly failure was caused by multiple thermal stress of the anode end of the lamp that resulted in a broken (cracked) glass envelope. CORRECTIVE_ACTION: Effective on STS-5, the electronic assemblies have been modified to include a larger, more porous vent that will significantly decrease the box venting time from 27 minutes to 2.6 seconds. The lamp fix consisted of modifying the lamp structure to reduce anode heating. Additional fixes are under review to significantly increase lamp life. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-4-V-12	C&T
	GMT: 181:09:00		**SPR**	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Video Tape Recorder (VTR) Rewind Function Failed. (ORB)

Summary: DISCUSSION: Midway through the mission, the rewind function of the VTR failed. This failure was verified during postmission testing at KSC and at JSC after the VTR was returned for analysis and repair. However, during inspection of the unit at JSC the rewind function became operative. No cause for the failure was uncovered. The SY-10 printed circuit board was removed and the rewind microswitch that is located on the board was replaced. The suspesct microswitch was X-rayed and cut open, but no problem was found. The SY-10 board will be run extensively in the crew trainer recorder in an effort to repeat and identify the inflight rewind failure.

CONCLUSION: The loss of the VTR rewind function was probably caused by an intermittent electrical problem on the SY-10 printed circuit board.
CORRECTIVE_ACTION: The VTR used for STS-4 was removed from OV-102 and the SY-10 printed circuit board was replaced. Another flight VTR has been installed

on OV-102 for STS-5.   EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification		Documentation	Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-4-V-13	MECH
	GMT: 181:18:00		**SPR**	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Aft Bulkhead Actuator on Port Door Stalled During Latch Closure. (ORB)

Summary: DISCUSSION: During the door closure test following approximately 20 hours with the Orbiter in the bottom-to-sun attitude (cold case), the aft port bulkhead latch gang failed to reach the fully latched position. The aft corner of the 22-inch breather panel at the Orbiter centerline was deflected outward approximately 7 degrees. After the door was opened, the Orbiter was oriented to a passive thernal control attitude for 10 hours followed by 3 hours of tail-to-sun attitude. The door was then successfully closed and latched. Subsequent door operations were normal.

Postflight inspection of the aft port door/bulkhead interface revealed: 1. Environmental seal (0.75-inch diameter Teflon tube) on aft bulkhead at approximately Yo -4 was pierced through the upper and lower surfaces. 2. Edge of Xo 1306.90 bulkhead had white paint chipped off in the area of seal penetration, but no other noticeable marks were observed. 3. PLBD (Payload Bay Door) aft frame had scratches in an area corresponding to the damaged seal and chipped paint on bulkhead. The door structure and latching mechanism were fully inspected and there was no reportable damage.   CONCLUSION: Based on inflight TV camera coverage and postflight observations, the jamming resulted when the aft leg of the channel that supports the door latch gang, at latch no. 4, contacted the seal and bulkhead, thus preventing aft port door latching. Therefore, failure of the aft bulkhead latches to fully latch was attributed to insufficient door-to-bulkhead clearances after attitude holds which caused bowing of the Orbiter structure.   CORRECTIVE_ACTION: OV-102 (STS-5), damaged environmental seal was replaced and no PLBD cold-case (side-to-sun attitude) operation was planned or performed. OV-099 (STS-6), at the no. 4 port and starboard aft bulkhead latches, the PLBD structures were trimmed, latch bellcranks modified, and shoulder bolts reworked to accommodate modified bellcranks. These changes provided an increase of door-to-bulkhead clearance. STS-5 and 6 postflight inspections indicated no contact of door or bulkhead. OV-102AA & subsequent vehicles will be modified to provide the additional aft bulkhead clearance incorporated in OV-099. This additional clearance does not guarantee a successful operation after a cold-case hold attitude (off-limit operation), but it provides ample clearance for planned PLBD closures. EFFECTS_ON_SUBSEQUENT_MISSIONS: No PLBD closure will be attempted during or immediately after an Orbiter has been exposed to a cold-case hold attitude. The PLBD should be thermally conditioned prior to any closure.

Tracking No	Time	Classification		Documentation	Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-4-V-14	GN&C
	GMT: 182:12:12		**SPR**	**UA**	**Manager:**

			IPR	**PR**	
					Engineer:

Title: Orbital DAP (Digital Autopilot) control auto select switch contact "A" failed (ORB)

Summary: DISCUSSION: During STS-4, the contact "A" of the forward orbital DAP (digital auto pilot) control auto select pushbutton switch (switch 3 on panel C3A6) contact "A" failed when the switch was activated. Subsequent activations indicated the contact had cleared, however, the RM (redundancy management) flag remained latched as there is no preprogrammed reset capability for this switch. The problem was duplicated after the flight by slowly depressing (teasing) the switch while monitoring the output of each contact. One or two contacts could be activated while the other(s) remained open. This is normal operation for this type of switch. The crew reported that extra care was necessary to insure that firm pressure was applied to push button switches while in zero g.

A switch review showed that the orbital DAP control auto and manual select switches are the only three contact push button switches used in zero g without a backup or item reset capability. A software change is being requested to provide backup switch capability during entry phase or to clear the RM flag if it remains latched.
CONCLUSION: The contact failure was caused by applying gentle pressure to the switch during zero g operation. CORRECTIVE_ACTION: The crew will insure that firm pressure is applied to all pushbutton switches for proper operation during zero g. A software change is being requested to provide either backup or reset capability for the orbital DAP control auto and manual pushbutton select switches. Fly as is for STS-5. Implement the Software Control Board decision for future flights.
EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-4-V-15	APU
	GMT: 180:23:00		**SPR**	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: APU 3 Fuel Cavity Drain System Leakage. (ORB)

Summary: DISCUSSION: APU 3 drain line leaked slightly on-orbit so that by entry the pressure had reached 7 psia (originally 16 psia).

After return to KSC, every component and fitting in the drain system was leak checked. No leak was found. The drain relief valve's reseat pressure was low however, which is sometimes an indication of contamination. The drain relief valve was removed from the vehicle and leak checked on the bench. No leak was found. The valve was flushed with alcohol and the alcohol subsequently filtered through a millipore pad. The constituents on the millipore pad were found to be hydrocarbon oil, an organic ester, silicone, inorganic siliceous material, and nitrate iron. The APU lubrication oil is an organic ester and there was a leak of oil into the seal cavity. There is also iron present in the APU components. The source of the other constituents is not known. All of the particles were extremely small. If there is still an undetected leak of the same magnitude as STS-4, there will be no adverse effect for STS-5. In fact, it is desirable to have a reduced pressure in the seal cavity drain so that the pressure in the seal cavity is lower than the gearbox pressure, thus alleviateing some of the problem caused by wax in the lubrication oil. The only concern is that if the leak increases so that the drain line reaches 0 psia, the possibility exists that the fuel leakage in the drain line would freeze and plug the line. However, a frozen line would only be a problem in the event a major fuel leak occurred which is very unlikely. CONCLUSION: The source of the leak was not found. It is possible that the relief valve had some contamination on the sealing surface that was washed away during an alcohol flush before the leak check was performed. CORRECTIVE_ACTION: The drain line was flushed with alcohol for cleaning. The drain relief valve relief pressure was reset and it was reinstalled. The system has been checked for leaks. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	MET:	Problem	FIAR	IFA STS-4-V-16	PRSD
	GMT: 183:22:14		SPR	UA	Manager:
			IPR	PR	
					Engineer:

Title: H2 Tank 2 Heater "B" Failed to Operate On-Orbit (ORB)

Summary: DISCUSSION: The hydrogen tank 2 heater "B" failed to operate and the redundant heater "A" was used for the remainder of the mission. Failure symptoms indicated heater "B" control-circuit problems (i.e., bad RPC (remote power controller) blown fuse, etc.).

Troubleshooting isolated the problem to a blown 5 -A fuse on the output of the two series RPC's distributing 28 Vdc to the heater. The fuse was replaced, and the heater "B" control circuit operated satisfactorily. The box wiring, vehicle wiring, and tank heaters were subjected to insulation resistance and dielectric testing to locate a possible short circuit to vehicle ground and none was found. In addition, the remaining seven 5 -A fuses from the four cryo control boxes were replaced. The removed fuses were analyzed to identify any degradation in the fusible links because of overstress conditions that might explain why the fuse had blown. The analysis was not conclusive in identifying a failure cause. The blown fuse could have been caused by an "educated" short (<=6.5 -A) in the vehicle wiring or the tank heater which would only be present under the proper thermal conditions, or a degraded fuse. Any other failure would have tripped the RPC. CONCLUSION: The 5 -A fuse distributing 28 Vdc to the heater was blown. Exhaustive attempts to identify the actual cause have been unsuccessful. CORRECTIVE_ACTION: The blown fuse was replaced, and the heater control circuit has checked out satisfactorily. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	MET:	Problem	FIAR	IFA STS-4-V-16A	
	GMT: 183:22:14		SPR	UA	Manager:
			IPR	PR	

Engineer:

Title: H2 tank 2 heater "B" failed to operate on-orbit on STS-4. (ORB)

Summary: DISCUSSION: The hydrogen tank 2 heater "B" failed to operate and the redundant heater "A" was used for the remainder of the mission. Failure symptoms indicated heater "B" control-circuit problems (i.e., bad RPC (remote power controller) blown fuse, etc.).

Troubleshooting isolated the problem to a blown 5 -A fuse on the output of the two series RPC's distributing 28 Vdc to the heater. The fuse was replaced, and the heater "B" control circuit operated satisfactorily. The box wiring, vehicle wiring, and tank heaters were subjected to insulation resistance and dielectric testing to locate a possible short circuit to vehicle ground and none was found. In addition, the remaining seven 5 -A fuses from the four cryo control boxes were replaced. The removed fuses were analyzed to identify any degradation in the fusible links because of overstress conditions that might explain why the fuse had blown. The analysis was not conclusive in identifying a failure cause. The blown fuse could have been caused by an "educated" short (<=6.5 -A) in the vehicle wiring or the tank heater which would only be present under the proper thermal conditions, or a degraded fuse. Any other failure would have tripped the RPC. Hydrogen tank 2 heater "B" functioned properly throughtout STS-5 cycling on for approximately 10 hours of the 120-hour mission. CONCLUSION: The 5 -A fuse distributing 28 Vdc to the heater was blown. Exhaustive attempts to identify the actual cause have been unsuccessful. CORRECTIVE_ACTION: The blown fuse was replaced, and the heater control circuit was checked out satisfactorily prior to STS-5. All hydrogen tank heater circuits on OV-099 will be tested during Flight Readiness Firing prior to STS-6. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-4-V-17	HYD
	GMT: 185:10:16		**SPR**	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: High Load FES Duct Heater System "B", Zone A, Failed. (ORB)

Summary: DISCUSSION: During entry preparation on day 7 (approximately 185:10:16:00 G.m.t.), the B system high-load duct heaters were activated by the crew to begin warm-up of the high-load ducts prior to payload bay door closure and FES (Flash Evaporator System) operation. Approximately 20 minutes later, the duct temperatures in duct heater zone A were not responding fast enough, and the zone B and C heaters were functioning properly. Crew activation of system "A/B" and later system "A" only resulted in proper duct temperature control.

The failed heater problem was traced to an open heater element in the system "B" heater for zone A. The FES high-load duct zone A has three heaters but only two elements are required. Heater system "C" was inoperative on STS-4 due to a failed switch in the "C" controls. The wiring to system "B" and system "C" has been exchanged for STS-5 to allow use of the existing crew-cabin heater-control procedures and to maintain the two-heater capability for zone A using systems "A" and "B". This high-load heater duct configuration established for STS-5 provided adequate thermal control throughout the flight. CONCLUSION: The failure was due to a defective heater element, (discontinuity). The system as wired for STS-5 is adequate to support STS-9. CORRECTIVE_ACTION: The wiring to heater system "B" and heater system "C" was exchanged. Heater system "C" remains inoperative as it was prior to STS-4. The entire FES system including the duct and heaters will be replaced with the new design system after STS-9 during the OV-102 major modification period. The new design FES system is now installed on OV-099 for STS-6. EFFECTS_ON_SUBSEQUENT_MISSIONS: None

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Tracking No	Time	Classification		Documentation	Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-4-V-18	DPS
	GMT: 185:13:45		**SPR**	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Payload Bay Door (PLBD) Talkback Indication Incorrect. (ORB)

Summary: DISCUSSION: During deorbit preparation, the crew saw the PLBD talkback on panel 13 change from "CLOSED" to "BARBER POLE" during the BFS initialization activities. The complete list of individual discretes which determine the PLBD status was checked via downlist and onboard, indicating the actual status of the doors was OK (closed) and the talkback indication incorrect.

A review of the BFS initialization code showed that the observed scenario is to be expected due to output reset functions coded into the BFS PLBD initialization software. Associated drawings and deorbit preparation procedures are being revised to account for this operational characteristic. CONCLUSION: The observed scenario is normal. The PLBD talkback is only meaningful when the doors are in use. CORRECTIVE_ACTION: Associated drawings and deorbit preparation procedures are being revised to account for this operational characteristic. A documentation CR is being prepared to clarify the BFS initialization implementation. Crews will be trained to understand that the PLBD talkback is only meaningful when the PLBD is in use. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification		Documentation	Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-4-V-19	TPS
	GMT: 178:22:00		**SPR**	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Vehicle Torquing Produced Attitude Excursions. (ORB)

Summary: DISCUSSION: During the first gravity gradient attitude control and first bottom sun attitude periods, negative-role vehicle torquing produced attitude excursions and additional control requirements.

Vehicle roll rate data taken between thruster firings during the two attitude control time periods indicate a negative roll torque of about 3 to 5 ft-lb in the sunlight and about 0.5 to 2 ft-lb in the dark portions of the orbit. No such torquing was observed during the second gravity-gradient test after the bottom sun tile dry-out periods. A postflight count of damaged tile has indicated about 1600 damaged tiles on the bottom surfaces of the Orbiter. About 900 of the damaged tiles show exposed LI-900. Of the 900, about 300 are to the left of the Orbiter X-axis centerline, and about 600 to the right. Of the 600, there are about 300 more at the outboard end of the right wing, compared to the left wing. The remaining 700 damaged tiles are generally distributed over both sides of the centerline. Water strains in the damaged areas indicate the presence of water in the absorbant tile material prior to dry-out in space. Three different sets of calculations based on kinetic energy theory, effect of venting gases through restrictive openings, and water loss rates determined from chamber tests with water-soaked tiles, showed that the thrust caused by outgassing vapor from water-soaked damaged tiles would produce a negative- roll torque from the differential of 300 damaged tiles on the right wing of about 4 to 8 ft-lb. The calculated 4 to 8 ft-lb compares favorably with the 3 to 5 ft-lb derived from the slope of the roll rate data. Ascent trajectory reconstruction analysis for STS-4 indicates about 1200 lb of inert material at engine cut-off. The 1200 lb do not show up in the landing weight data. Calculations based on the results of the tile dry-out chamber tests, the damaged tile count, and inflight dry-out times data indicate a total of about 800 to 850 lb of water in the 1600 tiles at lift-off and about 720 to 750 lb at engine cutoff. This compares favorably with the approximately 1200 lb of inert (water) which is indicated in the ascent trajectory analysis. Orbiter systems data indicated there were no systems venting that would cause torquing during the period in which this torquing was observed. CONCLUSION: 1. Tile damage due to hailstones allowed tiles to soak up a significant amound of water during the rainstorm. 2. Outgassing the entrapped water from the greater number of damaged tiles on the underside of the right wing provided a differential thrust which resulted in negative-roll torquing, until completion of the on-orbit bottom sun tile dry-out process. CORRECTIVE_ACTION: 1. Protection against tile damage and subsequent rain soaking of tiles is desirable. See problem STS-4-1. 2. Should damage and rain-soaking recur: a. Evaluate extent for acceptability of weight for launch, and/or time required on-orbit for dry-out. b. Provide for dry-out attitude in time line. c. Provide for consumables usage to compensate for torquing which may result from unequal distribution of thrust from drying water-soaked tiles. EFFECTS_ON_SUBSEQUENT_MISSIONS: See corrective action.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** Postlanding	Problem	**FIAR**	**IFA** STS-4-V-20	DPS
	GMT: Postlanding		**SPR**	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Item Entry Key on Left Keyboard Sticking (ORB)

Summary: DISCUSSION: During postflight operations at DFRF (Dryden Space Flight Facility), KBU (key board unit) S/N (serial number) 19 exhibited a stuck "item" key. A keyboard routine was in progress, and after the item key on the left keyboard was entered, no other keyboard entries were recognized. The suspect key switch assembly was returned to IBM/Owego for failure analysis. Extensive testing failed to reproduce the anomaly. Visual examination of the disassembled assembly and X-ray of the four Otto microswitches also failed to disclose any anomalous conditions.

Key switches of P/N 6091752-2 level are known to exhibit an intermittent sticking condition. This is due to the Otto microswitches that have an actuation force of 2 to 4 ounces. The corrective action for this condition is to replace these switches with new switches having an actuation force of 6 to 8 ounces (P/N 6091752-3). The program has agreed to replace these switches only when they fail. During ground testing in the OPF (Orbiter processing facility) the no. 3 DEU (display electronics unit) bite flag tripped while loading the DEU for GPC IPL (initial program load). The data was indicative of a key stroke during IPL or an intermittent keyboard switch closure. Several problems during previous ground turnaround activities appeared to be left on number 1 keyboard common. Keyboard was replaced for STS-5. Extensive testing of the keyboard at the vendor has failed to reproduce the problem or to identify any cause for the sticking item entry key or for the DEU 3 bite flag trip. CONCLUSION: The cause of the sticking item entry key on the left keyboard is unknown. CORRECTIVE_ACTION: The left keyboard was replaced with the spare keyboard that also contains low actuation force microswitches. The removed keyboard is being retrofitted at the vendor with all new higher actuation force microswitches. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	**Time**	**Classification**	**Documentation**		**Subsystem**
MER - 0	**MET:** Prelaunch	Problem	**FIAR**	**IFA** STS-4-V-21	MPS
	GMT: Prelaunch		**SPR**	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Liquid Oxygen 17-inch Disconnect Flow Liner Damaged (ORB)

Summary: DISCUSSION: The flow tube which is made of 6061-T6 Aluminum alloy is 0.040 in. thick, 16.3 in. in diameter, and 2.495 in. long. The flow tube fits like a liner between the Orbiter and external tank halves of the 17-inch disconnect. This liner prevents LO2 from being dumped overboard during the back-up mode of separation. The flow tube was bent inward one-third of the way around the circumference (toward the middle of the tube into the LO2 flow stream). The tube is held in place by 6 screws and 3 clips. A clip is spaced every 120? around the circumference. The same flow tube had been used on STS-1, 2, and 3. Normal wear over 3 flights or possible slight damage may have caused the flow tubes to be out of round prior to STS-4. An out-of-round flow tube would allow the LO2 flow to bend the tube into the flow stream during operation of the main engines in flight.

A special tool has been disigned to verify the roundness of the flow tube prior to ET mating on STS-6 and subsequent flights. Possible design changes for the flow tube include using a spun tube to eliminate the welded seam, increasing the thickness to 0.080 in., and contour stiffening of the upstream end of the tube. The flow tube was removed and replaced with a like design. Prior to mating the Orbiter and ET for STS-5, the tube will be remeasured using a calipers and reinspected. CONCLUSION: Normal wear over 3 flights or possible slight damage probably caused the flow tube to be out of round prior to STS-4. CORRECTIVE_ACTION: Calipers will be used prior to ET mating to verify that the flow tube installed for STS-5 is not out of round. Design improvements for the flow tube and a special inspection tool will be incorporated on STS-7 and subsequent flights. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	**Time**	**Classification**	**Documentation**		**Subsystem**
MER - 0	**MET:** Prelaunch	Problem	**FIAR**	**IFA** STS-4-V-22	RCS
	GMT: Prelaunch		**SPR**	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Water Intrusion in Forward RCS Thrusters (ORB)

Summary: DISCUSSION: Prelaunch pictures as well as evaporative cooling of the leak detectors during ascent indicate that water was trapped behind the protective paper covers of engines F3D and F1L. The lowest temperature seen on these 2 engines during ascent was 39? F.

Evaporative cooling of seven other engines without paper covers also indicated the presence of water. The lowest temperature seen on these engines was 47? F. The concern with water in the engines is deselection of that engine due to freezing in the chamber pressure (Pc) tube or unstable combustion with freezing in the injection ports. An evaluation has been conducted to determine the impact of launching after a rainstorm in which the vehicle was exposed on the launch pad with the following results: 1) The likelihood of a paper cover leak is small. Only 2 of 11 covers leaked on STS-4 after severe rain and hail. No leaks were seen on STS-2 after rain. 2) No positive inspection to determine the presence of water can be done with the RSS rolled back. For STS-5, the RSS roll back will be delayed until T-3 hours. 3) If a paper-covered engine were to leak it is unlikely that the water would freeze. The lowest temperature seen during ascent on 9 engines with water on STS-4 was 39? F. The temperature of any engine at launch on the previous shuttle flight was greater than 70? F. 4) The only time-critical use of the paper-covered engines is for an abort-once around underspeed, or return-to-launch site abort. For all other flight conditions time permits the reselection of a engine deselected due to freezing in the Pc tube or the deselection of a frozen engine. CONCLUSION: The water in engines F3D and F1L was due to a leak in the silicone seal between the paper cover and the engine bell. Launching with water in RCS engines is an acceptable risk with paper covers installed. CORRECTIVE_ACTION: The RCS OMI (prelaunch procedures) for STS-5 will include detailed installation and inspection of the RCS paper covers. The RSS rollback for STS-5 has been delayed to T-3 hours, thus lessening the time for exposure to rain. Additional rain protection for the vehicle has been approved for future implementation. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-4-V-23	APU
	GMT: 183:02:30		**SPR**	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Auxiliary Power Unit (APU) 1 Fuel Tank Pressure Decay (ORB)

Summary: DISCUSSION: A small decay in fuel tank pressure of 0.05 lb/hr was observed during the flight. After the return of the Orbiter to KSC, a leak of the APU 1 GN2 QD (quick disconnect) was verified to occur at tank residual pressures. The QD was replaced and the new QD was leak checked by mass spectrometer. An analysis of the failed QD showed a dent (or scratch), several smaller indentations, and brownish-colored residue on the cap seats. Discoloration was seen on the metallic sealing surface (rust-colored) and whitish particles were found on the face of the poppet sealing surface. In addition, rust was noted on the interior body of the QD. The source of contamination is not known, but possibilities include the ground-half coupling, moisture from the air, or Freon cleaning of the GSE (ground support equipment). Until recently, the GSE was cleaned with Freon. Freon in the presence of hydrazine is known to attack stainless steel. The method of cleaning has been corrected at KSC.

CONCLUSION: The cause of the leakage was contamination that caused indentations on the sealing surface of the GN2 QD cap seats. The source of the contaminant is unknown, but could be caused by humidity, or from the use of Freon at KSC to clean the GSE. CORRECTIVE_ACTION: The QD has been replaced and leak checked by mass spectrometer. The use of Freon for cleaning the GSE at KSC has been discontinued. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** Postlanding	Problem	**FIAR**	**IFA** STS-4-V-24	Water and Waste
	GMT: Postlanding		**SPR**	**UA**	Management System
			IPR	**PR**	**Manager:**
					Engineer:

Title: The Waste Management System (WMS) slinger speed was slow. (ORB)

Summary: DISCUSSION: The crew reported a decrease in slinger motor speed over the course of the mission. It did not completely stop or fail to operate. During postflight inspection at KSC the slinger speed was measured to be 860-1200 (<1000 rpm is considered degraded performance). The vendor is still investigating to determine the exact cause of the slow slinger. Because of this problem and the similar STS-3 problem the slinger motor will be replaced with one that has a direct drive and has twice the torque.

The crew also reported several other problems with the WCS system as follows: 1. The urinal air flow was low but seemed to increase after the prefilter was changed. Postflight tests with a clean prefilter showed normal air flow. 2. Urine wicked out under the urinal cap. 3. The restraint system design was not adequate to provide proper positioning for use of the WMS. A review of the WMS system design has been completed and a summary of design and procedure changes to be implemented for future missions is listed as corrective actions. CONCLUSION: The cause of the slinger slow down is not known. The higher torque motor and swept back tines will provide a useable system for STS-5. System performance will be evaluated after STS-5. CORRECTIVE_ACTION: 1. The slinger motor will be replaced with one that is direct drive and has higher torque. The lower tines will be swept back to prevent clogging. 2. The procedure will be changed to require the prefilter to be changed once a day and a change will be made to provide enough filters for flight. 3. There will be two urinal caps provided, one for male use and one for female use. The male cap will be sealed underneath to prevent leakage. 4. The restraint system has been redesigned. EFFECTS_ON_SUBSEQUENT_MISSIONS: None

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Tracking No	Time	Classification	Documentation		Subsystem
MER - 1	**MET:** Postlanding	Problem	**FIAR**	**IFA** STS-4-V-24A	Water and Waste Management System
	GMT: Postlanding		**SPR**	**UA**	
			IPR	**PR**	**Manager:**
					Engineer:

Title: Waste Collection System (WCS) slinger slow. (ORB)

Summary: DISCUSSION: On STS-4, the WCS slinger was reported to have slowed down over the course of the mission. In addition, the urinal air flow degraded and, during use, urine leaked from underneath the cap of the urinal. The crew reported that they have difficulty restraining the body during use and, because of this, did not have enough hands free to use it properly (reference problem STS-4-24).

After STS-4, several design changes were implimented. The slinger motor was replaced with one that is direct-drive and has four times the torque. The urnial was redesigned such that the prefliter is easier to replace and residual urine is completely collected. The urinal caps were redesigned with a smaller opening to enhance air velocity and with a seal underneath to prevent leakage. Thigh bar restraints and foot strap restraints were added to enhance body stabilization during use. The slinger slow down was most likely due to inadequate torque of the slinger motor. The urinal air flow degradation was due to debris collecting on the urinal prefilter. The low urinal air flow allowed urine to leak out from under the urinal through the spaces provided for air flow during female use. Poor body stabilization was a result of inadequate restraint equipment. On STS-5, the cre reported none of the problems that plagued the crew of STS-4. The slinger did not slow down (except for the normal momentary slow down during use). The prefilters were changed out easily when urinal air flow decreased or some debris was noted on the screen. The crew had no urine leaks and had no difficulty with body stabilization during use. CONCLUSIONS: The design changes incorporated after STS-4 were very effective in eliminating the problems experiemtned with the WCS during previous missions. CORRECTIVE ACTIONS: The OV-102 WCS system was removed, inspected, and cleaned and will be installed in OV-099 for STS-6. The waist belt restraint which the STS-5 crew found to be ineffective will be eleminated for STS-6. A similar design WCS system will be installed in OV-102 and sunsequent vehicles EFFECT ON SUBSEQUENT MISSIONS: none

Tracking No	Time	Classification		Documentation	Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-4-V-25	ECLSS
	GMT:		**SPR**	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Variations in PP02 Sensor Response During Ascent And Entry. (ORB)

Summary: DISCUSSION: The PPO2 sensors exhibited erratic performance during ascent and entry. Sensor A read 3.64 psia while sensors B and C read 3.44 psia early during entry. Subsequently A and B read 3.44 psia while C read 3.60 psia. Sensor readings returned to normal when the cabin heat exchanger air outlet temperature stabilized after ascent and entry. Sensors A and B are located in a common housing. The sensors are calibrated at stablilized temperature and have a specification accuracy of ?3%.

A design change was implemented for STS-4 to provide additional airflow over the amplifiers for sensors A and B. This increased the sensor accuracy by decreasing the temperature difference between sensor and amplifier during stabilized conditions. The variations in PP02 sensor response during ascent and entry are considered normal for transient temperature conditions and can be expected to occur on subsequent missions. CONCLUSION: The variations in PP02 sensor readings were caused by transient temperature conditions during ascent and entry. CORRECTIVE_ACTION: None. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification		Documentation	Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-4-V-26	C&T
	GMT:		**SPR**	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Mid-deck TV Camera Operation Erratic. (ORB)

Summary: DISCUSSION: The video from the mid-deck TV input location was intermittently degraded. The high frequency response was reduced and there was "smearing" of the scene content. Postmission testing revealed a problem in a spacecraft extension cable behind panel MO58F. The extension cable allows for the DFI installation on OV-102 and will not be used after the DFI is removed.

The wire in the cable was probably damaged during DFI installation. The positive half of the video signal was shorted to the shield. CONCLUSION: The spacecraft wiring was shorted in an extension cable used on OV-102 to allow for DFI installation. CORRECTIVE_ACTION: The extension cable was removed and two wire segments were replaced. The extension cable was reinstalled and an end-to-end functional test will be completed before STS-5.

EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification		Documentation	Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-4-V-27	C&T
	GMT:		**SPR**	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Wireless Crew Communications Unit (WCCU) "B" Operated intermittently. (ORB)

Summary: DISCUSSION: During a live TV pass on the fourth day the pilot reported that his audio was intermittent and that he had exchanged unit "C" for his unit "B". Prior to exchanging the units, the unit "B" batteries were checked and found to be good.

The "B" leg unit and corresponding wall unit were checked postflight and found to be working perfectly. However, the wall unit's antenna was missing. The antenna was later found behind the RMS control panel. The antenna was unbroken and operational. During discussions with the pilot, it has been determined that the system "B" wall unit antenna was properly attached before it was stowed. There is no explanations of why the pilot had an intermittent problem with the "B" system. The problem was subsequently solved when the "C" system was installed. The same WCCU "B" unit had been used by the pilot without a problem on STS-2 and 3. CONCLUSION: After test and analysis of the "B" system wall and leg unit, no problem can be found with the hardware. CORRECTIVE_ACTION: The "B" system will be reused by the pilot on STS-5. Fly as is. A spare system will be onboard again for STS-5. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification		Documentation	Subsystem
MER - 0	**MET:** Postlanding	Problem	**FIAR**	**IFA** STS-4-V-28	C&T
	GMT: Postlanding		**SPR**	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Data missing from tracks 1 through 7 when the DFI PCM recorder was dumped after STS-4 landing. (ORB)

Summary: DISCUSSION: Durng normal postflight ground dumping of the DFI PCM recorder, it was noted that tracks 1 through 7 contained excessive noise while the data on tracks 8 through 14 appeared normal.

The recorder was returned to the vendor where it was found that data was recorded on tracks 1 through 7 but was subsequently erased. Data erasure resulted from tape passage across the magnetized reproduce heads on tracks 1 through 7. Head magnetization resulted from a short which occurred when two feedthrough wires on a printed circuit board contacted the top of a relay on an adjacent printed circuit board. This short caused two transistors to fail which allowed a constant DC current to flow through the reproduce heads thereby erasing the recorded data. Conditions to cause loss of data can exist only while the recorder is being operated in the reverse direction. Dimentional analysis indicated that a 0.05 inch interference can exist if all components are within specification and workmanship standards. This condition can exist in all recorders built to date and cannot be detected by flight telemetry measurements. Conformal coating on the relay case probably prevented earlier failure of this recorder. All flight units will be returned to the vendor for modification which includes opening the recorder and partial disassembly. The two leads will then be clipped "flush" with the board and an insulator bonded to the top of the relay case. CONCLUSION: A short between protruding leads from a printed circuit board and the top of a relay on an adjacent board caused a constant voltage to be applied to the recorder reproduce heads which erased the recorded data on tracks 1 through 7. CORRECTIVE_ACTION: The DFI PCM recorder will be repaired for STS-5. A spare recorder will be returned to the vendor for modification and retest. It will replace the payload recorder for STS-5 if time permits. Risk of failure of the remaining three or four recorders of this type is acceptable since the OPS recorders are redundant and the DFI wideband ascent recorder and the payload recorder record only in parallel. Parallel recording is done in the forward direction only and recorded data will not pass across the reproduce heads until postlanding data dump. Procedures will be implemented to verify that the reproduce head has not be magnetized prior to playback of recorded data. Future corrective action includes return of all flight recorders to the vendor for modification and reacceptance. The three OV-099 recorders will be repaired and replaced prior to STS-6. EFFECTS_ON_SUBSEQUENT_MISSIONS: None

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Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-4-V-29	TPS
	GMT:		**SPR**	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Upper Body Flap Tile Degradation Caused by Aft Vernier RCS Plumes. (ORB)

Summary: DISCUSSION: The orientation of the two aft vernier RCS thrusters results in direct plume impingement on the upper body flap tiles. High aft vernier usage during STS-3 and STS-4 caused degradation of the HRSI (high temperature reusable surface insulation) tiles on the upper body flap. Errosion or roughening of the tile surface was first noted after STS-3. Accumulated degradation during STS-4 resulted in severe erosion of several tiles on the upper surfaces of the body flap.

Testing indicates that RTV (room temperature vulcanizing) material will still be elastic after ascent and should provide adequate protection from the thruster plumes. Verification of RTV-coated tiles is planned at White Sands on August 20, 1982, during thruster life testing. An AFRSI (advance flexible reusable surface insulation) blanket will also be tested as a long-range solution. CONCLUSION: High usage of the two aft vernier RCS thrusters resulted in continued degradation of HRSI tiles on the upper surfaces of the body flap and tile refurbishment or replacement was required. CORRECTIVE_ACTION: Nine tiles on the upper left body flap and three on the upper right have been coated with RTV. One tile on the upper left has been replaced. Potential long term solutions include thruster re-orientation, scarfing or plume deflectors for the aft vernier thrusters as well as an AFRSI blanket for the upper body flap tiles. FOD will limit vernier RCS usage to under .2?/second rates. EFFECTS_ON_SUBSEQUENT_MISSIONS: None. Repair and/or replacement of several upper body flap tiles may be required after each flight until a long range solution is implemented.

Tracking No	Time	Classification		Documentation	Subsystem
MER - 2	**MET:**	Problem	**FIAR**	**IFA** STS-4-V-29A	TPS
	GMT:		**SPR**	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Upper body flap tile degradation caused by aft verneier RCS plumes. (ORB)

Summary: DISCUSSION: The orientation of the two aft vernier RCS thrusters results in direct plume impingement on the upper body flap tiles. High aft vernier usage during STS-3 and STS-4 caused degradation of the HRSI (high temperature reusable surface insulation) tiles on the upper body flap. Errosion or roughening of the tile surface was first noted after STS-3. Accumulated degradation during STS-4 resulted in severe erosion of several tiles on the upper surfaces of the body flap. Erosion of tile surfaces that were not coated with RTV (room temperature vulcanizing) material occured on STS-5 and some of the RTV coating degraded.

Tests at WSTF (White Sands testing Facility) showed that RTV overcoating is a temporary solution to prevent continued eroding of tile surfaces. The tests also showed that AFRSI (advanced felt reusable surface insulation) (as a proposed fix) was unacceptable. CONCLUSION: Impingment of the two aft down firing vernier engines on body flap tiles will eventually erode he tile surface. CORRECTIVE_ACTION: The body flap tiles affected by the downward firing engines will be cated with black RTV for STS-6. A long term fix is being evaluated. EFFECTS_ON_SUBSEQUENT_MISSIONS: For all subsequent flights of OV-099 and OV-102, the RTV coating will be inspected and, if necessary, be re-coated for each flight until a long term fix is approved.

Tracking No	Time	Classification		Documentation	Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-4-V-30	FCP
	GMT:		**SPR**	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Fuel cell 2 water relief valve heater "B" was inoperative. (ORB)

Summary: DISCUSSION: The function of the water relief valve heater is to maintain the fuel cell water relief valve temperature well above freezing throughout the mission. The heaters in both "A" and "B" circuits are thermostatically controlled to come on at 70? F. Review of the data after the flight showed that the relief valve temperatures approached 70? F between 130 and 140 hours MET. The heater "B" circuit was active at this time, and the fuel cells 1 and 3 relief valve heaters cycled repeatedly while the no. 2 heater did not. Although there was no impact to this particular mission, subsequent checkout at KSC revealed a broken heater "B" ground wire at the vehicle attach point.

The fuel cell water relief valves would only be used in the event of a failure in the potable water system. Relief valve temperatures have been well above freezing during the cold case missions flown. CONCLUSION: The exact time and cause of the failure is unknown. The wire was possibly broken before liftoff but not detected because of ambient temperature above the 70? actuation point. CORRECTIVE_ACTION: The broken wire was repaired and the circuit and heater functions verified. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** Postlanding	Problem	**FIAR**	**IFA** STS-4-V-31	MECH
	GMT: Postlanding		**SPR**	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Right and Left-Hand Inboard Brake Rotors Damaged. (ORB)

Summary: DISCUSSION: The numbers 3 and 4 rotors on both inboard brake assemblies were found damage after STS-4. The inside diameter of these rotors scraped against their torque tubes which shaved off fragments of beryllium. Unlike STS-3, on this flight there were no bent drive lug notches on any rotor outside diameter, but there was a small amount of chafing on the contact faces of some notches.

Braking on STS-4 averaged about 7.5 ft/sec.?. Hard braking up to about 13 ft/sec? is planned for STS-5. Full brake design capability exists for STS-5, but the brake assemblies will probably require replacement again after the planned landing due to expected scraping of the rotors on the torque tubes and chafing on the contact faces of some notches. Brake modifications are being implemented for STS-6 and 7 to reduce rotor damage. If these fixes don't eliminate brake damage, consideration will be given to stiffening the axles. The damage to the inside diameter of the rotors and to the contact face of some notches is not a safety of flight issue, but rather a lifetime and cost issue. CONCLUSION: Landing loads during rollout produce relative deflections of the wheel, brake and axle resulting in damage to the brake rotors. STS-5 should have similar and more severe damage since harder braking at higher velocities is planned. The brake asssemblies will probably require replacement again after STS-5. CORRECTIVE_ACTION: The two inboard brake assemblies were replaced with new assemblies for STS-5 and full design capability exists. STS-6 will have a saddle installed between each brake assembly and axle to force the brake to move during axle deflections. Protective clips or caps for the rotor and stator drive lug notches should be installed for STS-7. EFFECTS_ON_SUBSEQUENT_MISSIONS: Similar brake damage may occur on STS-5. All brake rotors will be inspected for evidence of galling, bending or scraping after STS-5.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** Postlanding	Problem	**FIAR**	**IFA** STS-4-V-31A	MECH
	GMT: Postlanding		**SPR**	**UA**	**Manager:**
			IPR	**PR**	

Engineer:

Title: Right and Left-Hand Inboard Brake Rotors Damaged. (ORB)

Summary: DISCUSSION: The numbers 3 and 4 rotors on both inboard brake assemblies were found damage after STS-4. The inside diameter of these rotors scraped against their torque tubes which shaved off fragments of beryllium. Unlike STS-3, on STS-4 flight there were no bent drive lug notches on any rotor outside diameter, but there was a small amount of chafing on the contact faces of some notches. The inside diameter of some rotors and the outside diameter of some stators were scraped again to some degree on STS-5.

The damage to the inside diameter of the rotors and to the contact face of some notches is not a safety of flight issue, but rather a lifetime and cost issue. Braking on STS-4 averaged about 7.5 ft/sec.?. Hard braking up to about 13 ft/sec? was accomplished on STS-5 and averaged about 12 ft/sec.?. CONCLUSION: Landing loads during rollout produce relative deflections of the wheel, brake and axle resulting in damage to the brake rotors. CORRECTIVE_ACTION: All brake assemblies are new or rebuilt for STS-6 and full design capability exists. STS-6 has a saddle installed between each brake assembly and axle to force the brake to move during axle deflections. Protective clips or caps for the rotor and stator drive lug notches should be installed for STS-7. EFFECTS_ON_SUBSEQUENT_MISSIONS: All brake rotors will be inspected for evidence of galling, bending or scraping after STS-6.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-4-V-32	STR
	GMT:		**SPR**	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Environmental Control Life Support System (ECLSS) Airlock Vent Duct Damaged. (ORB)

Summary: DISCUSSION: During the EVA (extravehicular activity) preparation demonstration, the airlock vent duct was damaged while a crewmember was stowing airlock hatch "A". The vent duct was penetrated by the hatch's uplock fixture as the hatch was rotated toward the stowed position.

Postflight tests conducted in the 1g trainer at JSC verified the hatch's uplock fixture can contact the vent duct. If the hatch is pulled to a maximum position away from the airlock, then rotated to the stowed position, the hatch will not contact the vent duct. CONCLUSION: The airlock vent duct was damaged by the hatch-uplock fixture when the hatch was opened. CORRECTIVE_ACTION: KSC has repaired the vent duct damage. The duct support bracket has been removed and the duct has been reattached in a position that provides a 1.5-inch clearance when the hatch is opened. The same fix will be made for OV-099 and subsequent vehicles.
EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 3	**MET:**	Problem	**FIAR**	**IFA** STS-4-V-33	OMS/RCS
	GMT:		**SPR**	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Degradation of vernier thruster nozzle coating on jets R5R and F5L. (ORB)

Summary: DISCUSSION: Post STS-4 thruster inspection revealed small coating defects i the F5L and R5R vernier thrusters. A coating defect described as a small 0.050-0.060 inch crater was found at the throat of F5L. The coating thickness was apparently zero in this area. A small chip about 0.020 x 0.020 in. was found in the coating just upstream of the throat in R5R. The depth of the chip is not exactly measurable and the shape indicates possible mechanical damage. These two problems in combination with the previous qualification problems on the vernier thrusters caused concern for all the OV-102 vernier thrusters. The thrusters apparently have much shorter life than had been previously expected. Also, the usage during the mmissions has been much greater than anticipated. Potential Failure causes include thermal cycle fatigue of the coating, mechanical damage fromt throat plugs, quality problems during initial coating of the thruster, oxidation from the oxidizer rich mixture in the engine, rapid oxidation in the 1200-1500 degress F range or some combination of these causes.

CONCLUSIONS: The cause of the coating degradation is unknown. Because of the obvious concern for F5L and R5R and the unknown life of the other four verniers on OV-102, all six of the vernier engines were replaced with new OV-099 engines. CORRECTIVE ACTION: An extensive failure investigation program has been initiated. Additional testing to determine the effects of thermal cycles on nozzle life will be conducted, inspection techniques are being developed, additional engines and chambers are being ordered to meet near term replacement problems, and a program to develop an improved design is in work. EFFECT ON SUBSEQUENT MISSIONS: Frequent vernier engine changeouts are expected. Detailed vernier inspection will be preformed after each mission.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 4	**MET:**	Problem	**FIAR**	**IFA** STS-4-V-33A	OMS/RCS
	GMT:		**SPR**	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Degradation of vernier thruster nozzle coating on thrusters R5R and F5L. (ORB)

Summary: DISCUSSION: Post STS-4 thruster inspection revealed small coating defects in the F5L and R5R vernier thrusters. A coating defect described as a small 0.050-0.060 inch crater was found at the throat of F5L. The coating thickness was apparently zero in this area. A small chip about 0.020 x 0.020 in. was found in the coating just upstream of the throat in R5R. These two problems in combination with the previous qualification problems on the vernier thrusters caused concern for all the OV-102 vernier thrusters. The thrusters apparently have much shorter life than had been previously expected. Also, the usage during the mmissions has been much greater than anticipated. It was decided to inspect between flights and change out thrusters with any sign of defects. Testing has verified that inspection between flights can spot flaws before any further problems can occur. Information indicated that there are several causes for coating damage - mechanical damage from throat plugs, machining ridges left in the columbium chamber prior to coating, and potentially a quality problem associated with the adherence of the coating to the chamber.

All vernier thrusters on OV-102 were replaced after STS-4 and a post STS-5 inspection of these thrusters showed no degradation or damage. CONCLUSIONS: The expected life of the verniers is still unknown; however, a postflight inspection and replacement as necessary will be accomplished. CORRECTIVE ACTION: As the sources of coating damage are understood, remedial actions will be taken. At this time, the use of thoat plugs has been stopped, machining of the chamber has been altered to eliminate steps or ridges, and quality audits at the coating vendor have been initiated. EFFECT ON SUBSEQUENT MISSIONS: There is no STS-6 problem since the vernier engines have been inspected and found free of defects. Future missions will rely on postflight inspection and replacement as necessary until the problem is fully understoof and improvement can be implemented.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-4-V-34	C&T
	GMT:		**SPR**	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: The UHF Extravehicular Activity RF Communications Were Noisy While Donning the EMU (ORB)

Summary: DISCUSSION: During the EMU (extravehicular mobility unit) demonstration activities, the Commander reported that RF communications were poor due to high background noise. Postflight reviews indicated that the noise disappeared 30 seconds after egressing the EMU airlock mounting fixture. Hardware tests revealed no problems, but the same noise could be reproduced by unsquelching the EMU receivers. In previous tests, the intermittent metal-to-metal contact between the EMU and other surrounding metal objects caused high background noise levels i the EMU receivers. The EMU fits loosely in the airlock mounting fixture to allow easy ingress and egress. In zero-g, the EMU floats in these mounts, making intermittent contact with the mounting fixture.

CONCLUSION: The noise was probably due to the reradiation of the EMU RF signal caused by the intermittent contact between the EMU and the mounting fixture with the resulting unsquelching of the EMU receivers. CORRECTIVE_ACTION: For STS-5, the crew will switch to the hardline communications mode via the umbilical while the EMU is in its airlock mounts, if the problem recurs. A long-term fix is being evaluated to insulate the mounts and break the intermittent conductive path. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.