Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 000:00:08	Problem	**FIAR**	**IFA** STS-37-V-01	OMS/RCS
PROP-01	**GMT:** 095:14:31		**SPR** 37RF01	**UA**	**Manager:**
			IPR 43V-0005	**PR**	
					Engineer:

Title: Jet R1U Failed Off (ORB)

Summary: DISCUSSION: Reaction control subsystem (RCS) primary thruster R1U was declared failed off on its first attempted firing shortly after external tank separation. When the fire command was initiated, the thruster chamber pressure increased to approximately 10 psia. Redundancy management (RM) declared thruster R1U failed off after three consecutive chamber pressure discretes of less than 36 psia. Injector temperature profiles were nominal indicating that both oxidizer and fuel entered the injector tubes. A plugged chamber pressure transducer port is not suspected since the chamber pressure decayed abruptly when the fire command was removed.

The STS-37 failure is very similar to the two thruster failures seen during STS-36. The STS-36 failure analysis indicated that the oxidizer valve main stage failed to open and this condition was caused by iron nitrate contamination. CONCLUSION: The most probable cause of the low chamber pressure reading is pilot only operation of the oxidizer valve and nominal operation of the fuel valve. Previous thruster failure analyses indicate that this is most likely caused by iron nitrate contamination in the thruster valve. Analysis indicates that this condition would yield a chamber pressure of 10 to 15 psia. CORRECTIVE_ACTION: KSC removed and replaced the thruster and transferred it to White Sands Test Facility for test firing and the thruster flush program. The primary thruster throat plugs are installed during turnaround to reduce the likelihood of moisture intrusion. EFFECTS_ON_SUBSEQUENT_MISSIONS: None. A spare thruster was available.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 000:00:07	Problem	**FIAR**	**IFA** STS-37-V-02A	HYD
MMACS-02	**GMT:** 095:14:30		**SPR** 37RF02	**UA**	**Manager:**
			IPR	**PR**	
					Engineer:

Title: Water Spary Boiler 2A experienced a temporary spray bar freeze-up during ascent resulting in a momentary undercool of the auxiliary power unit 2 lube oil.

(ORB)

Summary: DISCUSSION: Water spray boiler (WSB) 2 experienced spray bar freeze up after MECO while on controller "A". There was no evidence of spraying for system 2, when the return lube oil reached 250 ?F. An undercooling of the auxiliary power unit (APU) 2 lube oil occurred as the return temperature increased above the 250 ?F setpoint. When the temperature rose above 275 ?F, the crew switched to the "B" controller. In the time required for this crew action, the temperature increased to a maximum of 280 ?F, where cooling began.

At that time the core temperature was approximately 32 ?F, indicating possible spray bar freeze-up. The lube oil temperature had already decreased to approximately 260 ?F when the switch to controller "B" was completed. An overcooling to 235 ?F was observed prior to attaining normal cooling control with the backup controller. This overcooling is expected with a spray bar freeze-up/thaw cycle and represents a delay in controller response to sudden cooling. Prior to APU shutdown, the crew returned to controller "A". This action was completed and normal cooling performance (approximately 25 seconds) was verified prior to APU shutdown. CONCLUSION: Analysis of ascent data identified three possibilities for the APU 2 lube oil overtemperature: (1) a momentary spray valve lockup, (2) a controller/spray temperature sensor malfunction, or (3) a core/spray bar freeze-up. The first possibility was considered remote due to the excellent failure history of the spray valve and the fact that it achieved normal cooling after some delay. The second possibility is also considered remote. Similar cases of the ascent lube oil overtemp (WSB overcooling) have been seen on numerous STS missions involving other boilers (STS-1, -2, -3, -4, -9, -51B, -29, -34, -35, and -38). Some of these were attributed to controller failures. However, the subsequent controller failure analysis failed to identify any problems. Finally, most incidents were blamed on wax/PE contamination in the core tube bundle that changed the heat transfer characteristics of the assembly and resulted in a core/spray bar freeze-up. Wax/PE is a product of the reaction between hydrazine and APU lube oil and it occurs when hydrazine leaks into the gearbox past the APU fuel pump seal cavity shaft seal. In some cases, this contamination is obvious because the gearbox pressure increases due to plugging of the inlet filter. However, no evidence of gearbox filter plugging existed in the STS-37 data. High gearbox pressure and an associated lube oil overtemperature were observed for system 2 during the previous flight of this vehicle (STS-38). Due to this event, WSB 2 (S/N 002) was removed for analysis and replaced with a new WSB (S/N 018). Also, APU 2 was hot oil flushed prior to STS-37 to remove system contamination. A remote possibility exists that recontamination of the system without an associated plugging of the gearbox filter could have occurred during STS-37 prelaunch or ascent, but no data are available to confirm or deny this theory. A review of previous lube oil cooling anomalies was conducted to search for any commonality. Two items were identified: (1) APU S/N 208 (STS-37 system 2 APU) has been involved in lube oil overtemperatures/freeze-ups during 6 of its 7 flights and (2) OV-104 system 2 has experienced overtemperature conditions during 3 of 4 previous flights. The analysis led the hydraulics community to agree that a core/spray bar freeze-up had probably occurred without a simultaneous controller/valve failure. This freeze-up resulted in the lube oil temperature because spraying could not immediately be initiated. Radiant heat energy from the lube oil tube bundle eventually thawed the spray bar. The WSB heat transfer phenomena are not completely understood at this time to determine the cause of the freeze-up. Definite conclusions concerning WSB flight anomalies cannot be extracted from the flight temperature history alone. Further study is required. WSB undercooling during ascent is an abort concern only. During an abort, a second system must fail for the failure to become criticality one. CORRECTIVE_ACTION: Since this WSB is new hardware and the flight data did not conclusively point toward wax as the primary cause for the spray bar freeze-up, the WSB will not be hot flushed this flow. A WSB/APU integrated

study plan has been approved by the Orbiter and GFE Projects Manager. The study is set to start June 1991. The study is designed to answer this flight anomaly and similar ascent/entry flight anomalies. The CAR 37RF02-010 has been closed and mothered to CAR 38RF01-010 which will track this problem.
EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 005:23:01	Problem	**FIAR**	**IFA** STS-37-V-02B	HYD
MMACS-02	**GMT:** 101:13:24		**SPR** 37RF15	**UA**	**Manager:**
			IPR None	**PR**	
					Engineer:

Title: Water Spray Boiler 2A Had an Incident of Lube Oil Overcooling during Entry. (ORB)

Summary: DISCUSSION: Five minutes into spray mode during entry, lube oil was overcooled for approximately 4.5 minutes. The minimum overcool temperature was 189 ?F.

CONCLUSION: The auxiliary power unit gearbox pressure was normal throughout entry, and this suggests minimal contamination of the gearbox filter. The water spray boiler (WSB) GN2 regulator outlet pressure did not indicate elevated spray rates prior to the overcooling incident. During the period of overcooling, core temperature and regulator pressure indicated a momentary increase in spraying in the heat exchanger core. The overcooling which occurred in system 2 was followed by an almost simultaneous period of overcooling in system 3, but vehicle accelerometer data showed no associated increase in vehicle maneuvers. When these data are taken together, it seems to rule out wax contamination of the APU lube oil as the primary cause of the overcooling, but wax could be a contributor. However, at this time the WSB heat-transfer phenomena are not completely understood to determine the cause for the periods of overcooling occurring during entry. Definite answers concerning WSB flight anomalies cannot be determined from flight data temperature histories alone. Further study is required. While WSB overcooling during entry may be an indication of anomalous WSB performance, it is not a flight safety concern. CORRECTIVE_ACTION: Since this WSB is new hardware and the associated APU was hot flushed prior to STS-37, the data suggest that was probably not a primary cause for this overcooling, and therefore, the system will not be hot flushed. A WSB/APU integrated study plan has been approved by the Orbiter and GFE Projects Manager. The study is scheduled to start in June 1991. The study is designed to answer this flight anomaly and similar ascent/entry flight anomalies. CAR 37RF15-010 has been closed and mothered to 37RF11-010 which will track both overcooling occurrences on STS-37.
EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 001:07:37	Problem	**FIAR**	**IFA** STS-37-V-03	PRSD
EGIL-01	**GMT:** 096:22:00		**SPR** 37RF03	**UA**	**Manager:**
			IPR 43V-0004	**PR**	

Engineer:

Title: PRSD 02 Manifold Valve 2 Failed to Close. (ORB)

Summary: DISCUSSION: At approximately 096:22:00 G.m.t., during the flight day 2 pre-sleep cryogenic reactant configuration activities, the power reactant storage and distribution (PRSD) system oxygen manifold isolation valve 2 failed to close when commanded by the crew through a cockpit switch. The switch was cycled three times without success and the crew subsequently closed the oxygen manifold isolation valve 1. The crew cycled the switch again approximately 36 hours later and the valve close satisfactorily. The valve was kept closed for the remainder of the flight. This problem appeared to be a repeat of the same problem that occurred on STS-34 when this valve did not close when first commanded.

A postlanding test was performed on the manifold valve during which the valve was cycled open three times to verify its operation on the ground. Also, a 26 lb/hr flow rate of oxygen was established through the environmental control and life support system (ECLSS) for 10 minutes to chill the valve to cryogenic temperatures. The valves was cycled three times satisfactorily, thus not proving the theory that the inflight failure was thermally induced. Wire wiggle tests while cycling the valve also failed to repeat the failure. CONCLUSION: The most probable cause of this and the STS-34 anomaly is an intermittent circuit in the bulkhead feed-through connector (40P348). A possible problem exists with this bulkhead connector that is caused by the use of a silicon sealant internal to the connector that can prevent proper electrical continuity. CORRECTIVE_ACTION: For the STS-43 mission (OV-104, flight 9), a wire-around has been implemented. Instead of going through bulkhead connector 40P348 pins 58 and 73, connector 40P320 pins 113 and 122 will be used for oxygen manifold isolation valve 2. KSC has proposed replacement of connector 40P348, but no spares will be available until July, 1991. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-37-V-04	C&T
INCO-03	**GMT:**		**SPR** 37RF04	**UA**	**Manager:**
			IPR 43V-0006	**PR**	

Engineer:

Title: The Ku-Band System Experienced Anlge Tracking Anomalies. (ORB)

Summary: DISCUSSION: During STS-37, the Ku-Band system experienced angle tracking anomalies in the communications mode while the system was in the general purpose computer (GPC) Acquisition mode. The anomalies occurred intermittently during orbits 15 through 29 and orbit 61. No further anomalies were seen in the communications mode nor during the 7 hours of radar operations after the Gamma Ray Observatory deployment and during development test objective (DTO) 0822.

CONCLUSION: Postflight testing did not repeat the anomaly; however, metallic shavings were found on the front and back of the antenna. The most probable cause for the angle tracking anomaly is that one of the metallic shavings obscured one of the difference feeds and interfered with the angle-error signal. CORRECTIVE_ACTION: Any corrective actions will be tracked on CAR 37RF04 and IPR 43V-0006. EFFECTS_ON_SUBSEQUENT_MISSIONS: None. If this anomaly were to repeat inflight, the system could be switched to the GPC Designate Steering mode where the Ku-Band antenna is pointed at the GPC designated angles and "open loop" tracks the TDRS signal (close-loop angle tracking is not required in the GPC Designate Steering mode).

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 002:04:25	Problem	**FIAR**	**IFA** STS-37-V-05	D&C
EGIL-02, EGIL-03	**GMT:** 097:18:48		**SPR** 37RF05; 37RF06	**UA**	**Manager:**
			IPR	**PR** DDC-4-43V-0050	
					Engineer:

Title: A. Forward Bulkhead Floodlight FailedB. Midport Payload Bay Floodlight Flickered (ORB)

Summary: DISCUSSION: A. The crew reported during the first extravehicular activity (EVA) that the forward bulkhead floodlight was not illuminated. The switch was turned off for 10 minutes, then back on, but the light remained off. The failure was repeated during postflight testing. The failed light (serial number 245) was replaced and sent to the NASA Shuttle Logistics Depot for failure analysis.

B. The crew reported that the midport payload bay floodlight flickered and failed to fully illuminate when switched on for payload bay door closure. The light had previously functioned normally during both the EVA periods. Also, this light had previously been reported as inoperative during STS-36, the sixth flight of OV-104 (reference IFA STS-36-15). The previous failure could not be repeated, and has been carried as a deferred unexplained anomaly. The anomaly recurred during STS-38, the seventh flight of OV-104. The most recent anomaly also could not be repeated. There have been several recent intermittent problems associated with the payload bay floodlights where the lamp is the suspected cause. A failure analysis of a lamp with a similar problem is currently underway. The midport floodlight (also known as floodlight number 3) is not required for STS-43. CONCLUSION: A. The forward bulkhead floodlight failed. B. The midport floodlight anomaly is unexplained. The most probable cause is the payload bay floodlight itself. CORRECTIVE_ACTION: A. The failed light has been replaced. Final corrective action to be documented on CAR 37RF05. B. Fly-as-is for STS-43. Replace the midport floodlight for STS-44. Final corrective action to be documented on CAR 37RF06. EFFECTS_ON_SUBSEQUENT_MISSIONS: A. None. B. Floodlight may fail again until anomaly has been explained and corrected.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 002:09:50	Problem	**FIAR** B-EMU-300-F001	**IFA** STS-37-V-06	GFE
EVA-01	**GMT:** 098:00:13		**SPR**	**UA**	**Manager:**
			IPR None	**PR**	

Engineer:

Title: EMU-1 battery would not recharge. (GFE)

Summary: DISCUSSION: Following the contingency extravehicular activity (EVA), the crew reported that it was not possible to recharge the extravehicular mobility unit (EMU) 1 battery. The crew performed several troubleshooting steps in an attempt to isolate the problem and determine if a workaround existed that would allow the battery to be charged. Troubleshooting revealed the following conditions:

1. The extravehicular suit 1 (EV 1) battery would not charge using the service and cooling umbilical (SCU) 1. 2. The EV 2 battery when installed in EV 2 would charge using SCU 2. 3. The EV 1 battery when installed in EV 1 would not charge using SCU 2. 4. The EV 3 battery when installed in EV 3 would charge using SCU 1. 5. The EV 1 battery when installed in EV 3 would charge using SCU 1. As a result of the troubleshooting, it was determined that the failure was confined to the display and control module (DCM) of EV 1. A method for charging the battery was found, (condition 5), and the failure caused no impact to the planned EVA on flight day 4. The battery-charging circuit in the DCM consists of connectors at each end, two switches (a microswitch and the power mode switch) and the cable between the connectors. One connector attaches to the battery harness and the other one connects to the SCU. A microswitch is used to open the charging circuit when the SCU is disconnected from the DCM. The circuit is complete when the umbilicals are mated. The power mode switch allows the battery to be charged. Postflight testing could not duplicate the failure and the EV 1 battery was able to be charged. Continued troubleshooting revealed that the power mode switch had a higher-than-expected resistance (about 4 percent of the time) indicating a possible intermittent condition in the switch. The high resistance could create an additional voltage drop, that, when coupled with the battery voltage, will stop charging of the EMU battery. Although the crew was asked to verify proper switch positions and confirmed that all were correct (the power mode switch was believed to have been cycled one time by the crew while troubleshooting the problem), postflight data review confirmed all switches properly configured. The power mode switch was the only component in the battery-charging circuit that exhibited any abnormal behavior during postflight testing. The power mode switch is unique to the Shuttle Program in that it is only used on the DCM. There have been no previous failures of this switch in the Shuttle Program. Replacing the power mode switch or further failure analysis will be invasive to the DCM; hence no further failure analysis will be performed. Should this failure condition, or failing that, the spare EV suit can be used to charge the battery. Additionally, a spare charged battery is stowed onboard each flight. CONCLUSION: The most probable cause of the failure was a high resistance or open condition in the power mode switch in DCM 1, however, only a small resistance (greater than the specification allowed) was repeated postflight. CORRECTIVE_ACTION: The DCM from EV 1 has been removed from flight status and has been replaced with an available spare unit. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	**Time**	**Classification**	**Documentation**		**Subsystem**
MER - 0	**MET:** 001:21:10	Problem	**FIAR** BFCE-029-F036	**IFA** STS-37-V-07	GFE
EVA-03	**GMT:** 097:11:33		**SPR**	**UA**	**Manager:**
			IPR	**PR** COM 4-09-10-02	

Engineer:

Title: Temporary Loss of Suit Parameters in Comm Mode A (GFE)

Summary: DISCUSSION: During the unscheduled Gamma Ray Observatory (GRO) extravehicular activity (EVA), no data were received from either extravehicular mobility unit (EMU) when using communications mode A (259.7 MHz). A dc voltage offset in the downlinked data was observed, and this indicated that the FM discriminator in the Orbiter's UHF transceiver had failed. The crew was instructed to switch to communication mode B, and a good datastream was resumed. Prior to the second EVA, the ground-based EMU data system was adjusted to compensate for the voltage offset, allowing the ground to receive data when in communications mode A. During postflight troubleshooting at KSC, this problem was duplicated.

CONCLUSION: The inflight problem was due to a failed FM discriminator in the Orbiter's UHF transceiver. CORRECTIVE_ACTION: The transceiver was removed and replaced and shipped to the flight equipment processing contractor (FEPC) at JSC for troubleshooting. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 004:01:17	Problem	**FIAR**	**IFA** STS-37-V-08	OMS/RCS
PROP-02	**GMT:** 099:15:40		**SPR** 37RF07	**UA**	**Manager:**
			IPR None	**PR**	
					Engineer:

Title: Low Pc Indications on Jets L1U and L1L During Interconnect (ORB)

Summary: DISCUSSION: During STS-38 (OV-104), STS-37 (OV-104), and STS-39 (OV-103), low chamber pressures were observed on minimum duration pulses (80-ms) from the primary reaction control subsystem (RCS) thrusters. The chamber pressures were in the 130 to 135 psia range instead of the nominal pressure of 150 psia. Nominal chamber pressures were observed for the longer duration firings and all low chamber pressures occurred while the RCS was interconnected to the orbital maneuvering subsystems (OMS) propellant tanks. During interconnect, one set of OMS propellant tanks supply propellant to both the left- and right-side aft RCS thrusters. The low chamber pressures were only seen on thrusters on the OMS pod opposite the pod supplying propellant. When the RCS was returned to straight feed, all chamber pressures returned to normal.

The low chamber pressures seen during recent flights were caused by nominal feedsystem dynamics during the interconnect mode that result in chamber pressures rising slower than normal. The chamber pressure is sampled at a rate of once every 40 ms and on a minimum duration (80-ms) pulse, only two data samples are obtained. The longer flow path through the crossfeed lines causes a slower pressure response to the thruster valves, and therefore, a slower rise in chamber pressure is at 150 psia for more than 40 ms and at least one data sample should be obtained at peak pressure. On a nominal (i.e. straight feed) 80-ms pulse, the chamber pressure is at 150 psia for more than 40 ms and at least one data sample should be obtained at peak pressure. On a low (i.e. interconnect) 80-ms pulse, the chamber pressure is at 150 psia for less than 40 ms and depending on when the pressure is sampled, peak pressure may or may not be sampled. In many cases, the two samples are straddling the peak pressure and the data obtained indicate a lower-than-nominal pressure. Contamination in the valve could possibly aggravate the condition and result in even slower chamber pressure responses. Also, the verniers are apparently not affected because the flow demands are not large enough to result in the pressure drops that cause the low chamber pressures. CONCLUSION: Low primary RCS thruster chamber pressures have only been seen on minimum duration pulses (80-ms) during interconnect mode for thrusters on the side opposite of the OMS tanks supplying propellant. During interconnect, those thrusters reach nominal chamber pressure slower because of slower feedsystem pressure recovery and, because of the data sample rate, peak pressures are not always being sampled. The low chamber pressures are not seen during interconnect on longer duration firings or for any condition (thruster location/pulse duration) during straight feed. CORRECTIVE_ACTION: None. The low chamber pressure indications are a characteristic of the system. EFFECTS_ON_SUBSEQUENT_MISSIONS: None. The low chamber pressure indications are a characteristic of the system.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** Prelaunch	Problem	**FIAR**	**IFA** STS-37-V-09	BFS
NAV-01	**GMT:** Prelaunch		**SPR** None	**UA**	**Manager:**
			IPR None	**PR**	
					Engineer:

Title: Prelaunch Backup Flight System Navigation Assembly (FSW)

Summary: DISCUSSION: Following the prelaunch OPS 0 to 1 transition, the runway 2 (altitude) component of the backup flight system (BFS) state vector was observed to be significantly higher than normal. The error continued to propagate upward to a value of 7700 feet just prior to the prelaunch state vector update at T-11 seconds. After the update, the BFS navigation performed nominally for the remainder of the mission.

CONCLUSION: The problem was caused by an incorrect BFS coding requirement that has existed since the software was originally written, but was never executed previously because of the slower speed of the original general purpose computers (GPC's). When used in the new GPC's, the coding requirement causes a 40 msec time bias that, when multiplied by the gravitational constant (32.2 ft/sec?), caused an initial rate error of 1.29 ft/sec. This error was then propagated, resulting in the observed altitude of 7700 feet just prior to prelaunch navigation initialization. Shuttle Avionics Integration Laboratory (SAIL) testing also reproduced this problem. CORRECTIVE_ACTION: Since the navigation anomaly introduced at the OPS 0 to 1 transition is corrected at the prelaunch navigation initialization, no corrective action is planned for the current software. The problem will be corrected beginning with the OI-22 software, and a waiver (along with an OPS note) will be issued during the interim period of time. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-37-V-10A	INST

None	**GMT:**		**SPR** 37RF08	**UA**	**Manager:**
			IPR 34V-0030	**PR**	
					Engineer:

Title: Body flap lower skin temperature sensor (V09T1026A) failed. (ORB)

Summary: DISCUSSION: The body flap lower skin temperature sensor exhibited a cold bias and intermittent off scale low indications. Troubleshooting per IPR 34V-0030 revealed a smaller metallic fragment contaminating one of the measurement leads in connector 50J88. The contaminant was removed and the measurement retested properly. The IPR was upgraded to a PR and closed.

CONCLUSION: The erratic measurement behavior was caused by the metallic contaminant. CORRECTIVE_ACTION: Removed the metallic contaminant from the connector. EFFECTS_ON_SUBSEQUENT_MISSIONS: None

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Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 005:23:56	Problem	**FIAR**	**IFA** STS-37-V-10B	APU
None	**GMT:** 101:14:19		**SPR** 37RF09	**UA**	**Manager:**
			IPR None	**PR**	
					Engineer:

Title: APU 2 Injector Tube Temperature (V46T0274A) Failed. (ORB)

Summary: DISCUSSION: At 101:14:03 G.m.t., about 07 minutes after wheel stop, the APU 2 injector tube temperature (V46T0274A) measurement became erratic and failed to a low value about 14 minutes later. All APU's were running at the time and the hydraulic load test had just been successfully completed. Approximately 1 hour into the postlanding cooldown period, the injector tube measurement recovered and responded nominally for the remainder of the cooldown period. No anomalous conditions were noted with this particular measurement at any other time during the mission. During KSC postflight turnaround operations, the sensor was repinned to the backup leads and the check-out has been successfully completed. Ground checks of the prime leads did not reveal any problems.

CONCLUSION: Unexplained anomaly. CORRECTIVE_ACTION: Connect the sensor to backup leads. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** Postlanding	Problem	**FIAR**	**IFA** STS-37-V-11	FC/PRSD
None	**GMT:** Postlanding		**SPR** 37RF10	**UA**	**Manager:**

			IPR	**PR** FCP-4-09-0127
				Engineer:

Title: Fuel Cell 3 High pH Reading Postlanding (ORB)

Summary: DISCUSSION: At 101:14:11:13 G.m.t., approximately 15 minutes after wheel stop, the fuel cell 3 water conductivity sensor began displaying an intermittent high potential hydrogen (pH) reading. This measurement is used to detect the presence of potassium hydroxide in the product water that would indicate flooding within the fuel cell. A true high-pH condition would have been verifiable through the high-pH reading in the downstream common manifold or through a change in fuel cell performance. Neither of these secondary cues verified a high-pH condition. Since the fuel cell 3 high pH indication was intermittent and not verified through the secondary cues, the problem was determined to be a malfunction of the fuel cell 3 water conductivity measurement instrumentation. However, fuel cell 3 was shut down prior to crew egress as an additional precaution.

Water samples from fuel cell 3 taken at the landing site and at the vendor indicated that the pH level was within specification, thereby verifying that the problem was within the measurement instrumentation. CONCLUSION: The intermittently high pH indications on fuel cell 3 were caused by a fault in the water conductivity measurement system. Fuel cell 3 did not experience a high pH condition, and no risk was posed to crew safety or mission success. CORRECTIVE_ACTION: Fuel cell 3 on OV-104 has been removed and replaced. The replaced fuel cell was successfully retested during V1022. The removed fuel cell has been shipped to the vendor where the acceptance test procedure (ATP) will be repeated to aid in failure analysis of the water conductivity measurement system. Following the ATP, the appropriate repairs and failure analysis will be performed under CAR 37RF10. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	**Time**	**Classification**	**Documentation**		**Subsystem**
MER - 0	**MET:** 005:23:02	Problem	**FIAR**	**IFA** STS-37-V-12	HYD
None	**GMT:** 101:13:25		**SPR** 37FR11	**UA**	**Manager:**
			IPR None	**PR**	
					Engineer:

Title: Water Spray Boiler 3A Experienced Two Instances of Overcooling during Entry. (ORB)

Summary: DISCUSSION: Water spray boiler (WSB) system 3 overcooled less than 1 minute after entry interface to a minimum temperature of 231 ?F for 1.5 minutes. System 3 also overcooled again later during entry for 4.5 minutes and reached a minimum temperature of 211 ?F.

CONCLUSION: The auxiliary power unit (APU)/WSB system 3 was known to have been contaminated prior to flight during the APU 3 pad confidence run. The gearbox filter was removed and replaced and the oil system was drained and reserviced to the flight level. Throughout STS-37 ascent and entry, the APU gearbox pressure was normal, and this suggests minimal contamination of the gearbox filter. During entry, WSB GN2 regulator outlet pressure did not indicate elevated spray rates prior to the initial overcooling incident. (Regulator pressure could not be used as an indicator for the second overcooling incident since the system was in regulating mode at that time.) During the initial period of overcooling, core temperature and regulator pressure indicated a momentary increase in spraying in the heat exchanger core. Core temperature indicated a similar spray increase during the second period of overcooling. The initial overcooling that occurred in system 3 was preceded by an almost simultaneous overcooling in system 2. System 1 and 2 lube oil temperatures out of the associated APU's also showed minor decreases in temperatures when system 3 experienced the second period of overcooling. In both cases, vehicle accelerometer data showed no associated sudden change in vehicle maneuvers. When these data are combined, it seems to rule out wax contamination of the APU lube oil as the primary cause of the overcooling in system 3, but wax could have been a contributor. However, the WSB heat-transfer phenomena are not completely understood at this time to determine the cause for the overcooling occurring during entry. Definite answers concerning WSB flight anomalies cannot be determined from the flight data temperature histories alone. Further study is required. While WSB overcooling during entry may be an indication of anomalous WSB performance, it is not a flight safety concern. CORRECTIVE_ACTION: The WSB system 3 is planned for a hot oil flush since it was contaminated prior to flight during the APU pad confidence run. A WSB/APU integrated study plan has been approved by the Orbiter and GFE Projects Manager. The study is set to start in June 1991. The study is designed to answer this flight anomaly and similar ascent/entry flight anomalies. This overcooling anomaly (and the similar one on system 2) is being tracked on CAR 37RF11-010. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** Postlanding	Problem	**FIAR**	**IFA** STS-37-V-13	MPS
None	**GMT:** Postlanding		**SPR** 37RF12	**UA**	**Manager:**
			IPR None	**PR**	
					Engineer:

Title: LH2 ET Umbilical Forward Lightning Contact Strip Debonded. (ORB)

Summary: DISCUSSION: A solder-plated bonding lightning protection sheet fell out when the external tank (ET) door was opened at Dryden Flight Research Center. The sheet was bonded to the ET half of the 17-inch disconnect and should have stayed with the ET at separation.

The sheet was bonded onto polyurethane cryogenic foam insulation using a polyurethane resin ME0130-136. The sheet has approximately 0.125-inch engagement with the disconnect structure (no adhesive) to establish the electrical ground path. The adhesive was applied to the foam, after which a piece of Fiberglass cloth was embedded in the adhesive followed by more adhesive. The sheet was held in place by a fixture while the adhesive cured. Rockwell Manufacturing indicated that bonding has been spotty in many cases. One possible problem, indicated by shop personnel, was that they did not apply adhesive directly to the sheet. Residues on the actual failed item were evaluated by laboratory personnel and found to be soluble in acetone, which suggests an inadequate cure. Examination spectrum analysis of the ground strip outer surface indicated the total ECS surface had a thin film of poorly cured polyurethane that had apparently been solvent wiped. A spot of well cured polyurethane was present as well as white room temperature vulcanizing (RTV) silicone (MB0180-119, Type III) around the edge. Examination and IR spectrum analysis in conjunction with acetone solvent rinse and non-volatile residue analysis of the ground strip surface showed adhesive failure with very little adhesive present on the surface. No evidence of foam material was present. No contaminants were detected other than traces of hydrocarbon and residuals from polyurethane. The IR spectrophotometric and evolved gas analyses (TEA) showed that the adhesive was a polyurethane; however, both the IR and TEA results indicate that the polyurethane was poorly cured. The cause of the improper cure of the polyurethane is not known. Perhaps the hardness specimen resin came from the center of the mixing container where the resin was more thoroughly mixed. The resin used to bond the part may have came from the sides of the mixing container where the resin/catalyst bonding was less than ideal. Rockwell Engineering is considering using a self-tapping screw to pick up the epoxy laminate that is approximately 0.875 inch below the foam surface. Once installed, a portion of the screw head will be ground off leaving a 0.040 inch protrusion. Rockwell Materials and Processing suggested dipping the lower portion of the screw threads in adhesive before installation to insure the screw does not come out. The new 14-inch disconnects were designed with fastened lighting protection sheets. The electrical contact strip (ECS) debris is not a safety-of-flight issue because of the remote chance of it traveling into the umbilical cavity or damaging the Orbiter TPS. The ECS relative motion is away from the Orbiter in the direction of the ET. Separation forces tend to accelerate debris away from the umbilical cavity. Successful closing of the umbilical door can be accomplished with debris lodged in the door mechanism, because the ECS is only .005-inch thick. CONCLUSION: Rockwell Manufacturing has indicated a history of inadequate bonding exists. Postflight analysis also indicates that an inadequate cure of the bonding materials occurred. The electrical contact strip (ECS) is too small to prevent the umbilical door from closing and therefore, is not a safety-of-flight issue. CORRECTIVE_ACTION: For the near term, fly as-is. The lightning contact strip is criticality 3 hardware, and its loss presents no impact to crew safety or mission success. For the long term, a modification is being considered that would incorporate a self-tapping screw to fasten the electrical contact strip. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** Prelaunch	Problem	**FIAR**	**IFA** STS-37-V-14	MPS
None	**GMT:** Prelaunch		**SPR** 37RF13	**UA**	**Manager:**
			IPR None	**PR**	
					Engineer:

Title: High O2 Concentraciton in Aft Compartment Prelaunch (ORB)

Summary: DISCUSSION: After fast fill operations began during the prelaunch liquid oxygen loading, the oxygen (O2) concentration in the aft compartment (GGDR2561T) rose to an abnormally high level. Values slightly above 250 ppm were obtained. Although the LCC limit of 500 ppm was never violated, the normal experience base for this reading is less than 50 ppm. The O2 concentration began to decline after stable replenish operations began and reached 60 to 70 ppm before lift-off. Prepressurization of the LO2 tank at T-2 minutes 55 seconds had no effect on the reading.

The data obtained during ascent in the gas sample bottle system was nominal for STS-37. The oxygen concentration was well within the data base. Although minor amounts of argon were measured in the aft compartment and these indicated that air was present, the amount of O2 that was detected was above that which would be accountable from the air. The instruments used to detect O2 concentration were calibrated against a known source prior to tanking operations. CONCLUSION: An O2 concentration level that was higher than normal, but within the specifications limits, was seen in the aft compartment during prelaunch loading operations. The concentration decreased during stable replenish operations and was not evident in the samples of the aft compartment atmosphere taken after launch. The source of the O2 is unknown. CORRECTIVE_ACTION: None. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 005:22:48	Problem	**FIAR**	**IFA** STS-37-V-15	HYD
None	**GMT:** 101:13:11		**SPR** 37RF14	**UA**	**Manager:**
			IPR None	**PR**	
					Engineer:

Title: Hydraulic System 2 Priority Valve Pressure Lag (ORB)

Summary: DISCUSSION: When the hydraulic system 2 main pump pressure switch was put to the "Normal" position during entry operations, the bootstrap accumulator pressure lagged the main pump pressure by 4 seconds before instantaneously rising to an equal pressure. No lag should have occurred in the equalization of these pressures. After pressure equalization, the system performed nominally for the remainder of auxiliary power unit operation.

Flight data indicated that the hydraulic system 2 accumulator pressure and reservoir pressure tracked each other during the period before and after the lag occurred, which implies that a check valve internal to the priority valve was sluggish to open. Similar lags were experienced by another priority valve on hydraulic system 2 on OV-104 (once during ascent and once during entry) during STS-27 (IFA STS-27-14) and the priority valve on system 2 of OV-103 during STS-41 entry (IFA STS-41-10). Examination of the STS-27 priority valve revealed contamination and scoring within the priority valve to be the probable cause of the lags. Examination of the OV-103 valve also revealed contamination to be the probable cause of the lag. CONCLUSION: The delay in hydraulic system 2 accumulator pressure reflecting the main pump pressure was probably the result of a restriction in the movement of the check valve internal to the priority valve. CORRECTIVE_ACTION: The hydraulic system 2 priority valve was removed and replaced. A failure analysis will be performed to determine the cause of the problem. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 000:12:37	Problem	**FIAR**	**IFA** STS-37-V-16	GN&C
GNC-01	**GMT:** 096:03:00		**SPR** 37RF16	**UA**	**Manager:**
			IPR 43V0009	**PR**	
					Engineer:

Title: The -Z Star Tracker Failed Self-Test. (ORB)

Summary: DISCUSSION: The -Z Star Tracker (serial no. 11) failed the self-test on the first attempt. Subsequent self-tests were successful and the star tracker performed normally for the remainder of the mission. The following is a simplified description of the self-test sequence.

Phase 1 of the self-test checks for a proper response to the bright object sensor when stimulated by a test light source. It also verifies acquisition and tracking of a simulated test-star light source which is projected at a known location (+4.5 deg, -4.5 deg) within the full field-of-view (FOV). The star tracker begins an offset mode (reduced field-of-view) scan with offset angles corresponding to the known test-star location. The 1 X 1 degree horizontal scan moves upward in the search field until it either acquires the test star or reaches the top of the offset frame, at which time a staircase reset signal is issued, which returns the scan to the bottom of the frame. The phase of the test continues until either the test star is acquired (pass condition) or the test times out after 3 seconds (fail condition). Phase 2 of the self-test is similar to the search portion of Phase 1, except that the offset search frame is in a quadrant which does not contain the test star. The objective is to verify proper generation of error codes 5 and 6 (position and magnitude errors). The error codes are generated if position and magnitude conditions are not satisfied by the time the second staircase reset occurs. This phase of the test continues until the error codes are generated (pass condition) or until the test times out after 3 seconds (fail condition). This anomaly was caused by failure to satisfy the phase 2 criteria. Detailed analysis of all downlist data associated with the self-test indicates that shortly after the phase 2 search pattern was initiated, the vertical component was suddenly and erroneously reset in the negative direction to an area which was not only outside the offset search frame, but was outside the entire full FOV causing the output A/D converter to saturate. The search pattern eventually re-entered the FOV, but the 3-second time-out period elapsed before the expected error conditions were satisfied, resulting in a failure of the self-test. CONCLUSION: The most probable cause of this anomaly was an intermittent erroneous closure of a solid state analog switch (S2/A) that has the function of resetting the search pattern to the bottom of the FOV. Closure of this switch without the accompanying staircase reset would result in the observed phenomena. The control path to this switch has a number of solder and weld joints through which an intermittent connection would result in erroneous switch closure. CORRECTIVE_ACTION: This star tracker has been removed from OV-104 and sent to the vendor for failure analysis. Final corrective action will be documented on the CAR. EFFECTS_ON_SUBSEQUENT_MISSIONS: An intermittent recurrence of this anomaly would have no serious effect on subsequent missions. A hard failure, however, would result in loss of the star tracker.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** Postlanding	Problem	**FIAR**	**IFA** STS-37-V-17	MECH
None	**GMT:** Postlanding		**SPR** None	**UA**	**Manager:**
			IPR 43V0008	**PR**	
					Engineer:

Title: Righthand Outboard 4A Brake Pressure Low. (ORB)

Summary: DISCUSSION: A review of the postflight data shows the righthand outboard brake pressure 4A is approximately 100 PSIA below brake pressure 2A.

Troubleshooting at KSC could not reproduce the flight problem. The brake/skid control box, brake/skid coils, brake/skid control module, and commander/pilot brake pedal output currents have all checked out to be functioning within specification. The most probable cause for the 100 PSIA delta is temporary contamination within the brake/skid control module. However, this could not be duplicated because the brakes are removed postflight and have to be bled prior to the installation of a new flight set. This bleeding process most likely cleared the contamination. Final processing of the hydraulic/brake system has yet to be completed. The final check-out may point out the specific problem. However, it is not expected. The carbon brakes have enough energy capability to accommodate the 100 PSIA delta pressure during the roll-out braking phase of flight. CONCLUSION: The brake system to date has checked out to spec. The most probable cause of the 100 PSIA delta is contamination. Final processing of the brakes are not complete. However, it is not expected to produce any specific failures. The carbon brakes have enough energy capability to accomodate the 100 PSIA delta pressure in the event that the delta pressure occurs at landing on the next flight of the vehicle. CORRECTIVE_ACTION: None. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** Postlanding	Problem	**FIAR**	**IFA** STS-37-V-18	C&T
None	**GMT:** Postlanding		**SPR** 37RF18	**UA**	**Manager:**
			IPR None	**PR**	
					Engineer:

Title: Aft Flight Deck Speaker Bad (ORB)

Summary: DISCUSSION: During the STS-37 crew debriefing, the crew reported that the aft flight deck speaker was overdriving and had poor sound quality.

CONCLUSION: During the mission, the crew reported an imbalance between voice levels from the ground (too low) and the EVA crewmen. The speaker volume was increased so that the crew could hear the ground, causing an excessively high volume level (too loud) when an EVA crewman talked. The narrow bandwidth from the ground as well as the relatively poor quality speaker, especially at high volumes, caused distortion of the sound. Poor sound quality of the aft flight deck and middeck speakers is a known condition of the speakers currently flown. Previous flight crews have complained about the distorted sound from these speakers. Furthermore, the problem is exacerbated by the volume imbalance between UHF and air-to-ground (A/G) during EVA operations (also a known design limitation). CORRECTIVE_ACTION: Subjective testing at KSC indicates the speaker microphone unit voice quality is acceptable. The speaker will remain on the vehicle and the STS-43 crew will be asked to evaluate its quality. A new speaker is being developed by the Tracking and Communications Division at JSC. The Orbiter and GFE Projects Office is in the process of expediting the development and manifesting of the DTO to test this new speaker. In addition, an operational workaround has been identified to minimize the volume imbalance between A/G and UHF (during EVA's) that involves having the forward link received through A/G 1 and A/G 2 simultaneously. This workaround would, in effect, double the signal strength from the ground thus reducing the imbalance between A/G and UHF. This workaround will be tested during the next mission that involves an EVA. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR** J-EMU-106-F001	**IFA** STS-37-V-19	GFE
None	**GMT:**		**SPR**	**UA**	**Manager:**
			IPR None	**PR**	
					Engineer:

Title: The EVA palm bar penetrated the restraint and bladder of the right glove of the EV2 crewman. (GFE)

Summary: DISCUSSION: During the receiving inspection at the Flight Equipment Processing Center, the palm bar of the right glove of the EV2 crewman was found to be penetrating through the restraint and bladder approximately 3/8 inch into the index finger side of the glove. Following the second EVA (total of 10.75 hours) and after doffing the gloves, the EV2 crewman noted an abrasion on his right hand approximately 3/4 inch behind his index finger metacarpal knuckle. The postflight inspection revealed that the palm bar was incorrectly positioned inside the palm restraint strap tunnel, thereby exposing the end of the bar to a non-reinforced area of the tunnel. The palm bar was able to work through the weave of the non-reinforced area of the tunnel fabric and penetrate the glove restraint and bladder.

The glove leakage rate with the palm bar in the failed condition was 3.8 sccm of air. The specification rate is 8.0 sccm. The leakage rate with the palm bar removed ranged from 18406 to 18972 sccm of air. Had the palm bar come out of the hole during the EVA, the leak rate would not have been sufficient to activate the secondary oxygen pack. The primary oxygen system would have maintained satisfactory suit pressure, but displayed a high oxygen use rate indication. CONCLUSION: The penetration of the glove restraint and bladder was caused by insufficient restraint at both ends of the palm restraint tunnel which allowed the palm bar to shift into a non-reinforced area of the tunnel. CORRECTIVE_ACTION: The palm bar strap will be modified to incorporate bar tack stitching at both ends of the glove palm bar restraint strap tunnel and thereby prevent movement of the bar within the tunnel. This corrective action will preclude the bar from being exposed to the non-reinforced section of the tunnel where it could push through the loose weave area. EFFECTS_ON_SUBSEQUENT_MISSIONS: None

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Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR** B-FCE-029-F033;	**IFA** STS-37-V-20	GFE
None	**GMT:**		B-FCE-029-F034	**UA**	**Manager:**
			SPR	**PR**	
			IPR None		**Engineer:**

Title: A. EV1 Right Earphone Lost CommB. EV2 Left Earphone Lost Comm (GFE)

Summary: DISCUSSION: During airlock depressurization, extravehicular (EV) 1 crewmember reported loss of communications through the communications carrier assembly (CCA) right earphone. The EV2 crewmember also reported loss of communications through the CCA left earphone during airlock depressurization. EV2 reported that the left earphone subsequently returned to normal.

CONCLUSION: Postflight troubleshooting revealed that one of the two transducers on EV1's right earphone had failed (two transducers are required for the audio signal to be perceptible to the crewmember). EV2's left earphone checked out satisfactorily. Both CCA's were also tested at reduced pressures to verify that the airlock environment was not a contributing factor to the earphone problems. No earphone problems were noted during these tests. CORRECTIVE_ACTION: The earphone transducers were removed from both CCA's and shipped to the vendor for further failure analysis. The CCA's in question have been removed from the inventory. New earphone modules will be installed and, upon successfully passing the acceptance test, will be returned to flight status. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.