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STS-27 National Space Transportation System Mission Report

February 1989

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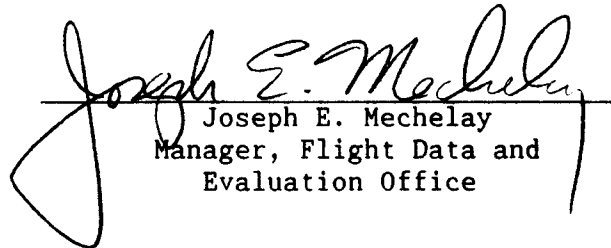
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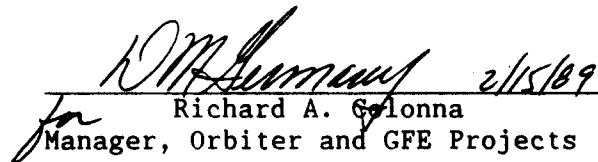
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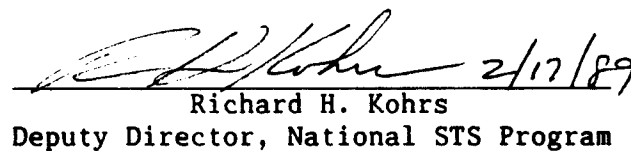
STS-27

NATIONAL SPACE TRANSPORTATION SYSTEM

MISSION REPORT


Joseph E. Mechelay
Manager, Flight Data and
Evaluation Office


Richard A. Galonna
Manager, Orbiter and GFE Projects


Richard H. Kohrs
Deputy Director, National STS Program

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS 77058

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INTRODUCTION

The STS-27 National STS (Space Transportation System) Program Mission Report contains a summary of the vehicle subsystems activities on this twenty-seventh flight of the Space Shuttle and the third flight of the OV-104 vehicle (Atlantis). The STS-27 flight was a classified Department of Defense mission, and as such, the classified portions of the mission are not presented in this report. The sequence of events for this mission is shown in Table I. This report also summarizes the significant problems that occurred during the STS-27 mission. The problem tracking list is presented in Table II to provide a complete list of all Orbiter problems that occurred. Each of the Orbiter problems are discussed in the body of this report.

MISSION SUMMARY

The Space Shuttle vehicle was successfully launched from Launch Complex 39B at the Kennedy Space Center (KSC) on December 2, 1988, with solid rocket booster (SRB) ignition occurring at 337:14:30:33.987 G.m.t. (08:30:33.987 a.m.c.s.t.). Data indicate that all subsystems performed satisfactorily.

The crew for this twenty-seventh flight of the Space Shuttle were Robert L. Gibson, Commander; Guy S. Gardner, Pilot; and Richard M. Mullane, Jerry L. Ross, and William M. Shepard, Mission Specialists.

The launch was delayed approximately 24 hours because the winds aloft were, on two occurrences, higher than the limits. On the second attempt, the launch was again delayed because the winds aloft were higher than limits. However, subsequent balloon data showed the winds were receding such that the conditions would reach a load of 102 percent. Prelaunch analysis indicated that vehicle structural load limits would be exceeded in the A18 area of the wing. A waiver was initiated for this condition and the countdown was continued. Also, the countdown was held for approximately 1 minute 11 seconds at T-31 seconds because of cloud cover at the Transatlantic Abort Landing (TAL) sites. Additional evaluation indicated that the conditions were acceptable at one TAL site, and the countdown was resumed.

During prelaunch activities, the left inboard main landing gear tire had a leak rate of 1.5 psi/day. As a result, extensive changes to the vehicle attitudes were required during the mission to maintain the tire pressure above the redline limit of 275 psi. Although these changes significantly impacted the mission, the efforts were successful as tire pressure was 306 psi at 76 °F at landing.

During prelaunch navigation aids activation, TACAN 1 did not lock on to the KSC ground station (Flight Problem STS-27-17). The TACAN power was recycled and lock was then accomplished with normal data.

During prelaunch activities, a concern arose when water spray boiler (WSB) 2 ready signal activated, then deactivated. This resulted from a low vent

temperature sensor 2A reading (below 130 °F) and a violation of the launch commit criteria. A waiver was approved and the countdown was continued.

The launch phase was satisfactory in all respects. No Orbiter subsystem anomalies were noted during ascent. A two-engine orbital maneuvering subsystem firing was performed satisfactorily after MECO at 337:15:13:08.9 G.m.t., and the duration was 214.6 seconds.

The crew discovered approximately two gallons of free water in the environmental control and life support subsystem bay shortly after wake-up on flight day 2. The free water was caused by a problem with the humidity separator B (Flight Problem STS-27-04). The crew switched to humidity separator A and then implemented established clean-up procedures.

The crew reported, at 338:11:25 G.m.t., that the text and graphics system (TAGS) printer had a paper jam that resulted in the loss of the TAGS for the remainder of the mission (Flight Problem STS-27-06).

The left and right reaction control subsystem (RCS) helium regulator and heater legs were switched from A to B at approximately 339:14:26 G.m.t. About 6 hours later, RCS activity caused the right oxidizer B leg regulator outlet pressure to drop to about 236 psia (Flight Problem STS-27-08). At that time, the crew switched to the A leg on the right RCS. The A leg regulator locked up at 253 psia and operated properly.

The flight control system (FCS) checkout and the RCS hot-fire test were satisfactorily completed on flight day 4 in preparation for entry. Auxiliary power unit (APU) 3 was used for the checkout.

All preparations for entry were completed and the 211.2-second deorbit maneuver was completed satisfactorily at 341:22:33:05.2 G.m.t. The entry was normal in all respects, and because of the Tracking and Data Relay Satellite - West, data were received throughout most the period of normal blackout. After completing a large heading alignment circle turn angle, the Orbiter was guided to a satisfactory landing on runway 17 on the Edwards Air Force Base lakebed. The rollout distance was 7123 feet and successful braking and nose wheel steering testing were completed during the rollout. The STS-27 mission was successfully concluded at 341:23:36:52 G.m.t. when the Orbiter came to a stop. All planned detailed test objectives were completed.

Initial postflight inspections of the exterior surface of the Orbiter revealed significant tile damage with 298 damage sites greater than 1 inch in area, and a total of 707 damage sites on the lower surface of the vehicle (Flight Problem STS-27-07). The area of major damage was concentrated outboard of a line from the bi-pod attachment to the external tank (ET) liquid oxygen umbilical. One tile was missing on the right side slightly forward of the L-band antenna. Also, there were many damage sites consisting of long narrow streaks with deep gouges. The damage noted is the most severe of any mission yet flown.

SOLID ROCKET BOOSTER PERFORMANCE

All SRB systems performed as expected. The SRB prelaunch countdown was normal and no SRB or solid rocket motor (SRM) problems were identified. There were no launch commit criteria (LCC) violations associated with the SRB.

The performance of both SRB's was near predicted values and well within the allowable performance envelopes. Data also indicate that SRB separations occurred at the predicted times. Reports of visual sightings from the recovery ships indicate that the deceleration subsystems performed as designed, and both SRB's were floating in the spar buoy mode.

EXTERNAL TANK PERFORMANCE

All objectives and requirements associated with the external tank (ET) support of the launch were met. There was one ET LCC violation, a nose-cone temperature that was 40.7 °F (LCC states 45 °F to 135 °F), and this condition was caused by improper operation of the ET nose-cone purge. The nose-cone temperatures violated the minimum LCC for approximately 2 hours. The LCC waiver for this condition was accepted.

All ET electrical and instrumentation systems performed satisfactorily.

SPACE SHUTTLE MAIN ENGINES PERFORMANCE

All Space Shuttle main engine (SSME) parameters appeared to be normal throughout the prelaunch countdown, comparing well with prelaunch parameters observed on previous flights.

Preliminary flight data indicate that SSME performance was normal. The high pressure oxidizer turbopump and high pressure fuel turbopump temperatures were close to predicted values throughout their operation. There was one sensor failure, which was the main engine 3 high pressure fuel turbopump discharge temperature, channel A measurement. This measurement failed at approximately 277 seconds after SRB ignition. Postflight inspection revealed a crack in the no. 3 bearing race in the SSME 2 turbopump. Additional information on this anomaly may be obtained from the Marshall Space Flight Center.

ORBITER PERFORMANCE

The overall Orbiter subsystem performance was very satisfactory. A total of 24 Orbiter problems have been identified, all of which are cited in the following discussion with a reference to the problem tracking list in parentheses.

MAIN PROPULSION SUBSYSTEM

The main propulsion subsystem (MPS) performance was nominal. The poppet/sleeve clearances of the gaseous oxygen flow control valves (FCV) were reworked to the 0.0010- to 0.0012-inch range for the STS-27 mission. As a result, the transient sluggish FCV operation seen during STS-26 was not repeated.

A topping valve showed simultaneous open and closed position indications during the MPS dump and the first vacuum inerting procedure (Flight Problem STS-27-03). Following the first vacuum inerting procedure, the hydrogen manifold pressure increased more rapidly than expected, to a value of 19 psi. This condition is indicative of a possible malfunction of the liquid hydrogen repressurization system (Flight Problem STS-27-13). The vacuum inerting procedure was performed a second time with satisfactory results.

The liquid hydrogen fill/drain valve response was slow and out of specification three of the four times the valve was actuated (Flight Problem STS-27-24).

Procedural changes instituted for STS-27 were successful in avoiding the erroneous master alarms experienced during the STS-26 entry purge/manifold repressurization operation. Additional changes are being made for subsequent missions to establish a plan for caution and warning system management in case of a 750-psia regulator failure during the entry configuration procedures at deorbit maneuver ignition minus 25 minutes.

REACTION CONTROL SUBSYSTEM

The performance of the reaction control subsystem (RCS) was nominal. One anomaly was noted in the right RCS oxidizer B leg regulator, which had a lockup shift and responded slowly during ET separation and subsequent usage (Flight Problem STS-27-08). RCS operation on the A leg was satisfactory.

The total propellant consumption for the mission from the RCS was as shown in the following table.

<u>RCS Module</u>	<u>Fuel</u>	<u>Oxidizer</u>	<u>Mixture ratio</u>
Forward	666.7	1058.4	1.59
Left aft	608.6	930.2	1.53
Right aft	755.7	1177.2	1.56

ORBITAL MANEUVERING SUBSYSTEM

Four maneuvers were performed satisfactorily with the orbital maneuvering subsystem (OMS), two of which were dual-engine firings. The remaining two firings were single engine, one with the left engine and the other with the right engine. OMS firing times and propellant consumption were consistent with predictions, indicating proper system performance. One problem was noted during prelaunch operations when one coil of the left OMS gaseous nitrogen isolation

valve appeared to fail as indicated by a gaseous nitrogen storage tank pressure rise of about one-half that normally seen during dual-coil operation (Flight Problem STS-27-11). This condition did not impact any future OMS firings.

STS-27 was the first flight for the revised B-leg keel web heater thermostat. The operation was nominal with the RCS tank temperature and fluids being maintained above the zot limits.

POWER REACTANT STORAGE AND DISTRIBUTION SUBSYSTEM

The power reactant storage and distribution subsystem (PRSD) performed satisfactorily. At lift-off, the PRSD subsystem contained 2337 lb of oxygen and 268.1 lb of hydrogen, of which 1100 lb of oxygen and 130 lb of hydrogen were supplied for the fuel cells and 39 lb for use as breathing oxygen. No problem was noted with the PRSD subsystem. Reactants remaining at touchdown were adequate to provide a 92-hour mission extension capability at average power levels.

FUEL CELL POWERPLANT SUBSYSTEM

The three "operational improvement configuration" fuel cells performed as predicted and fulfilled all electrical requirements throughout the mission. The average total Orbiter electrical power and load was 14.6 kW and 476 A, respectively. The fuel cells produced 1540 kWh of electrical energy and operated for approximately 187 hours. The fuel cells were shutdown 43 hours after landing.

The fuel cell 2 alternate water line temperature cycled erratically between 100 and 125 °F after the line heaters were switched from A circuit to B circuit. (Flight Problem STS-27-12). The normal operating band is between 70 and 90 °F. The erratic operation ceased when the structural bondline temperature in that area increased to approximately 100 °F.

AUXILIARY POWER UNIT SUBSYSTEM

The auxiliary power unit (APU) subsystem performed satisfactorily during prelaunch, ascent, flight control system checkout, and entry and landing operations. APU-1 operated for 01:45:27, APU-2 operated for 01:17:34, and APU-3 operated for 01:23:34, of which 14 minutes and 9 seconds occurred after landing. Several minor problems were noted.

The APU-1 exhaust gas temperature 2 measurement failed during ascent (Flight Problem STS-27-01a). The APU-2 gas generator/fuel system A heaters failed off (Flight Problem STS-27-04), however, switchover to system B heaters provided satisfactory temperature control and no mission impact was incurred. Also, APU-1 gas generator bed temperatures were biased approximately 45 °F during prelaunch operations. The bias did not reappear during on-orbit operations (Flight Problem STS-27-01b). The APU-1 gas generator valve module temperature

measurement (T-1) was biased 40 to 50 °F higher than T-2 temperatures during entry operations (Flight Problem STS-27-01d).

During the APU pre-start period prior to descent, it was noticed that the crew procedures pocket checklist left the APU controllers on after the pre-start checkout. The controllers remained on for about 35 minutes before APU 1 was started and for about 30 minutes before APU 2 and 3 were started. Because of the possibility of an inadvertent start signal being generated from a failure in the controller when the power is on, a change will be submitted to the pocket checklist to require controller power be turned off after pre-start checkout.

A hydraulic load test was performed after landing to ensure full recovery of the APU's when put under a high load. The APU's responded nominally with chamber pressures over 1200 psia. The run times and fuel consumption for the APU's are summarized in the following table.

APU	Ascent		FCS checkout		Descent		Total	
	Run time, min.	Consumption, lb	Run time, min.	Consumption, lb	Run time, min.	Consumption, lb	Run time, min.	Consumption, lb
1	19.9	52.0	0.0	0.0	85.6	155.0	105.5	207.0
2	19.9	51.0	0.0	0.0	57.7	130.0	77.6	181.0
3	19.8	56.0	6.1	15.0	57.7	137.0	83.6	208.0

HYDRAULICS/WATER SPRAY BOILER SUBSYSTEM

The hydraulics/water spray boiler subsystem performed satisfactorily during all phases of the mission. A launch commit criteria requirement was violated when the system 2 water spray boiler ready signal was lost 23 minutes before APU start. LCC requirements specify that a water spray boiler ready signal be present at APU start.

During the prelaunch operations, all conditions for achieving a water spray boiler ready signal were met except for steam vent temperature. The system 2 steam vent temperature exceeded 130 °F at 337:13:23 G.m.t., and a ready signal was achieved. However, 28 minutes later (less than 1 hour prior to lift-off), the temperature dropped below 130 °F and the signal was lost. Review of the data revealed all three water spray boiler systems steam vent heaters experienced a voltage drop at this time because of load demands on the combined ground support equipment/fuel cell power supply. These voltage drops were followed by decreases in steam vent temperatures. System 1 and 3 steam vent temperatures were elevated at the start of the voltage drop sufficiently that the temperatures did not go below 130 °F and the ready signals were maintained for APU start. Based on the heater voltage fluctuations and water spray boiler locations with respect to cryogenic lines, the LCC requirement was waived for system 2. The APU ready signal was disregarded and APU start was initiated on all three systems as scheduled. During ascent, the water spray boiler 2 ready signal returned as ascent heating elevated the vent temperature above 130 °F. All systems performed nominally for the remainder of the mission.

The system 2 accumulator pressure lagged main pump pressure at APU activation by 15 seconds during the ascent phase and by 5 1/2 minutes during the descent phase. When bootstrap pressures reached the main pump pressure, the reservoir and accumulator pressures tracked each other satisfactorily (Flight Problem STS-27-14).

ENVIRONMENTAL CONTROL AND LIFE SUPPORT SUBSYSTEM

The environmental control and life support subsystem (ECLSS) performance was nominal except for the failure of humidity separator B and cabin temperature controller 2.

The humidity separator B failed to flow water to the waste water tank (Flight Problem STS-27-05). Approximately two gallons of water were found on and under the middeck floor. Humidity separator A was used satisfactorily.

During the cabin temperature controller reconfiguration, cabin temperature controller 2 was non-responsive and the actuator could not be moved manually (Flight Problem STS-27-09). A change was made back to cabin temperature controller 1 which operated satisfactorily for the remainder of the mission.

A out-of-tolerance condition was noted in the air revitalization pressure control system oxygen flow transducer on system 1 (Flight Problem STS-27-01c). The transducer was toggling past the specification limit value of 0.25 lb/hr. The condition is understood and was of no consequence to the mission.

AVIONICS SUBSYSTEMS

All avionics subsystems operated satisfactorily with only minor anomalies noted.

a. The rudder surface position indicator appeared to be biased 4 degrees left throughout entry and the "off" flag was visible (Flight Problem STS-27-21).

b. Operations recorder 2 experienced a temporary loss of telemetry while in playback mode during ascent. The recorder was switched to track 1 and operated properly (Flight Problem STS-27-22).

c. During powerup, the modular auxiliary data system (MADS) pulse code modulation (PCM) 1 annunciated a bite, indicating a possible problem with that PCM. The power was cycled and normal operation returned (Flight Problem STS-27-23).

d. During entry, the MADS reinforced carbon carbon (RCC) chin temperature measurement (V09T9889A) operation became erratic. This erratic operation did not impact the mission.

COMMUNICATIONS AND TRACKING SUBSYSTEM

The communications and tracking equipment operated satisfactorily. The Tracking and Data Relay Satellite (TDRS) A and C were both used for communications for

the first time. Handover operations improved continuously with only minor handover delays. Because of TDRS-C (West), the normal 15- to 20-minute communications blackout period during entry lasted only 2 minutes, and this occurred near the 300,000-foot altitude.

Problems noted were as follows:

a. TACAN 1 did not lock correctly during prelaunch powerup (Flight Problem STS-27-17). Recycling of the power switch resulted in proper operation.

b. Text and graphics system printer paper feed jammed and the system was not used for the remainder of the mission (Flight Problem STS-27-06). A total of 46 pages were successfully transmitted prior to the failure.

c. Ku-band channel 2 operations recorder dumps could not be completed without channel 3 activated. (Flight Problem STS-27-15).

d. One of the crewmen (MS-2) reported a light shock when the headset interface unit (HIU) was used with sweaty skin. This occurred both on the ground and during flight operations (Flight Problem STS-27-19).

TELEVISION SUBSYSTEM

The television (TV) subsystem provided very satisfactory video communications throughout the mission, although some minor problems were noted:

a. During startup, television monitor 1 showed a fault light, but the light did not remain on after recycling the power (Flight Problem STS-27-20).

b. Television camera A focus would not drive and the crew reported a thumping noise emanating from the drive mechanism (Flight Problem STS-27-20).

c. The gamma button on the wrist camera would not work (Flight Problem STS-27-20).

MECHANICAL SUBSYSTEMS

The mechanical subsystems operated very successfully with three problems noted. The left inboard main landing gear tire had a known prelaunch leak rate of approximately 1.5 psi/day. The bottom-Sun attitude was required to maintain tire pressure above 275 psi. The estimated pressure at landing was 306 psi at a temperature of 76 °F.

When the payload bay doors were opened, the right forward bulkhead ready-to-latch indicator B stayed in the on condition for approximately 4.5 minutes while A and C disappeared as expected following opening of the right door (Flight Problem STS-27-16).

The left ET umbilical door ready-to-latch indicator 2 failed to indicate on (Flight Problem STS-27-02). The door latched properly with the remaining two latch indications.

The brakes performed as expected. The brakes were removed and inspected with no visual damage noted.

AERODYNAMICS

All aspects of the vehicle aerodynamics were satisfactory with nominal performance in the areas of angle of attack, side slip, and elevon and body flap positions. No problems were noted in the aerodynamics area.

THERMAL CONTROL SUBSYSTEM

The thermal control subsystem functioned satisfactorily. During the prelaunch phase of the mission, all temperatures were at nominal values, and no heater system or thermal instrumentation failures occurred. However, several thermal anomalies were noted during the on-orbit phase of the mission. One heater system failed, and this was APU 2 gas generator bed heater system A (Flight Problem STS-27-04). The alternate heater system B was used and successfully maintained all components within acceptable temperature limits. Six "dithering" thermostats were observed. This phenomena has been observed on all previous flights of the Shuttle and is not considered a problem.

One thermal sensor failure (V46T0140A) occurred (Flight Problem STS-27-01a) on the APU 1 exhaust vent. Several sensors appeared to be biased by as much as 45 °F. These were APU 1 gas generator bed temperature (V46T0122A) (Flight Problem STS-27-01b), and APU 1 gas generator valve module temperature (V460171A) (Flight Problem STS-27-01d).

An unusual temperature response was observed on the fuel cell system 2 alternate product water relief valve when heater system B was activated (Flight Problem STS-27-12).

THERMAL PROTECTION SUBSYSTEM

The thermal protection subsystem (TPS) performed nominally during the mission, although damage to the TPS was the most severe experienced in the STS program. (Flight Problem STS-27-07).

The TPS sustained a significant amount of debris hits from the right-hand chine area aft to the right-hand wing. A tile loss (V070-391015-193) occurred on the lower right-hand side of the fuselage at station Xo -390, Yo60. Structural damage was confined to the cavity over a small antenna access door. The tin plating on the aluminum door was melted with aluminum appearing to be half-way

between hardened and annealed. The door also had a small buckle. There was a total of 707 impact sites with 298 having a major diameter of equal to or greater than 1.0 inch. The number of impact sites was the most experienced on any flight. There were only eight impact sites on the left-hand side of the Orbiter.

An AFRSI-covered fiberglass carrier panel was lost from the right-hand OMS pod (V070-396403-002). The Koropan on the door looks excellent and this is attributed to the panel being located in a lower heating area. The panel loss is attributed to possible improper installation.

GOVERNMENT FURNISHED EQUIPMENT

The government furnished equipment operated very satisfactorily, however some minor discrepancies were noted:

- a. Several of the Volume H door fasteners could not be reinstalled (Flight Problem STS-27-18a).
- b. The wet trash door and access hatch were sticky when opening and closing (Flight Problem STS-27-18b).
- c. The foot restraints of the toilet were difficult to deploy and stow and appeared to be galled (Flight Problem STS-27-18c).
- d. The Shuttle portable onboard computer stopped working briefly during the mission (Flight Problem STS-27-18d).
- e. The galley dispensed 25 percent more water than required. Also, the package retention device had an in-place lever problem (Flight Problem STS-27-18e).

DETAILED TEST OBJECTIVES/DETAILED SUPPLEMENTARY OBJECTIVES

The following detailed test objectives (DTO)/detailed supplementary objectives (DSO) for the STS-27 mission are unclassified and have been accomplished.

<u>Number</u>	<u>Title</u>	<u>Activity</u>	<u>Status</u>
DT0301D	Ascent Structural Capability Evaluation	Data only	Met
DT0305D	Ascent Compartment Venting Evaluation	Data only	Met
DT0306D	Descent Compartment Venting Evaluation	Data only	Met
DT0307D	Entry Structural Capability	Data only	Met
DT0308D	Vibration and Acoustic Evaluation	Data only	Met
DT0311D	POGO Stability Performance	Data only	Met
DT0623	Cabin Air Monitoring	Samples of Orbiter atmos- phere	Met
DT0783	Secure CCTV System Test		Met
DT0784	Space Ground Link System Navigation Certification	Data only	Met
DT0786	Text and Graphics System Test		Met
DS0450	Salivary Cortisol Levels During Acute Phase of Spaceflight		Met
DS0458	Salivary Acetaminophen Pharmacokinetics		Met
DS0466	Variations in Supine and Standing Heart Rate, Blood Pressure and Cardiac Size as a Function of Spaceflight Duration and Time After the Flight		Met
DS0467	Influence of Weightlessness on BaroReflex Function		Met

TABLE I.- STS-27 SEQUENCE OF EVENTS

<u>Event</u>	<u>Description</u>	<u>Actual time,</u> <u>G.m.t.</u>
APU activation	APU-1 GG chamber pressure	337:14:24:30.27
	APU-2 GG chamber pressure	337:14:24:33.15
	APU-3 GG chamber pressure	337:14:24:36.33
SRB HPU activation	LH HPU system A start command	337:14:30:06.287
	LH HPU system B start command	337:14:30:06.237
	RH HPU system A start command	337:14:30:06.751
	RH HPU system B start command	337:14:30:06.751
Main propulsion System start	Engine 3 phase in effect	337:14:30:27.436
	Engine 2 phase in effect	337:14:30:27.549
	Engine 1 phase in effect	337:14:30:27.677
SRB ignition command (lift-off)	SRB ignition command to SRB	337:14:30:33.987
Throttle down to 96 percent thrust	Engine 3 vehicle command	337:14:30:53.957
	Engine 2 vehicle command	337:14:30:53.949
	Engine 1 vehicle command	337:14:30:53.958
Throttle down to 65 percent thrust	Engine 3 vehicle command	337:14:31:02.437
	Engine 2 vehicle command	337:14:31:02.429
	Engine 1 vehicle command	337:14:31:02.438
Maximum dynamic pressure (q)	Derived ascent dynamic pressure	337:14:31:41
Throttle up to 104 percent thrust	Engine 3 vehicle command	337:14:31:31.878
	Engine 2 vehicle command	337:14:31:31.879
	Engine 1 vehicle command	337:14:31:31.879
Both SRM's chamber pressure at 50 psi or below	LH SRM chamber pressure mid-range select	337:14:32:33.791
	RH SRM chamber pressure mid-range select	337:14:32:34.951
End SRM action	LH SRM chamber pressure mid-range select	337:14:32:36.347
	RH SRM chamber pressure mid-range select	337:14:32:37.147
SRB separation command	SRB separation command flag	337:14:32:40
SRB physical separation	SRB physical separation	
Throttle down for 3g acceleration	LH APU A turbine speed	337:14:32:40.151
	LH APU B turbine speed	337:14:32:40.111
	RH APU A turbine speed	337:14:32:40.191
	RH APU B turbine speed	337:14:32:40.311
	Engine 3 vehicle command	337:14:38:01.168
	Engine 2 vehicle command	337:14:38:01.158
	Engine 1 vehicle command	337:14:38:01.1

TABLE I.- CONCLUDED

<u>Event</u>	<u>Description</u>	<u>Actual time, G.m.t.</u>
3g acceleration	Total load factor	337:14:38:01
MECO	MECO command flag	337:14:39:08
	MECO confirm flag	337:14:39:08
ET separation	ET separation command flag	337:14:39:26
APU deactivation	APU-1 GG chamber pressure	337:14:44:24.42
	APU-2 GG chamber pressure	337:14:44:25.57
	APU-3 GG chamber pressure	337:14:44:26.42
OMS-2 ignition	Left engine bi-prop valve position	337:15:13:08.9
	Right engine bi-prop valve position	337:15:13:08.7
OMS-2 cutoff	Left engine bi-prop valve position	337:15:16:43.4
	Right engine bi-prop valve position	337:15:16:43.2
Flight control system checkout		
APU start	APU-3 GG chamber pressure	340:16:50:28.84
APU stop	APU-3 GG chamber pressure	340:16:56:31.71
APU activation for entry	APU-1 GG chamber pressure	341:22:24:37.82
	APU-2 GG chamber pressure	341:22:52:29.94
	APU-3 GG chamber pressure	341:22:52:31.04
Deorbit maneuver	Left engine bi-prop valve position	341:22:29:34.2
	Right engine bi-prop valve position	341:22:29:34.0
Deorbit maneuver cutoff	Left engine bi-prop valve position	341:22:33:05.2
	Right engine bi-prop valve position	341:22:33:05.0
Entry interface (400k)	Current orbital altitude above reference ellipsoid	341:23:05:19
Blackout end	No blackout because of use of TDRS-C	
Terminal area energy management	Major mode change	341:23:29:48
Main landing gear contact	LH MLG weight on wheels	341:23:36:11
	RH MLG weight on wheels	
Nose landing gear contact	NLG weight on wheels	341:23:36:18
Wheels stop	Velocity with respect to runway	341:23:36:52
APU deactivation	APU-1 GG chamber pressure	341:23:50:10.27
	APU-2 GG chamber pressure	341:23:50:10.97
	APU-3 GG chamber pressure	341:23:50:11.96

PROBLEM TRACKING LIST		STS-27/OV104 FINAL REPORT		DATE	PAGE
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STS-27-01	Instrumentation: a) V46T0140 APU 1 EGT #2 erratic.	a) 337:14:42 CAR 27RF08 CRIT 2R3	a) The auxiliary power unit (APU) 1 exhaust gas temperature 2 measurement (V46T0140) became erratic after Main Engine Cutoff (MECO). Later, the measurement failed open. Postflight troubleshooting confirmed the transducer failure. <u>Corrective Action:</u> The transducer has been removed and replaced. Failure analysis will be tracked by CAR 27RF08. This is a criticality 2R3 measurement. Closed. F/A tracked by CAR27RF08.	a) MMACS-02	W. Scott X39032 D. Corcoran X33329
	b) V46T0122 APU #1 GG bed temp. Bias 45°F high.	b) Prelaunch CRIT 3/3	b) The auxiliary power unit (APU) 1 gas generator (GG) bed temperature (V46T0122) had a high bias during prelaunch operations. The bias was approximately 45°F high at GG bed temperatures of 350°F. The bias was not present after APU start during the final prelaunch activities. <u>Corrective Action:</u> This bias is considered acceptable. No corrective action is required. This is a criticality 3/3 measurement. Closed.	b) MMACS-01	W. Scott X39032 D. Corcoran X33329
	c) O ₂ flow system 1 & 2 transducers bias	c) 377:19:00 CRIT 3/3	c) Oxygen flow transducer measurements 1 and 2 (V61R2105A and V61R2205A) were biased high and toggling just above the specification value of 0.25 lb/hr. <u>Corrective Action:</u> This bias is considered acceptable. No corrective action is required. This is a criticality 3/3 measurement. Closed.	c) EECOM-01	H. Rotter X39249 D. Corcoran X33329

PROBLEM TRACKING LIST		STS-27/OV104 FINAL REPORT		DATE	PAGE
NO.	TITLE	TIME	COMMENTS	MOD NO.	RESP. MGR.
STS-27-01	Instrumentation: d) APU #1 GG valve module T-1 temp biased e) MADS RCC chin temperature V09T9889A erratic	d) 337:05:16 CRIT 2R3 e) Reentry CRIT: NONE	d) The auxiliary power unit (APU) 1 GG valve module T-1 temperature measurement (V46T0171A) was biased 40 to 50° F higher than the T-2 temperature measurement which was 98° F during entry. Corrective Action: This bias is considered acceptable. No corrective action is required. This is a criticality 2R3 measurement. Closed. e) The modular auxiliary data system (MADS) reinforced carbon carbon (RCC) chin temperature measurement (V09T9889A) became erratic during entry. Postflight troubleshooting could not reproduce the anomaly. The temperature transducer and associated wiring check out within specification. Corrective Action: No corrective action required. This is a development measurement and has no flight criticality. Closed.		W. Scott X39032 D. Corcoran X33329 G. Salazar x30162 D. Corcoran x33329

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STS-27-02	Left ET umbilical door ready to latch indicator #2 (V56X3542X) indicated off/should be on.	337:14:48 CAR 27RF02 CRIT 3/3	<p>During closure of the external tank (ET) doors, the left umbilical door ready-to-latch indicator 2 (V56X3542X) indicated "off" when it should have indicated "on". Correct indications were received for latches 1 and 3 and the door latched normally. Testing at KSC reproduced the failure. Upon inspection, a broken connector was found; the shell over the electrical wires was broken between the motor control assembly and the latch mechanism. Two bare wires were exposed which later shorted and blew the associated fuses.</p> <p>Conclusions: The left ET umbilical door ready-to-latch indicator 2 failed due to a broken connector which caused a subsequent short and blown fuses.</p> <p>Corrective Action: The broken connector has been removed and replaced. Closed. F/A will be tracked by CAR 27RF02. Criticality 303.</p>	MMACS-03	N. Jevan X38950 J. Guthery X33306

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STS-27-03	LH2 topping valve (PV13) showed simultaneous open/closed indications during dump & vacuum inert.	337:14:42 CAR 27RF03 CRIT 3/3	The MPS topping valve closed indicated closed when the valve was powered open and the open indication (V41X1453E) indicated open during MPS dump. When open power was removed, both indications stayed on. When the valve was manually powered open during vacuum inert, both indications stayed on. When the switch removed power at the end of vacuum inert, the open indication was lost and only a closed indication remained (the correct position). Corrective Action: KSC Troubleshooting per PR-MPS-4-04-0449. Did not repeat problem. Valve removed and replaced. OV103 monitor during ground servicing. Closed. CAR 27RF03. Criticality 3/3.	BSTR-01,03	P. Cota X39037 S. McMillan X35913
STS-27-04	APU #2 GG heater system malfunction.	337:21:35 CAR 27RF07 CRIT 1R3	APU 2 GG bed heater system A failed to respond when switched on. Heater system B was selected when GGVM temperatures were observed to be below 60°F and falling. The GG bed heater system B then appeared to fail ON at MET 00:19:20:00. The crew turned heater system B off. Subsequently heater "B" was turned on and operated properly. Corrective Action: KSC Troubleshooting per IPR 30RV0030 and chit J2866. Verified heater switch failure. KSC R/R SW. on A-12 panel per PR-EPD-551. Closed. CAR 27RF07 CRIT 1R3	MMACS-05	W. Scott X39032 S. McMillan X35913

PROBLEM TRACKING LIST		STS-27/OV104 FINAL REPORT		DATE	PAGE
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STS-27-05	Humidity separator "B" flooded.	338:13:44 CAR27RF01 Crit. 2R3	<p>Shortly after wakeup on the second flight day (338:13:44 G.m.t.), the crew reported that about two gallons of free water was discovered in and around the ECLSS bay. Water appeared to be coming from humidity separator B. Waste water quantity showed a corresponding two-gallon deficit compared to predictions. The crew performed in-flight maintenance to clean up the free water and switched to humidity separator A which performed normally for the remainder of the mission.</p> <p>Both the OV-104 and OV-103 (STS-26) humidity separators were removed and sent to the vendor for testing. The OV-104 humidity separator B was found to be non-functional due to a clogged pitot tube which prevented liquid water from being pumped out of the unit. OV-104 humidity separator A functioned within specification.</p> <p>OV-103 humidity separator B functioned within specification. The OV-103 humidity separator A was degraded (6 percent water carryover vs. 1 percent specified). Check valve leaks are also suspected in OV-103 humidity separator A and may be contributing to its degradation. Disassembly of this unit to determine actual component failure is in process at the vendor.</p>	EECOM-02	E. Winkler X39244 D. Dillman X31733

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STS-27-05	Humidity separator B flooded. (Concluded)		<p>Corrective Action: Spare humidity separators were placed on board OV-103 and OV-104. Closed. CAR 27RF01. Criticality 2R3.</p>	EECOM-02	E. Winkler X39244 D. Dillman X31733
STS-27-06	TAGS paper jam and TAGS OHC status change at image start.	338:11:25 338:01:52 FIAR-JSC EE 646 CRIT 3	<p>At about 338:11:25 G.m.t., while receiving and processing Text and Graphics System (TAGS) Mode 1 images, the TAGS hardcopier experienced a paper jam. Attempts by the crew to clear the jam using the TAGS in-flight maintenance tool were unsuccessful. The TAGS hardcopier was powered off and the Teleprinter was utilized for all subsequent uplink message traffic during the mission. There was no adverse effect on the mission.</p> <p>At about 338:01:52 G.m.t., while configured in the READY state, the TAGS hardcopier spontaneously changed its status to STANDBY as a new message transmission began. The hardcopier was immediately reconfigured to READY and uplink message transmission continued. There was no mission impact and the anomaly did not recur during the flight.</p> <p>Corrective Action: The TAGS was removed, and replaced. Closed. F/A tracked on FIAR-JSC-EE-646. Criticality 3.</p>	INCO-02 INCO-03	W.R. Richards X30203 D. Suiter X33339

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STS-27-07	a) TPS Damage b) R OMS carrier panel missing c) TACAN #2 lower L-band antenna over temp.	Ascent CAR 27RF13 CRIT 1/1 CAR 27RF09 CRIT 1/1 CAR 27RF 12 CRIT 1R3	a) Post landing tile examination revealed approximately 250 tiles with damage greater than 1 inch in area. Most impact damage on right-side bottom of wing & fuselage. 250-300 tile. R/R; KSC estimate. Probable cause SRB Nose Cone Debris. Closed. CAR 27RF13. Criticality 101. b) R OMS carrier panel missing. Corrective Action: Post flight inspection revealed bolts in place, but no washers installed. Incorrect installation. Closed. CAR 27RF09. Criticality 1/1. c) Antenna overheated due to missing TPS tile on Orbiter lower surface. This condition was determined by postflight thermal analysis. Corrective Action: Remove and Replace antenna. Closed. CAR 27RF12. Criticality 1R3.		J. Smith X38860 J. Guthery X33306 J. Smith X38860 J. Guthery X33306 J. Smith X38860 J. Guthery X33306
STS-27-08	Right RCS oxid. "B" He regulator slow response	339:14:27 CAR 27RF10 CRIT 1R3	After switching from the helium "A" regulators to the "B" regulators, the aft right Reaction Control System (RCS) oxidizer tank pressure decreased from 249 to 242 psi. When switched back to the "A" regulators, the RCS oxidizer tank pressure rose to a nominal 249 psi. A helium blowdown test was performed on the "B" regulators by KSC which confirmed the low pressure regulation. Corrective Action: The regulator has been removed and replaced. Closed. F/A tracked by CAR 27RF10. Criticality 1R3.	PROP-01	G. Grush X39030 T. Welch X33335

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STS-27-09	Cabin temp. controller #2 non responsive	339:14:30 CRIT 3	<p>At approximately 339:14:30 G.m.t., the crew reported that the motor for cabin temperature controller 2 was frozen and would not move when the cabin temperature controller switch position was changed from controller 1 to controller 2. During the 4 to 5 minutes that controller 2 was selected, its actuator did not move from its original position and the crew reported that the actuator felt mechanically bound up. The crew then switched back to the original cabin temperature controller 1 which performed normally for the remainder of the mission. The cabin temperature controller 2 motor was retested at KSC and performed nominally.</p> <p><u>Corrective Action:</u> A crew procedure change is planned to alert the crew to the time required for the temperature controller to reach its normal operating position. Closed. Fly as is. Criticality 3.</p>	EECOM-03	E. Winkler X39244 D. Dillman X31733

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STS-27 -10	Ku Band boom stow indicator #2 malfunction (V54X0022E) Deleted as flight problem transferred to MCC-01.	341:03:49	During KU band stow, boom stow indicator #2 did not function properly. <u>Corrective Action:</u> Data review isolated problem to ground data processing. Problem transferred to MCC-01: STSOC DR 091909, IPR30RV-0034. Closed.	MMACS-06	M. Schmalz X30131 D. Suiter X33339
STS-27 -11	Left OMS GN2 isolation valve coil failure	CRIT 1R3	The left Orbital Maneuvering System (OMS) gaseous nitrogen (GN2) tank showed a pressure rise from coil heat of about one-half of the rise normally seen. Troubleshooting at KSC revealed no anomalies in the valve or power to the valve. Review of data indicates this was seen on previous flights. No impact during the missions. <u>Corrective Action:</u> None. Closed. Criticality 1R3	PROP-02	J. Hooper X39031 T. Welch X33335

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STS-27 -12	FCP #2 alternate H ₂ O line erratic temperature.	CAR 27RF14 CRIT 3/3	<p>The fuel cell 2 alternate water line temperature cycled erratically between 100 and 125° F after the line heaters were switched from the "A" circuit to the "B" circuit at approximately 339:15:16 G.m.t. The normal control range is 70 to 90° F. The erratic behavior ceased when the line heaters were switched back to the "A" circuit. Potential causes of this problem were isolated to either an erratic thermostat "B" or a small leak in the alternate water line check valve which allowed a trickle flow of hot water through the line. Troubleshooting at KSC could not duplicate the problem, with the thermostat "B" controlling within specification and the alternate water line check valve exhibiting no leakage.</p> <p><u>Corrective Action:</u> The thermostat has been removed and replaced. Failure analysis will be tracked via CAR27RF14 Closed. Criticality 3/3</p>	EECOM-04	F. Plauche x 39034 D. Dillman X31733

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STS-27-13	LH2 dump manifold pressurization response	Post MECO CRIT: Nominal 3/3 Abort 1	At 337:14:41:12 G.m.t., after initiation of the main propulsion system (MPS) liquid hydrogen (LH2) dump, the liquid hydrogen 17-inch feedline manifold pressure began decreasing from approximately 51 psia. When this pressure reached 20 psia approximately 20 seconds later, the LH2 manifold repressurization system should have begun flowing regulated helium at approximately 20 psia into the manifold. However, the manifold pressure continued to drop, reaching a value of 17 psia about 57 seconds after dump initiation. At this time, the manifold pressure suddenly increased and remained at 21 psia until commanded off. The LH2 manifold repressurization system includes two 2-way solenoid valves (LV42, 43) which provide series isolation of the MPS pneumatic regulated helium supply from the 20-psi regulator. The valves are commanded open by the general purpose computers at the start of the MPS dump. Helium flow into the manifold is subsequently controlled by the 20-psi regulator (PR6), which is referenced to the manifold through an external sense line. Helium flow initiation is confirmed by the simultaneous increase in the pneumatic helium supply pressure decay rate and the GH2 pressurization system pressure.	BSTR-01	P. Cota x 39037 S. McMillan X35913

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STS-27-13	LH2 dump manifold pressurization response (Concluded)		<p>Data review established the initiation of the helium flow into the manifold was delayed for 57 seconds. Once the manifold repressurization helium began flowing, the system operated nominally for the remainder of the mission, providing helium for the duration of the post-MECO dump and during entry. The failure had no impact on the mission.</p> <p>Troubleshooting could not duplicate anomaly.</p> <p>Corrective Action: <u>The MPS LH2 manifold repressurization system will undergo additional troubleshooting or regulator replacement during turnaround operations at KSC.</u> Closed. Criticality: Nominal 3/3; Abort 1.</p>		

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STS-27-14	Hydraulic system #2 accumulator low	CAR 27RF06-10 CRIT 1R2	When hydraulic system 2 main pump pressure switch was put to the "Normal" position during prelaunch operations at 337:14:24:48 G.m.t., the bootstrap accumulator pressure lagged the main pump pressure by approximately 15 seconds. The bootstrap pressure then instantaneously rose to equal the main pump pressure. No lag should have occurred in the equalization of these pressures. Similarly, when the hydraulic system 2 main pump pressure was brought to "Normal" for entry at 341:22:52:49 G.m.t., the bootstrap accumulator pressure lagged the main pump pressure by approximately 5 minutes 25 seconds before rapidly equalizing with the main pump pressure. In both instances, when the bootstrap accumulator pressure was equal to the main pump pressure, bootstrap accumulator pressure performance remained nominal for the remainder of the auxiliary power unit operation.	MMACS-07	J. Grush X39033 S. McMillan X35913

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STS-27-14	Hydraulic system #2 accumulator low (Concluded)		Flight data indicated that the hydraulic system 2 accumulator pressure and reservoir pressure tracked each other in both instances during the period before and after the lagging occurred, which implies that a check valve internal to the priority valve was sluggish to open. The occurrence of this problem had no impact on the mission. <u>Corrective Action:</u> The hydraulic system 2 priority valve was removed and replaced. A failure analysis will be performed and will be tracked by CAR 27RF06 - 10 Closed. Criticality 1R2.	MMACS-07	J. Grush X39033 S. McMillan X35913
STS-27-15	Ku-band channel #2 ops rcdr dumps	340:15:20	Ops rcdr dumps via KU-band ch 2 couldn't be recovered when KU in standby. With KU band on in comm mode, ch 3 must be activated for dumps to work on ch 2. Ch 3 then deactivated, dumps still work on ch 2. <u>Corrective Action:</u> None. Ground procedure problem. Closed.	INCO-05	J. Griffin X31449 D. Suiter X33339

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STS-27 -16	PLBD ready -to -latch indicator hung up	337:15:59 CAR 26RF04 CRIT 3/3	<p>During opening of starboard payload bay door at approximately 337:15:59 G.m.t., the starboard forward ready-to-latch indicator B (V37X3436Y) remained on while indicators A and C went off as designed. Within a few minutes, the B indicator also went off. No further problems were experienced with the indicator for the remainder of the mission. Testing at KSC could not reproduce the failure.</p> <p><u>Corrective Action:</u> None. Switch module removed and replaced. Closed. Criticality: Switch module 1R2; measurement 3/3. CAR26RF04.</p>	MMACS -04	N. Jevan X38950 J. Guthery X33306

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STS-27 -17	TACAN #1 prelaunch lock-on problem	337:09:42 CRIT 1R3	<p>During prelaunch navigation aids activation, at 9:34 G.m.t., TACAN 1 was initially powered up (MODE switch to T/R) with channel thumbwheels set to 90X for the blanking test. Approximately 2 minutes later, the channel thumbwheels were set to 59Y to acquire the KSC ground station. Automatic gain control (AGC) remained at 5.09 Vdc (indicating no signal at the receiver), and range and bearing remained in the search mode. After approximately 6 minutes, the MODE switch was cycled to OFF then back to T/R, at which time AGC went to approximately 3 Vdc (indicating signal at the receiver), and range and bearing locked on at 3.95 nmi. and 268 degrees, respectively. These operational conditions were not in violation of Launch Commit Criteria (2 of 3 TACAN's required), and no further TACAN 1 anomalies were observed for the remainder of the flight. Data analysis indicate all MODE switch and thumbwheel contacts were good. Postflight troubleshooting failed to reproduce the anomaly.</p> <p><u>Corrective Action:</u> None, pending recurrence of the failure. Closed. Criticality 1R3.</p>	GNC-01	M. Schmalz X30131 W. Leverich X30960

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STS-27 -18	CFE/GFE: a) Volume H door fasteners (CFE)	Crit: None	Following the humidity separator anomaly (reference problem STS-27-05), the crew opened the volume H door to clean up free water. After door closure, four or five of the door fasteners could not be re-engaged. The remainder of the fasteners were successfully re-engaged. After the flight, the volume H door was removed and the fasteners and receptacles were inspected. No anomalies in the fasteners or receptacles were noted. Following the inspection, the volume H door was re-closed and all of the fasteners successfully engaged. <u>Corrective Action:</u> None, fly as is. Closed. Criticality: None.		a) P.D. Smith X38857 D. Dillman X31733
STS-27 -18	b) Wet trash door & access hatch (CFE)		After performing the free water cleanup in-flight maintenance procedures (reference problem STS-27-05), the crew reported that the volume F wet trash access panel required more effort than normal to close and that the volume F wet trash door latch would not engage unless the latch was pre-compressed during closure. The wet trash panel and door latch were retested at KSC and the problems could not be duplicated. <u>Corrective Action:</u> None. Fly as is. Closed. Criticality: None.		b) F. McAllister 33644

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STS-27 -18	c) Foot restraints on toilet (GFE)		c) Foot rest on toilet difficult to deploy and stow. Crew reported evidence of galling. <u>Corrective Action</u> : At vendor for rework. <u>Closed</u> . <u>Criticality</u> : None.		c) H. Brasseaux Jr. 339248
	d) SPOC (carry on computer) (GFE)	FIAR-BFC-022 F001	d) One of the two Shuttle Portable Onboard Computer (SPOC) units onboard went to "Halt" and displayed the "Bad Pointer" fault message while executing the Center of Gravity Manager software on flight day 4. The crew followed standard procedures to reboot the SPOC and the SPOC functioned normally during the remainder of the mission. <u>Corrective Action</u> : None. <u>Fly as is</u> . <u>Closed</u> . <u>Criticality</u> : None.		d) L. McFadin 38539

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STS-27-18	e) Galley water dispenser and package- in-place lever problem. (GFE).	FIAR BFCE-023-F001 FIAR BFCE-023-F002	e) The crew reported that the galley dispensed approximately 25 percent more water than the amount selected. A similar report was received from the STS-26 crew. In addition, the "package-in-place" microswitch failed to disengage approximately 30 percent of the times after a package was removed. Testing of the package-in-place lever after the flight failed to reproduce the microswitch problem. Corrective Action: For the near term, fly as-is. A detailed test objective (DTO) is planned for STS-30 (next OV-104 flight) to determine how much extra water is dispensed. The OV-102 galley has been recalibrated to flow less water. If the package-in-place microswitch problem is repeated, the problem can be resolved by removing and re-inserting the package or by manually manipulating the microswitch.		e) F. McAllister 33644

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STS-27-18	e) Galley water dispenser & package in place lever problem. (GFE). (concluded)		Analysis of the dispenser problem is being tracked under FIAR BFCE-023-F001. Analysis of the package-in-place switch is being tracked under FIAR BFCE-023-F002. Closed. Criticality: None		e) F. Mcallister 33644
STS-27-19	Headset interface unit (HIU) anomaly	FIAR-JSC-EE-0647	During seat egress following the STS-27 scrub, Mission Specialist 2(MS-2) received a tingle in the left ear while touching the headset interface unit (HIU) when other crewmembers were talking. This problem was repeated in the laboratory after the mission. The earphone-low signal was internally shorted to the metal faceplate and when the MS-2 touched the HIU, the circuit was completed to ground. When other crewmembers spoke, a voltage was present on the earphone-low line which caused the problem. At a thumbwheel setting of 5, the voltage present is 16 Vrms. At the maximum volume control setting, the voltage present is 30 Vrms. At 30 Vrms the circuit current is only 1-2 ma. While these levels of voltage and current can be felt, there is no electrical hazard for the crew.		M. Schmalz x30131 D. Suiter X33339

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STS-27-19	Headset interface unit (HIU) anomaly (concluded)	FIAR-JSC-EE-0647 Crit 3R2	Corrective Action: The transducer will be removed, replaced, and subjected to failure analysis. The results of this activity will be tracked by FIAR JSC EE647. A continuity test for detecting shorts will be performed on each unit prior to flight. Closed. Criticality: 3R2		
STS-27-20	CCTV: a) TV monitor #1 would not display video	FIAR BF-CE-029-F 003 Crit 1R3	a) Closed circuit television (CCTV) monitor 1 would not display video from any signal source. The crew followed malfunction procedures and cycled power to monitor 1, and the monitor then worked properly for the remainder of the mission. The monitor fault light came on while setting up for the secure CCTV detailed test objective. There was no video signal input to the monitor, but power was applied. Under these conditions, it is normal for the fault light to come on. This condition was repeated during postflight testing.		B. Embry X30184 T. Welch X33335

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STS-27-20	CCTV: a) TV monitor #1 (concluded)	FIAR BF-CE-029-F003	Corrective Action: The Flight Training Division has been notified of the procedures to be used to prevent recurrence of this behavior. Tracked by FIAR BF-CE-029-F003. Closed. Criticality: IR3		B. Embry X30184 T. Welch X33335
	CCTV: b) Camera "A"	FIAR BF-CE-029-F005 FIAR BF-CE-029-F007 Crit 1R2	b) The crew reported a thumping noise when attempting to focus camera A. The camera would not focus throughout the mission. Postflight testing showed no problem in focusing the camera. The thumping noise is an indicator of proper performance of the camera. The malfunction has been determined to be in the monochrome lens assembly rather than in the camera.	INCO-06	B. Embry X30184 T. Welch X33335
STS-27-20	CCTV: b) Camera "A" (concluded)	FIAR BF-CE-029-F005 FIAR BF-CE-029-F007	Corrective Action: A FIAR has been opened on the monochrome lens assembly and will be returned to the vendor for failure analysis. Failure analysis tracked by FIAR BF-CE-029-F007. Closed. Criticality: 1R2	INCO-06	B. Embry X30184 T. Welch X33335
	c) Wrist camera	FIAR BF-CE-029 F004 Crit 1R2	c) The remote manipulator system (RMS) wrist camera would not respond to a gamma command. Power was cycled and the camera worked properly for the remainder of the mission. Postflight testing of the camera showed normal operation.		B. Embry X30184 T. Welch X33335

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STS-27-20	c) Wrist camera (concluded)	FIAR BF-CE-029 F004 CRIT 1R2	Corrective Action: The Crew Training Division has been notified to advise subsequent crews of the procedures to be used to prevent recurrence of this behavior. FAIR BFCE-029-F004. Closed. Criticality: 1R2.		B. Embry X30184 T. Welch X33335
STS-27-21	SPI rudder indicator biased	CAR 27RF11-010 CRIT 3/3	The flight crew reported that during entry, the surface position indicator (SPI) "OFF" flag was visible and the rudder position indicator appeared stationary at approximately four degrees left. The flag is driven by fault circuitry which detects a difference between commanded and actual indicator position. Postflight troubleshooting at KSC failed to reproduce the anomaly. The unit will be removed and sent to the Rockwell Services Center for additional testing. Disassembly of the unit is not planned unless a hard failure can be isolated.		E. Dickinson X31717 W. Leverich X30960

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STS-27-21	SPI rudder indicator biased (Concluded)		Corrective Action: None, pending hard failure. Closed. CAR 27RF11; Criticality 3/3		
STS-27-22	Temporary loss of OPS 2 telemetry	337:14:51	Temporary loss of TLM from the OPS 2 RCDR track #2 during a playback dump during ascent. RCDR at 29 percent, no show of motion, and percent tape not updating. Ground received dump modulation. When switched to track 1, it operated properly. Continued operating properly throughout flight. Corrective Action: Closed, fly as is.	INCO-01	G. Salazar X30162 W. Leverich X20960
STS-27-23	MADS PCM 1 bite	340:13:58 CAR 27RF15 CRIT 3	When the modular auxiliary data system (MADS) was powered up at 340:13:58 G.m.t., a built-in test equipment (BITE) signal (V78X9611E) was annunciated. This signal is generated by BITE circuitry within the MADS Pulse Code Modulation (PCM) multiplexer unit. Power was cycled to the MADS PCM and the BITE indication was reset. It did not recur for the remainder of the mission. This anomaly had occurred previously on OV-104 during checkout of the MADS PCM switch on November 3, 1988, but could not be reproduced in subsequent troubleshooting.		

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STS-27-23	MADS PCM 1 bite (Concluded)		The decision was made at the time to fly-as-is based on the criticality of the system. During postflight troubleshooting, the anomaly was reproduced by increasing Main B bus voltage to 31 Vdc. It was further isolated to within the MADS PCM multiplexer unit. The unit was removed and replaced with the unit designated for OV-102. Corrective Action: The failed unit will be returned to the vendor for failure analysis by CAR 27RF15. Closed Criticality: 3	INCO-04	G. Salazar X30162 W. Leverich X30960
STS-27-24	LH ₂ fill/drain valve response	CAR 27RF05 CRIT Nominal 3/3 Abort 1	The main propulsion system (MPS) liquid hydrogen (LH ₂) outboard fill/drain (PV11) closure times were greater than allowed by specification during prelaunch, MPS dump, and the first vacuum inerting. The valve functioned nominally for subsequent operations during the second vacuum inerting and postflight trouble-shooting. The outboard fill/drain valve closure response time is measured from the issuance of the close command to the closed microswitch indication. The specification requires a maximum closure time of 10 seconds which was exceeded during the following mission events:		P. Cota X39037 S. McMillan X35913

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STS-27-24	LH ₂ fill/drain valve reponse (Concluded)		<p>Lift-off - 48 sec Propellant dump 10.876 sec First vacuum inerting 13.276 sec 12.776 sec The slow closure during the terminal countdown sequencing came within 0.12 second of causing a Launch Commit Criteria (LCC) violation. Corrective Action: The actuator was removed and replaced with an actuator that exhibited rapid closure times under cryogenic conditions during acceptance tests. The removed actuator is undergoing failure analysis at the vendor and will be tracked by CAR 27RF05. An LCC change is being submitted to allow an additional 3 seconds for valve closure before declaring a violation. Close Criticality: Nominal 3.3 Abort 1.</p> <p>2-8-89</p> <p>David W. Camp, Manager Flight Evaluation Office</p>		

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