

STS-7

Quick Look Report

28 June 1983

David W. Whittle

David W. Whittle

H. Clancy

Harry Clancy

Jim Adamson

Jim Adamson

Charles Alford

Charles Alford

IMU #1 Resolver Limit Fail Bite

At a GMT of 169:10:04:30 the crew experienced 9 successive resolver limit fails on IMU #1. These were reported at the next AOS of 169:21:37:00. These messages were determined to have resulted from a "noisy" band on the roll resolver. Subsequent passes through this band on the OR resolver did not always result in messages. Another message was received at GMT 170:22:26:00 after which a read/write was uplinked to the GPC to MASK further nuisance alarms. The mask was placed onboard at 170:23:07:00. Subsequent to R/W implementation the change was declared acceptable for GPC set expansion and for OPS transition to OPS 8 and to OPS 3. The noisy band was at a outer roll resolver angle of between 122° and 128°. After the mask was uplinked further OR resolver bites were seen without triggering the fail messages or IMU S/W bite message.

Recommendation

Replace faulty IMU

OPS 9 BF POSN

Preflight it was determined that the BF position after ME repositioning was inconsistent with KSC needs. A S/W change was developed but not implemented preflight. The decision was to let the crew type in the three (3) half words required to position the BF at 20.7 degrees vice the 2 degrees currently in the software. The procedure was to input the R/W after transition to OPS 9 but before the ME repositioning was accomplished. Positioning of the BF at 20.7 cut 24 hours from the KSC turn around time. This procedure was not required due to the EDW landing.

Recommendation

Change onboard code so the required position will be automatic.

Right DDU BITE

The right DDU exhibited a bite on entry day. (175:09:12:00) Power supplies A,B,& C indicated good and the ADI, (the only active instrument at the time), compared favorably with the CDR's ADI. The PLT was advised that any or all of his instruments could be affected by the BITE and that they should be cross checked against the CDR's before use. No discrepancies were reported by the crew during entry.

Recommendation

Replace DDU with good unit.

L ADP DEP

The left Air Data Probe did not totally deploy on the first attempt. The probe stow discretes indicated it to be unstowed and probe pressures indicated it to be approximately in the deploy position but the two (2) deploy discretes were not present. EECOM was seeing stall motor currents on the deploy motors. Having the crew cycle the probe to stow and back to deploy resulted in the proper deploy discretes. Air data was incorporated to G&C at mach 2.4.

Recommendation

Investigate problem to determine source. If problem is associated with the door mechanism it should be repaired or modified to prevent future occurrences. If problem is due to a foreign substance measures should be taken to preclude future occurrences.

RADAR ALT #1

Radar Alt #1 showed only intermittent lock until 784 feet. Whereas radar altimeter #2 locked on at 5163 ft. RA #1 first locked on at 2763 ft but only intermittently.

Recommendation

Repair or replace RA #1 such that operation starting at 5000 ft can be expected.

ROB Elevon Chan 4

During ascent from GMT 169:11:38:32 to GMT 169:11:39:58 the Right Outboard Elevon Channel 4 position read -7.4 degrees vice 0.5 degrees as the other position feedbacks were reading. There was no indication this was other than an OI instrumentation failure. No force fight or secondary ΔP indications were present during the anomalies reading. The lack of secondary indications indicate that the position transducer and ASA were performing in a nominal fashion. A check of the calibration curve for this measurement revealed that " \emptyset " pcm counts is equivalent to -7.4° . Decision was that anomaly was an instrumentation problem having no effect on channel 4 operation. FCS checkout was used as a verification of channel 4 performance. The affected measurement is MSID V58H0955A.

Recommendation

Trouble shoot for possible cause of false readings.

ASA Chan 4

For on-orbit DTO purposes ASA Channel 4 was turned on during the flight. In cases where the hydraulic circ pumps were running the aero surfaces would move to their commanded null position at a $1^{\circ}/\text{sec}$ rate. This is not considered an anomaly, but will be of interest for further on orbit operations with ASA's powered.

Entry Maneuvers

Due to the large cross range to Edwards the entry aero maneuvers were called off as per mission rule 4-54A. At exit of blackout an assessment of the vehicles energy situation was made and a go was given to do the remaining PTI's. PTI's 5 thru 9 were accomplished.

Post Entry IMU Alignment

Normally IMU alignments are done as close to entry as possible to guarantee optimum platform conditions and favorable RM thresholds for the entry period. Early missions did the last align at 1 hour and 30 minutes before TIG. Due to workload and other considerations the last align was moved back to TIG minus two hours and forty minutes realizing that this would not support a 30 platform drift and a one Rev wave off. The STS-7 two rev wave off brings to the front a need to realign the platforms if more than a one rev wave off is expected. The STS-7 misalign was approximately $.27^\circ$ which is well below the $.5^\circ$ mandatory limit but slightly above the $.25^\circ$ highly desirable value. The second half of the problem created by the long time between align and entry involves two level RM. Since the RM thresholds grow with time the RM's capability to pick a bad IMU in a DLMA case (only 2 IMU's remaining) is greatly reduced with time. This problem can be solved by another star align or IMU to IMU align if platform drifts permit. Neither of these techniques were done on STS-7.

Recommendation

A mission rule to cover IMU management for entry is being submitted.

DTO #	TITLE	Scheduled D/HIM	Completed (Y/N)	Reflight Req'd	RESULTS/PURPOSE
203	AERO PTI's	ENTRY	PARTIAL	Y	Due to the 740 NM crossrange to the landing site only PTI's 5 thru 9 were accomplished.
211	Entry with lateral offset	ENTRY	NO	Y	Lateral trim during entry suggest that Y cg offset was less than + 1 inch.
762	Orbiter-RMS Dynamic Interaction Test	4/21:10	Y	N	To measure linear and angular accelerations of the vehicle due to RMS movements.
766	VRCS Plume Impingement Effects.	1/07:35	Y	N	To measure VRCS effective thrust reduction or cross axis coupling due to impingement on the vehicle.

9.1.4

POSN ID	REV	APPROX GMT	TITLE/DESCRIPTION/IMPACT/RESOLUTION	IF	ORB	KSC
				ST	IMPCT	VEH
						IMPCT
GNC-01	B	169:11:39	RIGHT OUTBD ELEVON OI POSITION - YACKOVETSKY	CL	099	Y

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FEEDBACK CHANNEL 4 JUMPED FROM 0.5 TO -7.4 THEN BACK TO 0.5 DURING ASCENT. NO CORRESPONDING JUMP IN SECONDARY DELTA P FOR THAT CHANNEL WAS SEEN. INCO REPORTS NO PROBLEM SEEN WITH OI MDM OA3, CH23 AT THAT TIME. MSID IS V58H0955A. SAW NO ANOMALIES DURING FCS C/O BEFORE APU UNDISPERSED.

RESOLUTION: APPEARS TO BE INTERMITTENT INSTRUMENTATION PROBLEM (I.E., NO PROBLEM IN THE ASA).

9.2.7

GNC-02		169:21:37	IMU #1 "RESOLVER LIMIT FAIL" BITE - LIEBMAN	CL	099	Y
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(1) THE CREW REPORTED 9 SUCCESSIVE BITE MESSAGES ON IMU #1 STARTING AT MET OF 10:04:30. ANALYSIS HAS IDENTIFIED A "NOISY BAND" ON THE 1X OUTER ROLL RESOLVER WHICH CAN ISSUE BITE/T MESSAGES.

(2) A 1X RESOLVER ERROR IS TRANSPARENT TO RM AS THE SOFTWARE COMPENSATES FOR 1X ERRORS BELOW 22.5 DEG.

(3) SHOULD THE OCCURRENCE OF BITE MESSAGES BECOME FREQUENT, A BITE MASK CAN BE IMPLEMENTED PER APPROVED G-MEM PROCEDURE.

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POSN ID	REV	APPROX GMT	TITLE/DESCRIPTION/IMPACT/RESOLUTION	IF ST	ORB IMPCT	VEH	KSC	IMPACT
GNC-03		175:09:28	RIGHT DDU BITE	OP		099	Y	
GNC-04		175:13:48:30	LEFT AIR DATA PROBE DID NOT FULLY DEPLOY	OP		099	Y	

DURING RIGHT DDU POWER UP, GOT RIGHT DDU BITE INDICATION. RIGHT FLIGHT CONTROLLER POWER WAS TURNED ON - R DDU POWER SUPPLIES A, B, C WERE GOOD. CREW INDICATED RIGHT ADI LOOKED GOOD--POWER SUPPLY E OKAY. THIS BITE DETECTION MONITORS MANY DDU FUNCTIONS NOT AVAILABLE ON DOWNLIST. POSSIBILITIES: FALSE BITE, LOSS OF HSI, AMI, AVVI.

AT SCHEDULED DEPLOY TIME (M=5) BOTH THE LEFT AND RIGHT AIR DATA PROBES BEGAN TO DEPLOY (ALL STOW DISCRETES INDICATED FULLY DEPLOYED CONDITION IN NOMINAL TIME; LADP DID NOT INDICATE DEPLOY. AFTER TWICE NOMINAL TIME (ALLOWING FOR POSSIBLE LOSS OF ONE MOTOR) MCC RECOMMENDED A RE-STOW COMMAND TO THE LADP, FOLLOWED BY A RE-DEPLOY COMMAND. THE CREW RESPONDED AND THE LADP WAS SUCCESSFULLY DEPLOYED, WITH ALL AIR DATA PARAMETERS WITHIN SPEC. NO FURTHER ANOMALIES THROUGHOUT REMAINDER OF ENTRY.

NEITHER OF THE TWO MICRO-SWITCHES AT THE DEPLOY POSITION WERE ACTIVATED, SUGGESTING A PROBE OR GEAR DRIVE ANOMALY, AS OPPOSED TO SWITCH FAILURE.

RM. DISREGARDS THE ERRONEOUS DATA APPLIED BY A PARTIALLY DEPLOYED PROBE, SO LONG AS NEITHER DEPLOY DISCRETE IS PRESENT.

ECCOM BOOSTER REPORTED STALL CURRENTS ON PROBE MOTORS DURING THE PARTIAL DEPLOY PERIOD.

9.2.8

POSN ID	REV	APPROX GMT	TITLE/DESCRIPTION/IMPACT/RESOLUTION	IF	ORB	KSC	
				ST	IMPCT	VEH	IMPCY
GNC-05		175:13.56	LEFT AIR DATA PROPE DID NOT FULLY DEPLOY RADAR ALTIMETER NO. 1 - LOSS OF LOCK - LIEBMAN	OP	N	099	N
			AT APPROXIMATELY 5000 FT ALTITUDE RADAR ALTIMETER NO. 2 LOCKED ON TO THE APPROACH SURFACE AND REMAINED LOCKED, AND IN AGREEMENT WITH GROUND RADAR THROUGHOUT THE REMAINDER OF DESCENT. HOWEVER, RADAR ALTIMETER NO. 1 EXHIBITED SPORADIC LOCK-ON'S UNTIL APPROXIMATELY 760 FT., FOLLOWED BY ACCEPTABLE DATA FOR THE REMAINDER OF DESCENT.				
INCO-01		169:14:36	OPS 1 TAPE RECORDER OUTPUT NOT INHIBITED - FENDELL IN PLAYBACK PARALLEL MODE	CL		099	N
			OPS 1 RECORDER WAS REMOUND AND CAUSED INTERFERENCE TO OPS 2 RECORDER PLAYBACKS. THIS SHOULD NOT HAPPEN AS THE RECORDER OUTPUT IS SUPPOSED TO BE INHIBITED DURING REWIND. THIS SHOULD NOT IMPACT RECORDER OPERATIONS.				
INCO-02	A	170:17:13	PI/SPAS LINK DROPOUT - PENNINGTON	CL		099	N
			CREW REPORTED S62 PDI DECOM FAIL. PLAYBACK OF DATA AT THE TIME OF OCCURRENCE SHOWED (1) A DEVIATION OF PI PHASE ERROR AND AGC, (2) A DEVIATION OF SPAS PHASE ERROR AND AGC, AND (3) A LOSS OF PSP FRAME SYNC AND PDI BIT SYNC IN THAT ORDER. NO HARD FAILURES NOTED, SYSTEM RETURNED TO NORMAL IMMEDIATELY.				
			PROBLEM IS MULTIPATH AND INTERFERENCE BY FM SYSTEM ON UPPER HEMI				

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9.2.9

Statement of problem:

Right Outboard Elevon Actuator Channel 4 Position (V58H9055A) Indicated A One-time Deflection

Discussion:

One time during ascent for a period of 1.5 minutes, the operational instrumentation (OI) elevon actuator position dropped from a value of +0.463 degree to off-scale low, then returned to normal.

The problem was not seen on the closed-loop GPC measurement. It was only present on the redundant OI measurement and the ACIP measurement which is pigtailed off of the wiring to the OI subsystem. The anomaly did not repeat during the flight, nor did it repeat during extensive troubleshooting at KSC.


Conclusions:

The cause of the data shift in the telemetry measurement of the right-hand outboard elevon position is unknown.

Corrective action:

NONE. Fly as is for STS-8.

APPROVED


 A. Aldrich

7-23-83

Date

Effects on subsequent missions:

NONE

Personnel assigned:

R. J. Ward 7/18/83
 O. Littleton/EH5; H. Hernandez/EH4; C. Walsh/MD3

O. P. Littleton 7/18/83 *H. Hernandez* 7/18/83 *R* 7/14/83

Resolution:

CLOSED 07/28/83

Statement of problem:

IMU 1 BITE Resolver Limit Threshold Exceeded At Attitude Of 120 Degrees

Discussion:

Shortly after the STS-7 first satellite deployment, several IMU 1 BITE/T messages were received. Subsequent investigations revealed that the messages were triggered during the resolver limit determination for the outer roll axis. This was caused by the software algorithm that is used for the 1X-resolver-angle minus the whole-angle difference determination. The whole angle uses resolver offset compensation whereas the 1X angle is uncompensated. The compensation plus the harmonic error at a roll gimbal angle of about 120 degrees caused the limit to exceed the 1-degree threshold and produced the BITE/T messages. During the remainder of the mission, the IMU 1 BITE/T annunciation was masked using a software read/write procedure and IMU 1 performance was nominal.

The harmonic error in the roll axis at 120 degrees for IMU 1 is slightly higher than the error on the other IMU's used for OV-102 and OV-099, but there is no hardware problem.

Conclusions:

1. The IMU 1 outer roll resolver limit threshold was exceeded because the software algorithm compared the 1X/8X resolver angles with the 8X offset compensation.
2. There is no problem with IMU 1 hardware.

Corrective action:

1. As a temporary fix, software change request CR 59864 was approved to increase the resolver limit threshold to 1.5 degrees for STS-8 and subsequent vehicles.
2. A permanent fix (CR 59872) to remove the resolver offset from the software algorithm is being reviewed.

JDL
7/15/83
APPROVED

A. Aldrich
A. Aldrich

7-15-83
Date

Effect on subsequent missions:

NONE

Personnel assigned:

Stan Bachman/EH6/2606 *R.D. Ward* 7/12/83
D. Suiter/MD3/4323

Stan Bachman 7/13/83

Resolution:

CLOSED for STS-8 and 9, 07/20/83

Statement of problem:

Left Air Data Transducer Assembly Did Not Initially Indicate Deploy

Discussion:

During entry, at about 175:13:49 G.m.t., the left air data transducer assembly (ADTA) was commanded to deploy for one minute and fifty four (54) seconds but the deployed indication was not received. The crew alternately stowed and redeployed the ADTA and this action produced the proper deployment and indication.

Postflight, TPS tile gap filler was found in the vicinity of the probe base. Also, wrinkles were found in the thermal barrier that is between the base and the probe well structure which indicates that tile gap filler had been wedged in between. Adjacent to the wrinkled area the TPS on the probe base had been sheared off indicating improper clearance (0.047 inches required) between gap filler (normally bonded to the fixed adjacent tile) and the rotating probe base tile. Following TPS repair procedures the proper deployment of the ADTA was demonstrated. Previous OMRSD requirements did not specify a demonstration of ADTA deployment following TPS repair near the ADTA.

Conclusions:

The stall condition of the ADTA was due to improper clearance between the gap filler and the rotating probe base tile. Review of acceptance test results indicates that ADTA clutch slippage for one minute and fifty four seconds is within design limits.

Corrective action:

Following TPS repairs the left ADTA was successfully stowed and deployed. OMRSD requirements will be changed to require ADTA deployment following TPS repair or replacement activity in the ADTA vicinity.

157-15-83
8-9-83 APPROVED A. Aldrich 8/9/83
for A. Aldrich Date

Effects on subsequent missions:

NONE

Personnel assigned:

Nick Jervas/ET52/x3643; Dwight Suiter/MD3/x4323

N Jervas 8/3/83

Resolution:

CLOSED 08/10/83

Statement of problem:

Radar Altimeter #1 Had Intermittent Lock Until 1000 Feet

Discussion:

Radar altimeter unit 1 attempted to lock, locked and provided data for about one second, lost lock and attempted to reacquire from 4000 feet down to approximately 1000 feet. Performance was nominal from 1000 feet through rollout.

Postflight sensitivity measurements showed that the unit 1 sensitivity had dropped 6 dB since its last measurement was taken. This makes it 11 dB less sensitive than unit 2.

Conclusions:

Altimeter #1 RF sensitivity has degraded to an unacceptable level. The cause of the degradation awaits vendor troubleshooting.

Corrective action:

Altimeter #1 has been replaced with the flight spare. The unit has been returned to the vendor and the problem will be tracked on CAR 07F028.

APPROVED

A. Aldrich

Date

Effects on subsequent missions:

NONE

Personnel assigned:

D. E. Rhoades/EE4/x5561; Chuck Walsh/MD3/x6353

D. E. Rhoades 7/27/83 CW Walsh 7/26/83

Resolution:

CLOSED 08/03/83 CAR 07F028