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ATTACHMENT
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FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL HARDWARE
NUMBER: 02-4H-R101-X

SUBSYSTEM NAME: KU-BAND DEPLOY MECHANISM

REVISION : 2 10/01/90

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
SRU :	DEPLOYMENT MECHANISM ASSEMBLY	Y070-544902

PART DATA

QUANTITY OF LIKE ITEMS: 1

FUNCTION:
REDUNDANT MOTORS ACT THROUGH A DIFFERENTIAL AND GEARBOX TO DRIVE THE KU-BAND DRIVE CAM. THE DRIVE CAM ROTATES THE KU-BAND ANTENNA TO STOW AND DEPLOY POSITIONS AND IS RETAINED BY ROLLER/DETENT LOCK MECHANISMS.

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL FAILURE MODE

NUMBER: 02-4H-R101-02

REVISION# 2 10/01/90 R

SUBSYSTEM: KU-BAND DEPLOY MECHANISM

ITEM NAME: DEPLOYMENT MECHANISM ASSEMBLY

CRITICALITY OF THIS
FAILURE MODE:1R2

FAILURE MODE:
FAILS FREE

MISSION PHASE:

OO ON-ORBIT
DO DE-ORBIT

- VEHICLE/PAYLOAD/KIT EFFECTIVITY: 102 COLUMBIA
- : 103 DISCOVERY
- : 104 ATLANTIS
- : 105 ENDEAVOUR

CAUSE:

CORROSION, DEFECTIVE PART/MATERIAL OR MANUFACTURING DEFECT, EXCESSIVE
LOAD, FAILURE/DEFLECTION OF INTERNAL PART, FATIGUE

CRITICALITY 1/1 DURING INTACT ABDORT ONLY? NO

REDUNDANCY SCREEN A) PASS
B) N/A
C) PASS

PASS/FAIL RATIONALE:

A)

B)

REDUNDANCY SCREEN "B" IS "N/A" BECAUSE THE REDUNDANT PATH FOR THIS
FAILURE MODE IS THE KU-BAND JETTISON SYSTEM.

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:

FAILURE WILL RESULT IN A LOSS OF ABILITY TO DRIVE THE KU-BAND STOWED OR
DEPLOYED BUT POSITION MICROSWITCH INDICATIONS MAY INDICATE COMMANDED
STATE AT EXPECTED TIMES.

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(B) INTERFACING SUBSYSTEM(S):

FAILURE WILL CAUSE FREELY PIVOTING DEPLOY MECHANISM AND RESULT IN AN INABILITY TO EITHER USE KU-BAND SYSTEM OR CLOSE PAYLOAD BAY DOOR.

(C) MISSION:

FAILURE WILL RESULT IN A POSSIBLE LOSS OF MISSION DUE TO INABILITY TO USE KU-BAND SYSTEM.

(D) CREW, VEHICLE, AND ELEMENT(S):

FAILURE WILL REQUIRE JETTISON OF KU-BAND TO ALLOW PAYLOAD BAY DOOR CLOSURE. LOSS OF ALL REDUNDANCY RESULTS IN POSSIBLE LOSS OF CREW/VEHICLE DUE TO AN INABILITY TO CLOSE PAYLOAD BAY DOORS.

(E) FUNCTIONAL CRITICALITY EFFECTS:

- DISPOSITION RATIONALE -

(A) DESIGN:

DESIGN INCLUDES CORROSION RESISTANT ALLOYS SUCH AS A-286 CRES, 440C CRES, BERYLLIUM COPPER, AND INCONEL 718. SEALS PROTECT ENCLOSED INTERNAL PARTS. THE MECHANISM IS DESIGNED FOR MAXIMUM STIFFNESS TO PREVENT LOAD AND DEFLECTION INFLUENCE. ULTIMATE FACTOR OF SAFETY 1.4 MINIMUM.

■ (B) TEST:

RIGGING TESTS: VERIFY ANTENNA INTERFACE PLATE IS LOCKED, DEPLOYED AND STOWED, WITH 1,200 INCH-LB TORQUE APPLIED. VERIFY ROTATIONAL POSITION ACCURACY. APPLY 24,000 INCH-LB TORQUE IN BOTH DIRECTIONS, THEN DISASSEMBLE, INSPECT, CLEAN, AND REASSEMBLE. REVERIFY POSITIONAL ACCURACY WITH TORQUE APPLIED. VERIFY SWITCH ASSEMBLY FUNCTION. VERIFY POSITIONAL ACCURACY IN THE FULL DEPLOY, INTERMEDIATE DEPLOY, AND STOW POSITIONS WITH THE MATCHED SET GEARBOX.

QUALIFICATION TESTS: THE FOLLOWING IS A SUMMARY OF TESTS CONDUCTED PER CR 44-544901-001 TO INCLUDE BOTH NATURAL AND INDUCED ENVIRONMENTAL EFFECTS TO THE KU-BAND DEPLOYMENT MECHANISM ASSEMBLY. FUNCTIONAL TESTS WERE CONDUCTED DURING AND FOLLOWING EACH PHASE OF TESTING TO DETERMINE EFFECTS. ENVIRONMENTS AND REQUIREMENTS ACCEPTED BY ANALYSIS INCLUDE FUNGUS, OZONE, SALT SPRAY, ACCELERATION, SOLAR RADIATION (THERMAL AND NUCLEAR), METEORITIDS, SAND AND DUST, STORAGE, AND FACTOR OF SAFETY. FLIGHT VIBRATION LEVEL 20 TO 2,000 HZ WITH MAXIMUM LEVEL OF 0.017 g²/HZ AT 100 TO 250 HZ ALL AXES, WITH AND WITHOUT SIMULATED ANTENNA. THERMAL - STABILIZED RANGE FROM -100 DEG F TO +300 DEG F. FUNCTIONAL TESTS CONDUCTED AT -100 DEG F, +70 DEG F, AND +160 DEG F. LOAD TESTS - COMBINED AXIS LOADING TO 140% LIMIT LOAD. LIFE CYCLE TESTS - 1,000

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CYCLES IN ADDITION TO CYCLES CONDUCTED DURING VARIOUS QUALIFICATION TESTING AT 24 VARIOUS LOAD AND MOTOR CONDITIONS. SEPARATION TESTS - BREECH AND RELEASE NUT ACTUATED IN SIMULATED ZERO-G ENVIRONMENT.

OMRSD: DEPLOY MOTORS' PERFORMANCE IS VERIFIED DURING NORMAL IN-FLIGHT OPERATIONS. GROUND TESTING WOULD BE ACCOMPLISHED WHEN A VALID VERIFICATION IS UNOBTAINABLE DURING FLIGHT, OR FOLLOWING LRU REPLACEMENT. ALSO, SINGLE MOTOR OPERATION IS VERIFIED EVERY FLOW: DEPLOY MOTOR 1/STOW MOTOR 2 IS VERIFIED ON ODD FLOWS; AND DEPLOY MOTOR 2/STOW MOTOR 1 IS VERIFIED ON EVEN FLOWS.

(C) INSPECTION:
RECEIVING INSPECTION
INSPECTION VERIFIES MATERIAL AND PROCESS CERTIFICATIONS.

CONTAMINATION CONTROL
INSPECTION VERIFIES CORROSION PROTECTION PER MA0608-301 AND MAINTENANCE OF COMPONENT CLEANLINESS PER MA0110-311 AND MA0110-306.

ASSEMBLY/INSTALLATION
INSPECTION VERIFIES ASSEMBLY AND RIGGING PER MLO308-0125 SPECIFICATION REQUIREMENTS. INSPECTION VERIFIES DIMENSIONS AND SURFACE FINISHES. INSPECTION VERIFIES INSTALLATION OF RIVETS, INSERTS, THREADED FASTENERS AND LOCKWIRE PER SPECIFICATION REQUIREMENTS. INSPECTION VERIFIES BEARING INSTALLATION.

NONDESTRUCTIVE EVALUATION
INSPECTION VERIFIES PENETRANT INSPECTION OF DETAIL PARTS.

CRITICAL PROCESSES
INSPECTION VERIFIES CHROME PLATING OF PIN, SOLDERING OF GROUNDING SPRING ASSEMBLY, AND HEAT TREATING OF DETAIL PARTS.

TESTING
FUNCTIONAL TESTING OF THE ASSEMBLY IS VERIFIED PER PROCEDURE.

HANDLING/PACKAGING
HANDLING AND PACKAGING REQUIREMENTS VERIFIED BY INSPECTION.

(D) FAILURE HISTORY:
THERE HAVE BEEN NO ACCEPTANCE TEST, QUALIFICATION TEST, FIELD OR FLIGHT FAILURES ASSOCIATED WITH THIS FAILURE MODE.

(E) OPERATIONAL USE:
AFTER THE KU-BAND ANTENNA STOW OR DEPLOY OPERATION IS COMPLETED, CREW PROCEDURES VERIFY THE POSITION OF THE ANTENNA USING THE ONBOARD CCTV OVERLAY FOR THE STOW POSITION AND VISUALLY VERIFYING THE DEPLOYED

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POSITION USING THE WINDOW ON THE STARBOARD SIDE TO AVOID THE EFFECTS OF THIS FAILURE. FAILURE WILL REQUIRE JETTISON OF THE KU-BAND TO ALLOW PAYLOAD DOOR CLOSURE AND PREVENT LOSS OF CREW/VEHICLE DURING ENTRY.

- APPROVALS -

RELIABILITY ENGINEERING:	D. M. MAYNE	: <u>D.M. Mayne</u> 12/1/90
DESIGN ENGINEERING	: S. L. SHARP	: <u>S.L. Sharp</u>
QUALITY ENGINEERING	: O. J. BUTTNER	: <u>O.J. Buttner</u> 12/4/90
NASA RELIABILITY	:	: <u>G.E.</u> 12/4/91
NASA SUBSYSTEM MANAGER	:	: <u>D. M. Balcerunas</u> 2/7/91
NASA QUALITY ASSURANCE	:	: <u>W.S. G. Gantman</u> 1/23/91