FAILURE MODES EFFECTS ANALYSIS (FMEA) – CIL HARDWARE
NUMBER:05-2B-23402M -X

SUBSYSTEM NAME: COMM & TRACK UHF SPACE COMMUNICATION
REVISION: 0 11/14/95

PART DATA

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	: ANTENNA, UHF - EVA COMM BOEING SSD	VO70-744120-001

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
UHF - EVA COMM ANTENNA

REFERENCE DESIGNATORS: 40V74A165

QUANTITY OF LIKE ITEMS: 1
ONE

FUNCTION:
PROVIDES FOR THE TRANSMISSION AND RECEPTION OF UHF SPACE-TO-SPACE (VOICE) COMMUNICATIONS ON ORBIT. ALSO, PROVIDES THE TRANSMISSION OF DATA TO SPACE STATION AND THE RECEPTION OF TELEMETRY FROM SPACE STATION.

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REVISION#: 0 10/03/96

SUBSYSTEM NAME: COMM & TRACK: UHF SPACE COMMUNICATION
LRU: ANTENNA, UHF - EVA COMM
ITEM NAME: ANTENNA, UHF - EVA COMM

CRITICALITY OF THIS FAILURE MODE: 2/2

FAILURE MODE:
LOSS OF SIGNAL

MISSION PHASE: OO ON-ORBIT

VEHICLE/PAYLOAD/KIT EFFECTIVITY:
102 COLUMBIA
103 DISCOVERY
104 ATLANTIS
105 ENDEAVOUR
AFTER SPACE COMM MODIFICATION

CAUSE:
PIECE PART FAILURE, CONTAMINATION, VIBRATION, MECHANICAL SHOCK, PROCESSING ANOMALY, THERMAL STRESS, DEFECTIVE SOLDERING

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

CRITICALITY 1R2 DURING INTACT ABORT ONLY (AVIONICS ONLY)? NO

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

PASS/FAIL RATIONALE:
A)

B)

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:
LOSS OF UHF RF COMMUNICATIONS BETWEEN ORBITER AND EMU'S. LOSS OF UHF RF COMMUNICATIONS BETWEEN ORBITER AND SPACE STATION.

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(B) INTERFACING SUBSYSTEM(S):
LOSS OF UHF RF COMMUNICATIONS BETWEEN ORBITER AND EMU'S. LOSS OF UHF RF COMMUNICATIONS BETWEEN ORBITER AND SPACE STATION.

(C) MISSION:
POSSIBLE LOSS OF MISSION (TEMINATE EVA OR TERMINATE STATION RENDEZVOUS) DUE TO LOSS OF UHF SPACE COMMUNICATIONS.

(D) CREW, VEHICLE, AND ELEMENT(S):
NO EFFECT.

- TIME FRAME -

TIME FROM FAILURE TO CRITICAL EFFECT: MINUTES

-DISPOSITION RATIONALE-

(A) DESIGN:
ANTENNA ELEMENTS ARE EMBEDDED IN FOAM-FILLED RADOME. THE VENTED HOUSING OF THE ANTENNA CONTAINS THE QUARATURE HYBRID.

THE EVA COMM ANTENNA IS DESIGNED TO OPERATE ON ORBIT IN THE PAYLOAD BAY ENVIRONMENT PER MF0004-014 (ENVIRONMENT REQUIREMENTS). ITS HARDWARE IS IMPLEMENTED TO MEET APPLICABLE PROVISIONS OF NHB 5300.4 FOR SOLDERING, CRIMPING/WIRE WRAP, CIRCUIT BOARD, AND INTERCONNECTING WIRING. MATERIALS AND PROCESSES FOR THE EVA COMM ANTENNA ARE IN ACCORDANCE WITH JSC SE-R-0006 AS DEFINED IN SD72-SH-0172.

(B) TEST:
ACCEPTANCE REQUIREMENTS INCLUDE:
EXAMINATION OF PRODUCT
FUNCTIONAL (VSWR, RADIATION PATTERNS AND GAIN)
ENVIRONMENT (RANDOM VIBRATION, THERMAL VACUUM/HIGH POWER)
PARTIAL FUNCTIONAL (VSWR)

FUNCTIONAL
FUNCTIONAL TESTING OF THE ANTENNA INCLUDES FREQUENCY SWEPT VOLTAGE STANDING WAVE RATIO (VSWR) MEASUREMENTS, RADIATION PATTERN AND GAIN MEASUREMENTS. THE FUNCTIONAL TEST IS CONDUCTED AFTER ANTENNA ASSEMBLY AND AFTER COMPLETION OF THE ENVIRONMENTAL TESTING.

VIBRATION

ACCEPTANCE RANDOM VIBRATION TESTS ARE CONDUCTED, FOR ONE MINUTE PER AXIS IN THREE ORTHOGONAL AXES. THE ELECTRICAL INTEGRITY OF THE ANTENNA IS MONITORED DURING THE TESTS BY CONTINUOUS VSWR MEASUREMENTS. VSWR DATA IS RECORDED FOR EACH AXIS, ONE PRIOR TO TEST START, AND THE SECOND AT THE COMPLETION OF THE AXIS TEST. VIBRATION TEST TOLERANCES IS IN ACCORDANCE WITH ML0103-0028.

PARTIAL FUNCTIONAL
THE PARTIAL FUNCTIONAL TESTING (VSWR) IS INTENDED TO VERIFY THAT NO DAMAGE OCCURRED AS A RESULT OF THE VIBRATION TESTING. THE PARTIAL FUNCTIONAL TEST IS PERFORMED AFTER RANDOM VIBRATION AND BEFORE THERMAL VACUUM TESTING. THIS TEST CONSISTS OF A SWEPT FREQUENCY VSWR MEASURED WITH THE NETWORK ANALYZER AT THE ANTENNA INPUT (ALSO INPUT TO THE QUADRATURE HYBRID COUPLER) CALIBRATED FROM 380 MHZ TO 430 MHZ AND RECORDED ON THE X-Y PLOTTER.

THERMAL VACUUM/HIGH POWER
THERMAL VACUUM TESTING IS CONDUCTED AT NOT MORE THAN 10^{-5} TORR PRESSURE. RF POWER IS APPLIED TO THE ANTENNA AT A LEVEL OF 10 WATTS DURING THE LAST HIGH AND LOW TEMPERATURE PORTION OF THE TEST CYCLE (NOT REQUIRED DURING THE TEMPERATURE TRANSITION PHASES OF THE TEST CYCLE). DWELL TIME EXCEEDS 30 MINUTES AFTER STABLE AT EACH HOT AND COLD TEMPERATURE LEVEL, ± 5° F. THE RAMP TIMES EXCEEDS 60 DEG/HR AND LESS THAN 360 DEG/HR. THERE ARE THREE COMPLETE TEST CYCLES RAN.

QUALIFICATION TESTS INCLUDE:
EXAMINATION OF PRODUCT
FUNCTIONAL (VSWR, RADIATION PATERNS AND GAIN)
ENVIRONMENT (RANDOM VIBRATION, THERMAL VACUUM/HIGH POWER, HUMIDITY, SALT FOG)
PARTIAL FUNCTIONAL (VSWR)
MECHANICAL (KICK-LOAD)

FUNCTIONAL
FUNCTIONAL TESTING OF THE ANTENNA INCLUDES FREQUENCY SWEPT VOLTAGE STANDING WAVE RATIO (VSWR) MEASUREMENTS, RADIATION PATTERN AND GAIN MEASUREMENTS. THE FUNCTIONAL TEST IS CONDUCTED AFTER ANTENNA ASSEMBLY AND AFTER COMPLETION OF THE ENVIRONMENTAL TESTING.

PARTIAL FUNCTIONAL
SWEPT FREQUENCY VSWR IS MEASURED WITH NETWORK ANALYZER AT ANTENNA INPUT CALIBRATED FROM 400 MHZ TO 430 MHZ AND RECORDED ON THE X-Y PLOTER. THE VSWR IS NO MORE THAN 2.5:1 OVER THE OPERATING FREQUENCIES.

THERMAL VACUUM/HIGH POWER
THERMAL VACUUM TESTING IS CONDUCTED AT NOT MORE THAN 10^{-5} TORR PRESSURE (THE REQUIRED REDUCED PRESSURE TO 10^{-10} TORR IS ACCEPTED BY ANALYSIS). DWELL TIME EXCEEDS 30 MINUTES AFTER EACH STABLE HOT AND COLD TEMPERATURE LEVELS. THE RAMP TIME IS NOT LESS THAN 60 DEG/HR AND LESS THAN 360 DEG/HR. AT THE LAST CYCLE OF THE FIVE CYCLES RAN, 10 WATTS RF POWER IS APPLIED TO THE

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ANTENNA DURING THE HIGH AND LOW TEMPERATURE PORTION OF THE TEST CYCLE (NOT REQUIRED DURING THE TEMPERATURE TRANSITION PHASES OF THE TEST CYCLE).

HUMIDITY
SUFFICIENT MOISTURE IS INTRODUCED TO OBTAIN A RELATIVE HUMIDITY OF 100 ± 5% WITH DISTILLED WATER. CHAMBER TEMPERATURE IS MAITAINED BETWEEN 100°F MINIMUM AND 150°F MAXIMUM. DURATION OF THE TEST IS 5 DAYS (120 HRS).

SALT FOG
ANTENNA IS EXPOSED TO 5+/- 1% SALT SOLUTION BY WEIGHT AND TEST IS IN ACCORDANCE WITH MIL-STD-810, METHOD 509, PROCEDURE I.

KICK-LOAD
THE ANTENNA IS CAPABLE OF WITHSTANDING A KICK-LOAD OF 175 LBS DISTRIBUTED OVER A 4 INCH BY 4 INCH AREA IN ZERO GRAVITY ENVIRONMENT.

GROUND TURNAROUND TEST
ANY TURNAROUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

(C) INSPECTION:
RECEIVING INSPECTION
CERTIFICATIONS & SOURCE INSPECTION TEST REPORTS ARE ON FILE. CRITICAL DIMENSIONS ARE VERIFIED BY INSPECTION.

CONTAMINATION CONTROL
CLEANLINESS TO CLASS GENERAL HOUSEKEEPING LEVEL (GHL) IS VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION
VISUAL INSPECTION IS PERFORMED AT KIT RELEASE. QUALITY CONTROL VERIFIES AND WITNESSES TORQUE OPERATIONS. QUALITY CONTROL VERIFIES SOLDERED CONNECTIONS AND ASSEMBLY OF PARTS. TOOL CERTIFICATION AND TENSILE TESTS ARE MAINTAINED. THERMAL PROTECTION CONTROLS EXIST FOR ALL SOLDERED CONNECTIONS.

CRITICAL PROCESSES
INSPECTION VERIFIES CRIMPING OPERATIONS AND CERTIFICATION. SOLDERING REQUIREMENTS PER NHB5300.4 (3A) AND JSC 08800A ARE VERIFIED BY INSPECTION.

TESTING
ATP IS OBSERVED AND VERIFIED BY QUALITY CONTROL, INCLUDING AVT AND ATT.

HANDLING/PACKAGING
PROPER GROUNDING OF ELECTRICALLY STATIC SENSITIVE DEVICES WHEN HANDLING IS PERFORMED. PACKAGING AND PROTECTION VERIFIED BY INSPECTION.

(D) FAILURE HISTORY:

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CURRENT DATA ON TEST FAILURES, FLIGHT FAILURES, UNEXPLAINED ANOMALIES, AND OTHER FAILURES EXPERIENCED DURING GROUND PROCESSING ACTIVITY CAN BE FOUND IN THE PRACA DATABASE.

(E) OPERATIONAL USE:
FOR EVA COMM - CREW IS TRAINED TO SAFELY TERMINATE EVA IF MINIMUM REQUIRED COMM IS LOST.

FOR STATION RENDEZVOUS - ALTERNATE COMM LINKS WOULD BE USED IF AVAILABLE (E.G. RELAY VIA GROUND SITE OR A VHF RADIO LIKE USED FOR SHUTTLE MIR).

- APPROVALS -

PAE MANAGER	: POLLY STENGER-NGUYEN	: 8/21/98
PRODUCT ASSURANCE ENGR	: VAN D. NGUYEN	: 8-26-98
DESIGN ENGINEERING	: HUNG TRAN	: 8/24-98
NASA SSMA	: Mike Penney	: 8-26-98
NASA EPD&C SSMA	: —	: NA to EPDC
NASA SUBSYSTEM MANAGER	:	: 8/26/98
NASA EPD&C SUBSYS MGR	: —	: NA to EPDC
NASA MOD	:	: 8-26-98
USA/SAM	: Karen Blumenthal	: 8/26/98