

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE

NUMBER: 05-3-12125 -X

SUBSYSTEM NAME: DISPLAYS & CONTROLS

REVISION: 1

08/27/97

PART DATA

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	: D&C PANEL F6	V070-730403
LRU	: D&C PANEL F8	V070-730404
LRU	: ATTITUDE DIRECTOR INDICATOR	MC432-0235-000X

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
ATTITUDE DIRECTOR INDICATOR (ADI), 3 AXIS .

REFERENCE DESIGNATORS: 34V73A6A3
34V73A8A2

QUANTITY OF LIKE ITEMS: 2
1 CMDR, 1 PILOT

FUNCTION:

PROVIDES DISPLAY OF THE ORBITER'S ROLL, PITCH AND YAW: (1) ATTITUDES VIA A GIMBALLED BALL, (2) ATTITUDE ERRORS VIA THREE METER POSITION NEEDLES, (3) ATTITUDE RATES VIA THREE METER POSITION POINTERS. ALSO PROVIDES VISUAL SELF CHECKS TO THE CREW, AND (4) PROVIDES GUIDANCE PREDICTOR AND NAVIGATION ERROR INFORMATION IN TAEM (MAJOR MODE 305) WHEN THE RATE SCALE IS SELECTED TO THE "MED" POSITION.

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SUBSYSTEM NAME: DISPLAYS & CONTROLS

LRU: D&C PANEL F6 & F8

ITEM NAME: ATTITUDE DIRECTOR INDICATOR

CRITICALITY OF THIS
FAILURE MODE: 1R2

FAILURE MODE:

ERRONEOUS OUTPUT(S). INCORRECT BALL, NEEDLE AND/OR POINTER INDICATIONS

MISSION PHASE:

PL	PRE-LAUNCH
LO	LIFT-OFF
OO	ON-ORBIT
DO	DE-ORBIT
LS	LANDING/SAFING

VEHICLE/PAYLOAD/KIT EFFECTIVITY:

102	COLUMBIA
103	DISCOVERY
104	ATLANTIS
105	ENDEAVOUR

CAUSE:

ERRONEOUS INPUT, SHOCK, VIBRATION, CONTAMINATION, JAMMING, PIECE PART FAILURE.

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN

A) PASS
B) PASS
C) PASS

PASS/FAIL RATIONALE:

A)

B)

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:

ADI DISPLAYS ERRONEOUS DATA IN CMDR OR PILOT STATION.

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(B) INTERFACING SUBSYSTEM(S):

FIRST FAILURE - NO EFFECT.

(C) MISSION:

FIRST FAILURE - NO EFFECT.

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

THE ADI IS THE ONLY USABLE SOURCE OF ATTITUDE INFORMATION PRIOR TO MAJOR MODE 305. THE FIRST ADI FAILURE HAS NO EFFECT. HOWEVER, THE SECOND ADI FAILURE COULD RESULT IN POSSIBLE LOSS OF CREW/VEHICLE DUE TO CREW REACTION TO ERRONEOUS DATA.

(E) FUNCTIONAL CRITICALITY EFFECTS:

THE FIRST FAILURE IS ERRONEOUS ATTITUDE DATA FROM ONE FORWARD STATION ADI. ERRONEOUS DATA FROM BOTH FORWARD ADI'S AND LOSS OF ALL RELATED INSTRUMENTATION COULD CAUSE LOSS OF CREW/VEHICLE. SUCCESS PATHS REMAINING AFTER THE FIRST FAILURE ARE THE REDUNDANT ADI AT THE OTHER FORWARD STATION AND, AFTER MAJOR MODE 305, THE TWO HUD'S ARE AVAILABLE TO THE CREW, WITH THE EXCEPTION OF YAW DATA.

-DISPOSITION RATIONALE-

(A) DESIGN:

EEE PARTS ARE SELECTED FROM OR IN ACCORDANCE WITH MF0004-400 (OPPL) REQUIREMENT. THE HOUSING IS HERMETICALLY SEALED AND BACKFILLED WITH NITROGEN/HELIUM GAS TO PROTECT CIRCUITS AND COMPONENTS FROM DIRECT EXPOSURE TO THE ENVIRONMENT. UNIT IS DESIGNED TO THE FLIGHT ENVIRONMENT. THE ADI SHALL HAVE A MINIMUM USEFUL LIFE OF 25,000 HOURS. THIS IS EQUIVALENT TO 100 ORBITAL MISSIONS IN A 10-YEAR PERIOD FROM DATE OF DELIVERY. AVERAGE ORBITAL MISSION DURATION WILL BE 7 DAYS; HOWEVER, ADI DESIGN SHALL NOT PRECLUDE THE CAPABILITY TO EXTEND ORBITAL STAY-TIME UP TO A TOTAL OF 30 DAYS. PREVENTIVE MAINTENANCE, SERVICING, REPAIR, AND REPLACEMENT OF PARTS SHALL BE CONSISTENT WITH THE SELLER'S TRADEOFF RESULTS, AS APPROVED BY THE BUYER. THE STATIC POSITIONING ACCURACY OF THE ATTITUDE INDICATOR (BALL) SHALL BE PLUS OR MINUS 0.5 DEGREES MAXIMUM WHEN COMMANDED TO THE ZERO POSITION ON ANY AXIS AND PLUS OR MINUS 1.0 DEGREES MAXIMUM AT ALL OTHER COMMANDED POSITIONS. THE DYNAMIC ACCURACY ERRORS (LAG) FOR EACH AXIS SHALL NOT EXCEED 1-DEGREE ATTITUDE FOR INPUT RATES UP TO 20 DEGREES PER SECOND. THE STATIC POSITIONING ACCURACY OF THE ATTITUDE ERROR NEEDLES AND RATE POINTERS SHALL BE A MAXIMUM OF PLUS OR MINUS 2 PERCENT OF FULL SCALE AT NULL, PLUS OR MINUS 5 PERCENT OF FULL SCALE FOR INPUT SIGNAL.

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LEVELS UP TO PLUS OR MINUS 2.5 VOLTS AND PLUS OR MINUS 7 PERCENT OF FULL SCALE FOR THE BALANCE OF THE DEFLECTION RANGES.

(B) TEST:
ACCEPTANCE REQUIREMENTS INCLUDE.

EXAMINATION OF PRODUCT
ABBREVIATED FUNCTIONAL
LEAK TEST
THERMAL - ATT
VIBRATION - AVT
INSULATION RESISTANCE
LIGHTING
FULL FUNCTIONAL

LEAK RATE

THE LEAK RATE SHALL NOT EXCEED 1×10^{-6} STANDARD CC OF GAS PER SECOND AT A PRESSURE DIFFERENTIAL OF 1 ATMOSPHERE.

AVT

20 TO 80 HZ	INCREASING AT 3 DB/OCTAVE TO 0.04 G ² /HZ AT 80 HZ
80 TO 350 HZ	CONSTANT AT 0.04 G ² /HZ
350 TO 2000 HZ	DECREASING AT 3 DB/OCTAVE FROM 0.04 G ² AT 350 HZ

ATT

INDICATOR SHALL BE THERMAL CYCLED FROM PLUS 70 DEG. F TO PLUS 125 DEG. F TO 125 DEG. F TO 70 DEG. F WITH CONTINUITY MONITORED THROUGHOUT. DWELL AT EACH LIMIT TEMPERATURE SHALL BE THE TIME REQUIRED TO STABILIZE THE UNIT'S TEMPERATURE PLUS THE TIME REQUIRED TO CONDUCT ANY PERFORMANCE TEST; HOWEVER, THE MINIMUM TIME SHALL NOT BE LESS THAN 1 HOUR. INPUTS SHALL BE PROVIDED TO ALL FUNCTIONS SO THEY ARE ACTIVE DURING THERMAL TESTS.

QUALIFICATION TESTS INCLUDE:

ACCEPTANCE
LIGHTING
MAGNETIC PROPERTIES
BONDING
POWER CONSUMPTION
TRANSIENT BUS VOLTAGE
EMC
THERMAL CYCLE
ACCELERATION
CABIN ATMOSPHERE

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VIBRATION
OPERATING LIFE
SHOCK

QAVT

20 TO 80 HZ	INCREASING AT 3 DB/ OCTAVE TO 0.067 G ² /HZ AT 80 HZ
80 TO 350 HZ	CONSTANT AT 0.067 G ² /HZ
350 TO 2000 HZ	DECREASING AT 3 DB/OCTAVE FROM 0.067 G ² /HZ AT 350 HZ
DURATION	FIVE TIME AVT MINUTES PER AXIS

QTT

THE ADI SHALL BE THERMALLY CYCLED FIVE TIMES FROM: PLUS 70 DEG. F TO PLUS 145 DEG. F. TO MINUS 0 DEG. F, TO PLUS 145 DEG. F, TO PLUS 70 DEG. F. RATE OF CHANGE SHALL NOT EXCEED 4 DEG. F PER MINUTE OR BE LESS THAN 1 DEG. F PER MINUTE. DWELL AT EACH THERMAL EXTREME SHALL NOT BE LESS THAN 60 MINUTES AFTER THERMAL STABILIZATION OF THE TEST ARTICLE.

ACCELERATION

PLUS AND MINUS 5 G'S IN ALL MAJOR AXES.

GROUND TURNAROUND TEST

ANY TURNAROUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

(C) INSPECTION:

RECEIVING INSPECTION

RECEIVING INSPECTION PERFORMS A VISUAL AND DIMENSIONAL EXAMINATION OF INCOMING PARTS. CERTIFICATION RECORDS AND TEST REPORTS ARE MAINTAINED CERTIFYING MATERIALS AND PROPERTIES.

CONTAMINATION CONTROL

QC VERIFIES THAT REQUIRED PROCEDURES AND SHOP PRACTICES ARE UTILIZED FOR CONTAMINATION CONTROL. HERMETIC SEALING AND BACKFILLING OPERATIONS VERIFIED BY QC.

ASSEMBLY/INSTALLATION

DETAILED INSPECTION IS PERFORMED ON ALL PARTS PRIOR TO NEXT ASSEMBLY. ALL CRITICAL DIMENSIONS AND ALIGNMENTS VERIFIED BY INSPECTION.

CRITICAL PROCESSES

ALL CRITICAL PROCESSES AND CERTIFICATIONS ARE MONITORED AND VERIFIED BY INSPECTION I.E.: SOLDERING, ADHESIVE BONDING, CONFORMAL COATING, AND PAINTING.

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TESTING

ALL PARTS OF THE ATP ARE OBSERVED AND VERIFIED BY QC, INCLUDING AVT, ATT, LEAK, AND FUNCTIONAL TEST.

HANDLING/PACKAGING

IN-PROCESS OPERATIONS ARE VERIFIED BY QC TO PROTECT PARTS AND PRECLUDE MISHANDLING.

PARTS PACKAGING IS VERIFIED BY INSPECTION TO APPLICABLE REQUIREMENTS.

(D) FAILURE HISTORY:

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

(E) OPERATIONAL USE:

THE FULLY AUTOMATIC FLIGHT MODE IS ALSO AVAILABLE AS A CONTINGENCY IF REQUIRED.

- APPROVALS -

EDITORIALLY APPROVED	: BNA	: <u>J. Kemura 8/28/97</u>
EDITORIALLY APPROVED	: JSC	: <u>Wanda Searcy 9-22-99</u>
TECHNICAL APPROVAL	: VIA APPROVAL FORM	: 96-CIL-024_05/3