

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- NON-CIL HARDWARE

NUMBER: 03-1-0662 -X

SUBSYSTEM NAME: D&C - MAIN PROPULSION

REVISION: 1 02/22/01

PART DATA

	PART NAME	PART NUMBER
	VENDOR NAME	VENDOR NUMBER
LRU	:D&C PANEL F7A7	
LRU	:METER	MC432-0232-0010

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:

METER, MAIN ENGINE HELIUM PRESSURE.

REFERENCE DESIGNATORS: 34V73A7A7M4A
34V73A7A7M4B
34V73A7A7M4C
34V73A7A7M4D

QUANTITY OF LIKE ITEMS: 1**FUNCTION:**

INDICATES HELIUM SUPPLY OR REGULATED PRESSURE FOR THE PNEUMATIC HELIUM TANK, LEFT ENGINE HELIUM TANK, CENTER ENGINE HELIUM TANK, AND RIGHT ENGINE HELIUM TANK.

RANGES: SUPPLY - 0 TO 5000 PSIA IN 500-PSI INCREMENTS.
REGULATED - 0 TO 1000 PAIS IN 100-PSI INCREMENTS.

FAILURE MODES EFFECTS ANALYSIS FMEA -- NON-CIL FAILURE MODE

NUMBER: 03-1-0662-01

REVISION#: 1 02/22/01

SUBSYSTEM NAME: D&C - MAIN PROPULSION

LRU: D&C PANEL F7A7

ITEM NAME: MPS MAIN ENGINE HELIUM METER

CRITICALITY OF THIS

FAILURE MODE: 1R3

FAILURE MODE:

INACCURATE READING.

MISSION PHASE: LO LIFT-OFF

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

CAUSE:

PIECE PART FAILURE, CONTAMINATION, VIBRATION, MECHANICAL SHOCK, PROCESSING ANOMALY, THERMAL STRESS.

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN

- A) PASS
- B) N/A
- C) PASS

PASS/FAIL RATIONALE:

A)

B)

METER IS STANDBY REDUNDANT TO HELIUM SYSTEM FAILURE

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:

INACCURATE INDICATION OF MAIN ENGINE HELIUM PRESSURE.

(B) INTERFACING SUBSYSTEM(S):

NO EFFECT - FIRST FAILURE.

(C) MISSION:

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- NON-CIL FAILURE MODE
NUMBER: 03-1-0662-01**

SAME AS B.

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

SAME AS B.

(E) FUNCTIONAL CRITICALITY EFFECTS:

1R/3 3 SUCCESS PATHS. TIME FRAME - ASCENT.

- 1) FA MDM FAILS. SOFTWARE CAUTION & WARNING, CRT MESSAGE, AND MCC MONITORING CAPABILITY FOR ASSOCIATED HELIUM ENGINE SYSTEM LOST.
- 2) LEAK IN ASSOCIATED ENGINE HELIUM SYSTEM.
- 3) HELIUM PRESSURE FALLS BELOW ZERO G SHUTDOWN REQUIREMENTS.

CREW DOES NOT INTERCONNECT PNEUMATIC HELIUM SUPPLY TO LEAKING ENGINE AT PROPER TIME SINCE METER SHIFT IS MASKING THE PROPER INTERCONNECT ACTION LEVEL. ZERO G HELIUM REQUIREMENT VIOLATION. POSSIBLE UNCONTAINED SSME SHUTDOWN.

POSSIBLE LOSS OF CREW/VEHICLE.

-DISPOSITION RATIONALE-

(A) DESIGN:

PHYSICAL/FUNCTIONAL DESCRIPTION

TAPE METER CONFIGURATIONS DIFFER IN METER MOVEMENT RANGE, SCALE INDICATION, AND NUMBER OF DISPLAYS. EACH TAPE METER IS A PANEL MOUNTED ELECTRONIC INDICATOR CONSISTING OF A SINGLE OR MULTIPLE-FIXED VERTICAL SCALE METER FACE WITH DUAL, TRIPLE, OR QUADRUPLE TAPE MOVEMENTS. THE METERS CONTAIN INTEGRAL LIGHTING, OPERATE FROM A 28 VOLT (DC) POWER SOURCE, AND PROVIDE INDICATION FROM A 0 TO 5 VOLT (DC) ANALOG INPUT SIGNAL.

THE ELECTRONIC/MECHANICAL ASSEMBLY IS ENCLOSED IN A SEALED ENVELOPE, TAPE METERS ARE USED IN THE ORBITER FOR DISPLAY PURPOSES. THEY PRESENT VISUAL INFORMATION ON SELECTED PARAMETERS USING SERVO DRIVEN TAPES. TAPE METERS PROVIDE INDICATION OF DISCRETE PRESSURE, QUANTITY, AND TEMPERATURE PARAMETERS WITHIN THE MAIN PROPULSION, HYDRAULIC, AND AUXILIARY POWER SUBSYSTEMS.

DESIGN EVOLUTION

DURING THE SUPPLIER MANUFACTURING PHASE VARIOUS DESIGN PROBLEMS AND FAILURES OCCURRED WHICH RESULTED IN CORRECTIVE ACTION IN AREAS OF FABRICATION PROCESSES, CONTROL DESIGN IMPROVEMENTS, AND ADDED INSPECTION POINTS. DESIGN IMPROVEMENTS RESULTED IN PART NUMBER CHANGES. THE MC432-0232-0013, -0014, AND -0010 CONFIGURATIONS WERE USED FOR QUALIFICATION AND OV101 CERTIFICATION (THESE ARE REPRESENTATIVE OF ALL METER CONFIGURATIONS). THE MC432-0232-0023, - 0025, -0026, AND -0027 WERE OV101 APPROACH AND LANDING TEST

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- NON-CIL FAILURE MODE
NUMBER: 03-1-0662-01**

(ALT) UNITS. THEY WERE FORMERLY -0003, -0005, -0006, AND -0007 UNITS, FINAL USED IN SAIL.

ACCUMULATION OF CORRECTIVE/REMEDIAL ACTIONS LEAD TO THE MODIFICATION OF THE - 0013, -0014, AND -0016 CONFIGURATIONS. FLIGHT METERS IDENTIFIED WITH PART NUMBERS MC432-0232-0008, -0009, -0010, -0011, - 0012, -0015, -0017, AND -0018 WERE ALSO MODIFIED. THESE MODIFICATIONS CONSISTED OF CHANGING BONDING MATERIALS FOR ADHERENCE OF TAPE TO DRUMS, RE-ROUTING OF WIRE, PREVENTING WIRE BREAKAGE USING WIRE RESTRAINTS AND STRESS RELIEF, CORRECTING MECHANICAL INTERFERENCE BY MACHINING IMPROVEMENTS (TO METER), AND ELIMINATING SPOT WELDING WITHIN THE UNITS. NOTE - TEST SPECIMENS DID NOT HAVE OPPL APPROVED PARTS. ALL FLIGHT UNITS USE JANTXV QUALITY LEVEL ELECTRONIC PARTS.

(B) TEST:
ACCEPTANCE TESTS

ALL PRODUCTION METERS ARE SUBJECTED THE FOLLOWING ACCEPTANCE TESTS.

INSPECTION AND TESTS
EXAMINATION OF PRODUCT
FUNCTIONAL TEST
ACCEPTANCE VIBRATION TESTS (0.04G ² HZ)
ACCURACY
ACCEPTANCE THERMAL TESTS
INSULATION RESISTANCE
PRESSURE/VACUUM/LEAK RATE
LIGHTING

CERTIFICATION

THE TAPE METER MOVEMENT RANGE AND SCALE INDICATIONS DIFFER. THE TEST SPECIMENS SELECTED REPRESENTED ALL CONFIGURATIONS AS CLOSELY AS POSSIBLE AND ARE CONSIDERED SIMILAR. THE TAPE METERS WERE CERTIFIED FOR OV101 ALT ON CR-19-432-0232-0013B BY TESTS CONDUCTED ON TEST ARTICLES MC432-0232-0013, -0014, AND -0016. DELTA QUALIFICATION TESTS ON THE MODIFIED UNITS -0013, -0014, AND -0016 CERTIFIED THE FLIGHT UNITS -0008, -0009, -0010, -0011, -0012, -0015, -0017, -0018 PER CERTIFICATION OF CR 19-432-0232-0008, EFFECTIVE ON OV102 THROUGH OV104.

ITEM IDENTIFICATION - TEST ARTICLES (OV101), CERTIFIED FLIGHT METER CONFIGURATIONS (OV102 AND SUBS), AND SIMILARITIES ARE SUMMARIZED IN THE FOLLOWING TABLE.

<u>CERTIFICATION & QUALIFICATION</u>	<u>FLIGHT CERTIFIED</u>	MC432-02320
TEST SAMPLE	SIMILAR	(TAPE METER)
DASH NO.	DASH NO.	CONFIGURATION/SIMILARITY

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- NON-CIL FAILURE MODE
NUMBER: 03-1-0662-01**

-0013	-0008 -0009	1) TRIPLE METER MOVEMENT 2) DIALS ON -0013, -0009, -0017 & -0018 ARE THE SAME 0-100%. 3) THE -0008 HAS A DUAL DIAL INDICATION PSIA AND °F. 4) CONNECTOR IS NON-OPPL HARDWARE ON TEST UNIT.
-0014	-0010	1) QUADRUPLE METER MOVEMENT WITH DUAL SCALE INDICATIONS. 2) CONNECTOR IS NON-OPPL HARDWARE ON TEST UNIT.
-0016	-0011 -0012	1) DUAL METER MOVEMENT. 2) DIFFERENT SCALE INDICATIONS. 3) CONNECTOR IS NON-OPPL HARDWARE ON TEST UNIT.

QUALIFICATION TESTS

TEST
ACCEPTANCE TEST
VIBRATION
QAVT - (0.067G ² /HZ)
FLIGHT - (0.9G ² /HZ)
ACCELERATION
SHOCK
BENCH HANDLING
BASIC DESIGN
CRASH SAFETY
WINDOW IMPACT
BONDING
ELECTROMAGNETIC COMPATIBILITY (EMC)
THERMAL CYCLE
OPERATING LIFE
POWER TEST
CABIN ATMOSPHERE
PACKAGE QUALIFICATION TEST
LIGHTNING TEST
LIGHTING

OMRSD
ANY TURNAROUND CHECKOUT IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

(C) INSPECTION:
RECEIVING INSPECTION

RECEIVING INSPECTION VERIFIES PURCHASED MATERIALS TO THE EXTENT NECESSARY TO ASSURE CONFORMANCE TO THE APPLICABLE TECHNICAL REQUIREMENTS OF THE PURCHASE ORDER AND DRAWING, PER DOCUMENTED POLICY.

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- NON-CIL FAILURE MODE
NUMBER: 03-1-0662-01**

ENGINEERING SPECIFIES CRITICAL AND MAJOR PARAMETERS OF PURCHASED PARTS AND MATERIALS TO BE VERIFIED BY RECEIVING INSPECTION, PER DOCUMENTED REQUIREMENTS.

ALL CERTIFICATION RECORDS AND TEST REPORTS ARE MAINTAINED WITH THE ORIGINAL RECEIVING REPORT AND PACKING SLIP.

COMPLETED RECEIVING REPORTS ARE MAINTAINED IN THE CLOSED PURCHASE ORDER FILE PER DOCUMENTED PROCEDURES.

CONTAMINATION CONTROL

QUALITY ASSURANCE (QA) MONITORS AND AUDITS SHOP AREAS TO ENSURE THAT THE RESPONSIBLE PARTIES ARE IN COMPLIANCE WITH ALL SPECIFIED CONTAMINATION CONTROLS, PER DOCUMENTED INSTRUCTIONS.

ASSEMBLY/INSTALLATION

IN-PROCESS INSPECTION POINTS ARE ESTABLISHED BY QA TO ENSURE ACCEPTABILITY OF ITEMS PRIOR TO SUBSEQUENT PROCESSING OR STOCKING, WHEN SUCH PROCESSING WOULD MAKE VERIFICATION OF ACCEPTABILITY OF PREVIOUS OPERATIONS IMPOSSIBLE, PER DOCUMENTED INSTRUCTIONS.

A CRIMP LOG IS MAINTAINED, AND CRIMP TOOL CALIBRATION VERIFICATION COMPLIES WITH MSC-SPEC-Q-1A.

ALL BRAZED JOINTS AND CRIMPS ARE VISUALLY INSPECTED.

CRITICAL PROCESSES

PROCESSING OPERATIONS ARE MONITORED FOR COMPLIANCE WITH QUALITY REQUIREMENTS, AND QA PERFORMS AUDITS TO VERIFY THAT PROCESSING REQUIREMENTS ARE MET.

CRITICAL PROCESSES ARE BRAZING, CRIMPING, SPOT WELDING, SOLDERING, SWAGING, COMPONENT BONDING, CONFORMAL COATING, SEALING, AND ETCHING.

CERTIFICATION OF OPERATORS IS VERIFIED FOR CRIMPING, SOLDERING, COMPONENT BONDING, CONFORMAL COATING, AND HARNESS/CABLE FABRICATION.

TESTING

QA REGULARLY CONDUCTS SURVEILLANCE OF PRODUCT TESTING IN ACCORDANCE WITH DOCUMENTED INSTRUCTIONS.

A PULL TEST IS PERFORMED FOR EVERY ONE HUNDRED SPOT WELDS.

HANDLING/PACKAGING

PARTS PACKAGED AND PROTECTED ARE VERIFIED BY INSPECTION TO APPLICABLE REQUIREMENTS.

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- NON-CIL FAILURE MODE
NUMBER: 03-1-0662-01**

SPECIAL HANDLING PER DOCUMENTED INSTRUCTIONS IS VERIFIED, TO PRECLUDE DAMAGE, SHOCK, AND CONTAMINATION DURING COMPONENT HANDLING/TRANSPORTING/PACKAGING BETWEEN WORK STATIONS.

CONTROLS ARE IMPLEMENTED TO PREVENT ELECTROSTATIC DISCHARGE, AND THE MAINTENANCE OF CONTROLS IS AUDITED BY QA.

(D) FAILURE HISTORY:

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

(E) OPERATIONAL USE:

NO CREW ACTION CAN BE TAKEN

- APPROVALS -

S&R ENGINEERING	: W.P. MUSTY	: /S/ W. P. MUSTY
S&R ENGINEERING ITM	: P. A. STENGER-NGUYEN	: /S/ P. A. STENGER-NGUYEN
D&C ENGINEERING	: LAITH COTTA	: /S/ LAITH COTTA
MPS SUBSYSTEM MGR.	: TIM REITH	: /S/ TIM REITH
EPD&C SUBSYSTEM MGR.	: RICHARD PHAN	: /S/ RICHARD PHAN
MOD	: JEFF MUSLER	: /S/ JEFF MUSLER
USA SAM	: MIKE SNYDER	: /S/ MIKE SNYDER
USA ORBITER ELEMENT	: SUZANNE LITTLE	: /S/ SUZANNE LITTLE
NASA SR&QA	: ERICH BASS	: /S/ ERICH BASS