

FAILURE MODES EFFECTS ANALYSIS (FMEA) - CIL HARDWARE
NUMBER: M4-1BG-OCV20 -X

SUBSYSTEM NAME: ELECTRICAL POWER GENERATION - CRYO, GENERIC
REVISION: 1 04/01/92

PART DATA

PART NAME	PART NUMBER
VENDOR NAME	VENDOR NUMBER
SRU : CHECK VALVE, O2 TANK 3 AERODYNE	MC284-0428-0410 3038-2-000

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
O2 TANK #3 FILL AND VENT SERVICING CHECK VALVE

REFERENCE DESIGNATORS: 40V45CV1100
40V45CV1110

QUANTITY OF LIKE ITEMS: 2
TWO

FUNCTION:
RELIEVES OVERPRESSURE FROM THE FILL OR VENT COMMON MANIFOLD TO O2 TANK
3.

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REVISION#: 2 03/27/96

SUBSYSTEM NAME: ELECTRICAL POWER GENERATION - CRYO, GENERIC

LRU:

CRITICALITY OF THIS

ITEM NAME: CHECK VALVE, O2 TANK

FAILURE MODE: 1R3

FAILURE MODE:

FAILS OPEN OR INTERNAL LEAKAGE

MISSION PHASE:

LO	LIFT-OFF
OO	ON-ORBIT
DO	DE-ORBIT

VEHICLE/PAYLOAD/KIT EFFECTIVITY:

102	COLUMBIA
104	ATLANTIS
105	ENDEAVOUR

CAUSE:

CONTAMINATION, CORROSION

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

REDUNDANCY SCREEN

A) PASS
B) FAIL
C) PASS

PASS/FAIL RATIONALE:

A)

B)

CHECK VALVE SEALING INTEGRITY IS NONVERIFIABLE DUE TO DISCONNECT AND CAP.

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:

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NO EFFECT AFTER FIRST FAILURE. A FLIGHT DISCONNECT INSTALLED IN-LINE, AND A FLIGHT CAP INSTALLED ON THE DISCONNECT, PROVIDE THE PRIMARY AND SECONDARY SEAL.

(B) INTERFACING SUBSYSTEM(S):
SAME AS (A).

(C) MISSION:
SAME AS (A).

(D) CREW, VEHICLE, AND ELEMENT(S):
SAME AS (A).

(E) FUNCTIONAL CRITICALITY EFFECTS:
GROSS LEAKAGE AS A RESULT OF FAILURES OF THE CHECK VALVE AND THE ASSOCIATED DISCONNECT, AND FLIGHT CAP MAY RESULT IN LOSS OF ALL THREE FUEL CELL POWERPLANTS DUE TO LOSS OF SYSTEM PRESSURE IF BOTH MANIFOLD ISOLATION VALVES FAIL TO CLOSE.

-DISPOSITION RATIONALE-

(A) DESIGN:
VALVE PROTECTED AGAINST CONTAMINATION BY A 12 MICRON ABSOLUTE FILTER UPSTREAM OF VALVE AND A 45 MICRON ABSOLUTE FILTER SCREEN IN VALVE. VALVE IS CONSTRUCTED OF CORROSION RESISTANT MATERIALS (304L, 304 COND. B, RC55 ELGILOY).

(B) TEST:
QUALIFICATION TEST INCLUDED THERMAL/OPERATING LIFE CYCLE TESTING (300K CYCLES) WITH NO EVIDENCE OF CHATTER, EXCESSIVE WEAR, CONTAMINATION, OR OPERATIONAL DEGRADATION.

ACCEPTANCE TEST VERIFIES CRACKING PRESSURES ARE WITHIN LIMITS (3 +/-0 PSI) TOLERANCE AND PRESSURE DROP DOES NOT EXCEED 7.5 PSI AT MAXIMUM SYSTEM FLOW RATES. VALVE VERIFIED CLEANED TO LEVEL 200A BY PARTICLE COUNT AND NON-VOLATILE RESIDUE (NVR). VALVE OPERATION IS FURTHER VERIFIED DURING PANEL MODULAR ASSEMBLY AND SUBSYSTEM CHECKOUT.

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OMRSD: NONE

(C) INSPECTION:

RECEIVING INSPECTION

MATERIAL CERTIFICATIONS AND TEST REPORTS ARE REVIEWED TO VERIFY THAT MATERIAL COMPOSITION, DIMENSIONS, AND SURFACE CONDITIONS COMPLY WITH DESIGN REQUIREMENTS.

CONTAMINATION CONTROL

ACCOMPLISHMENT OF PREASSEMBLY CLEANING, VAPOR DEGREASING, AND ULTRASONIC CLEANING IS VERIFIED. PIECE PART CLEANLINESS IS CERTIFIED TO LEVEL 200A (MA0110-301) BY A NVR AND PARTICLE COUNT (50 ML FLUSH THROUGH A MILLIPORE FILTER). COMPONENT ASSEMBLY, PACKAGING, AND SUBSEQUENT SUBASSEMBLY INSTALLATION ARE ACCOMPLISHED IN 100,000 CLASS CLEANROOM ENVIRONMENTS. COMPLETED ASSEMBLY IS VERIFIED TO LEVEL 200A.

CRITICAL PROCESSES

ELECTRON BEAM WELDS ARE INSPECTED FOR DEFECTS UNDER 10X VISUAL EXAMINATION DURING COMPONENT ASSEMBLY. INDUCTION BRAZING IS RADIOGRAPHICALLY INSPECTED DURING MODULAR ASSEMBLY.

TESTING

ATP IS VERIFIED BY INSPECTION.

NON-DESTRUCTIVE

TESTING RADIOGRAPHIC INSPECTION TO INSPECT THE BRAZING.

HANDLING/PACKAGING

HANDLING, PACKAGING, STORAGE AND SHIPPING PROVISIONS ARE VERIFIED BY INSPECTION.

(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.

CAR NO. A4385-010 SUPPLIER, QUALIFICATION

DURING A CHECK VALVE POST VIBRATION LEAK CHECK, OUT OF SPECIFICATION LEAKAGE WAS DETECTED IN THE CHECKED DIRECTION. LEAKAGE WAS CAUSED BY SEVERE WEAR AT THE POPPET/VALVE HOUSING INTERFACE DUE TO THE INTRODUCTION OF SECONDARY OSCILLATING VIBRATIONS. THE WEAR WAS AGGRAVATED BY THE PRESENCE OF EXCESS PARTICULATE CONTAMINATION WITHIN THE TEST SET-UP. THE SECONDARY OSCILLATIONS WERE DETERMINED TO BE CAUSED BY AN INADEQUATE TEST SET-UP. CORRECTIVE ACTION INCLUDED REDUCING THE VIBRATION TEST LEVEL SPECIFICATION FROM 0.4 G SQ/HZ TO 0.1 G SQ/HZ (THE APPROPRIATE LEVEL AS SPECIFIED IN MF0004-014 FOR ZONE VIBRATION

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REQUIREMENTS) AND REVISING THE QUALIFICATION TEST PROCEDURE TO INCLUDE: ADDING A REVERSE FLOW CHECK AFTER EACH AXIS OF RANDOM VIBRATION, REVISING THE TEST SET-UP AND FIXTURES TO PRECLUDE INTRODUCTION OF SECONDARY OSCILLATING VIBRATIONS AND TO PROVIDE POSITIVE FILTER PROTECTION OF TEST SPECIMEN.

CAR NO. AC0124-010 KSC, OV-102, GROUND CHECK
OUT OF SPECIFICATION LOSS OF MANIFOLD PRESSURE WAS DETECTED DURING OV-102 SUBSYSTEM CHECKOUT. LEAKAGE WAS ISOLATED TO THE MANIFOLD RELIEF VALVE AND/OR CHECK VALVE. LEAKAGE COULD NOT BE ISOLATED TO EITHER THE RELIEF VALVE OR CHECK VALVE SINCE THE COMPONENTS ARE INSTALLED IN PARALLEL. THIS LEAKAGE FELL WITHIN SPECIFICATION WITH FURTHER OPERATION WHICH PROMPTED MONITORING OF SYSTEM PERFORMANCE WITH FURTHER USE. THE LEAKAGE WAS SUSPECTED TO BE CAUSED BY A CONTAMINANT WHICH CLEARED ITSELF WITH SUBSEQUENT USE.

CAR NO. AC1281-010 KSC, OV-102, GROUND CHECK
DURING OV-102 SUBSYSTEM CHECKOUT, THE CHECK VALVE ASSOCIATED WITH TANK SET #3, EXHIBITED OUT OF SPECIFICATION LEAKAGE IN THE CHECKED DIRECTION. DISASSEMBLY REVEALED CORROSION ON THE POPPET, SEAT, AND GALLING BETWEEN THE POPPET AND GUIDE. THE CAUSE OF LEAKAGE WAS ATTRIBUTED TO CONTAMINATION, AS A RESULT OF FLUSHING OPERATIONS AFTER REPEATED BRAZING (9 TOTAL, MAXIMUM ALLOWABLE BRAZES IS 8) AND FLUSHING OPERATIONS. CORRECTIVE ACTION INCLUDED REVISING EO V544-454009, 801, AND EO V525-454010, A03 TO ELIMINATE FREON FLUSHING. TUBING IS INDIVIDUALLY CLEANED AND BRAZING IS DONE WITHIN CLEAN ROOM (FREON FLUSHING NOT REQUIRED AFTER BRAZING).

(E) OPERATIONAL USE:

NO CREW ACTION AFTER FIRST FAILURE. CREW WILL ISOLATE LEAK BY CLOSING MANIFOLD VALVES AFTER FOURTH FAILURE.

- APPROVALS -

PAE MANAGER : D. F. MIKULA
PRODUCT ASSURANCE ENGR : L. X. DANG
DESIGN ENGINEERING : G. AVILA
NASA SSMA :
NASA SUBSYSTEM MANAGER :

D.F. Mikula 29-Mar-96
L.X. Dang 3/29/96
G. Avila 3/24/96
A. J. Miller 6/16/97
David L. Wallace 4/16/97