FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL HARDWARE
NUMBER: M4-1BG-PC030-X

SUBSYSTEM NAME: ELECTRICAL POWER GENERATION - CRYO, GENERIC
REVISION : 1 11/12/91

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
■ LRU :	PRESSURE CAP, H2	MC276-0010-0260
■	FAIRCHILD	74347000-0260

PART DATA

■ EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
PRESSURE CAP, H2 FILL, VENT AND HORIZONTAL DRAIN

■ REFERENCE DESIGNATORS: 40V45P0030
: 40V45P0031
: 40V45P0040
: 40V45P0041
: 40V45P0032
: 40V45P0450
: 40V45P0451
: 40V45P0550
: 40V45P0551
: 40V45P0650
: 40V45P0651

■ QUANTITY OF LIKE ITEMS: 11
ELEVEN

■ FUNCTION:
PROVIDES A SECONDARY SEAL TO THE H2 FILL, VENT AND HORIZONTAL DRAIN DISCONNECTS.

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL FAILURE MODE
NUMBER: M4-1BG-PC030-01

REVISION# 1 11/12/91 R
SUBSYSTEM: ELECTRICAL POWER GENERATION - CRYO, GENERIC
LRU :PRESSURE CAP, H2 CRITICALITY OF THIS
ITEM NAME: PRESSURE CAP, H2 FAILURE MODE:1R3

- FAILURE MODE:
  EXTERNAL LEAKAGE

  MISSION PHASE:
  LO LIFT-OFF
  CO ON-ORBIT
  DO DE-ORBIT
  ~~LS LANDING SAFING~~

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

- CAUSE:
  VIBRATION, SEAL FAILURE, CONTAMINATION

- CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

- REDUNDANCY SCREEN A) PASS
- B) FAIL
- C) PASS

PASS/FAIL RATIONALE:
- A)

- B)
  FLIGHT CAP SEALING INTEGRITY IS NONVERIFIABLE DUE TO THE INTERFACING DISCONNECTS POPPET SEAL.

- C)

- FAILURE EFFECTS -

- (A) SUBSYSTEM:
  SUBSYSTEM DEGRADATION - LOSS OF H2 REACTANT NO GREATER THAN THE ASSOCIATED DISCONNECTS' ACCEPTED PREFLIGHT LEAK RATE. MAXIMUM

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ALLOWABLE LEAKAGE FOR THE FILL, VENT AND HORIZONTAL DRAIN DISCONNECTS IS 900 SCCM.

- (B) INTERFACING SUBSYSTEM(S):
DEGRADATION OF INTERFACE FUNCTION - LEAK ISOLATION MAY RESULT IN LOSS OF H2 REACTANT SUPPLY TO ONE FUEL CELL POWERPLANT.

- (C) MISSION:
MINIMUM DURATION MISSION INVOKED.

- (D) CREW, VEHICLE, AND ELEMENT(S):
NO EFFECT AFTER FIRST FAILURE.

- (E) FUNCTIONAL CRITICALITY EFFECTS:
GROSS LEAKAGE AS A RESULT OF FAILURES OF A FLIGHT CAP AND THE ASSOCIATED DISCONNECT, MAY RESULT IN LOSS OF ALL THREE FUEL CELL POWERPLANTS DUE TO LOSS OF SYSTEM PRESSURE IF BOTH MANIFOLD ISOLATION VALVES FAIL TO CLOSE. LOSS OF SYSTEM PRESSURE WITH GROSS LEAKAGE OF FLIGHT CAP ON FILL OR VENT ALSO REQUIRES FAILS OPEN OF TANK CHECK VALVES.

- DISPOSITION RATIONALE -

- (A) DESIGN:
PRESSURE-ASSISTED TEFLON SEAL IS REPLACED PRIOR TO EVERY CAP INSTALLATION. POSITIVE LOCKING DESIGN. BODY IS CONSTRUCTED OF INCONEL 718 CORROSION RESISTANT STEEL. ALL MATERIALS ARE COMPATIBLE WITH WORKING FLUIDS.

- (B) TEST:
QUALIFICATION TESTS INCLUDED; SINE (0.25 G PER AXIS AT 5 TO 35 HZ) AND RANDOM VIBRATION (34 MINUTES AT 1.0 G SQ/HZ, 14 MINUTES AT 0.5 G SQ/HZ) WITH THE UNIT PRESSURIZED (330 PSIG) AND MATED, 5 THERMAL CYCLES (-150 TO +350 DEG F) AND MATE/DEMATE CYCLES (100 AT AMBIENT TEMP). BURST-TESTED AT 640 PSI FOR 5 MINUTES.

ACCEPTANCE TESTS INCLUDE; PROOF PRESSURE AT 480 +/- 25 PSIG FOR 5 MINUTES AND LEAK TESTED FOR EXTERNAL LEAKAGE WITH THE UNIT PRESSURIZED AT 330 +/- 10 PSIG.

OMRSD: FLIGHT CAP LEAK CHECK PERFORMED DURING EVERY TURNAROUND.

- (C) INSPECTION:
RECEIVING INSPECTION
TEST REPORTS AND MATERIALS CERTIFICATIONS ARE MAINTAINED CERTIFYING MATERIALS AND PHYSICAL PROPERTIES.

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CONTAMINATION CONTROL
THE PART IS CLEANED PER REQUIREMENTS OF MA0110-301 LEVEL 200A AS A PART OF THE ATP. CORROSION PROTECTION AND COMPLIANCE WITH THE CONTAMINATION CONTROL PLAN ARE VERIFIED.

ASSEMBLY/INSTALLATION
MANUFACTURING PROCESSES, ASSEMBLY AND INSTALLATION REQUIREMENTS ARE VERIFIED BY INSPECTION.

CRITICAL PROCESSES
PASSIVATION AND APPLICATION OF DRY-LUBE ARE VERIFIED BY INSPECTION.

TESTING
CAP EXTERNAL LEAKAGE IS VERIFIED DURING ATP.

■ (O) FAILURE HISTORY:
CAR NO: A7391-010 H2 SUPPLIER, ATP
A7392-000 O2 SUPPLIER, ATP
A7393-000 H2 SUPPLIER, ATP
A7414-000 H2 SUPPLIER, ATP
A7767-010 O2 SUPPLIER, ATP
A7768-000 O2 SUPPLIER, ATP

3 O2 AND 3 H2 FLIGHT CAPS HAVE BEEN REPORTED LEAKING DURING ACCEPTANCE TESTING AS A RESULT OF A DEFORMED RACCO TEFLON SEAL. DEFORMATION OCCURRED AS A RESULT OF THE LOCKING NUT ASSEMBLY BEING TORQUED TO 20-30 IN/LBS VERSUS THE REQUIRED 150-180 IN/LBS.
CORRECTIVE ACTION INCLUDED A REVISION TO THE MASTER ROUTE SHEET TO INCLUDE PROPER TORQUE INSTRUCTIONS PRIOR TO RUNNING PRESSURE TEST.

CAR NO. A6275-C10 O2 SUPPLIER, ATP
AN O2 FLIGHT CAP WAS REPORTED LEAKING AS A RESULT OF A DEFECTIVE RACCO SEAL. THE INSPECTION PROCEDURES WERE REVIEWED AND DETERMINED TO BE ADEQUATE.
EACH ITEM IN THE LOT WAS REINSPECTED AND FOUND TO BE ACCEPTABLE, INDICATING ADEQUACY OF THE MANUFACTURING PROCESSES AND CONTROLS. IT WAS THEREFORE CONCLUDED THAT THE FAILURE WAS A RANDOM OCCURRENCE.

NOTE: A REQUIREMENT WAS IMPOSED REQUIRING THE INSPECTION OF EVERY SEAL IN FUTURE LOTS.

CAR NO. A9555-010 H2 SUPPLIER, QUALIFICATION
AN H2 FLIGHT CAP EXHIBITED OUT OF SPECIFICATION LEAKAGE IMMEDIATELY FOLLOWING THE FIRST CYCLE OF MATING AT CRYOGENIC TEMPERATURE (-423 DEG F) DURING QUALIFICATION TESTING. THE FAILURE WAS DETERMINED TO BE PRIMARILY ATTRIBUTED TO THE TEST TECHNIQUE AND FAULTY TEST EQUIPMENT, AND NOT A FAILURE OF THE PRESSURE CAP.

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CORRECTIVE ACTION INCLUDED: A TEST FIXTURE REDESIGN, INCORPORATION OF A -ELIUM PURGE DURING CHILLDOWN AND A REVISED METHOD FOR DETERMINING LEAKAGE. ALSO, THE PRESSURE CAP WAS TESTED AT -150 DEG F INSTEAD OF -423 DEG F (ANALYSIS INDICATED THAT BOTH O2 AND H2 FLIGHT CAPS WILL NEVER EXPERIENCE TEMPERATURES BELOW -150 DEG F).

CAR NO. AC1246-010 02 SUPPLIER, ATP
AN O2 FLIGHT CAP EXHIBITED OUT OF SPECIFICATION LEAKAGE DURING ITS ACCEPTANCE TEST. THE PROBLEM WAS CLOSED AS AN ATP SCREENABLE FAILURE.

NOTE: GENERAL REQUIREMENTS HAVE BEEN INCORPORATED TO THE FILE III EPG/PRSD OMRSD REQUIRING THE FLUSHING OF ALL AHC/GHC INTERFACES WITH FREON TF PRIOR TO DISCONNECT MATING AND TO REPLACE CAP INTERFACE SEALS PRIOR TO EACH INSTALLATION.

■ (E) OPERATIONAL USE:
CREW WILL PERFORM CRYO ISOLATION PROCEDURE AND ISOLATE LEAK TO AFFECTED MANIFOLD AFTER TWO FAILURES.

- APPROVALS -

RELIABILITY ENGINEERING	M. D. WEST	M D West Echo
DESIGN ENGINEERING	M. M. SCHEIERN	
QUALITY MANAGER	O. J. BUTTNER	
NASA RELIABILITY		
NASA SUBSYSTEM MANAGER		4/19/92
NASA QUALITY ASSURANCE		4/9/92 MF