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FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL HARDWARE

NUMBER: M4-1BG-PD010-X

SUBSYSTEM NAME: ELECTRICAL POWER GENERATION - CRYO, GENERIC

REVISION: 1 11/12/91

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
■ LRU	DISCONNECT, O2 FILL & VENT FAIRCHILD	MC276-0010-0110 74341000-0110
■ LRU	DISCONNECT, O2 FILL & VENT FAIRCHILD	MC276-0010-1110 74341000-1110
■ LRU	DISCONNECT, O2 FILL & VENT FAIRCHILD	MC276-0010-2110 74341000-2110

PART DATA

■ EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:  
DISCONNECT, O2 FILL AND VENT

- REFERENCE DESIGNATORS: 40V45PD010
- : 40V45PD011
- : 40V45PD020
- : 40V45PD021
- : 40V45PD410
- : 40V45PD411
- : 40V45PD500
- : 40V45PD501
- : 40V45PD600
- : 40V45PD601

■ QUANTITY OF LIKE ITEMS: 10

■ FUNCTION:  
PROVIDES FILL AND VENT CAPABILITY FOR O2 TANKS.

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL FAILURE MODE  
NUMBER: M4-1BG-P0010-01

SUBSYSTEM: ELECTRICAL POWER GENERATION - CRYO, GENERIC  
LRU :DISCONNECT, O2 FILL & VENT  
ITEM NAME: DISCONNECT, O2 FILL & VENT  
REVISION# 1 11/12/91 R  
CRITICALITY OF THIS FAILURE MODE:1R3

- FAILURE MODE:  
FAILS OPEN OR INTERNAL LEAKAGE

## MISSION PHASE:

LO LIFT-OFF  
CO ON-ORBIT  
DO DE-ORBIT  
~~LS LANDING SAFING~~ *e*

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

- CAUSE:  
MECHANICAL SHOCK, VIBRATION, CONTAMINATION

- CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

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

## PASS/FAIL RATIONALE:

- A)  
■ B)  
REDUNDANCY SCREEN B - POPPET SEALING INTEGRITY IS NONVERIFIABLE DUE TO INSTALLATION OF FLIGHT CAP.

- C)

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- FAILURE EFFECTS -  
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- (A) SUBSYSTEM:  
NO EFFECT AFTER FIRST FAILURE. A FLIGHT CAP IS INSTALLED ON DISCONNECT WHICH PROVIDES A SECONDARY SEAL.

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FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL FAILURE MODE  
NUMBER: M4-1BG-P0010-01

- (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:  
ADDITIONAL FAILURES OF THE ASSOCIATED FLIGHT CAP AND TANK CHECK VALVE OR MANIFOLD RELIEF VALVE, FAILING OPEN, MAY RESULT IN LOSS OF SYSTEM PRESSURE IF BOTH MANIFOLD ISOLATION VALVES FAIL TO CLOSE. LOSS OF SYSTEM PRESSURE RESULTS IN LOSS OF ALL THREE FUEL CELL POWERPLANTS.

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- DISPOSITION RATIONALE -  
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- (A) DESIGN:  
POPPET IS SPRING-LOADED CLOSED. SYSTEM PRESSURE AIDS IN SEALING POPPET. POPPET TRAVEL IS PERPENDICULAR TO LAUNCH ACCELERATION FORCES. LAPPED METAL-TO-METAL SEAT. LOCKING PRESSURE CAP PROVIDES A DUAL SEAL. 10 MICRON FILTER AT GROUND HALF COUPLING INLET. ALL COMPONENTS COMPATIBLE WITH WORKING FLUIDS. BODY CONSTRUCTED OF INCONEL 718 CORROSION RESISTANT STEEL.
- (B) TEST:  
QUALIFICATION TESTS INCLUDED; MECHANICAL SHOCK (20 G AT 1060 PSIG), SINUSOIDAL VIBRATION (+/- 0.25 G PEAK), RANDOM VIBRATION (1.0 G SQ/HZ FOR 34 MINUTES AND 0.5 G SQ/HZ FOR 14 MINUTES), AND THERMAL CYCLED (4 TIMES FROM CRYO TEMPERATURE TO +350 DEG F, 5 OPERATIONAL CYCLES PER THERMAL CYCLE), AND OPERATING CYCLES (2000 AT BOTH -297 DEG F AND AMBIENT TEMPERATURE).  
  
ACCEPTANCE TESTS INCLUDE; PROOF PRESSURE TEST IN THE UNMATED MODE AT 1525 PSIG FOR A MINIMUM OF 5 MINUTES. LEAK TEST FOR INTERNAL LEAKAGE PAST POPPET AT 1060 PSIG AND THE POPPET SPRING FORCE VERIFIED WITH THE DISCONNECT'S INTERFACE SIDE PRESSURIZED AT 20 PSIG, WITH THE DOWNSTREAM SIDE VENTED TO ATMOSPHERE.  
  
OMRSD: LEAK CHECK PERFORMED EVERY TURNAROUND.
- (C) INSPECTION:  
RECEIVING INSPECTION  
TEST REPORTS AND MATERIALS CERTIFICATIONS ARE MAINTAINED CERTIFYING MATERIALS AND PHYSICAL PROPERTIES.

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## CONTAMINATION CONTROL

ALL INTERNAL PARTS AND INTERNAL SURFACES OF THE DISCONNECT SHALL BE  
CLEANED TO LEVEL 200A OF MAQ110-301. *THEY ARE FLUSHED WITH FREON  
PRIOR TO MATING.*

## ASSEMBLY/INSTALLATION

DISCONNECT BODY ORIFICE, POPPET STEM DIAMETERS, AND OTHER CRITICAL  
DIMENSIONS ARE VERIFIED BY INSPECTION. TORQUES AND SURFACE FINISH ARE  
VERIFIED. LOG OF CLEAN ROOM AND TOOL CALIBRATION ARE VERIFIED. SEALS  
ARE VISUALLY EXAMINED PRIOR TO INSTALLATION FOR DAMAGE AND CLEANLINESS.  
ALL CLEANED SUBASSEMBLIES SHALL BE HANDLED IN A CLASS 100,000 CLEAN  
ROOM AS DEFINED IN FED-STD-209.

HW  
2ND  
ATTN BT

## CRITICAL PROCESSES

PARTS PASSIVATION AND ALL WELDS ARE VERIFIED BY INSPECTION.

## NONDESTRUCTIVE TESTING

WELDS ARE FLUORESCENT PENETRANT INSPECTED, USING LOX COMPATIBLE  
PENETRANT MATERIAL.

## TESTING

THE POPPET EXPERIENCES INTERNAL LEAKAGE TEST AND POPPET SPRING FORCE  
TEST DURING THE ATP WHICH IS VERIFIED BY INSPECTION.

## HANDLING/PACKAGING

PACKAGING FOR SHIPMENT IS VERIFIED BY INSPECTION.

■ (D) FAILURE HISTORY:

CAR NO. AB9963-010 H2 KSC, OV-102, GROUND CHECK \*  
AB9964-010 O2 KSC, OV-102, GROUND CHECK  
AC1626-010 O2 KSC, OV-102, GROUND CHECK  
AC6971-010 H2 KSC, OV-102, GROUND CHECK  
AC7021-010 O2 KSC, OV-102, GROUND CHECK \*  
AC9914-010 H2 KSC, OV-104, GROUND CHECK  
AD1160-010 H2 KSC, OV-102, GROUND CHECK

3 O2 AND 4 H2 FILL AND VENT DISCONNECTS HAVE BEEN REPORTED LEAKING.  
LEAKAGE HAS BEEN ATTRIBUTED TO CONTAMINATION FROM THE WORKING  
ENVIRONMENT IN ALL CASES.

\* - IN TWO CASES, LEAKAGE FELL WITHIN SPECIFICATION ONCE THE DISCONNECT  
WAS CYCLED OR FLUSHED.

NOTE: A GENERAL REQUIREMENT HAS BEEN INCORPORATED IN THE FILE III  
EPG/PRSD OMRSD REQUIRING THE FLUSHING OF ALL AHC/GHC INTERFACES WITH  
FREON T7 PRIOR TO DISCONNECT MATING.

CAR NO. AB1934-010 SUPPLIER, QUALIFICATION

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483544-010 SUPPLIER, QUALIFICATION  
483607-010 SUPPLIER, QUALIFICATION  
TWO H2 FILL AND VENT AND AN H2 HORIZONTAL DRAIN DISCONNECT EXHIBITED OUT OF SPECIFICATION LEAKAGE PAST POPPET DURING QUALIFICATION TEST. THE CAUSE OF LEAKAGE WAS THE RESULT OF A PITTED POPPET SEAT AREA. THIS CONDITION WAS DETERMINED TO BE A RESULT OF CONTAMINATION WHICH WAS INTRODUCED BY THE SUPPLIER. CORRECTIVE ACTION INCLUDED IMPLEMENTING FILTERS INTO THE SUPPLIER'S TEST SETUPS.

CAR NO. A5841-010 SUPPLIER, ATP  
AN O2 FILL AND VENT DISCONNECT EXHIBITED OUT OF SPECIFICATION FLOW PAST POPPET WITH THE DISCONNECT'S INTERFACE SIDE PRESSURIZED AT 20 PSIG. THE POPPET SPRING SHOULD HAVE PREVENTED FLOW. THE OUT OF SPECIFICATION LEAKAGE WAS CAUSED BY EXCESS CONTAMINANTS WITHIN THE UNIT WHICH WAS DETERMINED TO HAVE BEEN INTRODUCED DURING ASSEMBLY. CORRECTIVE ACTION INCLUDED CAUTIONING PERSONNEL TO MAINTAIN CLEANLINESS DURING ASSEMBLY AND HANDLING OF DISCONNECTS.

CAR NO. A6041-010 SUPPLIER, ATP  
AN H2 FILL AND VENT DISCONNECT EXHIBITED OUT OF SPECIFICATION LEAKAGE PAST POPPET DURING ITS ACCEPTANCE TEST. THE LEAKAGE WAS DETERMINED TO BE CAUSED BY A SCRATCH ON THE POPPET FACE. CORRECTIVE ACTION INCLUDED CAUTIONING ASSEMBLY PERSONNEL TO EXERCISE ADDITIONAL CARE IN HANDLING OF CRITICAL PARTS.

CAR NO. A88472-010 SUPPLIER, ATP  
AN O2 FILL AND VENT DISCONNECT EXHIBITED OUT OF SPECIFICATION POPPET LEAKAGE DURING ITS ACCEPTANCE TEST. THE PROBLEM WAS CLOSED AS AN ATP SCREENABLE FAILURE.

- (E) OPERATIONAL USE:  
NO CREW ACTION AFTER FIRST FAILURE. CREW WILL CLOSE MANIFOLD ISOLATION VALVE AFTER SECOND FAILURE.

- APPROVALS -

RELIABILITY ENGINEERING: M. O. WEST : M. O. West  
DESIGN ENGINEERING : M. M. SCHEIERN : M. M. Scheiern  
QUALITY MANAGER : O. J. BUTTNER : O. J. Buttner  
NASA RELIABILITY : : E. O'Connell  
NASA SUBSYSTEM MANAGER : : Tom W. H. ...  
NASA QUALITY ASSURANCE : : ... 4/17/92  
: ...