

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CIL HARDWARE  
NUMBER: 06-3D-0505 -X**

**SUBSYSTEM NAME:** ATCS - RADIATORS AND FLOW CONTROL  
**REVISION:** 0 12/02/97

**PART DATA**

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	<b>PART NAME VENDOR NAME</b>	<b>PART NUMBER VENDOR NUMBER</b>
LRU	: VALVE,CHECK CIRCLE SEAL	MC284-0472-0034 P200-180

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**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:**  
FREON LOOP, RADIATOR ISOLATION, VALVE, CHECK.

**REFERENCE DESIGNATORS:**

**QUANTITY OF LIKE ITEMS:** 2  
ONE PER LOOP

**FUNCTION:**  
PREVENTS BACKFLOW OF FREON INTO THE RADIATORS WHEN ISOLATION VALVE IS IN RADIATOR BYPASS POSITION.

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**REVISION#: 0 11/19/97**

**SUBSYSTEM NAME: ATCS - RADIATORS AND FLOW CONTROL**

**LRU: CHECK VALVE**

**ITEM NAME: VALVE, CHECK**

**CRITICALITY OF THIS  
FAILURE MODE: 1R2**

**FAILURE MODE:  
EXTERNAL LEAK**

**MISSION PHASE:           LO   LIFT-OFF  
                              OO   ON-ORBIT**

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

**CAUSE:  
VIBRATION, MECHANICAL SHOCK, CORROSION, CONTAMINATION.**

**REDUNDANCY SCREEN           A) PASS  
                                  B) PASS  
                                  C) PASS**

**PASS/FAIL RATIONALE:  
A)  
  
B)  
  
C)**

**- FAILURE EFFECTS -**

**(A) SUBSYSTEM:  
FIRST FAILURE WILL CAUSE LOSS OF EFFECTED COOLANT LOOP.**

**(B) INTERFACING SUBSYSTEM(S):  
FIRST FAILURE CAUSES LOSS OF ONE COOLANT LOOP WILL RESULT IN REDUCED  
VEHICLE COOLING AND PROBABLE SHUTDOWN OF SUBSYSTEMS DUE TO REDUCED  
COOLING CAPACITY.**

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**(C) MISSION:**

PROBABLE LOSS OF MISSION AFTER FIRST FAILURE:

- (1) EXTERNAL LEAK, CHECK VALVE.

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

POSSIBLE LOSS OF CREW/VEHICLE AFTER TWO FAILURES:

- (1) EXTERNAL LEAK CHECK VALVE
- (2) LOSS OF REDUNDANT COOLANT LOOP.

**(E) FUNCTIONAL CRITICALITY EFFECTS:**

PROBABLE LOSS OF MISSION AFTER FIRST FAILURE:

- (1) EXTERNAL LEAK CHECK VALVE CAUSES LOSS OF FREON FOR COOLANT LOOP WITH SUBSEQUENT LOSS OF COOLANT LOOP.

POSSIBLE LOSS CREW/VEHICLE AFTER TWO FAILURES:

- (1) EXTERNAL LEAK CHECK VALVE CAUSES LOSS OF FREON FOR COOLANT LOOP WITH SUBSEQUENT LOSS OF COOLANT LOOP.
- (2) LOSS OF REDUNDANT COOLANT LOOP CAUSES LOSS OF ALL VEHICLE COOLING.

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**-DISPOSITION RATIONALE-**

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**(A) DESIGN:**

THE CHECK VALVE IS A POPPET TYPE, SPRING LOADED AND PRESSURE ASSISTED TO THE CLOSED POSITION. THE POPPET AND SPRING ARE CONTAINED IN A THREADED HOUSING AND END CAP. THE POPPET SEAL IS A SELF-CENTERING TEFLON O-RING. THE VALVE BODY PROVIDES A GUIDE FOR THE POPPET TRAVEL. THE VALVE BODY IS DESIGNED TO A FACTOR OF SAFETY OF 2.0 PROOF AND 4.0 BURST.

THE THREADED HOUSING IS MANUFACTURED FROM 316L CRES AND THE END CAP IS INCONEL 718. THE END CAP IS THREADED INTO THE HOUSING (TORQUED TO 75 FT-LBS) AND TIG WELDED TO SEAL THE JOINT.

STRUCTURAL ANALYSIS, PERFORMED BY THE CHECK VALVE SUPPLIER, INDICATES POSITIVE MARGINS OF SAFETY FOR ALL CONDITIONS OF CHECK VALVE OPERATION

**(B) TEST:**

ATP

EXAMINATION OF PRODUCT

AMBIENT TESTS

BODY PROOF PRESSURE (1717 PSIG)

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CLOSURE DEVICE PROOF PRESSURE (1717 PSIG)  
EXTERNAL LEAKAGE (850 PSIG)  
INTERNAL LEAKAGE (5, 25, 100, 850 PSIG)  
CRACKING AND RESEAT PRESSURE: 3 CYCLES  
CRACKING PRESSURE 0.6 PSID MAX  
RESEAT PRESSURE 0.1 PSID MIN

LOW TEMPERATURE TESTS (-160 DEG F)  
INTERNAL LEAKAGE (5, 25, 100, 850 PSIG)

CERTIFICATION

FLOW TEST (0.202 LB/SEC GHE)  
MAX INLET PRESSURE OF 130 PSIG  
PRESSURE DROP (15 PSID MAX)

CHATTER TEST (850 TO 0 PSIG)  
RECORD FLOW RATE WHEN CHATTER OCCURS

CRACKING AND RESEAT PRESSURE  
AMBIENT: 3 CYCLES EACH  
CRACKING PRESSURE 0.6 PSID MAX  
RESEAT PRESSURE 0.1 PSID MIN

INTERNAL LEAKAGE AMBIENT (0 TO 850 PSIG) LOW TEMPERATURE (-160 DEG F, 0 TO 850 PSIG)

EXTERNAL LEAKAGE (AMBIENT, 850 PSIG)

LIFE CYCLE TEST

ONE CYCLE CONSISTS OF PRESSURIZING THE INLET TO 130 PSIG, VENTING THE INLET TO AMBIENT, PRESSURIZING THE OUTLET TO 850 PSIG, AND VENTING THE OUTLET TO AMBIENT.

42,000 CYCLES (AMBIENT)

FOLLOWED BY CRACK, RESEAT, AND INTERNAL LEAKAGE TESTS (-160 DEG F)

VIBRATION (AMBIENT, 2 AXES)

RANDOM  
4.4 HOURS FOR EACH OF 2 AXES

UPON COMPLETION OF VIBRATION TESTS PERFORM CRACK, RESEAT, AND INTERNAL LEAKAGE TEST.

BURST PRESSURE (3400 PSIG)

GROUND TURN AROUND TEST  
FREON COOLANT LOOPS ARE LEAK CHECKED PRIOR TO EACH FLIGHT

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**(C) INSPECTION:**

**RECEIVING INSPECTION**

ALL RAW MATERIALS ARE VERIFIED FOR MATERIAL AND PROCESS CERTIFICATION. RECEIVING INSPECTION VERIFIES CERTIFICATION OF SPRING HEAT TREATMENT AND PERFORMS LOAD TEST OF SPRINGS.

**CONTAMINATION CONTROL**

ALL PARTS AND ASSEMBLIES ARE MAINTAINED TO CLEANLINESS LEVEL OF 100A. INLET AND OUTLET ARE PROTECTED AFTER TESTS TO MAINTAIN INTERNAL CLEANLINESS.

**ASSEMBLY/INSTALLATION**

DIMENSIONS AND SURFACE FINISHES ARE VERIFIED BY INSPECTION. INSPECTION POINTS ARE ESTABLISHED TO VERIFY ASSEMBLY PROCESS. WELDS ARE VISUALLY VERIFIED BY 10X MAGNIFICATION.

**CRITICAL PROCESSES**

ALL WELDING, ELECTROPOLISHING AND PARTS PASSIVATION ARE VERIFIED BY INSPECTION.

**NONDESTRUCTIVE EVALUATION**

HELIUM LEAKAGE DETECTION IS VERIFIED.

**TESTING**

ATP IS VERIFIED BY INSPECTION.

**HANDLING/PACKAGING**

PACKAGING FOR SHIPMENT IS VERIFIED BY INSPECTION.

**(D) FAILURE HISTORY:**

AN EXTERNAL LEAK WAS DETECTED DURING PANEL ASSEMBLY AND CHECKOUT AT DOWNEY. THE LEAK WAS CAUSED BY A MISSING SECTION OF THE TEFLON COATING FROM THE DYNATUBE END FITTING ON THE CHECK VALVE CLOSER INSPECTION OF SEALING SURFACES PRIOR TO ASSEMBLY HAS BEEN IMPLEMENTED (REFERENCE DR AC1781).

**(E) OPERATIONAL USE:**

ON-BOARD ALARMS, FREON INLET PRESSURE AND ACCUMULATOR QUANTITY, WILL PROVIDE INDICATION OF HARDWARE FAILURE. FREON PUMP WILL BE TURNED OFF AND LOSS OF ONE FREON COOLANT LOOP POWERDOWN WILL BE PERFORMED. ENTRY AT NEXT PRIMARY LANDING SITE.

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- APPROVALS -

SS & PAE MANAGER  
SS & PAE ENGINEER  
ECLSS-ATCS  
BNA SSM  
JSC MOD  
JSC RDE

*USA/estoter*

*FAC* D.F. MIKULA  
: K.E. RYAN  
: L. T. HARPER  
: S. N. NGUYEN  
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*Nanette Cervin*  
*Suzanne Little 1/4/99*  
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