



SHUTTLE CRITICAL ITEMS LIST - ORBITER NUMBER: 03-2A-201013-X

SUMMARY

SUBSYSTEM NAME: AFT REACTION CONTROL SYSTEM (RCS)

LRU : CONTROL UNIT

LRU PART #: MC621-0059

ITEM NAME: CONTROL UNIT (FIELD FEEDING)

FIN 73A & 307

FMEA NUMBER	ABBREVIATED FAILURE MODE DESCRIPTION	CIL PLG	CRIT	HED FLG
03-2A-201013-01	EXTERNAL LEAKAGE	X	1 1	

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SUBSYSTEM: AFT REACTION CONTROL SYSTEM (RCS) REVISION: 0 11/21/88 W  
LRU : CONTROL UNIT CRUISE 200  
ITEM NAME: CONTROL UNIT CRUISE FEEDBACKS CRITICALITY OF THIS FAILURE MODE: 1 1

FAILURE MODE:  
STRUCTURAL FAILURE, RUPTURE, EXTERNAL LEAKAGE

MISSION PHASE:  
PL PRELAUNCH  
LO LIFT-OFF  
OO ON-ORBIT  
DO DE-ORBIT  
LS LANDING SEQUENCE

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

CAUSE:  
MAT'L DEF (SULPHIDE STRINGER), VIB, SHOCK, FATIGUE, WELD DEF, STRESS  
CORROS, IMPROPER INSTALL.

CRITICALITY 1/1 DURING ANY MISSION PHASE OR ABORT? Y

REDUNDANCY SCREEN A) N/A  
B) N/A  
C) N/A

PASS/FAIL RATIONALE:

- A)
- B)
- C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:  
LOSS OF SUBSYSTEM PRESSURIZATION CAPABILITY IF NOT ISOLATED (IF FAILURE IS UPSTREAM OF ISO VLV-INABILITY TO DEplete/UTILIZE PROP).

(B) INTERFACING SUBSYSTEM(S):  
LOSS OF INTERFACE FUNCTION (INABIL TO REPRESS PROP TANK - POTENTIAL FOR STRUCT AND/OR TPS DAMAGE.

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**(C) MISSION:**

ABORT DECISION (LOSS OF PRESS) POTENTIAL LOSS OF MISSION OR EARLY MISSION TERMINATION.

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

POSSIBLE LOSS OF CREW/VEHICLE - IF LEAK IS EXCESSIVE OR POD/TPS DAMAGE OCCURS PRECLUDING SAFE ENTRY. INABILITY TO EFFECTIVELY USE PROPELLANT FOR ET SEP/ENTRY. OVERPRESSURIZATION OF POD MAY OCCUR.

**RATIONALE FOR CRITICALITY:**

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 - DISPOSITION RATIONALE -  
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**(A) DESIGN:**

F.S. IS 1.5 TO 4.0 MAXIMUM OPERATING PRESSURE (SYSTEM RELIEF). THE FACTOR OF SAFETY FOR VALVE BODIES IS >1.5. THE WELDED CONSTRUCTION ELIMINATES JOINTS AND POSSIBLE LEAK PATHS. THE ANNEALED AREA (DUE TO WELDING) IS BACKED UP BY A SLEEVE.

FASTENING CLAMPS ALLOW FREEDOM OF MOVEMENT. TUBING BENDS ARE CONTROLLED BETWEEN FIXED POINTS TO FACILITATE INSTALLATION AND ACCOMMODATE VEHICLE GROWTH AND MOVEMENT. MECHANICAL FITTINGS ARE DYNATUBE OR DUAL SEAL TYPE. ADEQUACY OF SUPPORTING STRUCTURE IS VERIFIED BY DYNAMIC SUBSYSTEM TESTING.

**(B) TEST:**

ROCKWELL PERFORMED LIMITED TUBING CERTIFICATION TESTS PER "ORBITER TUBING VERIFICATION PLAN" (SD 75-SH-0205). THIS TESTING INCLUDED PRESSURE CYCLING AND FATIGUE FOR TYPICAL SHUTTLE LINES & JOINTS.

SYSTEM EVALUATION TESTS AT JSC INCLUDING APT POD VIBRATION ACOUSTIC TESTS (131 EQUIVALENT MISSIONS) ALSO ALLOW EVALUATION IN THE INSTALLED SYSTEM CONDITION. PROOF PRESSURE (1.25 MAX. OP) AND LEAKAGE TEST ARE PERFORMED IN-PROCESS FOR TUBING SECTIONS. OPTICAL INSPECTIONS ARE ALSO PERFORMED AT THIS TIME IN ADDITION TO X-RAY AND DYE PENETRANT. LEAKAGE TESTS ARE ALSO PERFORMED AFTER INSTALLATION INTO THE SYSTEM AND ADDITIONAL WELDS ARE ALSO SUBJECTED TO NDE.

HOT FIRE TESTING AT WSTF INCLUDED 24 EQUIVALENT MISSION DUTY CYCLES AND APPROX 7 YEARS OF PROPELLANT EXPOSURE.

OMRSD PERFORMS THE FOLLOWING: PRESSURE DECAY CHECKS ON HIGH PRESSURE HELIUM SYSTEM FOR EACH FLIGHT. PRESSURE DECAY CHECKS OF LOW PRESSURE HELIUM SYSTEM FOR EACH FLIGHT. FIRST FLIGHT EXTERNAL LEAK CHECKS AND ALSO WHEN COMPONENTS ARE REMOVED AND REPLACED. HELIUM SYSTEM ACTIVATION FOR EACH FLIGHT. HELIUM SERVICING FOR EACH FLIGHT. HELIUM QUALITY IS VERIFIED PER SE-S-2073. HELIUM SYSTEM SAMPLING EVERY THREE FLIGHTS AND ON A CONTINGENCY BASIS. SUBSYSTEM INSPECTION THE FIFTH FLIGHT AND EVERY FIVE FLIGHTS THEREAFTER AND ON A CONTINGENCY BASIS.

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(C) INSPECTION:

RECEIVING INSPECTION  
RAW MATERIAL AND PHYSICAL PROPERTIES ARE VERIFIED BY INSPECTION.

CONTAMINATION CONTROL

CORROSION PROTECTION AND CLEANLINESS TO LEVEL 200 FOR MMH AND 200A FOR  
NTC ARE VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

DIMENSIONAL AND VISUAL INSPECTIONS ARE VERIFIED.

NONDESTRUCTIVE EVALUATION

WELDS ARE VERIFIED BY X-RAY INSPECTIONS.

CRITICAL PROCESSES

WELDING IS VERIFIED BY INSPECTION.

TESTING

ATP IS WITNESSED AND VERIFIED BY INSPECTION.

(D) FAILURE HISTORY:

CAR AC1418:

AFTER STS-2 OV-102 HAD A LINE FAILURE DUE TO A BAD WELD DUE TO KRYTOX  
CONTAMINATION. THIS WAS A SPECIAL MR ACTION AND CONSIDERED AN ISOLATE  
INCIDENT. CORRECTIVE ACTION WAS TO MAKE PERSONNEL MORE AWARE OF  
SPECIAL MR ACTION CERTIFICATION.

CAR AC0058:

ONE OD FAILED BECAUSE OF FATIGUE SUBSEQUENT TO COMPLETING A 100  
MISSION ACOUSTIC TEST AND DURING AN ADDITIONAL 25 MISSION TEST.  
MCDONNELL DOUGLAS DWG 73A620000 HAS BEEN CHANGED TO PROVIDE ADDITIONAL  
SUPPORT.

CAR'S AB4724, AB5888, AB6494, AND AC1153:

THERE HAVE BEEN SEVERAL INSTANCES OF SMALL LEAKAGES THAT HAVE OCCURRED  
IN DYNATUBES (POST FLIGHT). THESE LEAKS ARE ALWAYS SMALL AND ARE CAUSED  
BY RELAXED TORQUE (LOW END OF ALLOWANCE) ON THE DYNATUBE FITTING DUE TO  
CYCLING OF TEMPERATURE OR VIBRATION LOADS. PROBLEM SOLVED BY BACKING  
OFF THE DYNATUBE FITTING AND RETORQUING TO MAX ALLOWED. IF THIS FAILED  
THE SEALING SURFACE WAS POLISHED AND RETORQUED. ANOTHER CAUSE FOR  
LEAKAGE IS IMPROPER ALIGNMENT. IN WHICH THE TUBE ALIGNMENT WAS  
ALSO CHECKED AND CORRECTED IF REQUIRED. THIS PROCEDURE HAS BEEN  
EXCEPTIONALLY SUCCESSFUL.

(E) OPERATIONAL USE:

FOR LARGE LEAKS ABOVE THE HE ISOLATION VALVE A CONTINGENCY PROCEDURE  
WOULD BE TO CLOSE THE HE ISO VLV AND USE SYSTEM BLOWDOWN FOR ENTRY  
UNTIL MINIMUM ENGINE PRESSURE IS REACHED. USE CROSSFEED FOR ENTRY.  
PROPELLANT MAY NOT BE SUFFICIENT FOR NOMINAL ENTRY.

IF FAILURE OCCURS PRIOR TO ET SEP, BLOWDOWN IS AVAILABLE FOR A NOMINAL

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ET SEP IF NO MAJOR DISPERSIONS OCCUR. FOR LEAKS BETWEEN HE ISO AND CHECK VALVES CLOSE THE HE ISO VALVE AND PERFORM STAGE PRESSURIZATION OF THE PROPELLANT SYSTEM.

FOR LEAKS BETWEEN THE CHECK VALVE AND PROP TANK THAT ARE NOTICEABLE DUMP ONBOARD PROPELLANT WHEN ON-ORBIT.

- APPROVALS -

RELIABILITY ENGINEERING: R. P. DIEHL  
 DESIGN ENGINEERING : V. FONDOKIAN  
 QUALITY ENGINEERING : W. J. SMITH  
 NASA RELIABILITY :  
 NASA SUBSYSTEM MANAGER :  
 NASA QUALITY ASSURANCE :

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