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PRINT DATE: 04/24/89

SHUTTLE CRITICAL ITEMS LIST - ORBITER NUMBER: 03-2F-101013-X

SUBSYSTEM NAME: FORWARD REACTION CONTROL SYSTEM (RCS)

REVISION : I 01/01/87

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
■ LRU :	HELIUM FEED LINE AND FITTINGS	V070-421701

■ EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
HELIUM FEED LINE (INCLUDING MECHANICAL FITTINGS AND VALVE BODIES)

■ QUANTITY OF LIKE ITEMS: 2
ONE SET PER PROPELLANT

■ FUNCTION:
1/2 X .042 304L S.S. LINES TO PROVIDE HELIUM FEED FROM HELIUM TANKS TO HELIUM REGULATION/PRESSURIZATION SYSTEM PANEL 1/4 X .020 304L S.S. LINES TO THE TEST POINT COUPLINGS. 3/4 X .020 304L S.S. LINES TO PROVIDE LOW PRESSURE HELIUM FROM THE REGULATOR TO THE PROPELLANT TANK. 1/4 X .028 VALVE BODIES FOR THE PRESSURIZATION SYSTEM INCLUDE COUPLING, TRANSDUCERS, HELIUM ISOLATION VALVES, PRESSURE REGULATORS, CHECK VALVES, RELIEF VALVE, AND MANUAL VALVE. THE COMPONENT BODIES ARE "CRES" FORGINGS OR MACHINED FROM BILLETS.

304L S.S. LINES TO PROVIDE FEED TO TEST POINT COUPLINGS. FITTINGS OF 304L S.S./21-6-9 S.S. ARE INTERCHANGEABLE AND COMPATIBLE.

SHUTTLE CRITICAL ITEMS LIST - ORBITER NUMBER: 03-2F-101013-X

SUMMARY

SUBSYSTEM NAME: FORWARD REACTION CONTROL SYSTEM (RCS)
LRU :HELIUM FEED LINE AND FITTINGS
ITEM NAME: HELIUM FEED LINE AND FITTINGS

FMEA NUMBER	ABBREVIATED FAILURE MODE DESCRIPTION	CIL FLG	CRIT	HZD FLG
03-2F-101013-01	RUPTURE/LEAKAGE	X	1/1	

 PRINT DATE: 04/24/89

SHUTTLE CRITICAL ITEMS LIST - ORBITER NUMBER: 03-2F-101013-01

REVISION: 1 01/01/87

SUBSYSTEM: FORWARD REACTION CONTROL SYSTEM (RCS)
LRU :HELIUM FEED LINE AND FITTINGS CRITICALITY OF THIS
ITEM NAME: HELIUM FEED LINE AND FITTINGS 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 SAFING

■ 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 INTACT ABORT ONLY? N

■ 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 (INABILITY TO REPRESS PROP TANK - POTENTIAL POD STRUCT AND/OR TPS DAMAGE).

■ (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.

■ (E) FUNCTIONAL CRITICALITY EFFECTS

- DISPOSITION RATIONALE -

■ (A) DESIGN:
F.S. IS 1.5 TO 4.0 MAXIMUM OPERATING PRESSURE (SYSTEM RELIEF). THE FACTOR OF SAFETY FOR THE 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 AND JOINTS.

SYSTEM EVALUATION TESTS AT JSC INCLUDING APS 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. HE SERVICING FOR EACH FLIGHT. HELIUM QUALITY IS VERIFIED PER SE-S-0073. 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.

■ (C) INSPECTION:
RECEIVING INSPECTION
RAW MATERIAL IS VERIFIED BY INSPECTION.

CONTAMINATION CONTROL
CLEANLINESS TO LEVEL 200 FOR MMH AND 200A FOR NTO IS VERIFIED BY INSPECTION. FABRICATION PER APPLICABLE DRAWINGS AND SPECIFICATIONS. TUBING INSTALLATION, AND MOUNTING CLAMPS AND ATTACHING HARDWARE ARE VERIFIED BY INSPECTION. SEALING SURFACES OF COMPONENTS AND MECHANICAL FITTINGS ARE VISUALLY INSPECTED PRIOR TO INSTALLATION.

ASSEMBLY/INSTALLATION
DIMENSIONAL AND VISUAL INSPECTIONS ARE VERIFIED.

NONDESTRUCTIVE EVALUATION
WELDS ARE VERIFIED BY RADIOGRAPHIC INSPECTION PER MTOS01-507.

CRITICAL PROCESSES
WELDING IS VERIFIED BY INSPECTION.

TESTING
ATP IS WITNESSED AND VERIFIED BY INSPECTION.

HANDLING/PACKAGING
RECEIVING INSPECTION VERIFIES THAT PARTS ARE PACKAGED PER SPECIFICATION REQUIREMENTS. CLEANED PARTS ARE PACKAGED TO MAINTAIN CLEANLINESS REQUIREMENTS. ANY EXPOSED SEALING SURFACES OF PARTIALLY INSTALLED COMPONENTS ARE PROTECTED AGAINST DAMAGE TO THE SEALING SURFACE AND SEALED TO PROTECT CONTAMINATION.

■ (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 WAS CONSIDERED AN ISOLATED INCIDENT. CORRECTIVE ACTION WAS TO MAKE PERSONNEL MORE AWARE OF SPECIAL MR ACTION CERTIFICATION.

CAR AC0058:
ONE QD 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, AC1153, AND KB0199:
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 ALLOWABLE) 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 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. DUMP TO MAX BLOWDOWN IF LEAKAGE RATE PERMITS.

IF FAILURE OCCURS PRIOR TO ET SEP, BLOWDOWN IS AVAILABLE FOR A NOMINAL 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	J. LAZARUS	
QUALITY ENGINEERING	W. J. SMITH	
NASA RELIABILITY		
NASA SUBSYSTEM MANAGER		
NASA QUALITY ASSURANCE		