

## FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL HARDWARE

NUMBER: 06-1C-0193-X

SUBSYSTEM NAME: ARS - ARPCS

REVISION : 1 10/16/90

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU :	FLEXLINE, BLKHD, O2 SYS 1 COAST METAL CRAFT	MC271-0085-1012 92160
LRU :	FLEXLINE, BLKHD, O2 SYS 2 COAST METAL CRAFT	MC271-0085-1013 92161
LRU :	FLEXLINE, BLKHD, AUX O2 COAST METAL CRAFT	MC271-0085-1014 92162

## PART DATA

- EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:  
FLEXLINES, O2, BULKHEAD INTERFACE
- QUANTITY OF LIKE ITEMS: 3  
THREE
- FUNCTION:  
PROVIDE FLEXIBILITY IN THE CREW MODULE/MID-FUSELAGE O2 SUPPLY SYSTEM  
MATING INSTALLATION. AUXILIARY O2 LINE IS USED ONLY WHEN THE AUXILIARY  
O2 TANK KIT IS INSTALLED.

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SUBSYSTEM: ARS - ARPCS  
LRU :FLEXLINE, BLKHD, O2 SYS 1  
ITEM NAME: FLEXLINE, BLKHD, AUX O2

CRITICALITY OF THIS  
FAILURE MODE:1/1

FAILURE MODE:  
RESTRICTED FLOW

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  
: 105 ENDEAVOUR

CAUSE:  
CONTAMINATION, CORROSION, MECHANICAL SHOCK

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

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

PASS/FAIL RATIONALE:

A)

B)

C)

- FAILURE EFFECTS -

(A) SUBSYSTEM:  
LOSS OF REDUNDANCY - RESTRICTED FLOW PATH CANNOT BE USED TO SUPPLY  
OXYGEN TO CABIN.

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(B) INTERFACING SUBSYSTEM(S):  
| REDUCED OXYGEN FLOW PATHS AVAILABLE.

(C) MISSION:  
POSSIBLE EARLY MISSION TERMINATION AS ONLY ONE OXYGEN SOURCE REMAINS FOR CABIN, AIRLOCK AND LES REQUIREMENTS.

(D) CREW, VEHICLE, AND ELEMENT(S):  
LOSS OF ONE O2 SUPPLY SYSTEM RESULTS IN INSUFFICIENT OXYGEN FLOW TO LES SYSTEM. LOSS OF THIS EMERGENCY SYSTEM MAY RESULT IN LOSS OF CREW/VEHICLE.

(E) FUNCTIONAL CRITICALITY EFFECTS:  
NONE.

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- DISPOSITION RATIONALE -  
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(A) DESIGN:  
THE BODY OF THE FLEXLINE AND THE FITTING ASSEMBLY ARE MADE OF 321 CRES AND 17-4 PH CRES RESPECTIVELY. BOTH OF THESE STAINLESS STEELS ARE CORROSION RESISTANT AND O2 COMPATIBLE. THE LINE ASSEMBLIES ARE A COMBINATION OF HARDLINE AND FLEX JOINTS WHICH PERMIT CONTROLLED FLEXURES IN THE X, Y AND Z DIRECTIONS. THE LINE ASSEMBLY, WHILE AT OPERATING PRESSURE AND TEMPERATURE, CAN WITHSTAND 800 FLEXURE CYCLES IN EACH OF THE ORTHOGONAL AXES WITHOUT LEAKAGE, IMPAIRMENT OR DEGRADATION OF PERFORMANCE.

(B) TEST:  
ACCEPTANCE TEST - CRYO O2: FLOW RATE 10 LB/HR, PROOF PRESSURE 2100 PSIG. AUXILIARY O2: FLOW 150 LB/HR, PROOF PRESS 2500 PSIG. ~~N2 FLOW 75 LB/HR, PROOF PRESS 550 PSIG. MAX LEAKAGE AT OPERATING PRESSURE 1 X 10 EXP -4 SCCS CHE; CRYO O2 AT 1050 PSIG, AUX O2 AT 1250 PSIG, N2 AT 275 PSIG.~~ *ROCKWELL TO VERIFY & REWRITE FOR O2 ONLY*  
MAX PRESSURE DROP AT OPERATING PRESSURE: CRYO O2 - 0.08 PSI, AUX O2 4.62 PSI, ~~N2 1.96 PSI.~~

QUALIFICATION TEST - QUALIFICATION TEST - VIBRATION: THE SPECIMENS WERE SUBJECTED TO 48 MINUTES OF RANDOM VIBRATION IN EACH OF THREE ORTHOGONAL AXES OVER A FREQUENCY RANGE OF 20 TO 2000 HZ AT THE FOLLOWING INTENSITIES - FROM 20 TO 150 HZ, 6 DB/OCTAVE RISE; FROM 150 TO 900 HZ, CONSTANT AT 0.09 G\*\*2/HZ; FROM 900 TO 2000 HZ, 9 DB/OCTAVE DECREASE. FOLLOWING THE VIBRATION TESTING, EACH SPECIMEN WAS SUBJECTED TO THE PROOF PRESSURE TEST. DESIGN SHOCK: THE SPECIMENS WERE SUBJECTED TO THREE SHOCK PULSES IN EACH DIRECTION OF THREE ORTHOGONAL AXES. EACH SHOCK PULSE HAS AN AMPLITUDE OF 20 G, A DURATION OF 11 MS, AND APPROXIMATED A TERMINAL PEAK SAWTOOTH SHAPE.

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TRANSIENT SHOCK TEST: WHILE PRESSURIZED THE SPECIMENS WERE SUBJECTED TO ONE SINUSOIDAL SWEEP IN THREE ORTHOGONAL AXES OVER THE FREQUENCY RANGE OF 5 TO 35 HZ AT A SWEEP RATE OF ONE OCTAVE PER MINUTE AT AN APPLIED ACCELERATION OF 0.25 G PEAK. BURST PRESSURE: CRYO O2 - 4200 PSIG, AUX O2 - 5000 PSIG, ~~N2 - 1100 PSIG.~~

IN-VEHICLE TESTING - FLOW LIMITER (RESTRICTOR) TEST VERIFIES THE REQUIRED FLOW RATE FROM THE PRSD CRYO O2 SYSTEM.

OMRSD - O2 REGULATOR ASSEMBLY CHECKS, PERFORMED BEFORE THE FIRST REFLIGHT OF EACH ORBITER AND AT INTERVALS OF FIVE FLIGHTS, VERIFY REQUIRED FLOW FROM THE PRSD SYSTEM. THE PRSD SYSTEM IS SERVICED WITH GO2 PER SE-S-0073 AND THE GROUND HALF QUICK DISCONNECTS CONTAIN FILTERS.

**(C) INSPECTION:**

RECEIVING INSPECTION  
RAW MATERIAL VERIFIED BY INSPECTION FOR MATERIAL AND PROCESS CERTIFICATION.

**CONTAMINATION CONTROL**

CLEANLINESS LEVEL 200A PER MA0110-301 AND 100 ML RINSE TESTS VERIFIED BY INSPECTION. ELECTRO-POLISH ON THE EXTERNAL SURFACES PRIOR TO WELDING VERIFIED BY INSPECTION.

**ASSEMBLY/INSTALLATION**

DIMENSIONAL CHECKS PERFORMED BY INSPECTION. TORQUE VERIFIED BY INSPECTION. MIPS ARE INCLUDED IN THE ASSEMBLY PROCEDURE. INERT ARC WELD APPLICATION IN ACCORDANCE WITH MA0107-3 VERIFIED BY INSPECTION.

**NONDESTRUCTIVE EVALUATION**

RADIOGRAPHIC INSPECTION OF WELDS IS VERIFIED BY INSPECTION.

**CRITICAL PROCESSES**

PASSIVATION OF COMPONENTS PRIOR TO WELDING PER P.S.101 AND ARCWELD ARE VERIFIED BY INSPECTION.

**TESTING**

ATP VERIFIED BY INSPECTION.

**HANDLING/PACKAGING**

HANDLING, PACKAGING, STORAGE AND SHIPPING PROCEDURES ARE VERIFIED.

**(D) FAILURE HISTORY:**

NO FAILURE HISTORY.

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(E) OPERATIONAL USE:

NONE

- APPROVALS -

RELIABILITY ENGINEERING:	D. R. RISING	<i>DRR</i>	:	<u><i>E. J. ...</i></u>
DESIGN ENGINEERING	: M. PRICE	<i>MP</i>	:	<u><i>C. J. ...</i></u>
QUALITY ENGINEERING	: M. SAVALA		:	<u><i>M. Savala for OSA 2/8/91</i></u>
NASA RELIABILITY	:		:	<u><i>JPB</i></u>
NASA SUBSYSTEM MANAGER	:		:	<u><i>T. ... 4-2-91</i></u>
NASA QUALITY ASSURANCE	:		:	<u><i>D. M. ... 2/3/91</i></u>
			:	<u><i>PT 2/11/91</i></u>

CONSIDERATION WILL BE GIVEN TO DEPRESSURIZING THE CABIN TO 10.2 PSIA FOR CREW SIZES FIVE OR MORE (REDUCED PRESSURE REDUCES O2 FLOW RATE REQUIREMENT TO ACCEPTABLE LEVELS).