

FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL HARDWARE

NUMBER: 06-1C-0193-X

SUBSYSTEM NAME: ARS - ARPCS

REVISION : 1 10/16/90

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	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

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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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ATTACHMENT -  
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FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL FAILURE MODE  
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SUBSYSTEM: ARS - ARPCS  
LRU : FLEXLINE, BLKHD, O2 SYS 1  
ITEM NAME: FLEXLINE, BLKHD, AUX O2

REVISION# 4 10/16/90

CRITICALITY OF THIS  
FAILURE MODE: 1/1

FAILURE MODE:  
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  
: 105 ENDEAVOUR

CAUSE:  
MECHANICAL SHOCK, VIBRATION, CORROSION, MATERIAL DEFECT, FATIGUE

| 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:

| EXCESSIVE LOSS OF OXYGEN UNTIL ASSOCIATED O2 SUPPLY VALVE IS CLOSED.

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(B) INTERFACING SUBSYSTEM(S):  
1 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: *RI TO VERIFY, RI TO UPDATE FOR O2 ONLY.*  
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 650 PSIG. MAX LEAKAGE AT OPERATING PRESSURE: X 10 EYE - 4 SECS GME; CRYO O2 AT 1050 PSIG, AUX O2 AT 1250 PSIG, N2 AT 275 PSIG. MAX PRESSURE DROP AT OPERATING PRESSURE: CRYO O2 - 0.08 PSI, AUX O2 4.62 PSI, N2 1.06 PSI.~~

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. TRANSIENT SHOCK TEST: WHILE

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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, ~~1100 PSIG.~~

## IN-VEHICLE TESTING -

O2 LINES ARE OVERPRESSURE (1070-1255 PSIG) AND LEAK (925 - 950 PSIG, 1 X 10 EXP -7 GHE MAX) TESTED, WITH COMPONENTS INSTALLED.

OMRSD - O2 SYSTEM LEAK TEST IS PERFORMED BEFORE THE FIRST REFLIGHT OF EACH ORBITER AND AT INTERVALS OF FIVE FLIGHTS, AT 900 - 950 PSIG, 70 SCCM MAX LEAKAGE. INFIGHT CHECKOUT DURING EACH MISSION WILL VERIFY NO EXTERNAL LEAKAGE.

## (C) INSPECTION:

## RECEIVING INSPECTION

RAW MATERIAL VERIFIED BY INSPECTION FOR MATERIAL AND PROCESS CERTIFICATION.

## CONTAMINATION CONTROL

CLEANLINESS LEVEL 200A PER MAQ110-301 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 MAQ107-3 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 BY INSPECTION.

## (D) FAILURE HISTORY:

NO FAILURE HISTORY.

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(E) OPERATIONAL USE:

1. CREW ACTION

PERFORM LEAK ISOLATION AND ~~HIGH O2 CONCENTRATION~~ TROUBLE SHOOTING.

~~2. TRAINING~~

~~STANDARD ECSS TRAINING COVERS THE GENERIC HIGH O2 CONCENTRATION.~~

2. OPERATIONAL CONSIDERATION

A. PRECLUDES USE OF LES UNLESS LEAK IS SMALL ENOUGH TO PERMIT  
SIMULTANEOUS LES USE PLUS O2 LEAKAGE TO CABIN.

~~B. HIGH O2 CONCENTRATION HAS FLAMABILITY CONCERN~~

- APPROVALS -

RELIABILITY ENGINEERING:	D. R. RISING	DR	:	<u>[Signature]</u>
DESIGN ENGINEERING	: K. KELLY	KK	:	<u>[Signature]</u>
QUALITY ENGINEERING	: M. SAVALA		:	<u>[Signature]</u>
NASA RELIABILITY	:		:	<u>[Signature]</u>
NASA SUBSYSTEM MANAGER	:		:	<u>[Signature]</u>
NASA QUALITY ASSURANCE	:		:	<u>[Signature]</u>

*Handwritten notes: JPB, 4-2-91, 4/3/91*

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).