

PAGE: 1

PRINT DATE: 08/27/93

FAILURE MODES EFFECTS ANALYSIS (FMEA) - CRITICAL HARDWARE  
NUMBER: 06-1C-0115-X

SUBSYSTEM NAME: ARS - ARPCS

REVISION: 3 08/26/93

---

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	FILTER, IN-LINE, O2 BRUNSWICK/WINTEC	ME286-0061-0001 15122-503

---

PART DATA

---

QUANTITY OF LIKE ITEMS: 2  
ONE PER LOOP  
TWO PER SUBSYSTEM

FUNCTION:  
FILTER, CRYOGENIC (1.5)

FILTERS SUPPLY OF OXYGEN FROM PRSD CRYOGENIC TANKS TO PROTECT OXYGEN  
RESTRICTOR FROM CONTAMINATION (STOPS PARTICLE SIZES GREATER THAN 70  
MICRONS).

**FAILURE MODES EFFECTS ANALYSIS (FMEA) – CRITICAL FAILURE MODE  
NUMBER: 06-1C-0115-03**

REVISION# 3 08/26/93

SUBSYSTEM NAME: ARS - ARPCS  
LRU: FILTER, IN-LINE, O2  
ITEM NAME: FILTER, IN-LINE, O2

CRITICALITY OF THIS  
FAILURE MODE: 1/1

**FAILURE MODE:**  
EXTERNAL LEAKAGE  
AUX O2 TANK NOT INSTALLED

**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

**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 ONE O2 SOURCE TO AIRLOCK AND LES.

**(B) INTERFACING SUBSYSTEM(S):**  
LOSS OF ONE O2 SOURCE TO AIRLOCK AND LES.

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

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- CRITICAL FAILURE MODE  
NUMBER: 06-1C-0115-03****(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

---

**-DISPOSITION RATIONALE-**

---

**(A) DESIGN:**

THE FILTER ASSEMBLY IS MADE OF 304L CRES CONDITION A STAINLESS STEEL. 304L CRES STEEL IS IN THE AUSTENITIC STEEL GROUP WHICH IS HIGHLY RESISTANT TO MANY ACIDS, INCLUDING HOT OR COLD NITRIC ACID. THEY HAVE EXCELLENT TOUGHNESS AT TEMPERATURES AS LOW AS LIQUID HELIUM (-452 F) AND ARE USEFUL FOR PARTS SUBJECTED TO SEVERE STRESSES AT ELEVATED TEMPERATURES. LIQUID O2 HAS A TEMPERATURE OF -381.12 F. THE FILTER SIZE IS 70 MICRONS ABSOLUTE. CLEANLINESS LEVEL IS 200A PER MAO110-301. THE FILTER CAN PASS A MINIMUM OF 6000 LBS OF OXYGEN WITHOUT EXCEEDING A PRESSURE DROP OF 40 PSID AT A FLOW RATE OF 10 LB/HR. THE MAIN PURPOSE OF THE FILTER IS TO PROTECT THE DOWNSTREAM RESTRICTOR AND SACRIFICE ITSELF IN THE CASE OF EXCESSIVE CONTAMINATION.

**(B) TEST:**

ACCEPTANCE TEST - THE FILTER SHALL WITHSTAND A MINIMUM INTERNAL PROOF PRESSURE OF 1.5 TIMES (1575 PSIG) ITS MAXIMUM OPERATING PRESSURE WITHOUT EXTERNAL LEAKAGE FOR 10 MINUTES. THE EXTERNAL LEAKAGE SHALL NOT EXCEED  $1 \times 10^{-4}$  SCCS GHE ACTUAL WHEN THE FILTER IS PRESSURIZED WITH GHE AT ANY PRESSURE FROM ZERO TO 1050 PSIA FOR 15 MINUTES.

QUALIFICATION TEST - THE FILTERS WERE MOUNTED IN A VIBRATION UNIT AND PRESSURIZED TO 970 PSIG WITH GN2. RANDOM VIBRATION - THE FILTERS WERE VIBRATED FOR 48 MINUTES IN EACH OF THE THREE AXES; VIBRATION FREQUENCY RANGE WAS 20 THROUGH 2000 HZ WITH AN OVERALL ACCELERATION OF 15.5 G RMS. SINUSOIDAL VIBRATION - ONE OCTAVE PER MINUTE SWEEP RATE OVER A FREQUENCY RANGE OF 5 THROUGH 35 HZ. UPON COMPLETION OF THE RANDOM AND SINUSOIDAL VIBRATION TESTS THE FILTER ASSEMBLIES WERE RETURNED TO WINTEC FOR AN EXTERNAL LEAKAGE TEST.

THERMAL SHOCK - THE FILTER ASSEMBLIES WERE SUBJECTED TO 100 THERMAL CYCLES.

DESIGN SHOCK - THREE 20G SHOCK TESTS IN EACH DIRECTION OF EACH AXIS FOR A TOTAL OF 18 SHOCKS.

BURST PRESSURE - FILTER ASSEMBLY WAS INSTALLED INTO A TEST SYSTEM AND SUBJECTED TO A BURST TEST. WITH THE OUTLET PORT SEALED THE INLET PORT WAS PRESSURIZED TO 2070 PSIG FOR A PERIOD OF FIVE MINUTES. THE FILTER ASSEMBLY DID NOT RUPTURE OR TAKE ON A PERMANENT DEFORMATION.

IN-VEHICLE TESTING - LINES ARE PROOF PRESSURE (1295 - 1345 PSIG) AND LEAK (925 - 950 PSIG,  $1 \times 10^{-7}$  SCCS GHE MAX) TESTED.

**FAILURE MODES EFFECTS ANALYSIS (FMEA) - CRITICAL FAILURE MODE  
NUMBER: 06-1C-0115-03**

OMRSD - 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. INFLIGHT CHECKOUT DURING EACH MISSION WILL VERIFY NO GROSS EXTERNAL LEAKAGE.

**(C) INSPECTION:**

**RECEIVING INSPECTION**

MATERIAL CERTIFICATION AND TEST REPORTS ARE REVIEWED TO VERIFY THAT MATERIAL COMPOSITION, DIMENSIONS AND SURFACE CONDITIONS COMPLY WITH DESIGN REQUIREMENTS.

**CONTAMINATION CONTROL**

VAPOR DEGREASING AND ULTRASONIC CLEANING ARE VERIFIED. PIECE PARTS CLEANLINESS IS CERTIFIED TO LEVEL 200A PER MAO110-301 PER ARP 599.

**ASSEMBLY/INSTALLATION**

PIECE PARTS ARE INSPECTED FOR BURRS. FITTING THREADS ARE INSPECTED AT 10X MAGNIFICATION FOR BURRS. RESISTANCE AND TIG WELD SCHEDULE VERIFIED BY INSPECTION.

**CRITICAL PROCESSES**

HOUSING PASSIVATION VERIFIED BY INSPECTION. RESISTANCE AND TIG WELDING VERIFIED BY INSPECTION.

**TESTING**

ATP VERIFIED BY INSPECTION.

**HANDLING/PACKAGING**

HANDLING AND PACKAGING ARE INSPECTED FOR INTEGRITY AND COMPLIANCES WITH MATERIAL HANDLING REQUIREMENTS.

**(D) FAILURE HISTORY:**

NO FAILURE HISTORY.

**(E) OPERATIONAL USE:**

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

**- APPROVALS -**

EDITORIALLY APPROVED : RI  
EDITORIALLY APPROVED : JSC  
TECHNICAL APPROVAL : VIA CR

*Quinn* 8/27/93  
*[Signature]* 8/31/93  
:S50260Y