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PRINT DATE: 01/10/90

SHUTTLE CRITICAL ITEMS LIST - ORBITER

NUMBER: 06-1C3-1510-X

SUBSYSTEM NAME: ARS - ARPCS

REVISION : 2 01/10/90

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	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU 01	LINES AND FITTINGS	V070-613130
LRU 02	LINES AND FITTINGS	M072-643300

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QUANTITY OF LIKE ITEMS: 1  
ONE SET PER SUBSYSTEM

**FUNCTION:**

PROVIDES FOR THE MOVEMENT OF OXYGEN FROM THE ARPCS N2/O2 CONTROL PANEL TO THE VARIOUS USING STATIONS (LES QUICK DISCONNECTS, DIRECT J2 VALVE, SCU INTERFACE) IN THE CABIN AND AIRLOCK.

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SHUTTLE CRITICAL ITEMS LIST - ORBITER

NUMBER: 06-1C3-1510-01

REVISION# 2 01/10/90

SUBSYSTEM: ARS - ARPCS  
LRULINES AND FITTINGS  
ITEM NAME: LINES AND FITTINGS

CRITICALITY OF THIS  
FAILURE MODE: I/I

- FAILURE MODE:  
EXTERNAL LEAKAGE

MISSION PHASE:

PL PRELAUNCH  
LO LIFT-OFF  
OO ON-ORBIT  
OD 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 I/I 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:

UNCONTROLLED O2 FLOW INTO CABIN.

(B) INTERFACING SUBSYSTEM(S):

POSSIBLE HIGH PPO2 UNTIL CORRECTING ACTION (C/A) TAKES EFFECT.  
POSSIBLE FLAMMABILITY LIMIT VIOLATION.

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**(C) MISSION:**

ABORT DECISION. LES/AIRLOCK O2 SUPPORT HAS BEEN LOST IF LEAKAGE IS SIGNIFICANT. CABIN O2 MAKE-UP CAPABILITY IS STILL AVAILABLE.

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

GROSS EXTERNAL LEAKAGE RESULTS IN INADEQUATE O2 SUPPLY TO LES STATIONS. THE LOSS OF LES SUPPORT CAPABILITY MAY RESULT IN LOSS OF CREW IF LEAK RATE PROHIBITS LES SYSTEM PRESSURIZATION AND LES ARE REQUIRED. NOTE - IN AN 8.0 PSIA HOLE IN CABIN CONTINGENCY MODE, AN EXTERNAL LEAK ALLOWING FLOW INTO THE CABIN MAY NOT BE CATASTROPHIC SINCE THERE IS A POSSIBILITY OF SAFELY BREATHING THE CABIN AIR, INTO WHICH THE O2 IS LEAKING, BY RAISING LES VISORS. THE WORST CASE FAILURE WOULD BE IN THE CASE OF A CONTAMINATED CABIN ATMOSPHERE, WHEN LEAKAGE PREVENTS ADEQUATE FLOW TO LES STATIONS AND CABIN AIR MAY NOT BE SAFE FOR BREATHING.

**(E) FUNCTIONAL CRITICALITY EFFECTS:**

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

PIPES ARE FABRICATED OF 21-6-9 STAINLESS STEEL WITH A THICKNESS OF 0.016 INCH. FITTINGS ARE DYNATUBES MADE OF 17-4 PH STAINLESS STEEL AND ARE BRAZED INTO THE SYSTEM. 21-6-9 STAINLESS STEEL HAS GOOD CORROSION RESISTANCE, HIGH MECHANICAL PROPERTIES, GOOD IMPACT STRENGTH, AND HIGH STRENGTH TO WEIGHT RATIO. 17-4 PH CONDITION 4 CRES IS PRECIPITATION HARDENED CORROSION RESISTANT STEEL WHICH HAS A HIGH STRENGTH TO WEIGHT RATIO. BOTH MATERIALS ARE COMPATIBLE WITH GO2. EXTENSIVE FLIGHT EXPERIENCE STS-1 TO PRESENT PROVIDES CONFIDENCE IN DESIGN INTEGRITY.

**(B) TEST:**

QUALIFICATION TEST - TESTING OF 21-6-9 STAINLESS TUBING AS FOLLOWS: PRETEST PROOF (2X OPERATING PRESSURE) AND EXTERNAL LEAK TEST (1 X 10 EXP -6 SCCS HE MAX), BURST TEST (BURST AT GREATER THAN OR EQUAL TO 4X OPERATING PRESSURE), IMPULSE FATIGUE TEST (TWO HUNDRED THOUSAND CYCLES OF IMPULSE WAVES), FLEXURE FATIGUE TEST (TEN MILLION CYCLES OF FLEXURE), RANDOM VIBRATION, POST TEST LEAK TEST (1 X 10 EXP -6 SCCS HE MAX). DYNATUBE COUPLINGS ARE AUTHORIZED BY RI SPEC MF0004-0100 "MECHANICAL - ORBITER PROJECT PARTS LIST."

IN-VEHICLE TESTING - AFTER INSTALLATION THE EMERGENCY BREATHING SYSTEM IS PROOF (1295-1345 PSIG) AND LEAK (925-950 PSIG, 1 X 10 EXP -7 MAX LEAKAGE) TESTED.

OMRSD - 900, 100 PSI O2 EMERGENCY BREATHING SYSTEM 1 & 2 LEAK CHECK IS PERFORMED PRIOR TO FIRST REFLIGHT OF EACH ORBITER AND EVERY FIVE FLIGHTS AT 900-950 PSI, 70 SCCM MAX LEAKAGE. ENFLIGHT CHECKOUT DURING EACH

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MISSION WILL VERIFY NO GROSS EXTERNAL LEAKAGE.

(C) INSPECTION:

RECEIVING INSPECTION

MATERIAL CERTIFICATIONS VERIFIED AND MAINTAINED BY INSPECTION.

CONTAMINATION CONTROL

CLEANLINESS LEVEL 200A PER MA0110-301 VERIFIED BY INSPECTION PRIOR TO AND DURING OPERATIONS.

ASSEMBLY/INSTALLATION

FABRICATION OF PARTS/COMPONENTS PER DRAWING, SPECS VERIFIED BY INSPECTION. ASSEMBLY AND INSTALLATION OF SYSTEM VERIFIED BY INSPECTION. RIGID TUBING INSTALLATION PER DRAWING, INCLUDING LUBRICANTS AND TORQUES, VERIFIED BY INSPECTION.

CRITICAL PROCESSES

BRAZING OF TUBING AND COMPONENTS VERIFIED BY INSPECTION. ELECTRICAL BONDING AND PARTS PASSIVATION VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION

RADIOGRAPHIC INSPECTION OF INDUCTION BRAZES VERIFIED BY INSPECTION.

TESTING

LEAK TEST VERIFIED BY INSPECTION.

HANDLING/PACKAGING

HANDLING, PACKAGING, STORAGE AND SHIPPING PROCEDURES ARE VERIFIED BY INSPECTION.

(D) FAILURE HISTORY:

CAR AB9765-010, 6/25/81. DURING A PRESSURE TEST OF THE N2/O2 CONTROL PANEL, IT WAS NOTED THAT DYNATUBE FITTINGS LEAKED. THE CAUSE WAS DETERMINED TO BE DAMAGED SEALING SURFACES. ALL DYNATUBE INTERFACE AND TEST POINT FITTINGS WERE REINSPECTED AND THOSE FOUND TO BE DAMAGED WERE REPLACED. CORRECTIVE ACTION: PANEL LEVEL ATP WAS REVISED TO IMPROVE SCREENING FOR EXTERNAL LEAKS. TRAINING PROCEDURES HAVE BEEN IMPLEMENTED TO NOT ALLOW ROTATIONAL MOVEMENT BETWEEN DYNATUBE FACES. THE SUPPLIER INITIATED THE USE OF SOFT SEATS FOR DYNATUBE INTERFACES EXCEPT FOR THE FINAL CONNECTION PRIOR TO LEAK TEST.

(E) OPERATIONAL USE: - - - -

1. CREW ACTION

PERFORM LEAK ISOLATION AND HIGH O2 CONCENTRATION TROUBLE SHOOTING.

2. TRAINING

STANDARD ECLSS TRAINING COVERS THE GENERIC "HIGH O2 CONCENTRATION" AND "SYSTEM LEAKAGE INTO CABIN" EFFECTS OF THIS FAILURE.

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- 3. OPERATIONAL CONSIDERATION
- A. PRECLUDES USE OF LES UNLESS LEAK IS SMALL ENOUGH TO PERMIT SIMULTANEOUS LES USE PLUS O2 LEAKAGE TO CABIN.
- B. REFERENCE FLIGHT RULE LOSS/FAILURE DEFINITION.
- C. REAL TIME DATA SYSTEM ALLOWS FOR GROUND MONITORING.

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- APPROVALS -

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RELIABILITY ENGINEERING:	D. R. RISING	DR	:	<u>E. Ockon</u>
DESIGN ENGINEERING	: K. KELLY	KL	:	<u>D. DeWitt</u>
QUALITY ENGINEERING	: M. SAVALA	MS	:	<u>De J. B. Hines 3/6/90</u>
NASA RELIABILITY	:	TD	:	<u>Dr. B. Staschinger 5/1/90</u>
NASA SUBSYSTEM MANAGER	:		:	<u>Dennis M. ... 5/1/90</u>
NASA QUALITY ASSURANCE	:		:	<u>...</u> 4-13-90