SHUTTLE CRITICAL ITEMS LIST - ORBITER NUMBER: 03-2A-221308-X

SUBSYSTEM NAME: AFT REACTION CONTROL SYSTEM (RCS) REVISION : 2 12/12/89

		PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	:	OMS	MC621-0059
LRU	:	BELLOWS ASSEMBLY	73P550003-1001 1008099-101,102
LRU	:	BELLOWS ASSEMBLY	73P550003-1002

EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:
BELLOWS ASSEMBLY, ENGINE ALIGNMENT

QUANTITY OF LIKE ITEMS: 48
ONE FUEL AND ONE OXIDIZ. PER PRIMARY THRUSTER

FUNCTION:
STAINLESS STEEL EXTERNALLY CONSTRAINED BELLOWS WITH RIGID TUBE END CONNECTIONS TO PROVIDE A MEANS OF CONNECTING AND ALIGNING THE THRUSTER VALVES TO THE PROPELLANT SYSTEM.

5

SHUTTLE CRITICAL ITEMS LIST - ORBITER NUMBER: 03-2A-221308-01

REVISION# 2 12/12/89

SUBSYSTEM: AFT REACTION CONTROL SYSTEM (RCS)
LRU :OMS
ITEM NAME: BELLOWS ASSEMBLY

CRITICALITY OF THIS FAILURE MODE:1/1

FAILURE MODE:
STRUCTURAL FAILURE, EXTERNAL LEAKAGE, RUPTURE.

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:
MECHANICAL SHOCK, FLOW INDUCED VIBRATION, FATIGUE, IMPROPER INSTALLATION (WELD), MATERIAL DEFECT, STRUCTURAL FAILURE, CORROSION, HANDLING DAMAGE, POROSITY, LEAK THROUGH CONVOLUTE, PROPELLANT EXPOSURE, PRESSURE SURGE.

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:
SUBSYSTEM DEGRADATION - LOSS OF PROPELLANT.

(B) INTERFACING SUBSYSTEM(S):
DEGRADATION OF INTERFACE FUNCTION - POSS CORROS DAMAGE WITHIN POD AND

ADVERSE EFFECT ON TPS (MOLECULAR VENTING). POSSIBLE LEAKAGE OF PROPELLANT INTO POD.

(C) MISSION:
LAUNCH DELAY OR ABORT DECISION.

(D) CREW, VEHICLE, AND ELEMENT(S):
POSSIBLE LOSS OF CREW OR VEHICLE IF LEAK RESULTS IN EXCESSIVE LOSS OF PROPELLANT OR EXPLOSIVE HAZARD. OVER- PRESSURIZATION OF POD MAY OCCUR. LOSS OF PROPELLANT FOR ET SEPARATION/ENTRY. LINE RUPTURES BELOW TANK ISO VALVE ARE NOT ISOLATABLE IN ALL INSTANCES DUE TO LIMITED TIME REQUIRED TO REACT.

(E) FUNCTIONAL CRITICALITY EFFECTS:

- DISPOSITION RATIONALE -

(A) DESIGN:
THE DESIGN FACTOR OF SAFETY IS 1.5.X MAX OPERATING PRESSURE OF 700 PSIG AND THE DESIGN PROOF PRESSURE IS 1.5X THE MAX OPERATING PRESSURE.

FLOW INDUCED VIBRATION AND STRESS ANALYSIS WERE CONDUCTED TO VERIFY ACCEPTABLE DESIGN. THE DESIGN ALLOWS SUFFICIENT MOVEMENT TO PRECLUDE EXCESSIVE STRESSES DURING INSTALLATION AND OPERATION. DOUBLE PLY BELLOWS ARE UTILIZED. ONE PLY IS ADEQUATE FOR PRESSURE LOAD.

MECHANICAL STOPS LIMIT EXCESSIVE ANGULATION . EXTERNAL CONSTRAINT WOULD LIMIT ANY GROSS PROPELLANT LEAKAGE. PROPELLANT LEAK FROM LINE TO THRUSTER COULD BE ISOLATED BY MANIFOLD VALVES. MATERIALS ARE SELECTED THAT ARE COMPATIBLE WITH PROPELLANTS. THE DESIGN FACTOR OF SAFETY IS 1.5 FOR PROOF AND 2.0 FOR BURST.

(B) TEST:
THE QUALIFICATION TEST PROGRAM INCLUDED ATP, THERMAL CYCLES, RANDOM VIBRATION, OPERATING LIFE (SURGE PRESSURES, FLOW CYCLES, ANGULATION CYCLES (BURST PRESSURE TEST 1140 PSI).

THE UNIT WAS ALSO QUALIFIED IN THE VIBRO-ACOUSTIC TEST AT JSC (131 EQUIVALENT MISSION DUTY CYCLES) AND THE HOT FIRE TESTING AT WSTF (24EQUIVALENT MISSION DUTY CYCLES AND APPROX. 7 YEARS OF PROPELLANT EXPOSURE).

ACCEPTANCE TESTING INCLUDES EXAMINATION OF PRODUCT, WELD INSPECTIONS, PROOF PRESSURE, LEAKAGE AND FUNCTION TESTS, AND CLEANLINESS.

OMRSD PERFORMS THE FOLLOWING: THE MANIFOLD ISOLATION VALVE (PRI) RELIEF DEVICE CHECKOUT EVERY FIVE FLIGHTS AND ON A CONTINGENCY BASIS.

THE MANIFOLD ISOLATION VALVE (VERN) RELIEF DEVICE CHECKOUT EVERY FIVE MISSIONS AND ON A CONTINGENCY BASIS. TOXIC VAPOR LEAK CHECK OF THE PROPELLANT MANIFOLDS FOR THE FIRST FLIGHT AND ON A CONTINGENCY BASIS. AN EXTERNAL LEAKAGE VERIFICATION OF THE SYSTEM FOR THE FIRST FLIGHT AND ON A CONTINGENCY BASIS WHENEVER A LRU IS REPLACED. THE PROPELLANT LOADING FOR EACH FLIGHT. A SUBSYSTEM INSPECTION EVERY FIFTH FLIGHT AND ON A CONTINGENCY BASIS. PROPELLANT SAMPLING THE SECOND FLIGHT AND ON A CONTINGENCY BASIS. STATIC AIR SAMPLING FOR THE MOD/POD THE SECOND FLIGHT AND EVERY FLIGHT THEREAFTER AND ON A CONTINGENCY BASIS.

(C) INSPECTION:
RECEIVING INSPECTION
INSPECTION VERIFIES TEST REPORTS AND MATERIAL CERTIFICATIONS CERTIFYING MATERIALS AND PHYSICAL PROPERTIES

CONTAMINATION CONTROL
CORROSION PROTECTION IS VERIFIED BY INSPECTION. CLEANLINESS LEVEL TO 200 FOR MMH AND 200A FOR NTO IS VERIFIED BY INSPECTION.
ASSEMBLY/INSTALLATION
BELLOWS ARE DIMENSIONALLY AND VISUALLY INSPECTED. SURFACE FINISHES ARE VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION
PENETRANT INSPECTION OF WELDS IS VERIFIED BY INSPECTION.

CRITICAL PROCESSES
WELDING IS VERIFIED BY INSPECTION.

TESTING
ATP IS WITNESSED AND VERIFIED BY INSPECTION.

HANDLING/PACKAGING
PACKAGING IS VERIFIED BY INSPECTION.

(D) FAILURE HISTORY:
NO FAILURE HISTORY.

(E) OPERATIONAL USE:
IF LEAK IS SLOW ENOUGH IT CAN BE ISOLATED BY CLOSING THE MANIFOLD ISOLATION VALVE. IF ALL PROPELLANT IS LOST PRIOR TO ENTRY, USE CROSSFEED FROM THE GOOD SYSTEM. PROPELLANT WILL NOT BE SUFFICIENT TO PERFORM NOMINAL ENTRY.

PRINT DATE: 12/13/89

SHUTTLE CRITICAL ITEMS LIST - ORBITER NUMBER: 03-2A-221308-01

- APPROVALS -

RELIABILITY ENGINEERING:	F.E. BARCENAS	F.E. Barcenas
DESIGN ENGINEERING :	B. DIPONTI	B. Diponti
QUALITY ENGINEERING :	M. SAVALA	M. Savala 1/8/90
NASA RELIABILITY :		2/22/90
NASA SUBSYSTEM MANAGER :		2/6/90
NASA QUALITY ASSURANCE :		4/19/