

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : ATMOSPHERIC REVIT. FMEA NO 06-1B -0616 -2 REV: 08/22/85  
ASSEMBLY : AIR DUCTS  
P/N RI : VO70-613427, 524, 558, 881  
P/N RI : ME276-0037  
P/N VENDOR:  
QUANTITY : 1 SET PER VEHICLE

VEHICLE	102	103	104
EFFECTIVITY:	X	X	X
PHASE(S):	PL	LO X CO X DO X LS	

CRIT. FUNC: 2  
CRIT. HDW: 2

PREPARED BY: DES N. K. DUONG  
REL N. L. STEISSLINGER  
QE D. STOICA

REDUNDANT SCREEN:  
APPROVED BY: *[Signature]*  
DES *[Signature]*  
REL *[Signature]*  
QS/QE *[Signature]*

A- APPROVED BY (NASA):  
SSM *[Signature]*  
REL *[Signature]*  
QE *[Signature]*

ITEM:  
DUCT SECTIONS, IMU, RETURN AIR TO CABIN

FUNCTION:  
ROUTE AIR FROM THE IMU FAN OUTLET TO THE IMU HEAT EXCHANGER, AND FROM THE HEAT EXCHANGER TO THE IMU MUFFLER.

FAILURE MODE:  
EXTERNAL LEAKAGE (DISLODGED DUCT AS WORST CASE)

CAUSE(S):  
PUNCTURE, ABRASION, MATERIAL DEFECT, BROKEN CLAMPS

EFFECT(S) ON:  
(A) SUBSYSTEM (B) INTERFACES (C) MISSION (D) CREW/VEHICLE

(A) REDUCED IMU FAN DELTA-P.

(B) NO EFFECT ON AIR FLOW THROUGH IMU'S. AIR FLOWS OUT THROUGH LEAK PATH, BYPASSING IMU HEAT EXCHANGER. AIR IS NOT COOLED BEFORE RETURNING TO THE CABIN, SO CABIN AIR TEMPERATURE INCREASES.

(C) POSSIBLE EARLY MISSION TERMINATION BASED UPON MAGNITUDE OF LEAK.

(D) NO EFFECT. EARLY MISSION TERMINATION WILL PRECLUDE LOSS OF CREW/VEHICLE.

DISPOSITION & RATIONALE:  
(A) DESIGN (B) TEST (C) INSPECTION (D) FAILURE HISTORY (E) OPERATIONAL USE

(A) DESIGN  
DUCT SYSTEM IS COMPRISED OF RIGID AND FLEXIBLE DUCT SECTIONS.

RIGID DUCTING IS FABRICATED OUT OF ALUMINUM TUBING WITH 0.035 OR 0.049 INCH THICK WALLS AND EPOXY/ARAMID MATERIAL. SECTIONS ARE FASTENED TOGETHER WITH CLAMPS AROUND END FLANGES AND HARD MOUNTED TO STRUCTURE BY A BRACKET/BAND CLAMP ASSEMBLY. DUCT BRANCHES LEADING TO IMU BOXES ARE WELDED INTO THE MAIN BRANCH DUCT SECTION.

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FLEXIBLE DUCTS OF SILICONE/FIBERGLASS FABRIC OVER STEEL HELICAL SPRING WIRE ARE USED AT THE MUFFLER/IMU INTERFACE, AT THE IMU/ALUMINUM DUCT INTERFACE, AND BETWEEN THE IMU FAN PACKAGE AND THE ALUMINUM DUCTS. ALL AIR ENTERING THE RETURN DUCT SYSTEM IS THROUGH THE IMU MUFFLER FILTERS. DUCTS ARE PROTECTED FROM DAMAGE BY CLOSEOUT PANELS.

(B) TEST

QUALIFICATION TESTING - SIMILAR SILICONE/FIBERGLASS FLEX DUCTS WERE SHOWN BY TEST TO WITHSTAND TEMPERATURES FROM -60 F TO 600 F WITHOUT PROBLEMS. NON-NUTRIENT TO FUNGUS DEMONSTRATED BY TEST. SALINITY TOLERANCE DEMONSTRATED BY TEST OF IDENTICAL MATERIAL EXPOSED TO A 20% SALT SOLUTION AT 95 F AND 85% RELATIVE HUMIDITY FOR 50 HOURS WITH NO EFFECT. BURST PRESSURE DEMONSTRATED BY TEST TO BE GREATER THAN 300 PSIG. TRANSIENT AND RANDOM VIBRATIONS WERE CERTIFIED BY TESTS OF THE SIMILAR DUCTS AND CRASH LOADS BY ANALYSIS. DUCTING IS STRESS AND FATIGUE CERTIFIED BY ANALYSIS.

ACCEPTANCE TESTING - PROOF PRESSURE TESTED AT 1.50 PSIG. LEAK TESTED AT 0.5 PSIG, MAX LEAKAGE 0.04 SCFM.

IN-VEHICLE TESTING - IMU FAN DELTA-P IS MONITORED CONTINUOUSLY WHEN IMU'S ARE POWERED UP.

OMRSD - IMU FAN DELTA-P IS MONITORED CONTINUOUSLY WHEN IMU'S ARE POWERED UP DURING EACH TURNAROUND AND SERVES AS AN INDICATION OF EXTERNAL LEAKAGE.

(C) INSPECTION

RECEIVING INSPECTION

MATERIAL AND PROCESS CERTIFICATION ARE VERIFIED BY INSPECTION.

CONTAMINATION CONTROL

CONTAMINATION CONTROL AND CORROSION PROTECTION PER MA0608-301 ARE VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

MANUFACTURING, INSTALLATION AND ASSEMBLY OPERATIONS ARE VERIFIED BY INSPECTION. STANDARD DETAIL, DIMENSIONING AND TOLERANCING ARE VERIFIED BY INSPECTION. INSPECTION VERIFIED TUBING FABRICATION PER MA0102-306.

CRITICAL PROCESSES

WELDING PER MA0107-303 IS VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION

PENETRANT INSPECTION IS VERIFIED BY INSPECTION.

TESTING

THE ATP, WHICH INCLUDES LEAK AND PROOF TESTING, EXAMINATION FOR WORKMANSHIP, FINISH AND DIMENSIONAL FEATURES IS VERIFIED BY INSPECTION.

HANDLING/PACKAGING

PARTS PROTECTION AND HANDLING REQUIREMENTS ARE VERIFIED BY INSPECTION.

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(D) FAILURE HISTORY

THERE IS NO FAILURE HISTORY OF THE RIGID DUCT. THE FLEXIBLE DUCTS HAVE DEVELOPED MINOR LEAKS THAT HAVE BEEN CAUSED BY ABRASION AND PUNCTURE DUE TO INTERFERING WITH THE SURROUNDING STRUCTURE. NONE OF THE LEAKAGE TO DATE HAS RESULTED IN SIGNIFICANT AIR FLOW REDUCTION TO CAUSE OVERHEATING AND SUBSEQUENT FAILURE OF AVIONICS EQUIPMENT. A REDESIGN IS IN PROGRESS WHICH WILL REPLACE THE STEEL SPRING IN THE DUCT WITH A NYLON SPRING AND THE FIBERGLASS SILICON SHEATH WITH ARAMID/SILICON FABRIC. CAR AD3187-010, DATED 7/15/87, WAS OPENED AGAINST DUCTS REMOVED DURING COMPLETE INSPECTION OF OV-103 DUCTS. IT REMAINS OPEN PENDING REDESIGN.

(E) OPERATIONAL USE

TBS.