

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : ATMOSPHERIC REVIT. FMEA NO 06-1B -0632 -1 REV: 08/22/88

ASSEMBLY : AIR DUCTS  
P/N RI : V070-613XXX, ME276-0024  
P/N VENDOR:  
QUANTITY : 1 SET PER VEHICLE  
:  
:  
:  
VEHICLE 102  
EFFECTIVITY: X X X  
PHASE(S): PL LO X OO X DO X LS  
CRIT. FUNC: 1R  
CRIT. HDW: 2  
103 104

PREPARED BY: DES N. K. DUONG  
REL N. L. STEISLINGER  
QE D. STOICA  
REDUNDANCY SCREEN  
APPROVED BY: DES [Signature]  
REL [Signature]  
MSQE [Signature]  
A-PASS B-PASS C-PASS  
APPROVED BY (NASA)  
SSM [Signature]  
REL [Signature]  
QE [Signature]

ITEM:  
DUCT SECTIONS, CABIN RETURN AIR

FUNCTION:  
PROVIDE RETURN AIR FLOW PATH FROM FLIGHT DECK SINGLE MAIN RETURN DUCT DOWN THE STARBOARD WALL OF MIDDECK TO THE CABIN FAN INLET PLENUM.  
P/N'S: V070-613638, 677, 678, 688, 689, 690, 691, 692, 697, 698, 699, 715, 717.

FAILURE MODE:  
RESTRICTED FLOW

CAUSE(S):  
PHYSICAL DAMAGE, DEBRIS/CONTAMINATION

EFFECT(S) ON:  
(A) SUBSYSTEM (B) INTERFACES (C) MISSION (D) CREW/VEHICLE  
(A) REDUCED CABIN AIR CIRCULATION PROPORTIONAL TO RESTRICTION.  
(B) ELEVATED TEMPERATURE OF AIR COOLED FLIGHT DECK EQUIPMENT. INCREASED CO2 PARTIAL PRESSURE.  
(C) POSSIBLE EARLY MISSION TERMINATION BASED UPON LOCATION AND MAGNITUDE OF FLOW RESTRICTION AND ITS EFFECT ON AVIONICS COOLING.  
(D) NO EFFECT.  
(E) BLOCKAGE OF MORE THAN ONE OF THE THREE RETURN DUCTS RESULTS IN INADEQUATE COOLING TO ALL AIR-COOLED FLIGHT DECK EQUIPMENT. POSSIBLE LOSS OF CREW/VEHICLE DUE TO FAILURE OF AVIONICS LRU'S FROM OVERHEATING.

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

(A) DESIGN  
THE COLLECTION RETURN AND DISTRIBUTION SUPPLY DUCTS ARE RIGID EPOXY/ARAMID SECTIONS NOMINALLY ABOUT 15 INCHES LONG AND PREFORMED TO FIT THE CONTOUR OF THE VEHICLE AT THE INSTALLATION SITE. SECTIONS ARE HARD MOUNTED TO STRUCTURE BY A BRACKET/BAND CLAMP ASSEMBLY. A 0.50 INCH

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STRESS RELIEF GAP IS PROVIDED BETWEEN DUCT SECTIONS. THIS GAP IS BRIDGED BY FLEXIBLE SILICONE/FIBERGLASS SLEEVES HELD IN PLACE BY BAND CLAMPS AND GROOVES THAT ARE PREFORMED INTO EACH DUCT SEGMENT. DUCT BRANCHES LEADING TO AVIONICS BOXES ARE PREFORMED INTO THE MAIN DUCT SECTIONS OR MOUNTED TO THE MAIN DUCTS VIA PREFORMED INTERFACE FITTINGS. DUCTS ARE PROTECTED FROM DAMAGE BY CLOSEOUT PANELS.

FLEXIBLE DUCTS OF SILICONE/FIBERGLASS FABRIC OVER STEEL HELICAL SPRING WIRE ARE USED AS REQUIRED AT THE DUCT/AVIONICS BOX INTERFACE. BAND CLAMPS ARE USED TO HOLD FLEXIBLE DUCTS TO LRU AND RIGID DUCT INTERFACES. ALL AIR ENTERING THE RETURN DUCT SYSTEM IS FILTERED BY THE AVIONICS LRU FILTERS AND WCS RETURN FILTER.

(B) TEST

RIGID DUCTS:

QUALIFICATION TEST - TESTS OF SIMILAR MATERIAL SHOW THAT RIGID EPOXY/ARAMID DUCTS ARE UNAFFECTED BY HUMIDITY AND TEMPERATURE WITHIN THE LIMITS IMPOSED BY THE CABIN ATMOSPHERE. TENSILE STRENGTH (500 KSI) REMAINED UNCHANGED AFTER EXPOSURE TO 100 PPM OZONE AT 70 F FOR 1000 HOURS. TOLERANCE TO SALINITY WAS DEMONSTRATED BY ANALYSIS BASED ON TESTS OF SIMILAR MATERIAL IN SALT WATER FOR 125 DAYS. TRANSIENT VIBRATIONS, RANDOM VIBRATIONS, AND CRASH LOADS WERE CERTIFIED BY TEST AND ANALYSIS.

FLEXIBLE DUCTS:

QUALIFICATION TEST - THE SILICONE/FIBERGLASS FLEX DUCTS WERE SHOWN 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 200 PSIG. TRANSIENT VIBRATIONS, RANDOM VIBRATIONS, AND CRASH LOADS WERE CERTIFIED BY TEST AND ANALYSIS.

ACCEPTANCE TEST - EXTERNAL LEAK TEST AT 0.5 PSIG FOR 5 MINUTES. MAX LEAKAGE 0.005 CFM/INCH DIAMETER/FT LENGTH. PROOF TEST AT 1.0 PSIG FOR 5 MINUTES.

IN-VEHICLE TESTING - CABIN FAN DELTA-P IS MONITORED CONTINUOUSLY WHEN THE VEHICLE IS POWERED UP. DUCT INSTALLATION IS INSPECTED FOR DAMAGE PRIOR TO INSTALLATION OF CLOSEOUT PANELS.

OMRSD - CABIN FAN DELTA-P IS MONITORED DURING EVERY TURNAROUND AND SERVES AS AN INDICATION OF SYSTEM PERFORMANCE.

FLEXIBLE AND HARD DUCTS ARE BEING COMPLETELY INSPECTED PRIOR TO FIRST REFLIGHT OF EACH ORBITER AND ARE ALSO INSPECTED AS AVAILABLE IN CONJUNCTION WITH REMOVAL OF PANELS/LRU'S. DUCTS ARE ALSO INSPECTED DURING PERIODIC ZONAL INSPECTIONS.

(C) INSPECTION

RECEIVING INSPECTION

RAW MATERIAL AND PROCESS CERTIFICATIONS VERIFIED BY INSPECTION.

CONTAMINATION CONTROL

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CLEANLINESS REQUIREMENTS TO THE GENERALLY CLEAN (GC) LEVEL.  
ASSEMBLY/INSPECTION

INSPECTION VERIFIES THE FOLLOWING: PROCESS REQUIREMENTS RELATIVE TO MATERIALS PREPARATION, FABRICATION OF DUCT SECTIONS (INCLUDING DUCT LENGTH AND WALL THICKNESS) AND CURE CYCLES IN ACCORDANCE WITH REQUIREMENTS, INSTALLATION OF CURED SECTIONS INTO THE DUCT SYSTEM (BONDING, SPLICING, SEAL COATING, INSTALLATION OF CLAMPS, FASTENERS, TAPE AND INSULATION) IN ACCORDANCE WITH DRAWING AND SPECIFICATION REQUIREMENTS.

CRITICAL PROCESSES

CURING IS VERIFIED BY INSPECTION.

TESTING

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

PACKAGING AND HANDLING

PARTS PROTECTION AND HANDLING REQUIREMENTS ARE VERIFIED BY INSPECTION.

(D) FAILURE HISTORY

DR ECL2010337, 9/24/79: IN CHECKING DFI CONTAINER AIR FLOW, THE CABIN AIR SUPPLY FLOW BALANCE INDICATED REDUCED FLOW TO THE FLT DIFFUSER. A PLASTIC BAG WAS FOUND INSIDE THE DUCT. RETEST YIELDED ADEQUATE FLOW. THIS PROBLEM WAS NOT A CAR; CLOSED AS A PR, WITH NO CORRECTIVE ACTION.

CAR AC2915-000, 9/13/83: DURING SUPPLY DUCT FLOW TESTS AT PALMDALE, REDUCED FLOW WAS NOTED AT AFT FLIGHT DECK DIFFUSER "A". A WHITE TAG WAS FOUND LODGED IN THE DIFFUSER. CORRECTIVE ACTION - AN "AWARE" WAS ISSUED TO HELP PROTECT DUCTS FROM DEBRIS. MANUFACTURING AND QUALITY AGREED TO APPLY INSPECTION SEALS ON ALL OPEN DUCT COVERS.

CAR AC8168-000, 8/24/84: WHILE WORKING A TPS AT KSC - REMOVING CAP TO VERIFY SUCTION LINE, A PARTS TAG (FORM 93-H) WAS FOUND TAPED INSIDE THE LINE. ACTION WAS TRANSFERRED TO CAR AD2016-000, ON WHICH SEVERAL OCCURRENCES OF DUCT/LINE CONTAMINATION WERE ACCUMULATED.. CORRECTIVE ACTION - DUCT INSTALLATION PLANNING WAS REVISED TO REQUIRE A BUY-OFF OF VISUAL VERIFICATION THAT THERE IS NO DEBRIS IN DUCTS JUST PRIOR TO CLOSEOUT.

(E) OPERATIONAL USE

TBS.