

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : ATMOSPHERIC REVIT. FMEA NO 06-1B -0574 -1 REV: 05/02/88

ASSEMBLY : IMU COOLING CRIT. FUNC: 1  
P/N RI : MC621-0008-0016, VG70-611427, 857 CRIT. HDW: 1  
P/N VENDOR: SV767312-1 HAM STD VEHICLE 102 103 104  
QUANTITY : 1 EFFECTIVITY: X X X  
: 1 PER VEHICLE PHASE(S): PL LO X OO X DO X 15  
:

PREPARED BY: DES N. K. DUONG  
REL N. L. STEISSLINGER  
QE J. BARKER

REDUNDANCY SCREEN: A- B- C-  
APPROVED BY: (NASA):  
DES *[Signature]* SSM  
REL *[Signature]* REL  
QE *[Signature]* QE

ITEM:  
SCREEN, DEBRIS TRAP  
AIR DUCT, IMU FAN INLET

FUNCTION:  
INLET SCREEN FILTERS (1600 MICRON) IMU COOLING AIR AT THE INLET TO THE FAN ASSEMBLY. AIR DUCT ROUTES COOLING AIR FROM THE THREE IMU OUTLETS TO THE FAN ASSEMBLY INLET.

FAILURE MODE:  
RESTRICTED FLOW (BLOCKED AS WORST CASE)

CAUSE(S):  
PHYSICAL DAMAGE, CONTAMINATION/DEBRIS

EFFECT(S) ON:  
(A) SUBSYSTEM (B) INTERFACES (C) MISSION (D) CREW/VEHICLE  
(A) INCREASED FAN DELTA-P AND REDUCED IMU AIRFLOW.  
(B) REDUCED IMU COOLING PROPORTIONAL TO RESTRICTION.  
(C) ABORT DECISION FOR LOSS OF AIR COOLING TO IMU'S.  
(D) LOSS OF AIR CIRCULATION FOR IMU COOLING RESULTS IN POSSIBLE  
(1) ERRONEOUS DATA FROM IMU OR (2) LOSS OF IMU DATA OUTPUT, LEADING TO POTENTIAL LOSS OF CREW/VEHICLE.

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

(A) DESIGN  
THE SCREEN IS A 10 X 10 STAINLESS STEEL WIRE MESH SCREEN FASTENED TO THE INSIDE OF THE INLET MANIFOLD. THERE ARE 300 MICRON STAINLESS STEEL FILTERS UPSTREAM OF THIS DEBRIS TRAP (ONE PER IMU) AT THE MUFFLER INLET. THERE IS AN ADDITIONAL 140 MICRON "TAPE-ON" FILTER AT EACH MUFFLER INLET IN SERIES WITH THE 300 MICRON FILTER. THE TAPE-ON FILTERS ARE CLEANABLE

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : ATMOSPHERIC REVIT. FMEA NO 06-1B -0574 -1 REV:05/02, 85

IN FLIGHT. IMU'S ARE NOT DEBRIS GENERATORS. THE INLET SCREEN FILTER IS APPROXIMATELY 3.3 SQ IN AND WOULD REQUIRE A SIGNIFICANT AMOUNT OF DEBRIS CONTAMINATION TO CAUSE TOTAL BLOCKAGE.

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

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

SCREEN:

ACCEPTANCE TEST - EXAMINATION OF PRODUCT. FAN PACKAGE AIR FLOW VS DELTA-P TESTED - 3.9 IN H2O MINIMUM AT 2.40 TO 2.45 LB/MIN.

DUCTS:

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 200 PSIG. TRANSIENT AND RANDOM VIBRATIONS WERE CERTIFIED BY TESTS OF THE SIMILAR DUCTS AT CRASH LOADS 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 AIRFLOW AND DELTA-P ARE VERIFIED. ALL ACCESSIBLE UPSTREAM FILTERS ARE CLEANED PRIOR TO SHIPPING.

OMRSD - THE IMU FANS ARE USED TO SUPPORT IMU OPERATIONS AND THE DELTA-P IS VERIFIED EVERY TURNAROUND. INCREASING DELTA-P WOULD INDICATE BLOCKAGE IN THE SYSTEM. UPSTREAM "TAPE ON" SCREEN FILTERS ARE INSPECTED AND CLEANED EVERY TURNAROUND AND AGAIN AS A CONTINGENCY IN THE EVENT OF AN EXTENDED OFF/OMCF FLOW OF 1500 OR MORE HOURS OF POWER-ON OPERATIONS. DEBRIS TRAP IS INSPECTED AND CLEANED BEFORE FIRST REFLIGHT OF EACH ORBITER AND AT INTERVALS OF FIVE FLIGHTS.

(C) INSPECTION

SCREEN:

RECEIVING INSPECTION

MATERIAL AND PROCESS CERTIFICATIONS ARE VERIFIED BY INSPECTION.

CONTAMINATION CONTROL

CORROSION PROTECTION PROVISIONS VERIFIED BY INSPECTION. CLEANLINESS TO

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : ATMOSPHERIC REKIT. FMEA NO 06-1B -0574 -1 REV:05/02/88

LEVEL 100 AND FLUSHING OPERATION AT FINAL ASSEMBLY IS VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

PARTS PROTECTION, MANUFACTURING PROCESSES, INSTALLATION AND ASSEMBLY INCLUDING TORQUING IS VERIFIED BY INSPECTION.

TESTING

ATP PROVIDES INSPECTION FOR CLOGGING AND DEBRIS.

HANDLING/PACKAGING

HANDLING AND PACKAGING REQUIREMENTS ARE VERIFIED BY INSPECTION.

DUCT (FLEXIBLE):

ARROWHEAD PRODUCTS INSPECTION VERIFIES THE FOLLOWING:

RECEIVING INSPECTION

RAW MATERIAL CERTIFICATIONS ARE TO DRAWING REQUIREMENTS.

ASSEMBLY/INSTALLATION

DUCT MOLDING PROCESS CONTROLS. PRODUCT WORKMANSHIP, FINISH, DIMENSIONS IDENTIFICATION AND MARKING.

TESTING

ACCEPTANCE TEST, INCLUDING LEAKAGE AND PROOF TEST.

HANDLING/PACKAGING

HANDLING, PACKAGING AND PACKING REQUIREMENTS PER NAS850.

DUCT (HARD):

RECEIVING INSPECTION

RAW MATERIAL AND PROCESS CERTIFICATION ARE VERIFIED BY INSPECTION.

CONTAMINATION CONTROL

CLEANLINESS IS VERIFIED BY INSPECTION. CORROSION PROTECT PER MA0608-301 IS VERIFIED BY INSPECTION.

ASSEMBLY/INSTALLATION

MANUFACTURING, INSTALLATION AND ASSEMBLY ARE VERIFIED BY INSPECTION. DUCT MOLDING PROCESS CONTROLS. PRODUCT WORKMANSHIP, FINISH, DIMENSIONS, IDENTIFICATION AND MARKING ARE VERIFIED BY INSPECTION.

NONDESTRUCTIVE EVALUATION

PENETRANT PER MT0501-508, CLASS 2 IS VERIFIED BY INSPECTION.

CRITICAL PROCESSES

WELDING AND ANODIZING ARE VERIFIED BY INSPECTION.

TESTING

ATP IS VERIFIED BY INSPECTION.

HANDLING/PACKAGING

HANDLING AND PACKAGING REQUIREMENTS ARE VERIFIED BY INSPECTION.

SHUTTLE CRITICAL ITEMS LIST - ORBITER

SUBSYSTEM : ATMOSPHERIC REVIT.      FMEA NO 06-1B -0574   -1      REV:02/02/88

(D) FAILURE HISTORY

THE SCREEN AND AIR DUCT HAVE SUCCESSFULLY PERFORMED WITHOUT FAILURE THROUGH THE DURATION OF THE SHUTTLE PROGRAM.

(E) OPERATIONAL USE

1. CREW ACTION

PERFORM SYSTEMS PERFORMANCE TROUBLESHOOTING AND CLEANING ACCESSIBLE FILTERS.

2. TRAINING

CURRENT ECSS AND IFM (IN FLIGHT MAINTENANCE) TRAINING COVER THE EFFECT OF THIS FAILURE.

3. OPERATIONAL CONSIDERATIONS

REAL TIME DATA SYSTEM ALLOWS FOR GROUND MONITORING.