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## ] FAILURE MODES EFFECTS ANALYSIS (FMEA) - CIL HARDWARE

NUMBER: M8-1MR-E020-X

SUBSYSTEM NAME: ECL55 - MIR

REVISION: 1 9/15/95

	PART NAME VENDOR NAME	PART NUMBER VENDOR NUMBER
LRU	: FAN PACKAGE	VL23-643001
SRU	: MUFFLER, FAN PACKAGE	V826-643025-003

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**PART DATA**

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**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:**

FAN PACKAGE MUFFLER

**REFERENCE DESIGNATORS:****QUANTITY OF LIKE ITEMS: 1**

ONE

**FUNCTION:**

PREVENTS NOISE GENERATED BY THE FANS CONTAINED IN THE FAN PACKAGE FROM PROPAGATING BACK INTO THE CREW CABIN AREA.

**REFERENCE DOCUMENTS:** M072-643400

V826-643001

V826-643025

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**FAILURE MODES EFFECTS ANALYSIS (FMEA) - CIL FAILURE MODE  
NUMBER: M8-1MR-E020-02**

REVISION# 1 9/15/95

SUBSYSTEM NAME: ECLSS - MIR  
LRU: PACKAGE, FAN  
ITEM NAME: MUFFLER

CRITICALITY OF THIS  
FAILURE MODE: 2/2

FAILURE MODE:  
RESTRICTED FLOW (CLOGGED)

MISSION PHASE:  
OO ON-ORBIT

VEHICLE/PAYLOAD/KIT EFFECTIVITY: 104 ATLANTIS

CAUSE:  
PHYSICAL DAMAGE, VIBRATION, CONTAMINATION, MECHANICAL SHOCK

CRITICALITY 1/1 DURING INTACT ABORT ONLY? NO

CRITICALITY 1R2 DURING INTACT ABORT ONLY (AVIONICS ONLY)? N/A

REDUNDANCY SCREEN A) N/A  
B) N/A  
C) N/A

**PASS/FAIL RATIONALE:**

A)  
N/A

B)  
N/A

C)  
N/A

METHOD OF FAULT DETECTION:  
PHYSICAL OBSERVATION - REDUCED AIRFLOW TO HABITABLE AREAS.

**- FAILURE EFFECTS -**

(A) SUBSYSTEM:  
LOSS OF AIRFLOW TO INLET OF FAN PACKAGE. INABILITY OF FANS TO FORCE AIR OUT OF FAN PACKAGE RESULTING IN LOSS OF CABIN AIRFLOW TO INTERNAL AIRLOCK, TUNNEL ADAPTER, EXTERNAL AIRLOCK, VESTIBULE TUNNEL, MIR, AND SPACELAB ENVIRONMENT (MIR 1 ONLY).

(B) INTERFACING SUBSYSTEM(S):  
NO EFFECT ON INTERFACING ORBITER SUBSYSTEMS.

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(C) MISSION:  
POSSIBLE EARLY MISSION TERMINATION IF FAILURE OCCURS PRIOR TO COMPLETION OF IVA. LOSS OF AIRFLOW TO EXTERNAL AIRLOCK/VESTIBULE TUNNEL INTERFACE COULD CAUSE FOGGING OF EXTERNAL AIRLOCK UPPER HATCH WINDOW. REDUCED VISIBILITY CAUSED BY FOGGING WOULD PRECLUDE MIR DOCKING CAPABILITIES.

(D) CREW, VEHICLE, AND ELEMENT(S):  
NO EFFECT ON CREW AND VEHICLE.

(E) FUNCTIONAL CRITICALITY EFFECTS:  
N/A

DESIGN CRITICALITY (PRIOR TO DOWNGRADE, DESCRIBED IN (F)): 2/2

(F) RATIONALE FOR CRITICALITY DOWNGRADE:  
N/A (THERE ARE NO WORKAROUNDS TO CIRCUMVENT THIS FAILURE).

- TIME FRAME -

TIME FROM FAILURE TO CRITICAL EFFECT: HOURS TO DAYS

TIME FROM FAILURE OCCURRENCE TO DETECTION: SECONDS

TIME FROM DETECTION TO COMPLETED CORRECTIVE ACTION: N/A

IS TIME REQUIRED TO IMPLEMENT CORRECTIVE ACTION LESS THAN TIME TO EFFECT?  
NO

RATIONALE FOR TIME TO CORRECTING ACTION VS TIME TO EFFECT:  
THERE IS NO CORRECTIVE ACTION TO RESTORE AIRFLOW THROUGH A CLOGGED FAN PACKAGE MUFFLER.

HAZARDS REPORT NUMBER(S): DM2SHA03(F)

HAZARD(S) DESCRIPTION:  
LOSS OF AIR CIRCULATION IN ODS/DOCKING MODULE HABITABLE ENVIRONMENT.

-DISPOSITION RATIONALE-

(A) DESIGN:  
FAN PACKAGE MUFFLER CONSISTS OF AN EXTERNAL SIX INCH HARD DUCT WITH TWO INCHES OF ACOUSTIC FOAM ON THE INSIDE, PRODUCING AN INSIDE DIAMETER OF FOUR INCHES. THE HARD DUCT IS FABRICATED FROM EPOXY RESIN IMPREGNATED ARAMID FABRIC AND THE ACOUSTIC MATERIAL IS SCOTTFELT FOAM.

(B) TEST:  
QUALIFICATION TESTS (MUFFLER) - TESTS OF SIMILAR MATERIAL SHOW THAT RIGID EPOXY/ARAMID DUCTS ARE UNAFFECTED BY HUMIDITY WITHIN THE LIMITS IMPOSED BY THE CABIN ATMOSPHERE. MATERIAL TESTS OF KEVLAR/EPOXY LAMINATES CONDUCTED AT TEMPERATURES OF -250 AND 350 DEGREES F SHOWED NO DEGRADATION IN MATERIAL. TENSILE STRENGTH (42 KSI) REMAINED UNCHANGED AFTER EXPOSURE TO 100 PHM OZONE AT 70 DEGREES F FOR 1000 HOURS.

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**FAILURE MODES EFFECTS ANALYSIS (FMEA) - CL FAILURE MODE**

NUMBER: M8-1MR-ED20-02

TOLERANCE TO SALINITY WAS DEMONSTRATED BY ANALYSIS BASED ON TEST OF SIMILAR MATERIAL IN SALT WATER FOR 125 DAYS. TRANSIENT VIBRATIONS, RANDOM VIBRATIONS, AND CRASH LOADS WERE CERTIFIED BY ANALYSIS.

QUALIFICATION/ACCEPTANCE TEST - THERE IS NO QTP/ATP FOR THE INDIVIDUAL MUFFLER. OVERALL PERFORMANCE OF THE FAN PACKAGE INCLUDES THE MUFFLER. FAN PACKAGE TESTING ADDRESSED AS FOLLOWS:

QUALIFICATION TEST - FAN PACKAGE ASSEMBLY SUBJECTED TO RANDOM VIBRATION SPECTRUM ENVELOPE OF 20 TO 160 HZ INCREASING AT 6 DB/OCTAVE TO 0.09 G<sup>2</sup>/HZ AT 150 HZ, CONSTANT AT 0.03 G<sup>2</sup>/HZ FROM 150 TO 1000 HZ, DECREASING AT 6 DB/OCTAVE FROM 1000-2000 HZ FOR 48 MINUTES PER AXIS IN THREE ORTHOGONAL AXES. DESIGN SHOCK - THREE TERMINAL SAWTOOTH PULSES OF 20 G PEAK AMPLITUDE AND 11 MS DURATION APPLIED IN BOTH DIRECTIONS ALONG EACH OF THREE ORTHOGONAL AXES. SALT SPRAY TEST WITH SOLUTION OF FIVE PARTS OF SALT BY WEIGHT AND 80% RH FOR 120 HOURS, CYCLED BETWEEN 60 AND 120°F.

IN-PROCESS AND ACCEPTANCE TEST - ECLSS AIRFLOW TEST PERFORMED TO VERIFY PROPER AIRFLOW. DELTA PRESSURE BETWEEN MUFFLER INLET AND FAN PACKAGE OUTLET MEASURED FOR 8.3 LBS/MIN, 11.7 LBS/MIN, 14.7 LBS/MIN, AND 16.7 LBS/MIN FLOWRATES. MINIMAL DELTA PRESSURE OF 0.5 IN/H<sub>2</sub>O. MAXIMUM DELTA PRESSURE OF 6.0 IN/H<sub>2</sub>O.

OMRSD - TURNAROUND CHECKOUT TESTING IS ACCOMPLISHED IN ACCORDANCE WITH OMRSD.

**(G) INSPECTION:**

RECEIVING INSPECTION

RAW MATERIAL AND PROCESS CERTIFICATIONS VERIFIED BY INSPECTION.

**CONTAMINATION CONTROL**

CLEANLINESS REQUIREMENTS TO THE GENERALLY CLEAN (GC) LEVEL

**ASSEMBLY/INSTALLATION**

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**

ATP/QTP/OMRSD TESTING VERIFIED BY INSPECTION.

**HANDLING/PACKAGING**

PARTS PROTECTION AND HANDLING REQUIREMENTS VERIFIED BY INSPECTION.

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(D) FAILURE HISTORY:

CURRENT DATA ON TEST FAILURES, FLIGHT FAILURES, UNEXPLAINED ANOMALIES, AND OTHER FAILURES EXPERIENCED DURING GROUND PROCESSING ACTIVITY CAN BE FOUND IN PRACA DATA BASE.

(E) OPERATIONAL USE:

NONE

- APPROVALS -

PRODUCT ASSURANCE ENGR . :	M. W. GUENTHER	: <u>M. W. Guenther</u>
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