

**FAILURE MODES EFFECTS ANALYSIS (FMEA) - NON-CIL HARDWARE**  
**NUMBER: M5-6SS-0922 -X**

SUBSYSTEM NAME: ISS DOCKING SYSTEM

REVISION: 0

02/27/98

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**PART DATA**


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	<b>PART NAME</b>	<b>PART NUMBER</b>
	<b>VENDOR NAME</b>	<b>VENDOR NUMBER</b>
ASSY	:EXTERNAL AIRLOCK	V828-000003
LRU	:HEATER - 28.8 W	ME363-0060-0001
LRU	:HEATER - 52.7 W	ME363-0060-0002

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**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:**

HEATER - EXTERNAL AIRLOCK STRUCTURE, 28.8 W - ZONES 1 AND 2; 52.7 W - ZONE 3

**REFERENCE DESIGNATORS:**

- 40V64HR23
- 40V64HR24
- 40V64HR25
- 40V64HR26
- 40V64HR27
- 40V64HR28
- 40V64HR29
- 40V64HR30
- 40V64HR31
- 40V64HR32

**QUANTITY OF LIKE ITEMS:** 10  
 (TEN)

**FUNCTION:**

PROVIDES REQUIRED HEAT TO PREVENT CONDENSATION ON EXTERNAL AIRLOCK WALLS, AND PREVENT FLUID IN LINES FROM FREEZING.

**REFERENCE DOCUMENTS:**

1) VS70-640109, SCHEMATIC DIAGRAM - AIRLOCK ENVIRONMENTAL CONTROL SUBSYSTEM

**FAILURE MODES EFFECTS ANALYSIS FMEA - NON-CIL FAILURE MODE**

**NUMBER: M5-6SS-0922-02**

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**SUBSYSTEM NAME: ISS DOCKING SYSTEM  
LRU: EXTERNAL AIRLOCK  
ITEM NAME: HEATER**

**CRITICALITY OF THIS  
FAILURE MODE: 1R3**

**FAILURE MODE:  
SHORT END TO END, SHORT TO GROUND**

**MISSION PHASE: OO ON-ORBIT**

**VEHICLE/PAYLOAD/KIT EFFECTIVITY:**  
103 DISCOVERY  
104 ATLANTIS  
105 ENDEAVOUR

**CAUSE:**

A) PIECE PART FAILURE, B) CONTAMINATION, C) VIBRATION, D) MECHANICAL SHOCK, E) PROCESSING ANOMALY

**CRITICALITY 1M DURING INTACT ABORT ONLY? NO**

**CRITICALITY 1R2 DURING INTACT ABORT ONLY (AVIONICS ONLY)? NO**

**REDUNDANCY SCREEN**  
A) PASS  
B) PASS  
C) PASS

**PASS/FAIL-RAISONALE:**

A)

B)

C)

**METHOD OF FAULT DETECTION:**

A FDA ALARM ACTIVATES IF A HEATER CIRCUIT FAILS OFF AND A ZONE TEMPERATURE SENSOR DROPS BELOW THE FDA LOWER TEMPERATURE LIMIT.

**MASTER MEAS. LIST NUMBERS:**  
V64T0135A  
V64T0136A  
V64T0137A

**FAILURE MODES EFFECTS ANALYSIS (FMEA) – NON-CIL FAILURE MODE  
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**CORRECTING ACTION: MANUAL**

**CORRECTING ACTION DESCRIPTION:  
CREW CAN ACTIVATE REDUNDANT HEATER CIRCUIT.**

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**- FAILURE EFFECTS -**

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**(A) SUBSYSTEM:**

POWER SIDE OF FIRST HEATER SHORTS TO GROUND - SERIES FUSE OPENS PROTECTING MAIN BUS. LOSS OF ONE HEATER CIRCUIT IN AFFECTED ZONE. REDUNDANT HEATER CIRCUIT IN ZONE PROVIDES REQUIRED HEAT.

**(B) INTERFACING SUBSYSTEM(S):**

FIRST FAILURE - NO EFFECT

**(C) MISSION:**

FIRST FAILURE - NO EFFECT

**(D) CREW, VEHICLE, AND ELEMENT(S):**

FIRST FAILURE - NO EFFECT

**(E) FUNCTIONAL CRITICALITY EFFECTS:**

POSSIBLE LOSS OF CREW/VEHICLE AFTER THREE FAILURES (WHILE DOCKED TO ISS):

- 1) POWER SIDE OF FIRST HEATER SHORTS TO GROUND - SERIES FUSE IN HEATER CIRCUIT OPENS PROTECTING MAIN BUS. LOSS OF ONE HEATER CIRCUIT IN AFFECTED ZONE. THE ASSOCIATED CIRCUIT BREAKER (A) IS OPENED AND THE REDUNDANT HEATER CIRCUIT BREAKER (B) IS CLOSED TO RESTORE HEATING IN THE AFFECTED ZONE.
- 2) GENERAL PURPOSE RELAY (B) IN REDUNDANT HEATER CIRCUIT FAILS OPEN - LOSS OF POWER TO REDUNDANT HEATERS IN ALL THREE ZONES.
- 3) CIRCUIT BREAKER (A) FAILS OPEN DURING ATTEMPT TO RE-ENERGIZE THE REMAINING INTACT (A) HEATERS RESULTING IN LOSS OF ALL HEATING CAPABILITY. POTENTIAL CONDENSATION ON EXTERNAL AIRLOCK WALLS, AND/OR RUPTURE OF FROZEN WATER LINE (DURING EVA) RESULTS IN WATER IN EXTERNAL AIRLOCK. WATER MIGRATION TO KEEL AREA COULD RENDER RUSSIAN AVIONICS INOPERATIVE, RESULTING IN LOSS OF NOMINAL AND PYROTECHNIC UNDOCKING CAPABILITY.

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

**(F) RATIONALE FOR CRITICALITY DOWNGRADE:**

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ALTHOUGH THE CRITICALITY REMAINS UNCHANGED AFTER WORKAROUNDS CONSIDERATION (ALLOWED PER CR S050107W), THEY ARE PROVIDING ADDITIONAL FAULT TOLERANCE TO THE SYSTEM.

AFTER THE THIRD FAILURE, THE CREW WOULD PERFORM EVA TO REMOVE 96 BOLTS FROM THE DOCKING BASE TO CIRCUMVENT THE WORST CASE "DESIGN CRITICALITY" EFFECT. IF UNABLE TO PERFORM EVA (FOURTH FAILURE), POSSIBLE LOSS OF CREW/VEHICLE DUE TO LOSS OF ALL UNDOCKING CAPABILITY.

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**- TIME FRAME -**

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TIME FROM FAILURE TO CRITICAL EFFECT: DAYS

TIME FROM FAILURE OCCURRENCE TO DETECTION: HOURS

TIME FROM DETECTION TO COMPLETED CORRECTING ACTION: HOURS

IS TIME REQUIRED TO IMPLEMENT CORRECTING ACTION LESS THAN TIME TO EFFECT?  
YES

RATIONALE FOR TIME TO CORRECTING ACTION VS TIME TO EFFECT:  
DESIGN FAULT TOLERANCE: POSSIBLE LOSS OF EXTERNAL AIRLOCK STRUCTURE HEATERS AFTER THREE FAILURES. AFTER THE THIRD FAILURE, THE CREW CAN PERFORM EVA TO REMOVE 96 BOLTS FROM THE DOCKING BASE TO UNDOCK.

HAZARD REPORT NUMBER(S): ORBI 401

HAZARD(S) DESCRIPTION:  
INABILITY TO SAFELY SEPARATE ORBITER FROM A MATED ELEMENT

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**- APPROVALS -**

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SS&PAE  
DESIGN ENGINEERING

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: *J. Kimura 4-13-98*  
: *[Signature]*