

**FAILURE MODES EFFECTS ANALYSIS (FMEA) -- NON-CIL HARDWARE  
NUMBER: M5-6SS-0921 -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	:THERMOSTAT, CONTROL	MC452-0147-0019
LRU	:THERMOSTAT, OVERTEMPERATURE	MC452-0147-0049

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**EXTENDED DESCRIPTION OF PART UNDER ANALYSIS:**

THERMOSTAT, CONTROL (55 - 75 DEG. F) AND OVERTEMPERATURE (70 - 90 DEG. F) -  
EXTERNAL AIRLOCK STRUCTURAL HEATER POWER, ZONES 1, 2, AND 3

**REFERENCE DESIGNATORS:** 40V64TS25  
40V64TS26  
40V64TS27  
40V64TS28  
40V64TS29  
40V64TS30  
40V64TS35  
40V64TS36  
40V64TS37  
40V64TS38  
40V64TS39  
40V64TS40

**QUANTITY OF LIKE ITEMS:** 12  
(SIX - CONTROL, SIX - OVERTEMPERATURE THERMOSTATS)

**FUNCTION:**

CONNECTS AND DISCONNECTS THE HEATER CIRCUITS IN ORDER TO CONTROL THE  
EXTERNAL AIRLOCK TEMPERATURE.

**REFERENCE DOCUMENTS:** 1) VS70-640109, SCHEMATIC DIAGRAM - AIRLOCK

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**ENVIRONMENTAL CONTROL SUBSYSTEM**

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

NUMBER: M5-6SS-0921-02

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SUBSYSTEM NAME: ISS DOCKING SYSTEM

LRU: DOCKING BASE

ITEM NAME: THERMOSTAT

CRITICALITY OF THIS

FAILURE MODE: 1R3

FAILURE MODE:

FAILS CLOSED

MISSION PHASE: 00 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 1/1 DURING INTACT ABORT ONLY? NO

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

REDUNDANCY SCREEN	A) PASS
	B) PASS
	C) PASS

**PASS/FAIL RATIONALE:**

A)

B)

C)

**METHOD OF FAULT DETECTION:**

IF TEMPERATURE CONTROLLING THERMOSTAT FAILED, THEN OVER TEMPERATURE THERMOSTAT WILL CONTROL TEMPERATURE. MEASURED TEMPERATURE WILL BE GREATER THAN EXPECTED BY UP TO 15 DEGREES FAHRENHEIT.

MASTER MEAS. LIST NUMBERS:	V64T0135A
	V64T0136A

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V64T0137A

**CORRECTING ACTION: MANUAL****CORRECTING ACTION DESCRIPTION:**

CREW CAN OPEN CIRCUIT BREAKER TO FAILED ON HEATER STRING AND SWITCH TO REDUNDANT HEATER CIRCUIT.

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**- FAILURE EFFECTS -**

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**(A) SUBSYSTEM:**

LOSS OF ABILITY TO AUTOMATICALLY CONTROL THE HEAT OUTPUT OF THE AFFECTED HEATER STRING WHEN CONTROL THERMOSTAT FAILS CLOSED.

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

NO EFFECT - OVER TEMPERATURE THERMOSTAT (IN SERIES WITH TEMPERATURE CONTROL THERMOSTAT) WILL OPEN IF TEMPERATURE INCREASES WITHIN 15 DEGREES ABOVE CONTROLLING THERMOSTAT UPPER LIMIT.

**(C) MISSION:**

FIRST FAILURE - NO EFFECT

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

FIRST FAILURE - NO EFFECT

**(E) FUNCTIONAL CRITICALITY EFFECTS:**

CASE 1:

POSSIBLE INJURY TO CREW AFTER FOUR FAILURES:

- 1) ZONE 1 OR 2 (UPPER EXTERNAL AIRLOCK) CONTROL THERMOSTAT FAILS CLOSED - LOSS OF ABILITY TO CONTROL THE HEATERS BETWEEN THE SET POINT TEMPERATURES (55 TO 75 DEG.F).
- 2) ASSOCIATED ZONE 1 OR 2 OVER TEMPERATURE THERMOSTAT FAILS CLOSED - LOSS OF ABILITY TO AUTOMATICALLY DE-ENERGIZE CIRCUIT WHEN UPPER SET TEMPERATURE IS REACHED. AFFECTED HEATERS FAILS ON.
- 3) ERRONEOUS OUTPUT OF ASSOCIATED TEMPERATURE SENSOR INDICATING LOWER THAN ACTUAL TEMPERATURE WHICH WILL NOT TRIGGER THE FDA ALARM WHEN THE HEATER ZONE TEMPERATURE SENSOR RISES ABOVE 113 DEG. F (UPPER FDA LIMIT). HEAT CONDUCTION TO THE SECOND TEMPERATURE SENSOR MAY NOT BE IN SUFFICIENT TIME TO TRIGGER THE FDA ALARM.
- 4) LOSS OF ABILITY OF GROUND PERSONNEL TO RECEIVE DOWNLINKED TEMPERATURE MEASUREMENT DATA - LOSS OF ABILITY TO DETECT HEATER SYSTEM FAILURES AND INFORM CREW TO PERFORM CORRECTIVE ACTION. POSSIBLE INJURY TO CREW DUE TO BURNS WHEN CONTACTING HOT STRUCTURE.

**FAILURE MODES EFFECTS ANALYSIS (FMEA) - NON-CIL FAILURE MODE  
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**CASE 2:****POSSIBLE LOSS OF CREW/VEHICLE AFTER FOUR FAILURES:**

- 1) ZONE 3 (KEEL) CONTROL THERMOSTAT FAILS CLOSED - LOSS OF ABILITY TO CONTROL THE HEATERS BETWEEN THE SET POINT TEMPERATURES (55 TO 75 DEG. F).
- 2) ASSOCIATED ZONE 3 OVER TEMPERATURE THERMOSTAT FAILS CLOSED - LOSS OF ABILITY TO AUTOMATICALLY DE-ENERGIZE CIRCUIT WHEN UPPER SET TEMPERATURE IS REACHED. AFFECTED HEATERS FAIL ON.
- 3) ERRONEOUS OUTPUT OF TEMPERATURE SENSOR INDICATING LOWER THAN ACTUAL TEMPERATURE WHICH WILL NOT TRIGGER THE FDA ALARM WHEN THE HEATER ZONE 3 TEMPERATURE SENSOR RISES ABOVE 113 DEG. F (UPPER FDA LIMIT).
- 4) LOSS OF ABILITY OF GROUND PERSONNEL TO RECEIVE DOWNLINKED TEMPERATURE MEASUREMENT DATA - LOSS OF ABILITY TO DETECT HEATER SYSTEM FAILURES AND INFORM CREW TO PERFORM CORRECTIVE ACTION. POSSIBLE LOSS OF RUSSIAN AVONICS ON PALLET DUE TO THE EXCEEDANCE OF THE UPPER CERTIFICATION TEMPERATURE LIMIT (122 DEG. F MAXIMUM DURING OPERATION) RESULTING IN LOSS OF NOMINAL UNDOCKING CAPABILITY.

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

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

**CASE 2:**

AFTER THE FOURTH FAILURE, THE CREW WOULD PERFORM IFM TO DRIVE THE HOOK MOTORS. IF THE IFM IS NOT SUCCESSFUL (FIFTH 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 (SIXTH 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:**

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CREW WOULD HAVE SUFFICIENT TIME TO REMOVE POWER TO AFFECTED HEATER  
CIRCUIT.

HAZARD REPORT NUMBER(S): CASE 1: ORBI 404 (STATUS - OPEN), CASE 2: ORBI 401

**HAZARD(S) DESCRIPTION:**

CASE 1: IVA CREW HAZARDS DUE TO ISS ODS (CAUSE D - HOT SPOTS).

CASE 2: 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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