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**FAILURE MODE EFFECTS ANALYSIS/CRITICAL ITEMS LIST**


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**FMEA NUMBER:** CSD-TB-34A**ORIGINATOR:** JSC**PROJECT:** EDFT-02

**PART NAME:** EVA C/O MECH  
**PART NUMBER:** SED39127549-301  
**LSC CONTROL NO:** N/A  
**ZONE/LOCATION:** CABIN/PLB

**LRU/ORU PART NUMBER:** SED39127468-301 **QUANTITY:** 1  
**LRU/ORU PART NAME:** ORT **SYSTEM:** DTO 671  
**DRAWING/REF DESIGNATOR:** SEE P/N **SUBSYSTEM:** EVA  
**EFFECTIVITY/AFFECT STAGE:** STS-69 & SUBS

**CRITICAL ITEM:** Yes  
**CRITICALITY CATEGORY:** 1R/2

**CRITICALITY:**

**SUCCESS PATHS:** 2  
**SUCCESS PATH REMAINING:** 1

**REDUNDANCY SCREENS:**

1. C/O PRELAUNCH: Pass
2. C/O ON ORBIT: N/A for NSTS
3. DETECTION FLIGHT CREW: N/A
4. DETECTION GROUND CREW: N/A
5. LOSS OF REDUNDANCY FROM SINGLE CAUSE: Pass

**FUNCTION:** The ORU Restraint Tether (ORT) is a semi-rigid restraint aid available to EVA crewman to temporarily mount ORU's. The ORT interfaces with a ORU's tether loop utilizing a push lock tether tool or nested hook tether tool and will be mounted to structure through a EVA change out mechanism. The base plate the ORT mounts to will incorporate EVA contingency bolts on STS-69. The closed coupled configured ORT is a modified version of the ORT. It is the same as the ORT without the ball stack. The closed coupled ORT interfaces at it's base to a load alleviating gimbal. All ORT configurations are designed to restrain a ORU up to 50 lb. mass.

**FAILURE MODE CODE:** N/A for NSTS

**FAILURE MODE:** Inadvertent release of EVA changeout mechanism.

**CAUSE:** Contamination, galling, piece part defect

**REMAINING PATHS:** 2nd Spring.

**EFFECT/ MISSION PHASE:** EVA

**CORRECTIVE ACTION:** None required.

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**-FAILURE EFFECTS-**


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**END ITEM/LRU/ORU/ASSEMBLY:**

None for single failure, force required to operate mechanism will be less.

**SUBSYSTEM/NEXT ASSEMBLY/INTERFACE:** N/A

**SYSTEM/END ITEM/MISSION:** None

**CREW/VEHICLE :** None for single failure, possible damage to vehicle if ORU is released and impacts the EMU or vehicle.

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**PART NUMBER:** SED39127549-301      **LRU/ORU PART NAME:** ORT      **SYSTEM:** DTO 671  
**LSC CONTROL NO:** N/A      **DRAWING/REF DESIGNATOR:** SEE P/N      **SUBSYSTEM:** EVA  
**ZONE/LOCATION:** CABIN/PLB      **EFFECTIVITY/AFFECT STAGE:** STS-69 & SUBS

### HAZARD INFORMATION:

**HAZARD:** YES: x      NO:

**HAZARD ORGANIZATION CODE:** N/A

**HAZARD NUMBER:** N/A

**TIME TO EFFECT:** Minute

**TIME TO DETECT:** Seconds

**TIME TO CORRECT:** Immediate

**FAILURE DETECTION/FLIGHT:** Visual

### REMARKS:

### -RATIONALE FOR ACCEPTABILITY-

(A) **DESIGN:** The ORT Assy. is designed to withstand a 1800 in-lb bending and torsion, 75 lb. tension load along it's long axis, and 125 lb. in shear without functional degradation. The sheath is designed to withstand a 125 lb. load independently from the cable in the ball stack. If cable failure were to occur, the sheath is designed to prevent any of the loss parts from becoming free in the PLB. Load verification is performed by analysis with a ultimate factor of safety of 2.0. Positive margin is required. Nested redundant springs are incorporated in the EVA changout mechanisms design to prevent a single failure from releasing the ORT or end effector.

(B) **TEST:** Applicable requirements from JSC33034.

Acceptance:

- 1) **Functional:** Verified at Predelivery Acceptance Test, Preinstallation acceptance, and Pre/Post environmental test. Minimum of 30 actuation cycles total.
  - a) EVA release mechanism installation and removal force shall be between 2 and 10 lb. verified per TPS.
  - b) The torque required to operate the mechanism shall be between 1 and 5 in-lb. and the force required to actuate the mechanism shall be between 1 and 5 lb. verified per TPS.
  - c) 75 lb. tensile load test performed on cable at PDA. verified per TPS
  - d) 125 lb. tensile load test performed on sheath at PDA verified per TPS.
- 2) **Environmental:** Acceptance Vibration

The ORT is subjected to the following vibration in each axis for a duration of 1 minute verified per TPS:

|                      |                         |
|----------------------|-------------------------|
| 20 Hz                | 0.01g <sup>2</sup> /Hz  |
| 20 to 80 Hz          | +3.0dB/oct              |
| 80 to 350 Hz         | .040 g <sup>2</sup> /Hz |
| 350 to 2000 Hz       | -3.0dB/oct              |
| 2000 Hz              | 0.007g <sup>2</sup> /Hz |
| load factor 6.1 Grms |                         |

Qualification:

**Environmental:**

**Thermal:** Functional verification performed at -100°F and +200°F. Forces are subjectively evaluated during the test and measured pre and post test verified per TPS.

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**LSC CONTROL NO: N/A      DRAWING/REF DESIGNATOR: SEE P/N      SUBSYSTEM: EVA**  
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Load test : Sheath load tested to 183 lb. verified per TPS.

**(C) INSPECTION:**

Fabrication - All ORT components are verified to be built to print and generally clean individually. The ORT assy. is verified to be visually clean at predelivery acceptance.

Test - Quality Assurance surveillance is required at all test and inspections. Discrepancy reports are written on all noncompliance's.

**(D) FAILURE HISTORY: None****(E) OPERATIONAL USE:**

- 1) Operational Effect - ORT or end effector inadvertently released from task board .
- 2) Crew Action - Retrieve loose item or verify it is out of PLB.
- 3) Crew Training - Crew trained in proper operation of ORT.
- 4) Mission constraint - When rigidized the ORT should not be operated with the ball stack bent at more than 120 degrees.
- 5) In Flight Checkout - The EVA change out mechanism operation will be functional verified at the of operation during the EVA.

**(F) MAINTAINABILITY: N/A**


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**PREPARED BY: G. Wright**
**REVISION:****DATE: 4/15/95****WAIVER NUMBER**