| HAZARD REPORT NUMBER: RT-03 | DATE: August 24, 1994 |
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| REV. LETTER: | REV. DATE: |

Title: Potential structure overload of the suit.

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|---|---|
| 1. SEVERITY: | Catastrophic I |
| 2. LIKELIHOOD OF OCCURENCE: | Improbable |
| 3. CLASSIFICATION: | Controlled |

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| CAUSE:<br>B. Overload the GTT tether cord. | REDUNDANCY SCREENS: |
| FMEA: # DTO671-64-3-5 Criticality 1R/2<br>NAME/QTY: Grip Tether Tool<br>FUNCTION:<br>The Grip Tether Tool (GTT) is designed to attach and lock to a standard EVA tether loop. The GTT tool is actuated by a primary trigger that deploys two jaws. Once the jaws have grappled a tether loop, a second trigger is depressed repeatedly to draw the tether loop inside the GTT tool housing.<br>FAILURE MODE:<br>Retractable tether breaks while extended.<br>CAUSE(S):<br>1) Knot(s) fail/improperly assembled.<br>2) Overload of the tether cord. | FAILURE DETECTION:<br>Flight: Visual<br>Ground: None<br>CORRECTIVE ACTION:<br>For APFR exercises, the crew must attach a secondary equipment tether from the installed PFR or additional Mass component tether loop to the EMU D-ring. |
| EFFECT:<br>Possible impact of an EMU and/or Orbiter critical flight hardware from loose equipment.<br>Time to Effect: Minutes<br>Time to Correct: Seconds | REMAINING PATHS: |

CONTROL/RETENTION RATIONALE (see retention rational information table):

1. GTT 6 ft retractable tether withstands a minimum of 30 lb pull load.
2. The RT withstands the AVT levels.
3. The structural materials are selected from JSC-0960F/MSFC-HDBK-527 and meet the requirements of SE-R-0006.
4. A Factor of Safety of at least 2.0 for ultimate loads is used as the standard value in structural design and interface load analysis.
5. The RT design precludes failure caused by initiation or propagation of cracks.
6. Crew procedures and training identifies the movements and area to avoid which eliminates the bump load potentials.

VERIFICATION:

1. Load Test was performed at PDA TPS #41080018.
2. An AVT of the RT was performed prior to flight to identify any potential for vibration induced damage, TPS # FV9420083.
3. Review and approval of the structural materials by ES5/Materials Branch was done per JSC Materials Certification Memo # MATL-94-116.
4. Stress Analysis Report # 10107-70974 verifies structural integrity of the RT components for all load conditions.
5. Fracture certification was implemented per JSC-25863 Fracture Control Plan for JSC Flight Hardware and documented in material certification form (MATL-94-116), there are no fracture critical parts in this assy.
6. Extensive training has been done with the RT in the WETF to make the crewmembers aware of the need for cautious movement while the RT is attached to the EMU.

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RETENTION RATIONAL INFORMATION

I. DESIGN FEATURES TO MINIMIZE THE CHANCE OF THE FAILURE MODE OCCURRENCE

A. Structural Margins: The RT is designed to take all limit load conditions as identified in section 3.2.3, "Load Requirements" of JSC-38039 (DTO 671 HRD). A factor of safety of 2.0 was implemented during analysis and 1.4 during testing.

B. Thermal Tolerances: The RT is designed to operate in the thermal environment (-100°F to +250°F) as specified in section 5.3.1, "Temperature" of JSC-38039. All moving parts were analyzed during the design process to determine the clearance and gap values.

C. Material Selection: All of the RT assembly materials that are considered safety critical are listed in Table 5-2 of JSC-38040 (DTO 671 FMEA). All material abide by SE-R-0006C and are approved per MATL-94-116 (RT), MATL-94-116 (GTT), MATL-94-116 (PLTT)

II. TESTING AND ANALYSIS

A. Testing:

1. Acceptance: The RT Assembly underwent the following PDAs: TP3# 679420059 (RT), 41080018 (GTT), and LEVAH9420054 (PLTT).
The RT hardware was operated in the thermal extremes during Cmbr T testing per (Included pre/post funct.): 679420110 (RT), 679420111 (GTT), 679420112 (PLTT).
PIA will be done prior to flight.
The RT hardware was exposed to AVT environments per (Includes pre/post funct.): LEVAH9420070 (RT and GTT), FV9420085 (PLTT)

2. Certification: The thermal tests listed above are used for certification as well.
Only one flight unit was built and it was exposed to AVT loads versus an QVT.
Pre/Post test functional were done on the hardware during certification testing.

B. Analysis: Stress analysis LESC-31291 was performed on the RT and PLTT and 10107-70974 was done for the GTT.
Stress analysis EMJM-934 was done by HSMS to indicate that the RT input loads do not overload the EMU.
Thermal analysis (LESC CTSD-1857) was done on the RT hardware and it did not exceed the certification limits.

III. INSPECTION

A. Manufacturing: The RT hardware components were inspected at conformance to their applicable drawings at Bld 16 prior to assembly.
The RT does not contain any fracture critical parts.

B. Assembly: The assembly was inspected to the assembly level drawings during PDAs.
The assemblies were cleaned to level VC after assembly and will be prior to flight.

C. Testing: Pre/Post testing was conducted prior to and after all acceptance and certification testing. The hardware was verified to be working properly before the test began and after the test.

IV. FAILURE HISTORY

A. Ground Testing: DRs were collected during the testing phase of the project but no FIARs were initiated. All DRs shall be closed prior to certification.

B. On-Orbit Use: None

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## V. OPERATIONAL USE

A. Effects of Failure: Possible damage to an EMU or injury to the crew from overload of the suit or impact from a loose ORU.

B. Crew Action: The crew has been made aware of the potential loading conditions with the RT. They have been training in the WETF to avoid inadvertant contact with the RT slider.

C. Training: WETF runs have been conducted where the crew actions were rehearsed.

D. Mission Constraints: None

E. In-Flight Check-Outs: Operation of all locks and mechanisms prior to use in the Payload Bay.

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| CONCURRENCE: | DATE: |
|---|---|
| DESIGN ENGINEER(S): J K Brady | 8/23/94 |
| PROJECT ENGINEER(S): Tom Gouti | 8/22/94 |
| SAFETY ENGINEER(S)/NS2: Ronald W. Cook | 8/24/94 |
| SAFETY MANAGER(S)/NS2: N/A | |
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| | |

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