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| HAZARD REPORT NUMBER: RT-01 | DATE: August 24, 1994 |
| REV. LETTER: | REV. DATE: |

Title: Structural failure and/or vibration induced damage during launch.

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| 1. SEVERITY: Critical | |
| 2. LIKELIHOOD OF OCCURENCE: Improbable | |
| 3. CLASSIFICATION: Controlled | |
| CAUSE: B. Grip Tether Tool EVA change-out mechanism inadvertently actuates. | REDUNDANCY SCREENS: A-Pass B-N/A C-Pass |
| FMEA: # DT0671-64-3-6, Criticality 1R/2 NAME/QTY: Grip Tether Tool/1 FUNCTION: 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. FAILURE MODE: EVA change-out mechanism inadvertently actuates during translation with an attached ORU. CAUSE(S): 1) Piece part failure of the locking mechanism. 2) Wear/Galling. | FAILURE DETECTION: Flight: Visual Ground: None CORRECTIVE ACTION: For APFR exercises, the crew must attach a secondary equipment tether from the installed PFR or additional Mass component tether loop to the RT at a spot beyond the change-out mechanism. |
| EFFECT: Possible impact of an EMU and/or orbiter critical hardware from loose equipment. Time to Effect: Minutes Time to Correct: Seconds | REMAINING PATHS: 1. Secondary equipment tether. |
| CONTROL/RETENTION RATIONALE (see retention rational information table): 1. Change-out mechanism can be actuated by 1-3 lb force to attach/detach and 2-5 in-lb locking torque. 2. The GTT withstands the AVT test levels. 3. The structural materials are selected from JSC-0960F/MSFC-HDBK-527 and meet the requirements of SE-R-0006 and are approved by material certification memo. 4. A FOS of 2.0 for ultimate loads is used in analysis, and 1.4 during test. 5. The GTT design precludes failure caused by fracture mechanics as identified in Material Certification Memo. | |
| VERIFICATION: 1. Operation of mechanism during thermal test per TPS # 579420093. 2. An AVT of the GTT was successfully performed prior to flight per TPS # FV9420083. 3. Review and approval of the structural materials by ESS/Materials Branch was done per MATL-94-116. 4. 10107-70974 verifies structural integrity of the GTT components for all load conditions. 5. Fracture certification was achieved per MATL-94-116, there are no fracture critical parts in this assembly. | |

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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 (DTC 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 (DTC 671 FMEA). All material abide by SE-R-0008C and are approved per MATL-64-118 (RT), MATL-64-118 (GTT), MATL-64-118 (PLTT)

II. TESTING AND ANALYSIS

- A. Testing:
- Acceptance: The RT Assembly underwent the following PDAs: TPS# 579420059 (RT), 41080018 (GTT), and LEVAHS420054 (PLTT). The RT hardware was exposed to the thermal extremes during Orbiter T testing per (includes pre/post funct.): 579420110 (RT), 579420111 (GTT), 579420112 (PLTT). PIA will be done prior to flight.
The RT hardware was exposed to AVT environments per (includes pre/post funct.): LEVAHS420070 (RT and GTT), FV9420065 (PLTT)
 - 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 LE9C-31291 was performed on the RT and PLTT and 10107-70674 was done for the GTT. Thermal analysis (LE9C CTSD-1807) was done on the RT hardware and it did not exceed the certification limits.

III. INSPECTION

- A. Manufacturing: The RT hardware components were inspected of conformance to their applicable drawings at Bid 10 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 impact to EMU and/or Orbiter critical hardware from loose equipment.
- B. Crew Action: The crew has been trained to attach the RT safety tether located on the MMWS to the RT tether loop upon RT installation to the MMWS. In addition, during ORU translation, a secondary tether shall be attached from an alternate ORU tether location to the RT side bar just behind the gimbal mechanism.
- C. Training: WETF runs have been conducted where the crew actions were rehearsed.
- D. Mission Constraints: None
- E. In-Fight Check-Out: Operation of all locks and mechanisms prior to use in the Payload Bay.

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