

CRITICAL ITEMS LIST

REFERENCE DESIGNATOR:
NAME/QUANTITY: ERCW Safety Tether Extended Assembly
DRAWING REFERENCE: 10167-20061-03104

PROJECT: ORBITER
LRU NAME/QUANTITY: ERCW Safety Tether Extended Assembly
LRU PART NUMBER: 10167-20061-03104

SUBSYSTEM
EFFECTIVITY: All Orbiters

FAILURE MODE NUMBER STA-1.A	CRITICALITY 1/1	FAILURE EFFECT	RETENTION RATIONALE
FUNCTION Provides adjustable safety tether interface between the crewmember waist tether and EVA slidewire assembly.		END ITEM Loss of safety restraint for EVA crewmember.	1. DESIGN FEATURES TO MINIMIZE FAILURE MODE. <ol style="list-style-type: none"> ERCW safety tether materials <ul style="list-style-type: none"> Housing is made of 6061T651 aluminum and is anodized according to MIL-A-86625. Cable takeup reel and most other internal parts are made of 6061T651 aluminum and are anodized according to MIL-A-8625. Cable is made to 133 preformed stands of 302 stainless steel, parts of the locking mechanism are also of stainless steel. The hook is made of 7075T73 aluminum and anodized according to MIL-A-8625. The ERCW safety tether was designed for a working load of 330 lbs., plus a safety factor requirement of 1.4. The cable has a rated breaking strength of 920 lbs. and meets the requirements of MIL-C-18375A and MIL-W-83420. The hook incorporates a lock-lock safety feature requiring separate forces applied simultaneously in three directions to enable the hook latch to open. Extension strap material. <ul style="list-style-type: none"> 1-inch wide Kevlar webbing conforming to MIL-T-87110 with tensile strength of 6000 lbs. Properties of kevlar reduce deterioration from exposure to space environments. Kevlar 5-ply cord is used for stitching per FED S11D-751A, lock stitch type 301 7 to 10 stitches per inch. KEL-F-800 is used to coat all cut edges of webbing to prevent fraying. 2. TEST OR ANALYSIS TO DETECT FAILURE MODE. <u>Acceptance</u> <ol style="list-style-type: none"> ERCW tether load tested to 600 lbs. according to acceptance test procedures P578/ATP-06002. Functional testing to verify that the tether operates smoothly to 55 feet, and brake locks and unlatches properly. Extension strap load tested to 600 lbs. according to ILC document 10107 70871.
FAILURE MODE AND CAUSE Failure Mode: Housing assembly, cable assembly, takeup reel assembly, hook extension strap, Nomex webbing, break or hook latch jams open. Cause: 1. Defective material. 2. Excessive load. 3. Contamination.		MISSION N/A	
REUNDANCY SCREENS A - N/A B - N/A C - N/A		CREW/VEHICLE Possible loss of crewmember due to separation from Orbiter.	
REMAINING PATHS N/A		INTERFACE N/A	
MISSION PHASE EVA	TIME TO EFFECT Seconds	TIME TO CORRECT N/A	

CRITICAL ITEMS LIST

REFERENCE DESIGNATOR:
NAME/QUANTITY: ERCM Safety Tether Extended Assembly
DRAWING REFERENCE: T0162-20061-03104

PROJECT: ORBITER
LRU NAME/QUANTITY: ERCM Safety Tether Extended Assembly
LRU PART NUMBER: T0162-20061-03104

SUBSYSTEM:
EFFECTIVITY: All Orbiters

FAILURE MODE NUMBER STA-1.A		CRITICALITY 1/1	FAILURE EFFECT	RETENTION RATIONALE
FUNCTION Provides adjustable safety tether interface between the crewmember waist tether and EVA slidewire assembly.			END ITEM Loss of safety restraint for EVA crewmember.	Certification: <ol style="list-style-type: none"> The 25-foot safety tether assembly was thermal vacuum tested at 1.4×10^{-5} torr at temperature of -115°F to $+287^{\circ}\text{F}$ according to TPS 01510020. The 55-foot tether is certified by similarity to the 25 foot tether. Functional test on ERCM tether was conducted at temperatures of -200°F and $+250^{\circ}\text{F}$ per TPS 91620005. The tether was cycled at each temperature level (one completed cycle is extended cable, lock, release cable, unlock and retract cable) The total assembly passed the required proof load test (PLT) of 600 pounds. Components subjected to ultimate load test (ULT) <ul style="list-style-type: none"> • Housing ULT to 4,183 lbs (TPS 10720032) for an ultimate safety factor (USF) of 2.73. • Hook assembly ULT to 995 lbs (TPS 10720010) for USF of 2.55 and functionally tested over temperature range of -270°F to $+270^{\circ}\text{F}$ (TPS 11510014 and TPS 118000183). • Cable assembly ULT to 906 lbs (TPS 10720032) for USF of 2.33 • Extension strap ULT to 2000 lbs. (TPS 01620007) for USF of 5.13 Turnaround: <ol style="list-style-type: none"> If the tether assembly is not used during the mission it is not to be removed from the vehicle. No inspection is performed If the tether assembly is used during the mission, the cable and extension strap are replaced and defective parts are replaced/ repaired. Load tested to 600 pounds is performed on tether and extension strap in accordance with PMA document PS28/P1A-06004.
FAILURE MODE AND CAUSE Failure Mode: Housing assembly, cable assembly, takeup reel assembly, hook extension strap, Nomex webbing, break or hook latch jams open. Cause: <ol style="list-style-type: none"> Defective material. Excessive load. Contamination. 			MISSION N/A	
REUNDANCY SCREENS A - N/A B - N/A C - N/A		REMAINING PATHS N/A		
MISSION PHASE EVA		TIME TO EFFECT Seconds	TIME TO CORRECT N/A	
		CREW/VEHICLE Possible loss of crewmember due to separation from Orbiter.		
		INTERFACE N/A		

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CRITICAL ITEMS LIST

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REFERENCE DESIGNATOR:
NAME/QUANTITY: ERCM Safety Tether Extended Assembly
DRAWING REFERENCE: 70162-20061-0304

PROJECT: ORBITER
LRU NAME/QUANTITY: ERCM Safety Tether Extended Assembly
LRU PART NUMBER: 70162-20061-0304

SIIR SYSTEM:
EFFECTIVITY: All Orbiters

FAILURE MODE NUMBER STA-1.A	CRITICALITY 1/1	FAILURE EFFECT	RETENTION RATIONALE
FUNCTION Provides adjustable safety tether interface between the crewmember waist tether and EVA slidewire assembly.		END ITEM Loss of safety restraint for EVA crewmember.	3. INSPECTION. Manufacturing: <ol style="list-style-type: none"> Quality Assurance inspection verification of manufacturing process. Monitoring of the acceptance and certification testing activities Performance of mandatory inspection points Verification of conformance to drawings. Quality Assurance inspection and material verification of housing assembly, cable takeup reel assembly, cable assembly, hook assembly and extension strap. Turnaround: <ol style="list-style-type: none"> Complete PIA inspection according to Boeing document P52B/P1A-06004 Inspect and monitor turnaround testing 4. FAILURE HISTORY No failure history of housing assembly, cable assembly, or extension strap. <ol style="list-style-type: none"> <u>Failure investigation action report (FIAR) H-ILC-001A, dated June 19, 1981</u> During EMU cold test the small hooks on both waist leathers froze in closed position. The large hook was sluggish. Cause of failure: Krytox lubricant in hooks froze. Fix: All hooks were disassembled and degreased the requirement for Krytox lubricant was deleted from assembly procedures. Thermal tests were conducted to confirm the Krytox problem TPS 1151001A (cold test) and TPS 118001B3 (hot test). FIAR was closed on June 29, 1981. <u>FIAR H-ILC-005B, dated February 27, 1984</u> During STS-11 EVA, the waist tether hooks would not close by themselves. Cause of failure: The large hook has a small hook spring in it and both hooks possible had Krytox lubricant that froze. Fix: Both hooks were degreased and the proper spring was put in the large hook. When reassembled, both hooks functioned properly. FIAR closed on March 19, 1984 <u>FIAR H-ILC-001B, dated August 11, 1981</u> The cable on the wet facility test unit would not retract when it was extended 25 feet. Cause of failure: The negator spring was kinked, decreasing spring retraction by about 50 percent. Fix: This problem was caused by mishandling or incorrect assembly procedure. The backup flight unit for the next flight was cycled successfully 50 times to assure proper operation. FIAR was closed on August 17, 1981.
FAILURE MODE AND CAUSE Failure Mode: Housing assembly, cable assembly, takeup reel assembly, hook extension strap, Nomex webbing, break or hook latch jams open. Cause: <ol style="list-style-type: none"> Defective material. Excessive load. Contamination. 		MISSION N/A	
		CREW/VEHICLE Possible loss of crewmember due to separation from Orbiter.	
REUNDANCY SCREENS A - N/A B - N/A C - N/A	REMAINING PATHS N/A	INTERFACE N/A	
MISSION PHASE EVA	TIME TO EFFECT Seconds	TIME TO CORRECT N/A	

CRITICAL ITEMS LIST

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REFERENCE DESIGNATOR
NAME/QUANTITY: ERCM Safety Tether Extended Assembly
DRAWING REFERENCE: TD162-20061-03104

PROJECT: ORBITER
LRU NAME/QUANTITY: ERCM Safety Tether Extended Assembly
LRU PART NUMBER: TD162-20061-03104

SUBSYSTEM:
EFFECTIVITY: All Orbiters

FAILURE MODE NUMBER STA-1.A	CRITICALITY 1/1	FAILURE EFFECT	RETENTION RATIONALE
FUNCTION Provides adjustable safety tether interface between the crewmember waist tether and EVA slidewire assembly.		END ITEM Loss of safety restraint for EVA crewmember.	<p>d. <u>FIAR ISC-EC-0396</u>, dated July 26, 1989: During the 820 lb proofload test of new tether hook P/N 9797-02, the hook yielded at 790 lbs. Preliminary analysis indicates hooks are being tested near their load limit and repeated tests weaken the hook. Fix: Proof load test requirement was changed to 600 lbs. and working load requirement from 585 to 390 lbs. per CCBD G2258.</p> <p>e. <u>FIAR-B-FCE-ADD5</u>. Problem: Small EVA hook was sticking during a manned thermal vacuum test. Fix: The pivot pin was redesigned and all plunger dimensions will be verified prior to pin installation. This change was authorized by CCBD-2508.</p> <p>5. OPERATIONAL USE.</p> <p>a. <u>Operation Effect of Failure</u>. Worst case this failure would allow the crewmember to become separated from the Orbiter. The EVA task would be stopped temporarily. Overall time of EVA may be increased.</p> <p>b. <u>Crew Action</u>. The remaining crew in the Orbiter would be required to maneuver the Orbiter over to the free-floating crewmember for rescue. At this point, the crewmember could tether to the Orbiter using the waist tether. With additional time, the failure could be overcome allowing the crewmember to move about the payload bay with limited flexibility compared to the nominal configuration.</p> <p>c. <u>Crew Training</u>. Standard crew training teaches the crewmember to maneuver under complete control at all times during EVA. Free floating is not suggested or practiced. This would minimize the chance of the crewmember becoming separated from the Orbiter.</p> <p>d. <u>Mission Constraints</u>. EVA tasks and hardware will be designed so that positive crewmember restraint aids will be provided at all work sites and EVA translation paths.</p> <p>e. <u>In Flight Checkout</u>. The EVA crewmember will inspect all the EVA restraint hardware prior to its use. This will minimize the effect of failures during EVA.</p>
FAILURE MODE AND CAUSE Failure Mode: Housing assembly, cable assembly, takeup reel assembly, hook extension strap, Nomex webbing, break or hook latch jams open. Cause: 1. Defective material. 2. Excessive load. 3. Contamination.		MISSION N/A	
REUNDANCY SCREENS A - N/A B - N/A C - N/A		CREW/VEHICLE Possible loss of crewmember due to separation from Orbiter.	
REMAINING PATHS N/A		INTERFACE N/A	
MISSION PHASE EVA	TIME TO EFFECT Seconds	TIME TO CORRECT N/A	

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