

CRITICAL ITEMS LIST

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REFERENCE DESIGNATOR:
NAME/QUANTITY: Waist Safety Tether
DRAWING REFERENCE: 10151-20000-07

PROJECT: ORBITER
LRU NAME/QUANTITY: Waist Safety Tether
LRU PART NUMBER: 10151-20000-07

SUBSYSTEM: EVA TETHERS
EFFECTIVITY: All Orbiters

FAILURE MODE NUMBER STA-2.A	CRITICALITY 1/1	FAILURE EFFECT	RETENTION RATIONALE
FUNCTION Interfaces with the EMU and the extended range crewmember safety tether, Orbiter handrails, or payload attach points.		END ITEM Loss of safety restraint for EVA crewmember.	<p>1. DESIGN FEATURES TO MINIMIZE FAILURE MODE.</p> <ul style="list-style-type: none"> a. Design working load of 390 lbs. minimum safety factor of 1.4 for all components b. Nomex webbing rated minimum breaking strength of 1,400 lbs c. Stitching pattern and material rated for 1,000 lbs. minimum breaking strength. d. Small and large hook assembly made of 7075T73 aluminum anodized per MIL-A-8625. e. Hook design for working load of 390 lbs f. Hooks incorporate a lock-lock safety feature requiring three independent forces applied simultaneously in three directions to enable hook latch to open. g. Hooks incorporate new latch/hook mechanism design. This includes stronger latch springs and vespel plunger and pivot bushing to prevent hook latch jamming. <p>2. TEST OR ANALYSIS TO DETECT FAILURE MODE.</p> <p><u>Acceptance.</u></p> <ul style="list-style-type: none"> • Proof load testing of webbing to 600 lbs., per CCBD G2258 prior to implementing breakaway load stitching according to TPS 10720010. • Small hook is load tested to 600 lbs • Large hook is load tested to 600 lbs • Hooks functional tested to verify that hooks operate properly. <p><u>Certification.</u></p> <ul style="list-style-type: none"> a. The waist tether was proof load tested to 819 lbs b. The small and large hooks were functionally tested over a temperature range of 200°F to +250°F (TPS S192002). c. ULT was performed as follows: <ul style="list-style-type: none"> • ULT performed on the webbing to 1,400 lbs. resulting in a USF of 3.51 • Small hook - ULT to 995 lbs. in a USF of 2.55 • Large hook - ULT to 2,500 lbs. resulting in a USF of 6.41
FAILURE MODE AND CAUSE Failure Mode: <u>Webbing, small hook or large hook breaks, or either hook latch jams open.</u> Cause: <ul style="list-style-type: none">1. Defective material.2. Excessive load.3. Contamination.4. Deformation.		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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CRITICAL ITEMS LIST

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REFERENCE DESIGNATOR:
NAME/QUANTITY: Waist Safety Tether
DRAWING REFERENCE: 19151-20040-07

PROJECT: ORBITER
LRU NAME/QUANTITY: Waist Safety Tether
LRU PART NUMBER: 19151-20040-07

SUBSYSTEM: EVA TETHERS
EFFECTIVITY: AN Orbiters

FAILURE MODE NUMBER STA-2.A	CRITICALITY 1/1	FAILURE EFFECT	RETENTION RATIONALE
FUNCTION Interfaces with the EMU and the extended range crewmember safety tether, Orbiter handrails, or payload attach points.		END ITEM Loss of safety restraint for EVA crewmember.	<p>2. TEST OR ANALYSIS TO DETECT FAILURE MODE. (Continued)</p> <p><u>Turnaround:</u></p> <p>If the tether was used during the mission, PIA test is performed and any defective parts are repaired and tether assembly is load tested to 600 lbs. If the tether was not used during the mission, it is removed from the EMU and placed in bonded stores.</p> <p>3. INSPECTION.</p> <p><u>Manufacturing:</u></p> <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 of waist tether and material <p><u>Turnaround:</u></p> <ol style="list-style-type: none"> Complete PIA inspection according to TPS 944. Inspect and monitor turnaround testing <p>4. FAILURE HISTORY.</p> <ol style="list-style-type: none"> <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 had a small spring in it and both hooks possibly had the 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 0077E, dated April 15, 1985</u> During STS-51D payload flight inspection, the large hook failed to close. Cause of Failure: There was a burr on one end of the torsion spring. Fix: Redesign of the torsion spring that bends both ends of the torsion spring 10 degrees inward allowing a smooth sliding surface near each end of the spring. This design change was incorporated in all large hooks. FIAR was closed on May 22, 1985.
FAILURE MODE AND CAUSE Failure Mode: <u>Webbing, small hook or large hook breaks, or either hook latch jams open.</u> Cause: <ol style="list-style-type: none">Defective material.Excessive load.Contamination.Deformation.		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	TIME TO EFFECT	TIME TO CORRECT	
EVA	Seconds	N/A	

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CRITICAL ITEMS LIST

REFERENCE DESIGNATOR:
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PROJECT: ORBITER
LRU NAME/QUANTITY: Waist Safety Tether
LRU PART NUMBER: 10151-20040-07

SUBSYSTEM: EVA TETHERS
EFFECTIVITY: All Orbiters

FAILURE MODE NUMBER STA-2.A	CRITICALITY 1/1	FAILURE EFFECT	RETENTION RATIONALE
FUNCTION interfaces with the EMU and the extended range crewmember safety tether, Orbiter handrails, or payload attach points.		END ITEM Loss of safety restraint for EVA crewmember.	4. FAILURE HISTORY. (Continued) c. <u>FIAR H-ILC 0014, dated June 19, 1981</u> . During EMU cold test the small hooks on both waist tethers 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 11510014 (cold test) and TPS 11800181 (hot test). FIAR was closed on June 29, 1981. d. <u>FIAR ILC-H-0085, dated July 15, 1988</u> . The small hook yielded during proof load testing to 619 lbs. Cause of Failure: Due to large allowable tolerances in hook design, causing inadequate safety factor. Fix: This problem will be screened during acceptance testing of each tether to the acceptance criteria defined in fabrication T O 10151-80001-05. Any hook that fails this criteria is scrapped and the unit will be refabricated and tested. FIAR was closed on August 13, 1988. e. <u>FIAR JSCEC 0392, dated April 28, 1989</u> . Hooks operated sluggishly during thermal/vacuum chamber testing. Cause of Failure: Due to weakened latch keeper spring. Fix: New latch/lock mechanism approved per G2224. Hooks incorporate stronger latch springs and vespel plunger and pivot bushings. f. <u>FIAR's B FCE 076-A005/A006</u> . Problem: Large and small EVA hooks were sticking during a manned thermal/vacuum test. Fix: The pivot pins were redesigned and plunger dimensions will be verified prior to pin installation. This change was authorized by CCBD 2508.
FAILURE MODE AND CAUSE Failure Mode: <u>Webbing, small hook or large hook breaks, or either hook latch jams open.</u> Cause: <ol style="list-style-type: none"> 1. Defective material. 2. Excessive load. 3. Contamination. 4. Deformation. 		MISSION N/A	
REDUNDANCY 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	TIME TO EFFECT	TIME TO CORRECT	
EVA	Seconds	N/A	

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REFERENCE DESIGNATOR:
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PROJECT: ORBITER
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LRU PART NUMBER: 10151-20040-07

SUBSYSTEM: EVA TETHERS
EFFECTIVITY: All Orbiters

FAILURE MODE NUMBER STA-2.A	CRITICALITY 1/1	FAILURE EFFECT	RETENTION RATIONALE
FUNCTION Interfaces with the EMU and the extended range crewmember safety tether, Orbiter handrails, or payload attach points.		END ITEM Loss of safety restraint for EVA crewmember.	5. OPERATIONAL. a. <u>Operational 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. 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 payload bay with limited flexibility compared to the nominal configuration. 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. 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. 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.
FAILURE MODE AND CAUSE Failure Mode: <u>Webbing, small hook or large hook breaks, or either hook latch jams open.</u> Cause: <ol style="list-style-type: none"> 1. Defective material. 2. Excessive load. 3. Contamination. 4. Deformation. 		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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