CRITICAL ITEMS LIST

ASSY NOMENCLATURE: *POLE ARRESTOR ASSEMBLY* SYSTEM: *CREW ESCAPE SYSTEM* REVISION:

ASSY P/N: *SED27101363* SUBSYSTEM: *POLE CREW ESCAPE SYSTEM*

FMEA REF	FMEA REV	NAME, QTY & DRAWING REF DESIGNATION	CRIT'Y	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	RATIONALE FOR ACCEPTANCE
1.2.1		ENERGY ABSORBER ASSEMBLY (4), SED27101365-301	I/I	1.2.1 Mode: Energy absorber binds Cause: • Contamination • Corrosion	Damage to pole or Orbiter brackets during deployment if one energy absorber binds and stop plate fails	1. Design Features. The design features which minimize the probability of this failure mode are. a. The absorbers are fabricated of materials not conducive to corrosion. Dry lubricant is applied to the rod and friction washers during assembly, and design tolerances are established to minimize the probability of binding. b. The absorber rod is fabricated from inconel 718 in accordance with specifications AMS 5662 and 5663. The rod is passivated after machining, and dye penetrant inspected in accordance with MIL-STD-6866, with no cracks permissible. c. The friction washers are machined from CRES 416 material, specification QQ 5-763, passivated after machining, and heat treated. Dry lubricant, MS-122 is applied to the rod and washers during assembly. d. The absorber body is machined from 6061-T651 aluminum, in accordance with QQ A 225/8, and anodized. e. The retainer plug is fabricated by the bonding together of nylon and aluminum with Hysol adhesive. The aluminum portion is anodized after machining. f. The four shock absorbers are installed on centers at least 2.8 inches apart on the stop plate. The stop plate is fabricated from .875 inch thick aluminum plate and anodized after machining. The stop plate is designed to an ultimate safety factor of 1.4 for all mission phases. g. The energy absorbers are designed to an ultimate safety factor of 1.4 for all mission phases.

PREPARED BY *R. HENRATA* SUPERSEDING DATE APPROVED BY *T. PELTSCHEK* DATE

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ASSY P/N: *SED27101363* SUBSYSTEM: *POLE CREW ESCAPE SYSTEM* PAGE 8 OF 70

FMEA REF	FMEA REV	NAME, QTY & DRAWING REF DESIGNATION	CRIT'Y	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	RATIONALE FOR ACCEPTANCE
1 2 1		ENERGY ABSORBER ASSEMBLY (4), SED27101365-301	1/1	1.2.1 Mode: Energy absorber binds Cause: • Contamination • Corrosion	Damage to pole or Orbiter brackets during deployment if one energy absorber binds and stop plate fails	2. Testing/Analyses. a <u>Acceptance Tests</u> (1) Acceptance vibration test (AVT). • Duration: 3 minutes/axis • Levels: 20 - 80 Hz, increasing 3dB/Octave 80 - 350 Hz at 0.04 g^2/Hz 350 - 2000 Hz, decreasing 3dB/Octave (2) Functional test (prior to and after AVT). • Initial process, controlled PCES deployment and rerorking • Noncontrolled deployment with equivalent aerodynamic loads on pole tip • Manual deployment with ratchet assembly b. <u>Certification Tests</u> (These tests were performed at the system level.) (1) Qualification acceptance vibration tests (QAVT). • Duration: 5 times AVT, 15 minutes/axis • Levels: 20 - 80 Hz, increasing 3dB/Octave 80 - 350 Hz, at 0.06 g^2/Hz 350 - 2000 Hz, decreasing 3dB/Octave (2) Functional test (after QAVT) • Controlled deployment and retocking of PCES • Noncontrolled deployment with equivalent aerodynamic loads on the pole tip

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ASSY NOMENCLATURE: *POLE ARRESTOR ASSEMBLY* SYSTEM: *CREW ESCAPE SYSTEM* REVISION

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FMEA REF	FMEA REV	NAME, QTY & DRAWING REF DESIGNATION	CRIT'Y	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	RATIONALE FOR ACCEPTANCE
1 2.1		ENERGY ABSORBER ASSEMBLY (4), SED27101365-301	1/1	1.2.1 Mode: Energy absorber binds Cause: • Contamination • Corrosion	Damage to pole or Orbiter brackets during deployment if one energy absorber binds and stop plate fails	(3) Flight random vibration tests, 48 minutes/axis, in 4 segments as follows •Segment No. / No. of Missions / Vibration Duration/Axis 1 / 6 / 173 sec 2 / 19 / 548 sec. 3 / 25 / 720 sec. 4 / 50 / 1440 sec. • Duration: Segment dependent (48 minutes/axis). • Levels: 20 - 150 Hz, increasing 6dB/Octave 150 - 1000 Hz, at 0.05g²/Hz 1000 - 2000 Hz, decreasing 6dB/Octave (4) Life cycle tests • 14 controlled deployments • 6 noncontrolled deployments (which stroke the energy absorbers) (5) Design limit load and ultimate limit load tests • With PCES fully deployed, a series of load ramps will be applied to the pole tip and verified no yielding below 100 percent of design limit. • With PCES fully deployed, a series of load ramps will be applied to the pole tip and verified no failure below 140 percent (1.4 safety factor) of design limit loads (6) Thermal testing (by analyses) • Ground operations: 45 to 120°F • Normal operations: 65 to 90°F • Ascent/entry transients: 95°F maximum peak • Ferry flight: Not applicable, PCES will be removed from Orbiter • Launch/landing emergency escapes via PCES: 12 to 75°F • Temperature (structure): 120°F maximum

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ASSY P/N: *SED27101363*, SUBSYSTEM: *POLE CREW ESCAPE SYSTEM*

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1.2.1		ENERGY ABSORBER ASSEMBLY (4), SED27101365-301	1/1	1.2.1 Mode: Energy absorber binds Cause: • Contamination • Corrosion	Damage to pole or Orbiter brackets during deployment if one energy absorber binds and stop plate fails	(7) Fungus (by analysis). • Non-nutrient to fungi in accordance with MIL-STD-810D, method 508.3 or materials adequately treated (refer to MF0004-014C, paragraph 3.1.1.c.) (8) Humidity (by analysis). • The PCES materials list was analyzed to certify compliance with MF0004-014, paragraph 3.1.1.e (9) Salt spray (by analysis) • The PCES materials list was analyzed to certify compliance with MF0004-014, paragraph 3.1.3.f (10) Sand/dust (by analysis). • Sand - diameter 0.0031 to 0.039 inches - suspended sand 1.2 lbs per cubic ft. - wind speed 33 ft/sec - hardness 7 to 8 Moh scale • Dust - diameter 0.0000039 to 0.003 inches - suspended dust 3.7 to 0.7 lb/cu ft - wind speed 33 ft/sec - hardness 7 to 8 Moh scale (11) Additional certification tests/analyses. • Transportation - packaging, shock, and vibration. Packaging designed and protective procedures developed in accordance with FED-STD-101 • On/off cycle life test (by testing): PCES deployed 20 times, refer to (4) above • Transient vibration (by analysis) • Structural fatigue (by analysis) • Corrosion: (by analysis) • Handling shock, crash shock, and landing shock (by analyses) • Acceleration and cabin atmosphere (by analysis) • Full life and limited life certification (by analysis)

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CRITICAL ITEMS LIST

ASSY NOMENCLATURE: *POLE ARRESTOR ASSEMBLY* SYSTEM: *CREW ESCAPE SYSTEM* REVISION:

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FMEA REF	FMEA REV	NAME, QTY & DRAWING REF DESIGNATION	CRIT'Y	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	RATIONALE FOR ACCEPTANCE
1.2.1		ENERGY ABSORBER ASSEMBLY (4), SED27101365-301	1/1	1.2.1 Mode: Energy absorber binds Cause: • Contamination • Corrosion	Damage to pole or Orbiter brackets during deployment if one energy absorber binds and stop plate fails	c. Turnaround Testing Each PCES is subjected to a controlled functional deployment test, per ORMHSD requirements, every 10 missions or every 2 years, whichever occurs first. 3. Inspection/QA/Manufacturing. a All PCES fabrication, assembly, and test activities were performed under the jurisdiction of the NASA JSC Quality Assurance (QA) Division in accordance with ISEM 5312 SR&QA Manual Requirements. QA surveillance was provided for procurement, planning, processing, fabrication, assembly, certification testing, and acceptance testing. One hundred percent mandatory inspection points were employed at appropriate points in the fabrication, assembly and acceptance process. b Receiving inspection verified that materials provided by suppliers were as identified on the procurement documents, and that data was provided attesting to the traceability and acceptability of materials and components received from suppliers. c. The energy absorber assembly components were fabricated of aerospace approved materials by trained technicians. QA inspections performed during the fabrication, assembly, testing, and acceptance process prior to delivery verified: (1) Use of correct, approved materials (2) Dimensional tolerances specified on design drawings (3) Cleaning of parts and assemblies in accordance with JSC Manual 5322, paragraph 7.1.3 to level GC (4) Inspection of surfaces assuring proper surface preparation prior to application of special surface coating processes. (5) Liquid dye penetrant inspection in accordance with MIL-STD-6866 after machining, with no cracks permissible

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ASSY NOMENCLATURE: *POLE ARRESTOR ASSEMBLY* SYSTEM: *CREW ESCAPE SYSTEM* REVISION:

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FMEA REF	FMEA REV	NAME, QTY & DRAWING REF DESIGNATION	CRIT'Y	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	RATIONALE FOR ACCEPTANCE
1.2.1		ENERGY ABSORBER ASSEMBLY (4), SED27101365-301	1/1	1.2.1 Mode: Energy absorber binds Cause: • Contamination • Corrosion	Damage to pole or Orbiter brackets during deployment if one energy absorber binds and stop plate fails	(6) Anodizing of aluminum surfaces as specified on engineering drawings; passivating of inconel and steel components, as defined by drawings (7) Proper assembly of components, torquing of threaded fasteners, alignment, and fitting of components into the PCES in accordance with drawing requirements (8) Demonstration of energy absorber functional performance in the PCES in accordance with TPS instructions; visual inspection for damage d Turnaround. The PCES end item is removed after each flight and visually inspected, per OMRSD requirements, prior to reinstallation for each mission. The 2 year inspections include visual examination of the energy absorbers for signs of deterioration or damage and corrosion, and performance of controlled deployment tests, and recocking 4. Failure History. The energy absorber assembly is a newly designed hardware item and has no failure history 5. Operational Use. a. Operational Effect of Failure. Probable loss of crew if more than one energy absorber fails b Crew Action. None. c Crew Training Not applicable d Mission Constraints. None Mission would be terminated prior to use of this equipment e In-Flight Checkout None

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