

CRITICAL ITEMS LIST

ASSY NOMENCLATURE: EXTENSION POLE ASSEMBLY

SYSTEM: CREW ESCAPE SYSTEM

REVISION:

ASSY P/N: SED27101325

SUBSYSTEM: POLE CREW ESCAPE SYSTEM

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FMEA		NAME, QTY & DRAWING REF DESIGNATION	CRITY	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	RATIONALE FOR ACCEPTANCE
REF	REV					
6.1.1		SPRING (1), SDD27101332	2/1R	<p>6.1.1 Mode: Spring jammed</p> <p>Cause: • Contamination • Defective spring • Stress Corrosion</p>	<p>Extension pole jammed, unable to deploy if loss of all spring force or inertia of primary pole failed to deploy the extension</p>	<p>1. Design Features. The design features which minimize the probability of this failure mode are</p> <p>a. The PCES spring is manufactured from stainless steel 17-7 PH material in accordance with specification AMS 5673, condition CH 900. The spring is 29.9 inches long and has an outside diameter of 2.062 inches. The spring has 52 active coils of .125 diameter wire and provides a 42 lb. kick force to the primary pole during deployment.</p> <p>b. The spring housing is fabricated from 6061-T651 aluminum in accordance with specification QQ-A-200/B. The housing flange is fabricated from 6061 plate in accordance with specification QQ-A-25011 and welded to the housing in accordance with specification SN-VV-0082. Teflon penetrant hard coat anodize process Tufium is applied to the assembly to minimize friction.</p> <p>c. The housing bands are fabricated from CRES PH 15-5, H1075 in accordance with specification AMS 5659, and passivated after machining. Loctite thread adhesive is applied to the retaining screws and stop screws during attachment of the bands to the housing.</p> <p>d. The design drawings provide tolerances that assure the pole assemblies will not jam during deployment. The components that would be involved in the failure mode are enclosed in the PCES housing assembly, which is adequately sealed to prevent entry of contamination.</p>

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FMEA		NAME, QTY & DRAWING REF DESIGNATIONS	CRITY	FAILURE MODE AND CAUSE	FAILURE EFFECT OR END ITEM	RATIONALE FOR ACCEPTANCE
REF	REV					
6.1.1		SPRING (1), SDD27F01332	2/1R	<p>6.1.1 Mode: Spring jammed</p> <p>Cause:</p> <ul style="list-style-type: none"> • Contamination • Defective spring • Stress Corrosion 	<p>Extension pole jammed, unable to deploy if loss of all spring force or inertia of primary pole failed to deploy the extension.</p>	<p>2. Testing/Analyses.</p> <p>a. <u>Acceptance Tests</u></p> <p>(1) Acceptance vibration test (AVT).</p> <ul style="list-style-type: none"> • Duration: 3 minutes/axis • Levels: 20 - 80 Hz, increasing 3dB/Octave 80 - 350 Hz at 0.04g²/Hz 350 - 2000 Hz, decreasing 3dB/Octave <p>(2) Functional test (prior to and after AVT)</p> <ul style="list-style-type: none"> • Initial process, controlled PCES deployment and recocking • Noncontrolled deployment with equivalent aerodynamic loads on pole tip • Manual deployment with ratchet assembly <p>b. <u>Certification Tests</u> (These tests were performed at the system level)</p> <p>(1) Qualification acceptance vibration tests (QAVT).</p> <ul style="list-style-type: none"> • Duration: 5 times AVT, 15 minutes/axis • Levels: 20 - 80 Hz, increasing 3dB/Octave 80 - 350 Hz, at 0.067g²/Hz 350 - 2000 Hz, decreasing 3dB/Octave <p>(2) Functional test (after QAVT)</p> <ul style="list-style-type: none"> • Controlled deployment and recocking of PCES • Noncontrolled deployment with equivalent aerodynamic loads on the pole tip

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SUPERSEDING DATE

APPROVED BY: T. PELESCHER

DATE

PCES: 38

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FMEA		NAME, QTY & DRAWING REF DESIGNATION	CRITY	FAILURE MODE AND CAUSE	FAILURE EFFECT ON END ITEM	RATIONALE FOR ACCEPTANCE															
REF	REV																				
611		SPRING (1), SDD27101332	2/1R	<p>6.1.1 Mode: Spring jammed</p> <p>Cause: <ul style="list-style-type: none"> • Contamination • Defective spring • Stress • Corrosion </p>	<p>Extension pole jammed, unable to deploy if loss of all spring force or inertia of primary pole failed to deploy the extension</p>	<p>(3) Flight random vibration tests, 48 minutes/axis, in 4 cycles as follows:</p> <table border="1"> <thead> <tr> <th>Segment No.</th> <th>No. of Missions</th> <th>Vibration Duration/Axis</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>6</td> <td>173 sec</td> </tr> <tr> <td>2</td> <td>19</td> <td>548 sec.</td> </tr> <tr> <td>3</td> <td>25</td> <td>720 sec.</td> </tr> <tr> <td>4</td> <td>50</td> <td>1440 sec</td> </tr> </tbody> </table> <ul style="list-style-type: none"> • Duration: Segment dependent (48 minutes/axis). • Levels: 20 - 150 Hz, increasing 6dB/Octave 150 - 1000 Hz, at 0.03g²/Hz 1000 - 2000 Hz, decreasing 6dB/Octave <p>(4) Life cycle tests.</p> <ul style="list-style-type: none"> • 14 controlled deployments • 6 noncontrolled deployments (which stroke the energy absorbers) <p>(5) Thermal testing (by analysis).</p> <ul style="list-style-type: none"> • Ground operations: 35 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 <p>(6) Fungus (by analysis)</p> <ul style="list-style-type: none"> • 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.) 	Segment No.	No. of Missions	Vibration Duration/Axis	1	6	173 sec	2	19	548 sec.	3	25	720 sec.	4	50	1440 sec
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REF	REV					
6.1.1		SPRING (1), SDD27101332	2/1R	<p>6.1.1 Mode: Spring jammed</p> <p>Cause:</p> <ul style="list-style-type: none"> • Contamination • Defective spring • Stress • Corrosion 	<p>Extension pole jammed, unable to deploy if loss of all spring force or inertia of primary pole failed to deploy the extension</p>	<p>(7) Humidity (by analysis)</p> <ul style="list-style-type: none"> • The PCES materials list was analyzed to certify compliance with MF0004-014, paragraph 3.1.1 e. <p>(8) Salt spray (by analysis)</p> <ul style="list-style-type: none"> • The PCES materials list was analyzed to certify compliance with MF0004-014, paragraph 3.3.3.7 <p>(9) Sand/dust (by analysis)</p> <ul style="list-style-type: none"> • Sand <ul style="list-style-type: none"> - 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 <ul style="list-style-type: none"> - diameter 0.000039 to 0.003 inches - suspended dust 3.7 to 0.1 lb./cu. ft - wind speed 33 ft/sec - hardness 7 to 8 Moh scale <p>(10) Additional certification tests/analyses</p> <ul style="list-style-type: none"> • 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) <p>c. <u>Turnaround Testing</u> Each PCES is subjected to a controlled functional deployment test, per OMRSD requirements, every 10 missions or every 2 years, whichever occurs first</p>

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SUPERSEDING DATE:

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12/20/14

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REF	REV					
611		SPRING (1), SDD27101332	2/IR	6.1.1 Mode: Spring jammed Cause: • Contamination • Defective spring • Stress Corrosion	Extension pole jammed, unable to deploy if loss of all spring force or inertia of primary pole failed to deploy the extension	<p>3. Inspection/QA/Manufacturing.</p> <p>a. All PCES fabrication, assembly, and test activities were performed under the jurisdiction of the NASA JSC Quality Assurance (QA) Division in accordance with ISCM 5312 SR&QA Manual Requirements. QA surveillance was provided for procurement, planning, processing, fabrication, assembly, certification testing, and acceptance testing. Mandatory inspection points were employed at appropriate points in the fabrication, assembly and acceptance process.</p> <p>b. Receiving inspection verified that the spring and other materials provided by suppliers were as identified on the procurement documents, and that data was provided attesting to their traceability and acceptability.</p> <p>c. The spring and related assemblies were fabricated of aerospace approved materials and assembled by trained technicians. QA inspections performed during the fabrication, assembly, testing, and acceptance process verified:</p> <ol style="list-style-type: none"> (1) Use of correct, approved materials (2) Dimensional tolerances specified on design drawings (3) Removal of all burrs and sharp edges (4) Cleaning of parts and assemblies in accordance with JSC Manual 5322, paragraph 7.1.3 to level GC (5) Inspection of surface preparations on the spring housing assembly for subsequent processes (6) Liquid dye penetrant inspection of the spring housing assembly in accordance with MIL-STD-6886 after machining, with no cracks permissible (7) Anodizing of aluminum surfaces on the spring housing and related assemblies as specified on engineering drawings, as defined by drawings

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EMEA		NAME, QTY & DRAWING REF DESIGNATION	CRITY	FAILURE MODE AND CAUSE	FAILURE EFFECT ON LMD ITEM	RATIONALE FOR ACCEPTANCE
REF	REV					
6.1.1		SPRING (1). SDD27101332	2/1A	6.1.1 Mode: Spring jammed Cause: • Contamination • Defective spring • Stress Corrosion	Extension pole jammed, unable to deploy if loss of all spring force or inertia of primary pole failed to deploy the extension	<p>(8) Proper installation of the spring, torquing of threaded fasteners on related assemblies, proper application of lubricants and thread locking compounds, alignment, and fitting of parts in accordance with drawing requirements</p> <p>(9) Functional performance of the spring and related assemblies in accordance with TPS instructions, visual inspection for damage, and proper packaging of the PCES for transport.</p> <p>d. <u>Turnaround</u>. The PCES and 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 for signs of deterioration or damage and contamination, and performance of controlled deployment tests, and recocking</p> <p>4. <u>Failure History</u>. The PCES springs and related assemblies are newly designed hardware items and have no failure history.</p> <p>5. <u>Operational Use</u>.</p> <p>a. <u>Operational Effect of Failure</u>. Probable loss of crew if unable to deploy pole with ratchet</p> <p>b. <u>Crew Action</u>. Use ratchet to deploy pole</p> <p>c. <u>Crew Training</u>. Crew is trained for back up pole deployment</p> <p>d. <u>Mission Constraints</u>. None. Mission would be terminated prior to use of the pole</p> <p>e. <u>In-Flight Checkout</u>. None</p>

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DATE

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ATTACHMENT -
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