

## CRITICAL ITEMS LIST

REFERENCE DESIGNATOR: HST-PFR-1  
 NAME / QUANTITY: Pivot and Roll Assy/1 each  
 DRAWING REFERENCE: 417700 B 417701

PROJECT: HST  
 LRU NAME / QUANTITY: PFR/2  
 LRU PART NUMBER: 342031 0703-201

PAGE 1 OF 5  
 SUBSYSTEM: PVA  
 EFFECTIVITY: ALL ORBITERS

FAILURE MODE NUMBER HST-PFR-1-4	CRITICALITY 1R/2	FAILURE EFFECT	RETENTION RATIONALE
<b>FUNCTION</b> The pivot and roll joint allows the user to configure the PFR to a desired position by changing the elevation of the arm with respect to the PFR socket and rotating the PFR about the arm axis.		<b>END ITEM</b> PFR loses stability, cannot be used	1. <b>Design Feature to Minimize the Chance of the Failure Mode</b> A. <b>Design</b> All HST PFRs were designed to an ultimate structural safety factor of 1.4. B. <b>Tolerances</b> Sufficient tolerances were used in the HST PFR design to prevent jamming by expansion and contraction of material due to temperature extremes or on-orbit use. C. <b>Materials - Major Components</b> See material list (Table B-2). D. <b>Testing and Analysis</b> A. <b>Acceptance Testing</b> 1. PIA A full pre-installation acceptance (PIA) test will be performed on each HST PFR before it is delivered to KSC to support any STS flight. The PIA will verify that the HST PFRs are functioning within tolerances and that the assembly is clean. 2. Vibration The HST PFRs were exposed to qualification level vibration loads during their initial development in support of STS-31. The test verified that the HST PFRs were free of manufacturing defects and tolerance problems. (Reference LMSC Document number H177007-501.
<b>FAILURE MODE AND CAUSE</b> <b>MODE</b> While attached to an STS-PFR socket in the orbiter payload bay, the pivot and/or roll joint assembly inadvertently becomes unlocked and rotates when the crew member is in the HST PFR. <b>CAUSE(S)</b> 1) Torsion spring comes loose 2) Linkage comes loose		<b>MISSION</b> Possible damage to the HST and/or primary servicing mission hardware	
		<b>CREW / VEHICLE</b> Possible damage to orbiter	
<b>REUNDANTCY SCREENS</b> A - P169 B - P153 C - P154	<b>REPAIRING PATHS</b> 1) Crew is inhibited preventing the crew from floating off.		
<b>MISSION PHASE</b>	<b>CORRECTIVE ACTION TIMES</b> TIME TO EFFECT      TIME TO CORRECT		
EVA	Minutes	Seconds	
		<b>INTERFACE</b> HST	

HST-PFR-1

## CRITICAL ITEMS LIST

REFERENCE DESIGNATOR: HST-PFR-1  
 NAME / QUANTITY: Pivot and Roll Assy/1 each  
 DRAWING REFERENCE: 4177100 & 4177108

PROJECT: HST  
 LRU NAME / QUANTITY: PFR/1  
 LRU PART NUMBER: 92901107003-001

PAGE 2 OF 5  
 SUBSYSTEM: H/A  
 EFFECTIVITY: ALL ORBITERS

FAILURE MODE NUMBER HST-PFR-1-4	CRITICALITY 1R/2	FAILURE EFFECT	RETENTION RATIONALE																								
<b>FUNCTION</b> The pivot and roll joint allows the user to configure the PFR to a desired position by changing the elevation of the arm with respect to the PFR socket and rotating the PFR about the arm axis.		<b>END ITEM</b> PFR loses stability, cannot be used	<p><b>A. Acceptance Testing (continued)</b>                      The following vibration levels are per:</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Frequency (Hz)</th> <th>Slope (dB/oct.)</th> <th>Constant Level G<sup>2</sup>/Hz</th> <th>Overall G rms</th> </tr> </thead> <tbody> <tr> <td>20</td> <td></td> <td>.009</td> <td>7.7</td> </tr> <tr> <td>20-45</td> <td>+7.0</td> <td>.08</td> <td></td> </tr> <tr> <td>45-600</td> <td></td> <td>.08</td> <td></td> </tr> <tr> <td>600-2000</td> <td>-6.0</td> <td>.0054</td> <td></td> </tr> <tr> <td>2000</td> <td></td> <td>.0054</td> <td></td> </tr> </tbody> </table> <p><b>B. Certification Testing</b></p> <p>1. Thermal Vacuum                      The HST PFR was exposed to a cold temperature (-132°F) vacuum (1x10<sup>-5</sup> torrs) environment. This test was used to check the tolerances of the linkages and locking pin. The operational requirement was -90°F (Ref. JSC-23550)</p> <p>2. Functionals                      The HST PFR was functionally operated prior to and immediately after all acceptance/certification tests to verify that the test environment did not degrade the hardware performance.</p>	Frequency (Hz)	Slope (dB/oct.)	Constant Level G <sup>2</sup> /Hz	Overall G rms	20		.009	7.7	20-45	+7.0	.08		45-600		.08		600-2000	-6.0	.0054		2000		.0054	
Frequency (Hz)	Slope (dB/oct.)	Constant Level G <sup>2</sup> /Hz		Overall G rms																							
20		.009		7.7																							
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<b>FAILURE MODE AND CAUSE</b>		<b>MISSION</b> No effect on mission objectives if failure occurs in payload bay																									
<b>MODE</b> While attached to an STS-PFR socket in the orbiter payload bay, the pivot end/or roll joint assembly inadvertently becomes unlocked and rotates when the crew member is in the HST PFR		<b>CREW / VEHICLE</b> Possible damage to orbiter																									
<b>CAUSE/S</b> 1) Torsion spring comes loose 2) Linkage comes loose		<b>INTERFACE</b> None																									
<b>REDUNDANCY SCREENS</b> A - Pass B - Pass C - Pass	<b>REMAINING PATHS</b> 1.) Crew is tethered preventing the crew from floating off.																										
<b>MISSION PHASE</b>	<b>CORRECTIVE ACTION TIMES</b>																										
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EVA	Minutes	Seconds																									

HST-PFR-2

## CRITICAL ITEMS LIST

REFERENCE DESIGNATOR: HST-PFR-1  
 NAME / QUANTITY: Pivot and Roll Assy/1 each  
 DRAWING REFERENCE: 4177101 & 4177101

PROJECT: 1487  
 LRU NAME / QUANTITY: PFR/2  
 LRU PART NUMBER: 9ED89167651-301

PAGE 3 OF 5  
 SUBSYSTEM: MA  
 EFFECTIVITY: ALL ORBITERS

HST-PFR-3

FAILURE MODE NUMBER HST-PFR-1-4	CRITICALITY 1R/2	FAILURE EFFECT	RETENTION RATIONALE
<b>FUNCTION</b> The pivot and roll joint allows the user to configure the PFR to a desired position by changing the elevation of the arm with respect to the PFR socket and rotating the PFR about the arm axis.		<b>END ITEM</b> PFR loses stability, cannot be used  <b>MISSION</b> No effect on mission objectives if failure occurs in payload bay  <b>CREW / VEHICLE</b> Possible damage to orbiter  <b>INTERFACE</b> None	<b>C. Certification Analysis</b> All HST PFR components were analyzed to the following induced environments to verify that the assembly can withstand the environment levels:  I. Requirements Source  a. Shock - Functional NSTS-07700 VOL. XIV  b. Vibration (FR Levels) - Acoustics NSTS-07700 VOL. XIV  c. Structures - Ult. (fs = 2.0) NSTS-07700 VOL. XIV - Fracture NSTS-07700 VOL. XIV  d. Acceleration - Flight MFG004-0140 - Crush ML-STD-810, Meth. 518, Proceed. I  e. Temperature - Hot (+250°F) NSTS-07700 VOL. XIV, Appendix 7 - Cold (-90°F) JSC-23560
<b>FAILURE MODE AND CAUSE</b> <b>MODE</b> While attached to an STS-PFR socket in the orbiter payload bay, the pivot and/or roll joint assembly inoperably becomes unlocked and rotates when the crew member is in the HST PFR. <b>CAUSE(S)</b> 1) Torsion spring comes loose 2) Linkage comes loose			
<b>REUNDANCY SCREENS</b> A - N/A B - N/A C - N/A	<b>REMAINING PATHS</b> 1.) Crew is tethered preventing the crew from floating off		
<b>MISSION PHASE</b>	<b>CORRECTIVE ACTION TIMES</b> TIME TO EFFECT      TIME TO CORRECT		
EVA	Minutes	N/A	

## CRITICAL ITEMS LIST

IDENTIFICATION SIGNATOR: HST-PFR-1  
 NAME / QUANTITY: Pivot and Roll Assembly each  
 DRAWING REFERENCE: 4177600 & 4177101

PROJECT: HST  
 LRU NAME / QUANTITY: PFR/2  
 LRU PART NUMBER: 9600107853-381

PAGE 4 OF 5  
 SUBSYSTEM: N/A  
 EFFECTIVITY: ALL ORBITERS

FAILURE MODE NUMBER HST-PFR-1-4	CRITICALITY 1R/2	FAILURE EFFECT	RETENTION RATIONALE			
<b>FUNCTION</b> The pivot and roll joint allows the user to configure the PFR to a desired position by changing the elevation of the arm with respect to the PFR socket and rotating the PFR about the arm axis.		<b>EMO ITEM</b> PFR loses stability, cannot be used  <b>MISSION</b> No effect on mission objectives if failure occurs in payload bay  <b>CREW / VEHICLE</b> Possible damage to orbiter  <b>INTERFACE</b> None	<b>III. Inspection</b> <b>A. Manufacturing</b> <ol style="list-style-type: none"> <li>The HST PFR components were inspected prior to build-up for conformance to their applicable drawings.</li> <li>All fracture critical piece parts were and will be inspected as described on their applicable drawings.</li> </ol> <b>B. Assembly</b> <ol style="list-style-type: none"> <li>HST PFR will be cleaned and inspected to the levels described in JSC 5322B. Once cleaned, the HST PFR will be bagged to prevent any contamination from entering the unit.</li> </ol> <b>C. Testing</b> <ol style="list-style-type: none"> <li>The hardware was fully inspected for any signs of loose parts as a part of the pre-post functional tests performed prior to and (immediately after all certification and acceptance tests (reference LMSC H177097-501).</li> </ol>			
<b>FAILURE MODE AND CAUSE</b> <b>MODE</b> While attached to an STS-PFR socket in the orbiter payload bay, the pivot and/or roll joint assembly inadvertently becomes unlocked and rotates when the crew member is in the HST PFR. <b>CAUSE(S)</b> <ol style="list-style-type: none"> <li>Torsion spring comes loose</li> <li>Linkage comes loose</li> </ol>						
<b>REDUNDANCY SCREENS</b> A - N/A B - N/A C - N/A	<b>REMAINING PATHS</b> <ol style="list-style-type: none"> <li>Crew is tethered preventing the crew from floating off</li> </ol>					
<b>MISSION PHASE</b> EVA	<b>CORRECTIVE ACTION TIMES</b> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%;">TIME TO EFFECT</th> <th style="width: 50%;">TIME TO CORRECT</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">Minutes</td> <td style="text-align: center;">N/A</td> </tr> </tbody> </table>			TIME TO EFFECT	TIME TO CORRECT	Minutes
TIME TO EFFECT	TIME TO CORRECT					
Minutes	N/A					

HST-PFR-4

## CRITICAL ITEMS LIST

REFERENCE DESIGNATION: HST-PFR-1  
 NAME / QUANTITY: Pivot and Roll Assy/1 each  
 DRAWING REFERENCE: 1077100 & 4177101

PROJECT: HST  
 LRU NAME / QUANTITY: PFR/2  
 LRU PART NUMBER: BEO32109025-204

PAGE 4 OF 5  
 SUBSYSTEM: N/A  
 EFFECTIVITY: ALL ORBITERS

FAILURE MODE NUMBER	CRITICALITY	FAILURE EFFECT	RETENTION RATIONALE		
HST-PFR-1-4	1R/2				
<b>FUNCTION</b> The pivot and roll joint allows the user to configure the PFR to a desired position by changing the elevation of the arm with respect to the PFR socket and rotating the PFR about the arm axis.		<b>END ITEM</b> PFR loses stability, cannot be used  <b>MISSION</b> No effect on mission objectives if failure occurs in payload bay  <b>CREW / VEHICLE</b> Possible damage to orbiter  <b>INTERFACE</b> None	<b>IV. Failure History</b> A. None. HST PFR flew on STS-31, but was not used during the mission. <b>V. Operations</b> A. <u>Effects of Failure</u> Loss of stability, Possible damage to orbiter. B. <u>Crew Actions</u> Functionally check-out of all joints after unstowing from stowage location. C. <u>Training</u> Crew must be tethered during operation in the HST PFR. D. <u>Mission Constraints</u> None E. <u>In flight Check-Outs</u> None		
<b>FAILURE MODE AND CAUSE</b> <b>MODE</b> While attached to an STS-PFR socket in the orbiter payload bay, the pivot and/or roll joint assembly inadvertently becomes unlocked and rotates when the crew member is in the HST PFR. <b>CAUSE(S)</b> 1) Torsion spring comes loose 2) Linkage comes loose					
<b>REUNDANCY SCREENS</b> A - N/A B - N/A C - N/A	<b>REMAINING PATHS</b> 1) Crew is tethered preventing the crew from loading off				
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Minutes	N/A				

HST-PFR - 5