

CRITICAL ITEMS LIST

REFERENCE DESIGNATOR: HST-PFR-3
 NAME / QUANTITY: Pip Pin/1
 DRAWING REFERENCE: 017211

PROJECT: HST
 LRU NAME / QUANTITY: PFR3
 LRU PART NUMBER: SED2117095-301

PAGE 1 OF 5
 SUBSYSTEM: N/A
 EFFECTIVITY: ALL ORBITERS

FAILURE MODE NUMBER HST-PFR-3-3	CRITICALITY 1R/2	FAILURE EFFECT	RETENTION RATIONALE
FUNCTION Single-acting T-handle pip pin is used as a locking mechanism for the PFR probe once it is installed into the PFR socket.		END ITEM PFR loses stability, cannot be used MISSION No effect on mission objectives if back-up HST PFR is available	I. Design Features to Minimize the Chance of the Failure Mode A. Design All HST PFRs were designed to an ultimate structural safety factor of 1.4 B. Tolerances 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. Materials - Major Components See material list (Table B-2). II. Testing and Analysis A. Acceptance Testing 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 H177097-601.)
FAILURE MODE AND CAUSE MODE Cannot remove pip pin from PFR socket located in the payload bay while the HST PFR is in the socket. CAUSE(S) 1) Binding 2) Contamination 3) Actuation bar/spindle is jammed 4) Pip Pin spring has failed 5) Bolts have bound in shank holes			
REUNDANCY SCREENS A - Pass B - Pass C - Pass	REMAINING PATHS 1) Utilize 7/16 in bolt to release hex pin.	CREW / VEHICLE Possible damage to the orbiter if the HST PFR is jammed in a payload bay socket for reentry. INTERFACE None	
MISSION PHASE	CORRECTIVE ACTION TIMES TIME TO EFFECT TIME TO CORRECT		
EVA	Minutes Seconds		

HST-PFR - 13

CRITICAL ITEMS LIST

PART ITEM AND DESIGNATION: HST-PFR-3
 NAME / QUANTITY: Pip Pin
 DRAWING REFERENCE: 417211

PROJECT: HST
 LRU NAME / QUANTITY: PFR/2
 LRU PART NUMBER: 98093107966-301

PAGE 3 OF 5
 SUBSYSTEM: IVA
 EFFECTIVITY: ALL ORBITERS

FAILURE MODE NUMBER HST-PFR-3-3	CRITICALITY 1R/2	FAILURE EFFECT	RETENTION RATIONALE																								
FUNCTION Single acting T-handle pip pin is used as a locking mechanism for the PFR probe once it is installed into the PFR socket.		END ITEM Cannot remove HST-PFR from socket	A. Accelerance Testing (continued) The following vibration levels are per : <table style="width: 100%; border-collapse: collapse; margin-top: 10px;"> <thead> <tr> <th style="text-align: left;">Frequency (Hz)</th> <th style="text-align: left;">Slope (dB/oct)</th> <th style="text-align: left;">Constant Level G²/Hz</th> <th style="text-align: left;">Overall Gms</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></td> <td></td> </tr> <tr> <td>45-600</td> <td></td> <td>.06</td> <td></td> </tr> <tr> <td>600-2000</td> <td>-6.0</td> <td></td> <td></td> </tr> <tr> <td>2000</td> <td></td> <td>.0054</td> <td></td> </tr> </tbody> </table> B. Certification Testing 1. Thermal Vacuum The HST PFR was exposed to a cold temperature (-132°F) vacuum (1x10 ⁻⁵ torrs) environment. This test was used to check the tolerances of the PFR hex pin to the PFR socket and the operation of the pip pin. The operational requirement was -90°F (Ref. JSC-23550) 2. Functionals The HST PFR pip pin was functionally operated prior to and immediately after all acceptance/certification tests to verify that the test environment did not degrade the hardware performance.	Frequency (Hz)	Slope (dB/oct)	Constant Level G ² /Hz	Overall Gms	20		.009	7.7	20-45	+7.0			45-600		.06		600-2000	-6.0			2000		.0054	
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REUNDANCY SCREENS A - Pass B - Pass C - Pass		CREW / VEHICLE Possible damage to the orbiter if the HST-PFR is jammed in socket for reentry																									
REMAINING PARTS 1) Utilize 7/18 in bolt to release hex pin		INTERFACE None																									
MISSION PHASE		CORRECTIVE ACTION TIMES																									
		TIME TO EFFECT	TIME TO CORRECT																								
EVA		Minutes	Seconds																								

HST-PFR - 14

CRITICAL ITEMS LIST

REFERENCE DESIGNATOR: HST-PFR-3
 NAME / QUANTITY: Pip Pin/1
 DRAWING REFERENCE: 417211

PROJECT: HST
 LRU NAME / QUANTITY: PFR/1
 LRU PART NUMBER: 8203318765-301

PAGE 3 OF 5
 SUBSYSTEM: MA
 EFFECTIVITY: ALL ORBITERS

FAILURE MODE NUMBER HST-PFR-3-3	CRITICALITY 1R/2	FAILURE EFFECT	RETENTION RATIONALE																												
FUNCTION Single-acting T-handle pip pin is used as a locking mechanism for the PFR probe once it is installed into the PFR socket.		END ITEM Cannot remove HST-PFR from socket MISSION No effect on mission objective if backup HST-PFR is available CREW / VEHICLE Possible damage to the orbiter if the HST-PFR is jammed in socket for reentry INTERFACE None	C. Certification Analysis All HST PFR components were analyzed to the following induced environments to verify that the assembly can withstand the environment levels. <table style="width: 100%; border: none;"> <tr> <td style="width: 50%;">1. Requirements</td> <td style="width: 50%; text-align: right;">Source</td> </tr> <tr> <td>a. Shock</td> <td></td> </tr> <tr> <td style="padding-left: 20px;">- Functional</td> <td style="text-align: right;">NSTS-07700 VOL. XIV</td> </tr> <tr> <td>b. Vibration (FPL Levels)</td> <td></td> </tr> <tr> <td style="padding-left: 20px;">- Acoustics</td> <td style="text-align: right;">NSTS-07700 VOL. XIV</td> </tr> <tr> <td>c. Structures</td> <td></td> </tr> <tr> <td style="padding-left: 20px;">- UL (fs = 2.0)</td> <td style="text-align: right;">NSTS-07700 VOL. XIV</td> </tr> <tr> <td style="padding-left: 20px;">- Fracture</td> <td style="text-align: right;">NSTS-07700 VOL. XIV</td> </tr> <tr> <td>d. Acceleration</td> <td></td> </tr> <tr> <td style="padding-left: 20px;">- Flight</td> <td style="text-align: right;">MF0004-014D</td> </tr> <tr> <td style="padding-left: 20px;">- Crash</td> <td style="text-align: right;">MIL-STD-810, Meth. 516, Proced. 1</td> </tr> <tr> <td>e. Temperature</td> <td></td> </tr> <tr> <td style="padding-left: 20px;">- Hot (+250°F)</td> <td style="text-align: right;">NSTS-07700 VOL. XIV, Appendix 7.</td> </tr> <tr> <td style="padding-left: 20px;">- Cold (-00°F)</td> <td style="text-align: right;">JSC-23850</td> </tr> </table>	1. Requirements	Source	a. Shock		- Functional	NSTS-07700 VOL. XIV	b. Vibration (FPL Levels)		- Acoustics	NSTS-07700 VOL. XIV	c. Structures		- UL (fs = 2.0)	NSTS-07700 VOL. XIV	- Fracture	NSTS-07700 VOL. XIV	d. Acceleration		- Flight	MF0004-014D	- Crash	MIL-STD-810, Meth. 516, Proced. 1	e. Temperature		- Hot (+250°F)	NSTS-07700 VOL. XIV, Appendix 7.	- Cold (-00°F)	JSC-23850
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HST-PFR - 15

CRITICAL ITEMS LIST

REFERENCE DESIGNATOR: HST-PFR-3
 NAME / QUANTITY: Pip Pin
 DRAWING REFERENCE: 4112211

PROJECT: HST
 LRU NAME / QUANTITY: PFR/2
 LRU PART NUMBER: 9409310705-011

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 SUBSYSTEM: N/A
 EFFICIENCY: ALL ORBITERS

FAILURE MODE NUMBER HST-PFR-3-3	CRITICALITY 1R/2	FAILURE EFFECT	RETENTION RATIONALE
FUNCTION		END ITEM	<p>III. <u>Inspection</u></p> <p>A. <u>Manufacturing</u></p> <ol style="list-style-type: none"> 1. The HST PFR components were inspected prior to build-up for conformance to their applicable drawings. 2. All fracture critical piece parts were and will be inspected as described on their applicable drawings. <p>B. <u>Assembly</u></p> <ol style="list-style-type: none"> 1. HST PFR and pip pin are to 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. <p>C. <u>Testing</u></p> <ol style="list-style-type: none"> 1. The hardware will be fully inspected for any signs of galling as a part of the pre/post functional tests performed prior to and immediately after all certification and acceptance tests. 2. All HST PFRs will be fit-checked with as many PFR sockets as possible.
FAILURE MODE AND CAUSE		Cannot remove HST-PFR from socket	
MODE		MISSION	
Cannot remove pip pin from PFR socket located in the payload bay while the HST PFR is in the socket		No effect on mission objective if backup HST-PFR is available	
CAUSE(S)		CREW / VEHICLE	
<ol style="list-style-type: none"> 1) Blinding 2) Contamination 3) Actuation bar/spindle is jammed 4) Pip Pin spring has failed 5) Balls have bound in shank holes 		Possible damage to the orbiter if the HST-PFR is jammed in socket for reentry	
REUNDANCY SCREENS	REMAINING PARTS	INTERFACE	
A - Pass	1) Utilize 7/16 in bolt to release hex pin	None	
B - Pass			
C - Pass			
MISSION PHASE	CORRECTIVE ACTION TIMES		
	TIME TO EFFECT	TIME TO CORRECT	
EVA	Minutes	Seconds	

HST-PFR - 16

CRITICAL ITEMS LIST

REFERENCE DESIGNATOR: HST-PFR-3
 NAME / QUANTITY: Pip Pin
 DRAWING REFERENCE: 437211

PROJECT: HST
 LRU NAME / QUANTITY: PFR/1
 LRU PART NUMBER: SED219764-301

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

FAILURE MODE NUMBER HST-PFR-3-3	CRITICALITY 1R/2	FAILURE EFFECT	RETENTION RATIONALE				
FUNCTION Single acting T-handle pip pin is used as a locking mechanism for the PFR probe once it is installed into the PFR socket.		END ITEM Cannot remove HST-PFR from socket	IV. Failure History A. None, HST PFR flew on STS-31, but was not used during the mission. V. Operations A. <u>Effects of Failure</u> Cannot remove HST PFR, possible orbital damage. B. <u>Crew Actions</u> Release 7/16 in, double height EVA hex head bolt to release hex pin. Crew can try to hammer the pip pin out with a probe through the PFR socket. C. <u>Training</u> Crew must practice this procedure in the WETF. D. <u>Mission Constraints</u> None E. <u>In Flight Check-Outs</u> None				
FAILURE MODE AND CAUSE MODE Cannot remove pip pin from PFR socket located in the payload bay while the HST PFR is in the socket.		MISSION No effect on mission objective if backup HST-PFR is available					
CAUSE(S) 1) Blinding 2) Contamination 3) Actuator bar/spindle is jammed 4) Pip Pin spring has failed 5) Balls have bound in shank holes		CREW / VEHICLE Possible damage to the orbiter if the HST-PFR is jammed in socket for reentry					
REUNDANCY SCREENS A - Pass B - Pass C - Pass	REMAINING PARTS 1) Utilize 7/16 in bolt to release hex pin	INTERFACE None					
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HST-PFR - 17