

CRITICAL ITEMS LIST

ASSY NOMENCLATURE: SEADS NOSE CAP
ASSY P/N: ME279-0002

SYSTEM OEX
SUBSYSTEM: SEADS

REV. C
PAGE 1 OF 8

FMEA		FUNCTION	NAME, QTY. & DRAWING REF. DESIGNATION	CRIT.	FAILURE MODE AND CAUSE	FAILURE EFFECT ON		MISSION PHASE	TIME TO EFFECT / CORRECT	RATIONALE FOR ACCEPTANCE
REF.	REV.					END ITEM	CREW / VEHICLE			
OEX-SE0501-1	0	Pneumatic ports through RCC nose cap provide pressure readings to the SEADS	Pressure ports (14)	1/1	<p>Mode:</p> <ul style="list-style-type: none"> Structural failure Nose cone penetration failure <p>Cause:</p> <ul style="list-style-type: none"> Mechanical shock Vibration Rotation Material defect 	Functional degradation of SEADS experiment	Reentry heat may severely damage vehicle	Liftoff, reentry, landing	None	<p>Design - The SEADS Nose Cap Structural Assembly (VS77-399251) is composed of:</p> <ul style="list-style-type: none"> RCC Nose Cap - Specification RCC T-Seal - Control Drawing RCC Expansion Seal - MC621-0007 1020 Penetration Port Bulkhead - Drawing VS77-399251 Access Door - Drawing VS77-399254 <p>RCC to Bulkhead fittings, supports, etc. are baseline parts. Drawings W07B-399XXX</p> <p>The SEADS Nose Cap Structural Assembly is fabricated and assembled by Vought Corporation under subcontract</p> <p>The Reinforced Carbon Carbon (RCC) nose cap for SEADS is a special design based on the baseline design. It has locally reinforced areas for the 14 penetrations, otherwise, it is identical to the baseline. The shape of the penetrations (holes) was selected to provide anti-rotation of the Penetration Ports. The RCC T-Seal and RCC Expansion Seal are baseline parts that are not changed, and no further definition is provided</p> <p>The fittings that attach to the nose cap, in the penetrations, provide the orifice, and provide for attachment of the pressure tubes are called Penetration Ports. There are 14 Penetration Ports made of Columium and slide roated for the 14 holes in the nose cap. The Penetration Ports are certified for 6 flights and therefore are limited life items</p> <p>The bulk head is the baseline design modified for attachment of the manifold posts, the passage for pressure tubes, the passage of</p>

EFFECTIVITY: OV-102, all, STS-2B-999 (OV-102 flights only)

PREPARED BY: D A Crouch

SUPERSEDING DATE: 2/88

APPROVED BY:

DATE 10/31/89

CRITICAL ITEMS LIST

ASSY NOMENCLATURE: SEADS NOSE CAP
ASSY P/N: ME279 0002

SYSTEM: OEX
SUBSYSTEM: SEADS

REV: C
PAGE 2 OF 8

FMEA		FUNCTION	NAME, QTY. & DRAWING REF. DESIGNATION	CRIT.	FAILURE MODE AND CAUSE	FAILURE EFFECT ON		MISSION PHASE	TIME TO EFFECT / CORRECT	RATIONALE FOR ACCEPTANCE
REF.	REV.					END ITEM	CREW / VEHICLE			
										<p>instrumentation leads, and the attachment of the instrumentation and wiring</p> <p>The structural fittings, supports, and brackets between the RCC parts and the bulkhead are baseline design parts, and therefore further definition is not provided</p> <p>The tubes attached to the Penetration Ports that conduct the dynamic pressure to the manifold post are 1/4-inch silicide coated columbium tubes. Design considerations for these tubes were the high temperature, the oxidizing atmosphere, the dynamics, the stress, and lightning. The tubes are configured with adequate bends to provide for the thermal expansion and vibration. The forward end of the columbium tube is flared, silicide coated, and attached to the Penetration Port with a silicide coated B Nut (part of the Penetration Port). The aft end of the tube is flared, not coated, and attached to the manifold post by a corrosion resistant steel B-nut</p> <p>The SEADS has a 6 mission total lifetime</p> <ul style="list-style-type: none"> • Test - Development Tests were conducted mainly by Vought Corporation under contract to NASA Langley Research Center. Those tests were as follows: <ul style="list-style-type: none"> 1 Thermal Exposure Test - conducted at NASA-LaRC Plasma Arc Facility. The test specimens consisted of: <ul style="list-style-type: none"> RCC representative of the nose cap and the penetration (hole) Penetration Port (two materials were used to determine capability of graphite versus silicide coated columbium)

EFFECTIVITY: OV-102, all, STS-28-999 (OV-102 flights only)

PREPARED BY: D. A. Crouch

SUPERSEDING DATE: 2/88

APPROVED BY:

DATE: 10/31/89

CRITICAL ITEMS LIST

ASSY NOMENCLATURE: SEADS NOSE CAP
 ASSY P/N: ME279 0002

SYSTEM: OEX
 SUBSYSTEM: SEADS

REV: C
 PAGE 3 OF 8

PAREA		FUNCTION	NAME, QTY. & DRAWING REF. DESIGNATION	CRIT.	FAILURE MODE AND CAUSE	FAILURE EFFECT ON		MISSION PHASE	TIME TO EFFECT/ CORRECT	RATIONALE FOR ACCEPTANCE
REF.	REV.					END ITEM	CREW/ VEHICLE			
										<p>Silicide Coated Columbian Tube Assembly held in a graphite holder</p> <p>Front face temperature of the specimen was brought up to 2660 °F and held for 10 minutes. Specimen was returned to room temperature and then again exposed to the elevated temperature. After each hour (six 10 minute runs) of high temperature exposure, the specimen was disassembled for inspection and then reassembled for further testing. Each specimen was exposed to 2660 °F for a total of 5 hours, which represents the accumulated time of missions of the design trajectory. Test objectives were to verify the design geometry of the Penetration Port and the attached tubes. During the disassembly operations, it was found that the use of Methocel/ Silicon Carbide as an anti-seize compound during the assembly aided the disassembly.</p> <p>References: (a) "Plasma Arc Model Test Summary" DIR 2 51710/ADP/1 0009, dated 20 May 1981, by Vought Corp. (b) "Investigation of SEADS Temperature Anomaly" DIR 2 53210/ADP/2-001, dated 14 Jan 1982, by Vought Corp. (c) "Evaluation of Stacking Threaded Parts" TR 221T100762, dated 10 Sept 1979, by Vought Corp.</p>

EFFECTIVITY: OV-102, all STS-28-999 (OV-102 flights only)

PREPARED BY: D A Crouch

SUPERSEDING DATE: 2/88

APPROVED BY

DATE: 10/31/89

CRITICAL ITEMS LIST

ASSY NOMENCLATURE: SEADS NOSE CAP
 ASSY P/N: ME279-0002

SYSTEM OEX
 SUBSYSTEM: SEADS

REV: C
 PAGE 4 OF 8

FMEA		FUNCTION	NAME, QTY. & DRAWING REF. DESIGNATION	CRIT.	FAILURE MODE AND CAUSE	FAILURE EFFECT ON		MISSION PHASE	TIME TO EFFECT / CORRECT	RATIONALE FOR ACCEPTANCE
REF.	REV.					END ITEM	CREW / VEHICLE			
										<p>2 Thermal Exposure Test - conducted at NASA Ames Plasma Arc Facility. This test was conducted due to some lack of confidence in the temperature attained at NASA LaRC. The specimen was like the ones used at NASA-LaRC and used only the slide coated Columium Penetration Port. This facility over temperatured the specimen inadvertently, but the specimen still satisfied the 5 hours of elevated temperature exposure.</p> <p>References: (Same as above)</p> <p>1 Bending/Breakout Test - conducted at Vought Corporation (under contract to NASA LaRC). This specimen consisted of RCC representative of the nose cap with the penetration (hole) Penetration Post (Graphite) Columium Tube, RES Steel Rod</p> <p>The objective of the test was to verify that the tube would fail in bending prior to a failure in the Penetration Post or the RCC Nose Cap. This was demonstrated and proves a fail safe design even with the Graphite Penetration Post. The steel rod was also used to find the next failure mode, which turned out to be the union just forward of the B Nut that left intact the flange/crest of the union that retains the Port in the Nose Lap RCC.</p> <p>Reference: "Strength Determination SEADS Penetration Assembly" DR 2-30400/SAOP 0019, dated 24 Sept 1979, by Vought Corp.</p>

EFFECTIVITY: OV-102, all STS-28-999 (OV-102 flights only)

PREPARED BY: D. A. Crouch

SUPERSADING DATE: 2/88

APPROVED BY:

DATE: 10/11/89

CRITICAL ITEMS LIST

ASSY NOMENCLATURE SEADS NOSE CAP
 ASSY P/N: ME279-0002

SYSTEM: OEX
 SUBSYSTEM: SEADS

REV: C
 PAGE 5 OF 8

FMEA		FUNCTION	NAME, QTY. & DRAWING REF. DESIGNATION	CRIT.	FAILURE MODE AND CAUSE	FAILURE EFFECT ON		MISSION PHASE	TIME TO EFFECT / CORRECT	RATIONALE FOR ACCEPTANCE
REF.	REV.					END ITEM	CREW / VEHICLE			
										<p>4 Thermal Deflection Test - conducted at Vought Corporation (under contract to NASA-LaRC). The specimens consisted of:</p> <ul style="list-style-type: none"> RCC representative of the nose cap with the penetration (hole) Penetration Post (Silicide Coated Columium) Silicide Coated Columium Tubes shaped to flight article configuration (tube No. 5 and No. 8) Graphite holder <p>The objective of the test was to define the cycles of temperature/strain that the silicide coated columium tubes would take to failure. The test results were questionable due to the environment in the oven which caused embrittlement of the tubes, but they still lasted for more cycles than anticipated for the nose cap.</p> <p>Ref Letter 80 59940-416 FIR "Thermal Deflection, SEADS Pressure Tubes Assemblies" dated 30 Oct 1980, by Vought Corp</p> <p>5 Vibration Test - conducted at Vought Corporation (under contract to NASA-LaRC). The specimen consisted of</p> <ul style="list-style-type: none"> RCC representative of the nose cap with the penetration (hole) - 7 parts. Cast/machined fixture to hold the 7 nose cap RCC parts in the nose cap positions

EFFECTIVITY: OV-102, all, STS-2B-999 (OV-102 flights only)

PREPARED BY: D A Crouch

SUPERSEDING DATE: 2/88

APPROVED BY:

DATE: 10/31/89

CRITICAL ITEMS LIST

ASSY NOMENCLATURE: SEADS NOSE CAP
 ASSY P/N: ME279 0002

SYSTEM: OEX
 SUBSYSTEM: SEADS

REV: L
 PAGE 6 OF 8

FMEA		FUNCTION	NAME, QTY. & DRAWING REF. DESIGNATION	CRIT.	FAILURE MODE AND CAUSE	FAILURE EFFECT ON		MISSION PHASE	TIME TO EFFECT / CORRECT	RATIONALE FOR ACCEPTANCE
REF.	REV.					END ITEM	CREW / VEHICLE			
										<p>Penetration Ports (7) - some with anti-rotation, some of graphite, and some of columbium</p> <p>Silicide Coated Columbium Tubes (7) - shaped to flight attitude configuration</p> <p>Fixture - represent nose cap bulk head for mounting the manifold post</p> <p>Manifold Insulation</p> <p>The above parts were assembled to represent the nose cap / bulk head / left hand manifold post / Columbium tubes / insulation. The nose cap and the bulk head were vibrated independently in two different setups to stress the tubes at, or above, the expected levels for a period of time equivalent to 25 missions, including a scatter factor of four. There were no failures in these tests.</p> <p>References: (a) "Engineering Development Vibration Test of the Shuttle Entry Air Data System" ETL 181, dated 17 Dec. 1980, by Vought Corp</p> <p>(b) "SEADS Static and Dynamic Analysis of Manifold and Pressure Tube Assembly" STS 81 0131, dated Jan. 1981, by Rockwell Int'l</p> <p>6 Basic Design and Materials Processes Tests - These tests, conducted by Rockwell International at Downey, consisted of vibration tests of early design tube configurations to define effects of shape, material, and wall thickness, and the type of silicide coating, thickness of coating, and inspection techniques.</p>

EFFECTIVITY: OV-102, all, STS-28-999 (OV-102 flights only)

PREPARED BY: D. A. Crouch

SUPERSEDING DATE: 2/88

APPROVED BY:

DATE: 10/31/89

CRITICAL ITEMS LIST

ASSY NOMENCLATURE: SEADS NOSE CAP
ASSY P/N: ME279 0002

SYSTEM OLC
SUBSYSTEM SEADS

REV 1
PAGE 7 OF 8

FMEA		FUNCTION	NAME, QTY. & DRAWING REF. DESIGNATION	CMT.	FAILURE MODE AND CAUSE	FAILURE EFFECT ON		MISSION PHASE	TIME TO EFFECT/ CORRECT	RATIONALE FOR ACCEPTANCE
REF.	REV.					END ITEM	CREW/ VEHICLE			
										<p>References: (a) 09B 204 80-308 "Coated Columbium Tubes - Performance in Hot Atmosphere" dated 16 Dec 1980 (b) 391-204-080-180 "Allowable for Columbium 12r" dated 12 Aug 1980, by Rockwell Int'l</p> <p>The following reports document the results of these tests. An approved CAR dated 7/1/85 is available.</p> <p>CAR no. 15 08 399200 0111 CR no. 08 399200-011</p> <p>1) 391 204 80-180 Stress Allowables for Columbium 2) 30400/9A(IP-0018 Evaluation of Anti-Rotation Concepts for SEADS Penetrations 2) 30400/9A(OP-0019 Strength Determination - SEADS Penetrations Assembly TR221T000050 Vibration Test of SEADS 1) VNA-380 301-80 101 SEADS Vibration Test/Analysis Results 2) J0320/RCCO 0004 Thermal Analysis of SEADS Penetration Post Plasma Air Jet Test</p> <p>* TAL abort - In response to the Orbiter vehicle 102 (OV-102) Design Certification Review review item disposition (RID) no. 01 08 04, the SEADS nose cap columbium pressure ports were subjected to thermal analysis for the transatlantic Abort landing (TAL) abort entry environment to assure single mission survivability in accordance with NSIS 07700, volume X, paragraph 3.2.1.5.1 (Intact Abort)</p>

EFFECTIVITY OV-102, MI, STS-28-999 (OV-102 flights only)

PREPARED BY: D. A. Crouch

SUPERSEDING DATE: 2/88

APPROVED BY

DATE: 10/31/89

CRITICAL ITEMS LIST

ASSY NOMENCLATURE: SEADS NOSE CAP
ASSY P/N ME279 0002

SYSTEM: DEX
SUBSYSTEM: SEADS

REV. C
PAGE 8 OF 8

FMEA		FUNCTION	NAME, QTY. & DRAWING REF. DESIGNATION	CRBT.	FAILURE MODE AND CAUSE	FAILURE EFFECT ON		MISSION PHASE	TIME TO EFFECT / CORRECT	RATIONALE FOR ACCEPTANCE												
REF.	REV.					END ITEM	CREW / VEHICLE															
										<p>The results of this analysis concluded that the SEADS ports are certified for the TAL abort case (Reference: Rockwell II SAS 1A-TPS-BB 164, ASE TSAT BB 077, STS 07-0475, and Lockheed Report APD 380). Addendums were added to the Leading Edge Subsystem (LESS) certification requirement (CR) and certification approval request (CAR) both 11/18/88 to include an assessment of the Orbiter LESS for compatibility with the TAL environment. The documents affected are:</p> <table border="1"> <thead> <tr> <th>File No.</th> <th>Document</th> <th>CAR No.</th> </tr> </thead> <tbody> <tr> <td>331430</td> <td>Forward Fovelage, TPS Thermal Installation</td> <td>CAR 12 07-391001-0015</td> </tr> <tr> <td>331431</td> <td>Structure Assembly, Wing Leading Edge</td> <td>CAR 17A 08-197200-003K</td> </tr> <tr> <td>331432</td> <td>Structure Assembly, RCC Nose Cap</td> <td>CAR 20 08-399260-001L</td> </tr> </tbody> </table> <ul style="list-style-type: none"> • Inspection - Hardware has been inspected in accordance with Quality Planning Requirements (QPR) documents which have been approved by NASA and are documented at Rockwell International Manufacturing Operation Record (MOR) V577 (derived from mission kit MV0577). During turnaround, visually inspect for damage and test for leakage per OMRSD V01A10 010, V01A10 50, and V01A10 055. • Operational use - None • Failure history - No nose cap failures to date 	File No.	Document	CAR No.	331430	Forward Fovelage, TPS Thermal Installation	CAR 12 07-391001-0015	331431	Structure Assembly, Wing Leading Edge	CAR 17A 08-197200-003K	331432	Structure Assembly, RCC Nose Cap	CAR 20 08-399260-001L
File No.	Document	CAR No.																				
331430	Forward Fovelage, TPS Thermal Installation	CAR 12 07-391001-0015																				
331431	Structure Assembly, Wing Leading Edge	CAR 17A 08-197200-003K																				
331432	Structure Assembly, RCC Nose Cap	CAR 20 08-399260-001L																				

EFFECTIVITY: OV-102, all, STS-28-999 (OV-102 flights only)

PREPARED BY: D A Crouch

SUPERSEDING DATE: 2/88

APPROVED BY:

DATE: 10/31/89