CRITICAL ITEMS LIST (CIL)

No. 10-05-04-12R/01

SYSTEM:	Space Shuttle RSRM 10	CRITICALITY CATEGORY:	1R
SUBSYSTEM:	Assembly Hardware/Interfaces 10-05	PART NAME:	Forward-to-Aft Exit Cone Joint, Primary O-ring and Aft Exit Cone GCP-to-Metal Bond line (2)
ASSEMBLY:	Fwd-to-Aft Exit Cone Interface 10-05-04		
FMEA ITEM NO.:	10-05-04-12R Rev N		
CIL REV NO.:	N		
DATE:	17 Jun 2002	PART NO.:	(See Section 6.0)
SUPERSEDES PAGE:	363-1ff.	PHASE(S):	Boost (BT)
DATED:	10 Apr 2002	QUANTITY:	(See Section 6.0)
CIL ANALYST:	R. E. L. Hamilton	EFFECTIVITY:	(See Table 101-6)
		HAZARD REF.:	BN-03
APPROVED BY:		DATE:	

RELIABILITY ENGINEERING: K. G. Sanofsky 17 Jun 2002

ENGINEERING: P. M. McCluskey 17 Jun 2002

1.0 FAILURE CONDITION: Failure during operation (D)

2.0 FAILURE MODE: 1.0 Leakage of primary O-ring and Aft Exit Cone Glass-Cloth Phenolic-to-Metal bond line

3.0 FAILURE EFFECTS: Leakage could result in hot gases flowing past cap screws, resulting in a burn-through and loss of nozzle causing thrust imbalance between SRBs and loss of RSRM SRB, crew, and vehicle

4.0 FAILURE CAUSES (FC):

FC NO.	DESCRIPTION	FAILURE CAUSE KEY
1.1	Leakage past O-ring	
1.1.1	Nonconforming O-ring splice or repair	A
1.1.2	Nonconforming O-ring dimensions	B
1.1.3	O-ring cut or damaged	C
1.1.4	Nonconforming O-ring voids, inclusions, or subsurface indications	D
1.1.5	Age degradation of O-ring or calcium grease	E
1.1.6	Moisture and/or fungus degradation of O-ring	F
1.1.7	O-ring gland does not meet dimensional or surface finish requirements	G
1.1.8	O-ring improperly installed	H
1.1.9	Sealing surfaces contamination or corrosion	I
1.1.10	Nonconforming material properties of O-ring or calcium grease	J
1.2	Leakage along the Glass-Cloth Phenolic-to-Metal Bond line	
1.2.1	Bonding surfaces not properly prepared or adequately cleaned	K

1.2.2	Bonding material not properly mixed, applied, or cured	L
1.2.3	Contamination during processing	M
1.2.4	Process environments detrimental to bond strength	N
1.2.5	Bond line not to required thickness	O
1.2.6	Nonconforming material properties of epoxy adhesive, primer, or sealing compound	P
1.2.7	Age degradation of components	Q
1.3	Porosity, voids, unbonds, inclusions, or cracks in phenolic	R
1.4	Transportation, handling, or assembly damage	S
1.5	Temperature, vibration, and shock during boost phase	T

5.0 REDUNDANCY SCREENS:

SCREEN A: Pass--The leak test procedure verifies the primary O-ring seal and the GCP-to-Metal bond line seal.
SCREEN B: Fail--No provision is made for failure detection by the crew.
SCREEN C: Pass--The primary O-ring seal and the GCP-to-Metal Bond line seal cannot both be lost due to a single credible cause.

1. The primary O-ring seal and the GCP-to-metal seal form part of a redundant seal system at the Forward-to-Aft Exit Cone Joint. The GCP-to-metal seal will see no pressure unless the primary O-ring fails. If both the primary O-ring seal and GCP-to-metal seal fail, a leak path past the cap screws could exist and result in loss of vehicle and crew.

6.0 ITEM DESCRIPTION:

1. Forward-to-Aft Exit Cone Joint, (primary O-ring and Aft Exit Cone GCP-to-Metal Bond line (Figures 1 and 2)), is assembled at KSC per engineering drawings, between the Exit Cone Assembly-Nozzle, Aft and the forward exit cone that are part of the assembled nozzle in the aft segment.

2. Room temperature vulcanizing sealing compound backfill provides a thermal barrier to protect other joint components from the high-combustion temperatures. The primary and secondary O-ring, leak check port plug and O-ring, and GCP-to-Metal Bond line seal provide a redundant sealing system to prevent leakage of hot gasses. Only the primary O-ring and GCP-to-Metal Bond line seal are addressed in this CIL.

3. Both the Forward Exit Cone Assembly and forward portion of the Aft Exit Cone Assembly consist of a metal shell enclosing a thin layer of glass phenolic resin-impregnated cloth insulation, over which is laid a thicker layer of carbon phenolic resin-impregnated cloth that acts as a liner of ablative material to the gas flow through the nozzle.

4. The glass phenolic layer is bonded to the metal shell with two-part epoxy adhesive, and carbon phenolic is thermoset to the glass phenolic with a phenolic resin. The glass phenolic layer in the Aft Exit Cone Assembly is also pinned to the metal shell using cap screws. The cap screws are installed with adhesive. Adhesive fills the cavity surrounding the tip of each cap screw and also extrudes into the hole provided for hydraulic relief. It is quite probable that the adhesive and cap screws would, in fact, provide an effective seal should hot gasses reach that point. This would then be a tertiary seal.

5. Polysulfide sealing compound per engineering is used to fill the groove in the glass phenolic at the forward end of the Aft Exit Cone to protect against a gas path along the structural bond line and past the cap screws. Materials are listed in Table 1.

TABLE 1. MATERIALS

Drawing No.	Name	Material	Specification	Quantity
1U77647	Aft Booster Build-up--KSC			1/motor
1U79157	Exit Cone Assembly-Nozzle, Aft			1/motor
	Aft Exit Cone	Product Specification	STW3-3463	A/R
1U79155	Exit Cone Subassembly, Aft			1/motor
1U79152	Exit Cone Assembly, Forward Section			1/motor
1U75150	Packing, Preformed Fluorocarbon	Black Fluorocarbon Rubber	STW4-3339	1/ motor
1U75801	Packing, Lubricated	Black Fluorocarbon Rubber O-ring and Lubricant	STW7-2999	1/ motor
1U51916	Cartridge Assembly	Heavy-Duty Calcium Grease, Filtered and Loaded in an Application Cartridge	STW7-3657	A/R
	Corrosion-Preventive Compound and O-ring Lubricant	Heavy-Duty Calcium Grease	STW5-2942	A/R
	Adhesive, Epoxy TIGA 321	Adhesive, Two Part	STW5-9203	A/R
	Cyslohexane Silane Primer	Silane Primer	STW5-9206	A/R

6.1 CHARACTERISTICS:

1. The Forward-to-Aft Exit Cone Joint allows the Aft Exit Cone to be mounted to the aft case segment at the launch site. The unit is sealed with O-rings and there is one leak check port to verify there is no leakage after assembly. The phenolic-to-metal interface provides an additional seal.

2. Seals at the Forward-to-Aft Exit Cone Joint are designed so that the O-ring maintains constant contact with its cavity at all times. Squeeze, fill, and tracking are taken into account relating to O-ring groove tolerances.

3. The O-ring is a one-time-use item.

4. The joint and seals are an important part of the assembled rocket motor case. The assembled RSRM is a combustion chamber made up of segments and the nozzle. It is sealed with O-rings, and must contain and direct pressure generated by burning propellant.

5. The forward portion of the Aft Exit Cone Assembly includes an aluminum shell that encloses the ablative glass and carbon phenolics and provides structural shape and strength.

6. Glass-cloth pre-impregnated with phenolic resin has low-thermal conductivity and is used as an insulator next to the aluminum shell. It also provides structural support for the ablative liner material next to it. The GCP insulator is pinned with cap screws to the shell as well as being bonded with adhesive. A change in ply lay up angle (going from one material to another) is an added safety factor to slow down or stop through de-lamination.

7. Carbon-cloth pre-impregnated with phenolic resin is used as the ablative liner over glass phenolic and is bonded to the glass phenolic with thermosetting laminating phenolic resin. Carbon phenolic slowly chars away under the influence of exhaust gas at temperatures over 5600^{o}F. A cooling, localized gas layer next to the exhaust gas passageway extends the lifetime of liner material. Carbon-cloth phenolic material has a relatively high thermal conductivity compared to glass phenolic that aids the formation of the localized gas layer and spreads heat evenly to produce even charring of the surface.

8. Structural analyses for nozzle bondlines using adhesives EA946 and EA913NA do not include residual stresses. For this reason, RWW0548 has been approved to waive the requirements to include residual stress in ultimate combined load structural analyses for the current nozzle structural adhesives. New analyses techniques developed for TIGA adhesive may show a negative margin of safety if same analyses were applied to EA946 and EA913NA bondlines. Extensive testing and model validation was conducted for TIGA adhesive to address residual stresses, which have not been performed on EA946 and EA913NA adhesives. Therefore, inclusion of residual stresses in the structural analyses for EA946 and EA913NA bondlines is waived.

   Flight rational includes the following: 1. Nozzles are considered fully qualified with a demonstrated reliability of 0.996. 2. The 2.0 bond safety factor is meant to cover unknown conditions such as residual stress effects. 3. Process controls have been added to include monitoring and controlling of bond loads, monitoring Coeflex-shim differentials, controls on rounding forces, controls on flange mismatch, controls on transportation temperatures, improvements in grit blast, eliminated bond surface contact with black plastic, TCA-wipe prior to grit blast rather than after, and other process changes. 4. The use of improved materials include adding silane primer (adhesion promoter), virgin grit blast media for pre-bond grit blast, and incorporate the use of fresh adhesive for nozzle structural bonds.

   Future incorporation of TIGA 321 adhesive on RSRM-94 will eliminate the need for waiver RWW0548. Certification analyses will include residual stresses for TIGA 321 adhesive.

7.0 FAILURE HISTORY/RELATED EXPERIENCE:

1. Current data on test failures, flight failures, unexplained failures, and other failures during RSRM ground processing activity can be found in the PRACA database.

8.0 OPERATIONAL USE: N/A

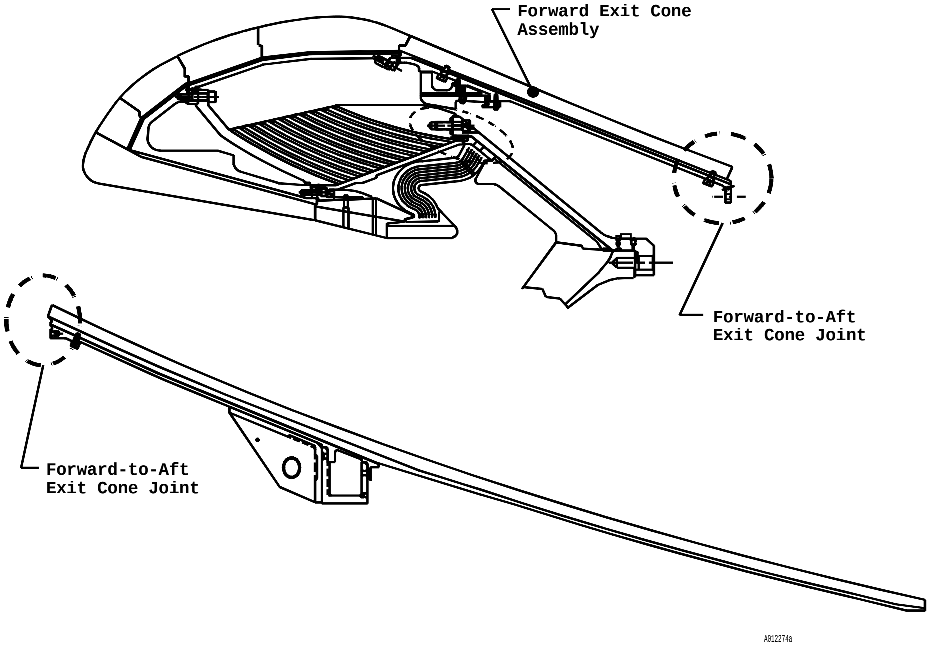

Figure 1. Forward-to-Aft Exit Cone Joint Location

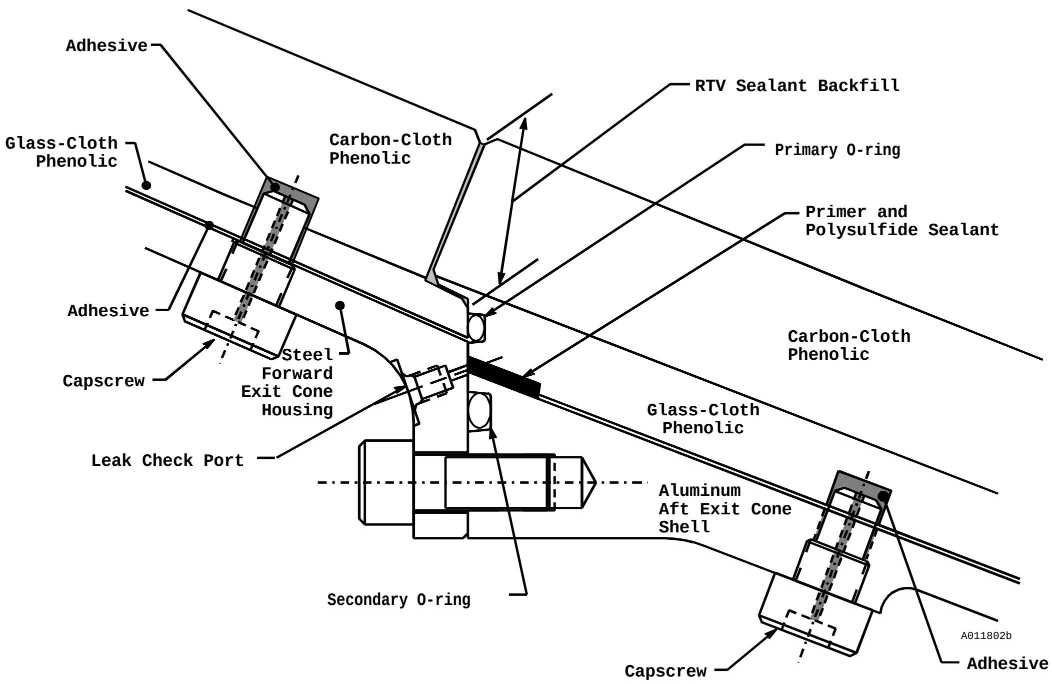

Figure 2. Forward-to-Aft Exit Cone Joint

9.0 RATIONALE FOR RETENTION:

9.1 DESIGN:

DCN	FAILURE CAUSES
A	1. Large O-rings are per engineering that covers process controls for fabrication of spliced joints and repairs.
A	2. Splice joints are cut on an angle and bonded together in a mold (using 100 percent of the scarf area) using an adhesive with the same physical and chemical properties as the parent stock.
A,D	3. O-rings were tested to determine size and types of flaws that could cause sealing problems per TWR-17750 and TWR-17991.
B	4. Criteria determining O-ring dimensions are per TWR-15771.
B,H	5. O-ring design provides constant contact between the O-ring and mating nozzle sealing surfaces.
B,D	6. Large O-rings are per engineering that establishes geometric dimensions and fabrication details.
C,H	7. Large O-rings are individually packaged as follows: a. Per engineering drawings prior to lubrication. b. Per engineering drawings after lubrication.
C,H	8. Large O-ring design allows for a minimum of stretching during installation without damage to the O-ring per engineering.
H	9. The O-ring is installed at KSC per engineering drawings.
C,H	10. Large O-rings are taken out of the package and installed one at a time to assure proper installation.
C	11. Material selection for the O-rings was based in part on resistance to damage per TWR-17082.
C,H	12. Design development testing of O-ring twisting and its effect on performance is per ETP-0153 and TWR-17991.
E	13. Fluorocarbon rubber O-rings are suitable for periods of storage up to 20 years (O-ring Handbook, ORD 5700, Copyright 1982, by Parker Seal Group, Lexington, KY). Environment and age is significant to useful seal life, both in storage and actual service as follows: a. O-rings are packaged and stored to preclude deterioration caused by ozone, grease, ultraviolet light, and excessive temperature.
E	14. Large O-ring time duration of supplier storage and total shelf life prior to installation is per engineering.
E	15. Aging studies of O-rings after 5 years installation life were performed. Test results are applicable to all RSRM fluorocarbon seals. Fluorocarbon maintained its tracking ability and resiliency. Fluorocarbon was certified to maintain its sealing capability over 5 years per TWR-65546.

E	16.	O-rings are one-time-use items.
E	17.	Grease is stored at warehouse-ambient condition that is any condition of temperature and relative humidity experienced by the material when stored in an enclosed warehouse, in unopened containers, or containers that were resealed after each use. Storage life under these conditions is per engineering.
E	18.	Aging studies to demonstrate characteristics of grease after 5 years installation life were performed on TEM-9. Results showed that grease provided adequate corrosion protection for D6AC steel, and that all chemical properties of grease remained intact per TWR-61408 and TWR-64397.
F	19.	Large O-rings are black fluorocarbon rubber.
F	20.	O-ring swell is negligible unless the O-ring undergoes a long period of water immersion (O-ring Handbook, ORD 5700, Copyright 1982, by Parker Seal Group, Lexington, KY).
F	21.	Fluorocarbon rubber is a non-nutrient to fungus growth (O-ring Handbook, ORD 5700, Copyright 1982, by Parker Seal Group, Lexington, KY).
F	22.	Prior to packaging large O-rings are kept: a. Dry and clean per engineering drawings. b. Clean per engineering drawings after lubrication.
G	23.	Primary O-ring gland design is per engineering drawings and conforms to dimensions determined by Thiokol Design Engineering calculations for squeeze, fill, and tracking per TWR-15771.
G	24.	Results of qualification tests and analysis for O-ring sealing in phenolics are per TWR-16357.
I	25.	Filtered grease is applied to nozzle sealing surfaces per engineering drawings during final assembly processes.
I	26.	Filtered grease filtering is per engineering to control contamination.
I	27.	Removal of surface contamination or corrosion is a standard shop practice used whenever contamination or corrosion is noted on metal components.
J	28.	Large O-rings are high-temperature, low-compression set, fluid-resistant, black fluorocarbon rubber.
J	29.	Temperature prior to launch is monitored for the nozzle flexible bearing and case-to-nozzle joint and is maintained per TWR 15832. The Aft Exit Cone-to-nozzle joint is within the temperature maintained area and benefits from temperature conditioning. Joint thermal analysis (O-ring resiliency testing) is per ETP-0276 and TWR-18597.
J	30.	Material properties for grease are per engineering.
K,L,M	31.	Preparation and cleaning methods for bonding surfaces are per shop planning. Cleanliness of bonding surfaces is determined by a combination of visual inspection and visual inspection aided by black light. Type of inspection for each surface is per shop planning. Preparation, cleaning, and inspection methods for aft exit cone bond lines are identified as process critical planning.

K	32.	The effect of contamination on bond strength is per TWR-16858. Surface finish of metal parts is per engineering and TWR-31719.
K	33.	Radiographic criteria are per TWR-16340.
K,L,M,O,P,R,T	34.	Thermal analysis per TWR-17219 shows the nozzle phenolic meets the new performance factor equation based on the remaining virgin material after boost phase is complete. This performance factor will be equal to or greater than a safety factor of 1.4 for the forward exit cone assembly and the aft exit cone assembly per TWR-74238 and TWR-75135. (Carbon phenolic-to-glass interface, bondline temperature and metal housing temperatures were all taken into consideration). The new performance factor will insure that the CEI requirements will be met which requires that the bond between carbon and glass will not exceed 600 degree F, bondline of glass-to-metal remains at ambient temperature during boost phase, and the metal will not be heat affected at splashdown.
L	35.	Two-part epoxy adhesive is mixed, applied, and cured per shop planning and engineering drawings.
L	36.	Phenolic laminating resin is applied to the carbon phenolic surface, and the glass phenolic over wrapped composite structure is autoclave cured per shop planning and engineering drawings.
L	37.	Base compound and curing compound constituents of polysulfide sealing compound are packaged in separate or sectional containers per engineering so the quantity of each yields the recommended mixing ratio. Additional mixing requirements are imposed per shop planning and the batch card.
L	38.	Mixing requirements for silane primer are per engineering.
L	39.	Primer and sealant application and cure are per engineering drawings and shop planning.
M,N	40.	Contamination control requirements and procedures are per TWR-16564.
N	41.	The nozzle manufacturing building is a controlled environment facility with temperature and humidity controls. There is controlled access to the building through a separate room.
O	42.	Bond line thickness of the glass phenolic-to-metal housing is per engineering drawings.
O	43.	Dry-fit to develop bond line shim size is done with Coe-flex per shop planning.
O	44.	Preparation methods for bond line thickness are per shop planning. Type of inspection for each surface as well as the bonding process is per process critical planning.
P	45.	Material properties for epoxy adhesive are per engineering.
P	46.	Material properties for polysulfide sealing compound are per engineering.
P	47.	Material properties for silane primer used with polysulfide sealing compound are per engineering.
P	48.	Epoxy adhesive, primer, and sealing compound are qualified per TWR-18764-11.

L,P,Q,R 49. The two-part constituent of epoxy adhesive is provided in kit form per engineering. Material is per engineering.

Q 50. The micro-fine silicon dioxide constituent of epoxy adhesive has an unlimited storage life when stored at warehouse ambient conditions per engineering.

Q 51. The base compound and curing compound comprising the polysulfide sealing compound have a controlled storage life per engineering.

Q 52. Silane primer used with sealing compound has a storage life of 9 months from date of manufacture when stored in closed containers at ambient temperature.

Q 53. Age degradation of nozzle materials is shown to not be a concern. Full-scale testing of a six-year old nozzle showed that there was no performance degradation due to aging per TWR-63944. Tests on a fifteen-year old flex bearing showed no degradation of flex bearing material properties per TWR-63806.

R 54. Aft exit cone assembly manufacturing processes are per engineering drawings and shop planning.

R 55. Manufacturing processes were used on development and qualification motors per TWR-18764-11.

R 56. Surface and subsurface defect criteria rationale are per TWR-16340.

R 57. Sixty flat-bottom holes are drilled around the forward end of the aft exit cone assembly into the glass phenolic insulator for installation of cap screws per engineering drawings.

R 58. Cracks in the phenolic material at the cap screw holes are minimized by the use of:

a. Sharp drills
b. Drill bushings
c. Drill depth stop
d. Flat bottom drills

S 59. Analysis is conducted by Thiokol engineering to assess vibration and shock load response of the RSRM nozzle during transportation and handling to assembly and launch sites per TWR-16975.

S 60. Pre-assembly mismatch causing bond line stresses was shown by analysis to be within allowable limits per TWR-16975.

S 61. Handling and lifting requirements for SRM components are similar to those for previous and current programs as conducted by Thiokol per TWR-13880.

a. Proof loading of all lifting equipment is per TWR-10212.

S 62. The exit cone and exit cone fragment shipping kit is designed for transportation of the exit cone to the launch facility and return of the recovered exit cone fragment to Thiokol per TWA-1123. The shipping kit provides an enclosed container to protect the Aft Exit Cone from external environments.

a. A detailed description of the shipping kit is per TWA-1189.

S 63. The primary storage configuration for the aft nozzle exit cone assembly is on the exit cone installation fixture. Exit cones in storage are grounded and under protection from the elements per TWA-1123.

S	64.	Transportation and handling of Aft Exit Cone Assembly items by Thiokol is per IHM 29.
S	65.	Positive cradling or support devices and tie downs that conform to shape, size, weight, and contour of components to be transported are provided to support RSRM segments and other components. Shock mounting and other protective devices are used on trucks and dollies to move sensitive loads per TWR-13880.
S	66.	Support equipment used to test, handle, transport, and assemble or disassemble the RSRM is per TWR-15723.
S	67.	The nozzle assembly is shipped in the aft segment. Railcar transportation shock and vibration levels are monitored per engineering and applicable loads are derived by analysis. Monitoring records are evaluated by Thiokol to verify shock and vibration levels per MSFC Specification SE-019-049-2H were not exceeded. TWR-16975 documents compliance of the nozzle with environments per MSFC Specifications.
T	68.	Analysis is conducted by Thiokol engineering to assess dynamic, acoustic, and vibration response of the RSRM nozzle operation during the boost phase per TWR-16975.
T	69.	The Aft Exit Cone is designed not to be adversely affected when experiencing temperature, pressure, humidity, vibration or shock environments per TWR-15723.
T	70.	Analysis of nozzle natural frequency and vibration response throughout motor burn is per TWR-16975.
K	71.	A Spray-in-Air cleaning system is used to clean metal components as part of the bonding surface preparation processing sequence.
B,G,N,S,T	72.	Analysis of carbon-cloth phenolic ply angle changes for the nozzle was performed. Results show that redesigned nozzle phenolic components have a reduced in-plane fiber strain and wedge-out potential per TWR-16975. New loads that were driven by the Performance Enhancement (PE) Program were addressed in TWR-73984. No significant effects on the performance of the RSRM nozzle were identified due to PE.
B,G,N,S,T	73.	TWR-17219 was revised to include updated boundary conditions as part of the Generic/Performance Enhancement (PE) aero/plume heating environment certification effort. Comparison of resulting temperatures showed the generic environment analysis to be slightly higher than PE in all areas of the nozzle. Margins of safety still meet CEI requirements for char and erosion when using either generic or PE environments.
	74.	Structural analysis documented in TWR-16975 show that nozzle phenolic-to-metal bondlines have positive margins of safety based on a safety factor of 2.0. These analyses used standard conditions as allowed by the CEI specification.

9.2 TEST AND INSPECTION:

DCN	FAILURE CAUSES and TESTS	(T)				CIL CODES
			1.	For New Large O-ring verify:		
	A			a.	Diameter	AEB026,AEB027
	A			b.	Splice is bonded over 100 percent of the scarf area	AEB133,AEB134
	A			c.	No more than five splices	AEB167,AEB169
	A			d.	Repairs	AEB265,AEB266
	A			e.	Adhesive is made from fluorocarbon rubber	AEB308,AEB311
	A			f.	Splice bond integrity	AEB317,AEB319
	A,D,E	(T)		g.	Subsurface indications	AEB354
	A,C,D,E,F			h.	Surface quality	AEB388,AEB389
	A	(T)		i.	Tensile strength	AEB401,AEB402
	A	(T)		j.	Ultimate elongation	AEB442,AEB443
	A			k.	Supplier inspection records	AEB468
	B			l.	Diameter	AEB014,AEB018,AEB015,AEB023
	B			m.	Correct identification	AEB087,AEB100
	C,F			n.	Packaging for damage or violation	AEB179
	F			o.	Clean and dry when packaged	AEB031,AEB034
	F,J			p.	Material is fluorocarbon rubber	AEB141,AEB151
	J	(T)		q.	Tensile strength	AEB394,AEB396
	J	(T)		r.	Shore A hardness	AGM304,AGM312
	J	(T)		s.	Ultimate elongation	AGM408,AGW075
	J	(T)		t.	Compression set	AKW006,AKW011
			2.	For New Exit Cone Assembly, Forward Section verify:		
	C,G			a.	Insulation-to-housing bond line is flush with adjacent surfaces	NCC005
	C,G			b.	No unacceptable defects or sharp edges of adhesive bond line, aft end	NCC007
	G			c.	O-ring sealing surfaces	ADI159
	G			d.	No unacceptable defects and surface finish of phenolic sealing surface of aft end	NCC006
			3.	For New Exit Cone, Subassembly-Nozzle, Aft verify:		
	G			a.	O-ring groove depth	AGL083
	G			b.	O-ring groove surface finish	AGL183
	G			c.	O-ring groove width	AGL086
	G			d.	O-ring groove diametric location	AGL064
	K,M			e.	Bonding surfaces free of contamination (Blacklight)	AGL022,AGL023
	K			f.	Solvent wipe dry time	AGL067A
	K,M			g.	Metal bonding surface grit blast to primer application time limits	AGL080
	K			h.	Solvent dry wipe	AGL073
	K			i.	Solvent wipe down	AGL167
	K,L,N			j.	Proper cure of primer	NCC014
	K,L,M			k.	Primer application	NCC015
	L			l.	Adhesive (LER, Silicon filled) is mixed per planning requirements	AGL004
	L			m.	Metal shell is seated within pot life of adhesive	AGL094
	L,N			n.	Bonding cure	AGL059
	L			o.	Layer of adhesive applied to bonding surface	AGL200
	L,P	(T)		p.	Cure-cup hardness test	AGL051
	L,O			q.	Sealing compound groove depth	AGL114
	L,O			r.	Sealing compound groove width	AGL115
	L,P	(T)		s.	Results of witness panel tests for aft exit cone assembly	NCC011
	M,R	(T)		t.	Radiographic examination is acceptable	AGL118

N			u.	Temperature of shell bonding surface	AIB041
O			v.	Correct shim location	AGL049
O			w.	Correct shim size	AGL048
O			x.	Bond gap thickness	AGL102
Q			y.	Shelf life of adhesive	AGL166
R			z.	Alcohol wipe test	AGL010
R			aa.	Holes are drilled per engineering	AGL028
		4.	For New Exit Cone Assembly--Nozzle, Aft verify:		
S			a.	Handling of aft exit cone	AGK011
		5.	For New Exit Cone Sub Assembly, Aft Insulated verify:		
K,M			a.	Polysulfide sealing compound groove is free of contamination after groove was cleaned with solvent	AEC200
K,M			b.	Polysulfide sealing compound groove metal side wall is free of contamination after metal surface was hand-sanded	AEC201
L			c.	Primer is allowed to air dry per specification	AGK042
L			d.	Polysulfide sealing compound is cured at required temperature for required time per specification	AGK040
L			e.	Polysulfide is cured until tack-free per specification	AGK038
L	(T)		f.	Shore A hardness--cure cup sample of polysulfide sealing compound per specification	AGK048
L,O			g.	Groove is back filled with polysulfide sealing compound to required depth	AGK009
Q			h.	Shelf life of polysulfide base compound is not expired	AGK045
Q			i.	Shelf life of polysulfide curing compound is not expired	AGK046
Q			j.	Shelf life of primer used with the sealing compound is not expired	AGK047
		6.	For New Filtered Grease verify:		
I	(T)		a.	Contamination	ANO064
		7.	For New Grease verify:		
J	(T)		a.	Penetration	LAA037
J	(T)		b.	Dropping point	ANO042
J	(T)		c.	Zinc concentration	LAA038
585		8.	For New Approved Solvent, verify:		
K,M			a.	Certificate of Conformance is complete and acceptable	AJJ007A
		9.	For New Exit Cone, Aft verify:		
O			a.	Acceptable completion of tape wrap per shop planning	AGL078
		10.	For New Adhesive, LER, Silicone Filled verify:		
P			a.	Pot life	ANM025
P	(T)		b.	Tensile Adhesion Strength	ANM045
		11.	For New Adhesive, Modified Epoxy (Grey) verify:		
P			a.	Average molecular weight (epoxy paste)	ANL002
P			b.	Epoxide equivalent, epoxy resin	ANL029,ANL027
P			c.	Pot life	ANL074,ANL075

P		d.	Titratable nitrogen, curing agent	ANL159,ANL160
P	(T)	e.	Viscosity, epoxy resin	ANL176,ANL178
P		f.	Ingredient percentages	ANL045,ANL060
P	(T)	g.	Steel-to-steel tensile adhesion	ANL094
P		h.	Visual examination (workmanship)	ANL117

12. For New Silicon Dioxide, verify:

P	(T)	a.	Bulk density	ALP002,ALP008
P	(T)	b.	Moisture	ALP058,ALP064
P	(T)	c.	pH	ALP097,ALP101
P	(T)	d.	Loss on ignition	ALP040

13. For New Sealant, Polysulfide verify:

P	(T)	a.	Chalking	AJH011
P	(T)	b.	Flow	AJH020
P	(T)	c.	Nonvolatile content	AJH028
P	(T)	d.	Peel strength	AJH030
P	(T)	e.	Application life	AJH035
P	(T)	f.	Resistance to thermal rupture	AJH037
P	(T)	g.	Shore A hardness	AJH058
P	(T)	h.	Tack-free time	AJH061
P	(T)	i.	Air content	AJH065A
P	(T)	j.	Viscosity of base compound	AJH068
P	(T)	k.	Viscosity of curing compound	AJH074

14. For New Primer, Adhesive - Silane verify:

P		a.	Workmanship	ANY013
P		b.	Color	POG001
P	(T)	c.	Infrared identification	ANY022
P	(T)	d.	Bond strength and durability	ANY000
P	(T)	e.	Acidity	ANY001

15. KSC verifies:

A,B,C,D, G,H,I,R,S	(T)	a.	Leak test is performed prior to sealant backfill and the results are acceptable per OMRSD File V, Vol I, B47NZ0.110	OMD056
C,E,F		b.	No damage to shipping box, shipping bag, and O-ring prior to installation per OMRSD File V, Vol I, B47NZ0.052	OMD050
I,H		c.	Application of filtered grease on forward and aft exit cone sealing surfaces prior to installation of O-rings per OMRSD File V, Vol I, B47NZ0.120	OMD057
C		d.	Correct parallel alignment of the nozzle field joint mating surfaces during the mating operation per OMRSD File V, Vol I, B47NZ0.060	OMD051
F,G,I,S		e.	Aft exit cone mating surfaces for damage or contamination prior to application of primer and again just prior to assembly (including blacklight inspection for contamination) per OMRSD File V, Vol I, B47NZ0.032	OMD048
G,I		f.	Forward exit cone mating surfaces prior to assembly to ensure absence of damage or contamination per OMRSD File V, Vol I, B47SG0.072	OMD080
I		g.	Application of filtered grease to nozzle field joint O-rings per OMRSD File V, Vol I, B47NZ0.130	OMD058
S		h.	Aft exit cone for damage (absence or penetration of ablative	

carbon material) prior to assembly per OMRSD File V, Vol I, B47NZ0.041 OMD049