CRITICAL ITEMS LIST (CIL)

No. 10-05-04-10R/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 Forward Exit Cone GCP-Metal Bondline (2)
ASSEMBLY:	Fwd-to-Aft Exit Cone Interface 10-05-04		
FMEA ITEM NO.:	10-05-04-10R Rev N		
CIL REV NO.:	N		
DATE:	17 Jun 2002	PART NO.:	(See Section 6.0)
SUPERSEDES PAGE:	362-1ff.	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 Forward Exit Cone (FEC) Glass-Cloth Phenolic (GCP)-to-Metal bond line

3.0 FAILURE EFFECTS: Leakage could result in hot gasses flowing past cap screws, resulting in a burn-through and loss of nozzle causing thrust imbalance between SRBs, 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	P
1.2.7	Age degradation of components	Q
1.3	Porosity, voids, unbonds, inclusions, or cracks in phenolics	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 glass-cloth phenolic-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 glass-cloth phenolic-to-Metal bond line seal cannot both be lost due to a single credible cause.

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

6.0 ITEM DESCRIPTION:

1. The Forward-to-Aft Exit Cone Joint, (primary O-ring and Forward Exit Cone Glass-Cloth Phenolic (GCP)-to-Metal bond line (Figures 1 and 2), is assembled at KSC per engineering drawings.

2. The sealing compound backfill provides a thermal barrier to protect other joint components from high combustion temperatures. The primary and secondary O-ring, leak check port plug and O-ring, and Glass-Cloth Phenolic-to-Metal bond line seal provide a redundant sealing system to prevent leakage of hot gasses. Only the primary O-ring and Glass-Cloth Phenolic-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 a two-part epoxy adhesive, and carbon phenolic is thermoset to the glass phenolic with a phenolic resin. The glass phenolic layer in the Forward 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. Materials are listed in Table 1.

TABLE 1. MATERIALS

Drawing No.	Name	Material	Specification	Quantity
1U77647	Aft Booster Build-up--KSC			1/motor
1U77660	Nozzle Assembly, Final			1/motor
1U77640	Segment Assembly, Rocket Motor, Aft			1/motor
1U79155	Exit Cone Subassembly, Aft			1/motor
5U77659	Forward Exit Cone Phenolics			1/motor
5U77804	Forward Exit Cone			1/motor
1U79152	Exit Cone Assembly, Forward Section			1/motor
	Forward Exit Cone	Product Specification	STW3-3462	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
	Adhesive, Epoxy TIGA 321	Adhesive, Two Part	STW5-9203	A/R
	Primer, Cyclohexane Silane	Silane Primer	STW5-9206	A/R
	Corrosion-Preventive Compound and O-ring Lubricant	Heavy-Duty Calcium Grease	STW5-2942	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 bond line 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. The O-ring is a one-time-use item.

3. 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.

4. The Forward Exit Cone Assembly includes a D6AC steel housing that encloses the ablative glass and carbon phenolics and provides structural shape and strength.

5. Glass-cloth pre-impregnated with phenolic resin has low-thermal conductivity and is used as an insulator next to the D6AC steel 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.

6. Carbon-cloth pre-impregnated with phenolic resin is used as the ablative liner over glass phenolic and is bonded to the glass phenolic with a 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.

7. 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

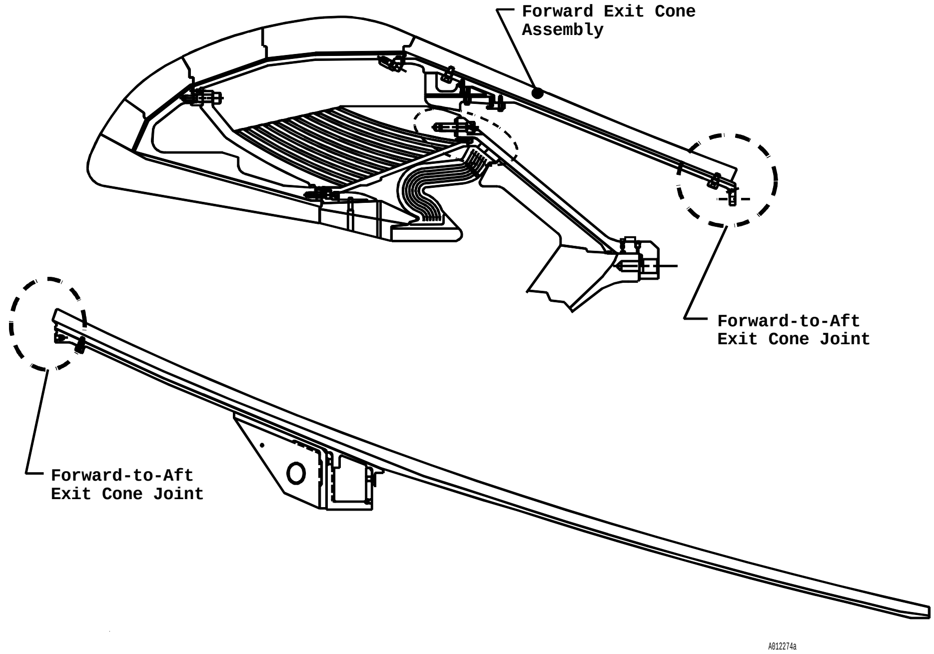

Figure 1. Forward-to-Aft Exit Cone Joint Location

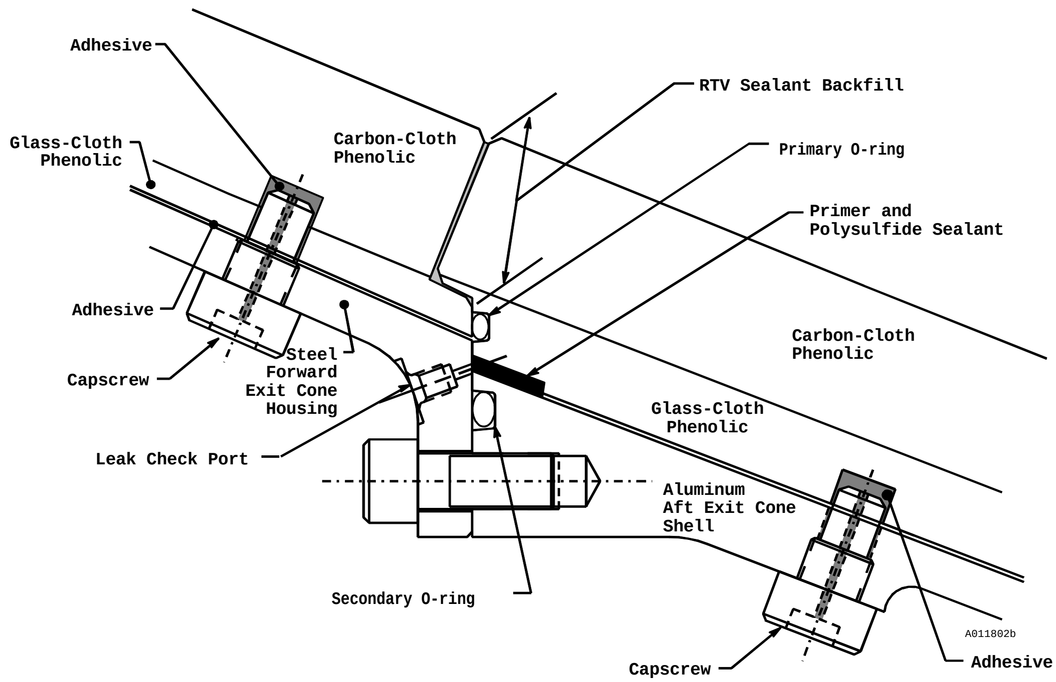

Figure 2. Forward-to-Aft Exit Cone Joint

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.
H	10.	The primary and secondary O-rings are taken out of the package and installed one at a time to assure proper installation.
C	11.	Material selection for 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.
E	19.	Large O-rings and filtered grease are included in the nozzle life verification.
F	20.	Large O-rings are black fluorocarbon rubber.
F	21.	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	22.	Fluorocarbon rubber is a non-nutrient to fungus growth (O-ring Handbook, ORD 5700, Copyright 1982, by Parker Seal Group, Lexington, KY).
F	23.	Prior to packaging large O-rings are kept: a. Dry and clean per engineering drawings. b. Clean per engineering drawings after lubrication.
G	24.	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	25.	Results of qualification tests and analysis for O-ring sealing in phenolics are per TWR-16357.
I	26.	Filtered grease is applied to nozzle sealing surfaces per engineering drawings during final assembly processes.
I	27.	Filtered grease filtering is per engineering to control contamination.
I	28.	Removal of surface contamination or corrosion is per standard shop practice used whenever contamination or corrosion is noted on metal components.
J	29.	Large O-rings are high-temperature, low-compression set, fluid-resistant, black fluorocarbon rubber.
J	30.	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	31.	Material properties for grease are per engineering.
K,L,M	32.	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. Conscan also verifies surface

condition of bonding surfaces prior to bonding. The 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	33.	The effect of contamination on bond strength is per TWR-16858. Surface finish of metal parts is per engineering and TWR-31719.
K	34.	Radiographic criteria are per TWR-16340.
K,L,M,O,P,R,T	35.	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.
K,M	36.	There is a recommended time limit of 6 hours between grit blasting and bonding operations on steel parts per shop planning. This is not an engineering requirement. However, if the 6-hour recommendation is exceeded manufacturing engineering is notified.
L	37.	Two-part epoxy adhesive is mixed, applied, and cured per shop planning and engineering drawings.
L	38.	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.
M	39.	The preparation and cleaning method for bonding GCP insulation and metal housing is per shop planning.
N	40.	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	41.	Bond line thickness of the glass phenolic-to-metal housing is controlled per engineering drawings.
O	42.	Dry-fit to develop bond line shim size is done with Coe-flex per shop planning.
O	43.	Preparation methods for bond line thickness are per shop planning. Type of inspection for each surface as well as bonding processes are per process critical planning.
P	44.	Material properties for epoxy adhesive are per engineering.
P	45.	Epoxy adhesive is qualified per TWR-18764-11.
L,P,Q,R	46.	The two-part constituent of epoxy adhesive is provided in kit form per engineering. Material is per engineering.
Q	47.	The micro-fine silicon dioxide constituent of the epoxy adhesive has an unlimited storage life when stored at warehouse-ambient conditions per engineering.

Q 48. Age degradation of nozzle materials was 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 15-year old flex bearing also showed no degradation of flex bearing material properties per TWR-63806.

R 49. Forward Exit Cone Assembly manufacturing processes are per shop planning.

R 50. Manufacturing processes were used on development and qualification motors per TWR-18764-11.

R 51. Surface and subsurface defect criteria are per TWR-16340.

R 52. Forty-eight flat bottom holes are drilled around the aft end of the Forward Exit Cone Assembly through the class phenolic insulator into carbon phenolic for the installation of cap screws.

R 53. Cracks in the phenolic material at the cap screw holes are minimized by use of:

a. Sharp drills
b. Drill bushings
c. Drill depth stops
d. Flat bottom drills
e. Drill shims

S 54. Analysis was conducted by Thiokol engineering to assess the effects of transportation and handling loads on the RSRM nozzle per TWR-16975.

S 55. Handling and lifting requirements for SRM components are similar to those for previous and current programs conducted by Thiokol per TWR-13880.

S 56. Transportation and handling of the Nozzle Assembly by Thiokol is per IHM 29.

S 57. The RSRM and its component parts are protected per TWR-10299 and TWR-11325. The nozzle, which is shipped as part of the Aft Segment, is protected from external environments at all times by either covers or shipping containers until assembled as part of the RSRM.

S 58. 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 59. Support equipment used to test, handle, transport, and assemble or disassemble the RSRM is certified and verified per TWR-15723.

S 60. 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.

S 61. Pre-assembly mismatch causing bond line stresses is shown by analysis to be within allowable limits per TWR-16975.

S 62. The Forward Exit Cone Assembly is covered with a protective cover and stored in a temperature controlled building until used as part of a larger assembly.

T	63.	Analysis is conducted by Thiokol engineering to assess dynamic, acoustic, and vibration of the RSRM nozzle operation during the boost phase per TWR-16975.
T	64.	Analysis of nozzle natural frequency and vibration throughout motor burn is per TWR-16975.
T	65.	Environmental (thermal) conditions, similar to those occurring during the boost phase, were demonstrated per static firings and TWR-18764-11.
K	66.	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,I	67.	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,I	68.	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.
B, G, O	69.	Measurements are done and an analysis performed in accordance with TWR-76864 to ensure the Joint 1 Primary O-ring footprint adequately covers the glass phenolic of the Forward Exit Cone, ensuring there is not a Criticality 1 gas path to the glass phenolic/Forward Exit Cone bond line.
	70.	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 CODE
		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	(T)	g. Subsurface indications	AEB354
A,C,D,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,E,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, Fwd 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
K,M		e. Free of contamination (Black light)	ADI022,ADI021
K,M		f. Grit blast	ADI093
K		g. Solvent wipe dry time	ADI073A
K		h. Solvent dry wipe	ADI075
K		i. Solvent wipe down	ADI176
K,L,P		j. Proper cure of primer	NCC008
K,L		k. Primer application on bond surfaces	NCC009
K,L,M,N,P	(T)	l. Witness panel results for adhesive integrity	NCC010
L		m. Adhesive was mixed according to sheet standardization	ADI007
L,N		n. Bonding cure	ADI067
L,M		o. Primer application ends within specified time limit after CONSCAN	ABA004
L		p. Phenolic is seated within the pot life of the adhesive	ADI102
L,M		q. Adhesive is applied to bonding surfaces	ADI190
L,P	(T)	r. Cure-cup hardness tests	ADI063
L,M		s. With CONSCAN the steel housing bonding surfaces	ABA003
N		t. Temperature of bonding surface	ADI187
O		u. Correct bond line-shim location	ADI052
O		v. Correct bond line-shim size	ADI031
O		w. Bond gap thickness	ADI109
Q		x. adhesive is acceptable	ANM000
R		y. Alcohol wipe test	ADI120,SAA103
R		z. Cap screw holes are per blueprint	ADI034

		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,L,M,N,P	(T)	e.	Witness panel results for adhesive integrity		NCC011
		4.	For New Segment, Rocket Motor, Aft verify:		
S		a.	Nozzle Assembly for handling damage and protective cover is clean and in place		AGJ167
		5.	For New Filtered Grease verify:		
I	(T)	a.	Contamination		ANO064
		6.	For New Grease verify:		
J	(T)	a.	Penetration		LAA037
J	(T)	b.	Dropping point		ANO042
J	(T)	c.	Zinc concentration		LAA038
585		7.	For New Approved Solvent, verify:		
K		a.	Certificate of Conformance is complete and acceptable		AJJ007A
		8.	For New Forward Exit Cone verify:		
N		a.	Autoclave cure of glass phenolic is acceptable		AHM005
M,N,R	(T)	b.	Radiographic examination is acceptable		ADI136
O		c.	Acceptable completion of tape wrap per shop planning		AHM018
		9.	For New Adhesive, LER, Silicone Filled verify:		
P	(T)	a.	Pot life		ANM025
P	(T)	b.	Tensile Adhesion Strength		ANM045
		10.	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	(T)	h.	Visual examination (workmanship)		ANL117
		11.	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
		12.	For New Nozzle Assembly, Final verify:		

S		a.	All metal and plastic interfacing surfaces of the forward exit cone are cleaned prior to installation	ADG007
S		b.	Alcohol wipe test of nozzle insulation prior to shipment to nozzle installation operation	ADI014
S		c.	Phenolic surfaces are free of damage prior to primer application to forward exit cone assembly	ADR044
S		d.	Exit Cone Assembly, Fwd Section forward end O-ring sealing surface is free from damage prior to installation of secondary O-ring	ADR064
S		e.	Forward exit cone sealing surfaces are free of contamination at time of assembly	ADR073
S		f.	Forward exit cone sealing surfaces are free from damage prior to assembly	ADR165
	13.		For Nozzle Assembly, Structural Bond line Requirements For verify:	
K,L,M,N,P (T)		a.	Phenolic-to-adhesive interface checks meet specification requirements	PPC001
	14.		For Nozzle Joint 1 Primary O-ring Footprint Calculation, Requirements verify:	
B,G,O		a.	O-Ring footprint lies upstream of Glass phenolic/Forward Exit Cone Assembly bond line by data review of RSRM Joint 1 Primary O-ring Footprint Calculation	SAB001
	15.		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
	16.		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
HI		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
H		d.	Application of filtered grease to nozzle field joint O-rings per OMRSD File V, Vol I, B47NZ0.130	OMD058
C		e.	Correct parallel alignment of the nozzle field joint mating surfaces during the mating operation per OMRSD File V, Vol I, B47NZ0.060	OMD051
E		f.	Expiration date is not exceeded for materials installed at KSC per OMRSD File V, Vol I, B47GEN.160	OMD042
F,G,I		g.	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,S		h.	Forward exit cone mating surfaces prior to assembly to ensure absence of damage or contamination per OMRSD File V, Vol I, B47SG0.072	OMD080