ATK ALLIANT TECHSYSTEMS
THIOKOL PROPULSION

CRITICAL ITEMS LIST (CIL)

No. 10-02-01-44R/01

SYSTEM:	Space Shuttle RSRM 10	CRITICALITY CATEGORY:	1R
SUBSYSTEM:	Nozzle Subsystem 10-02	PART NAME:	Throat Inlet-to-Forward Exit Cone Joint, Primary O-ring and Glass Cloth Phenolic-to-Metal Bondline
ASSEMBLY:	Nozzle and Aft Exit Cone 10-02-01		
FMEA ITEM NO.:	10-02-01-44R Rev N		
CIL REV NO.:	N	PART NO.:	(See Section 6.0)
DATE:	17 Jun 2002	PHASE(S):	Boost (BT)
SUPERSEDES PAGE:	343-1ff.	QUANTITY:	(See Section 6.0)
DATED:	10 Apr 2002	EFFECTIVITY:	(See Table 101-6)
CIL ANALYST:	B. A. Frandsen	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 glass-cloth phenolic-to-metal bond line

3.0 FAILURE EFFECTS: Leakage could result in hot gas 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 bondline	
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 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 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 seal can not 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 throat inlet-to-forward 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 the glass-cloth phenolic-to-metal bond line seal fail, a leak path will exist and could result in loss of crew and vehicle.

6.0 ITEM DESCRIPTION:

Throat Inlet-to-Forward Exit Cone Joint, Primary O-ring and Forward Exit Cone Glass-Cloth Phenolic-to-Metal Bond line (Figures 1 and 2)

1. Sealing compound backfill provides a thermal barrier to protect other joint components from high-combustion temperatures. The primary and secondary O-ring, RSRM 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 the glass-cloth phenolic-to-metal bond line seal are addressed in this CIL.

2. Both the throat inlet assembly and the forward 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.

3. 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. As shown in Figure 2, 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
1U77660	Nozzle Assembly, Final			1/motor
1U75150	Packing, Preformed Fluorocarbon	Black Fluorocarbon Rubber	STW4-3339	1/motor
1U79144	Throat Inlet Assembly, Nozzle			1/motor
1U75547	Housing, Throat Inlet			1/motor
1U51916	Cartridge Assembly	Heavy-Duty Calcium Grease, Filtered and Loaded in an Application Cartridge	STW7-3657	A/R
1U79152	Exit Cone Assembly, Fwd Section			1/motor
5U77804	Forward Exit Cone			1/motor
	Forward Exit Cone	Product Specification	STW3-3462	1/motor
	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 Throat Inlet-to-Forward Exit Cone Joint allows the Throat Inlet Housing to be mounted to the Forward Exit Cone. The unit is assembled with O-rings and bolts to assure there is no leakage after assembly. The phenolic-to-metal interface provides an additional seal.

2. The primary and secondary O-ring at the Throat Inlet-to-Forward 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 tolerance. 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. For each assembly, a D6AC steel housing encloses 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 ablative liner material next to it. The glass-cloth phenolic insulator in the forward exit cone assembly 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 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

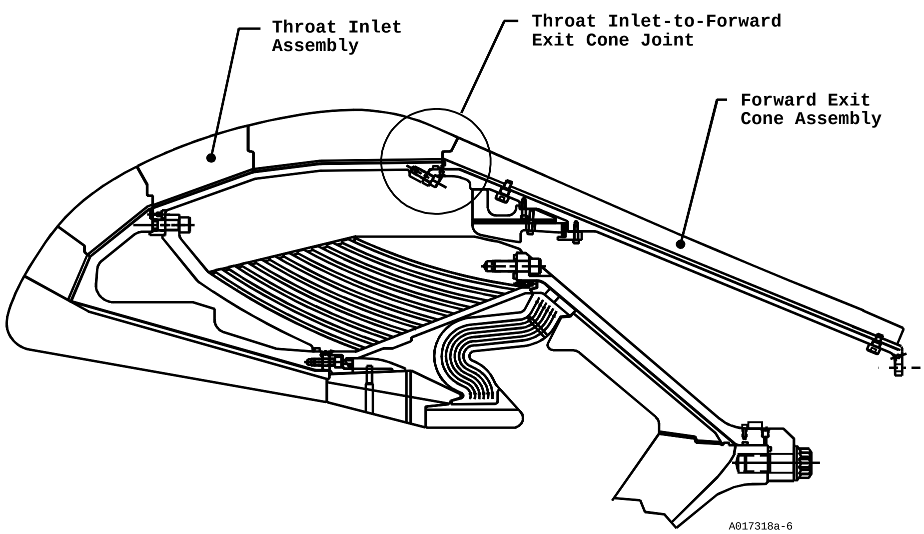

Figure 1. Throat Inlet-to-Forward Exit Cone Joint Location

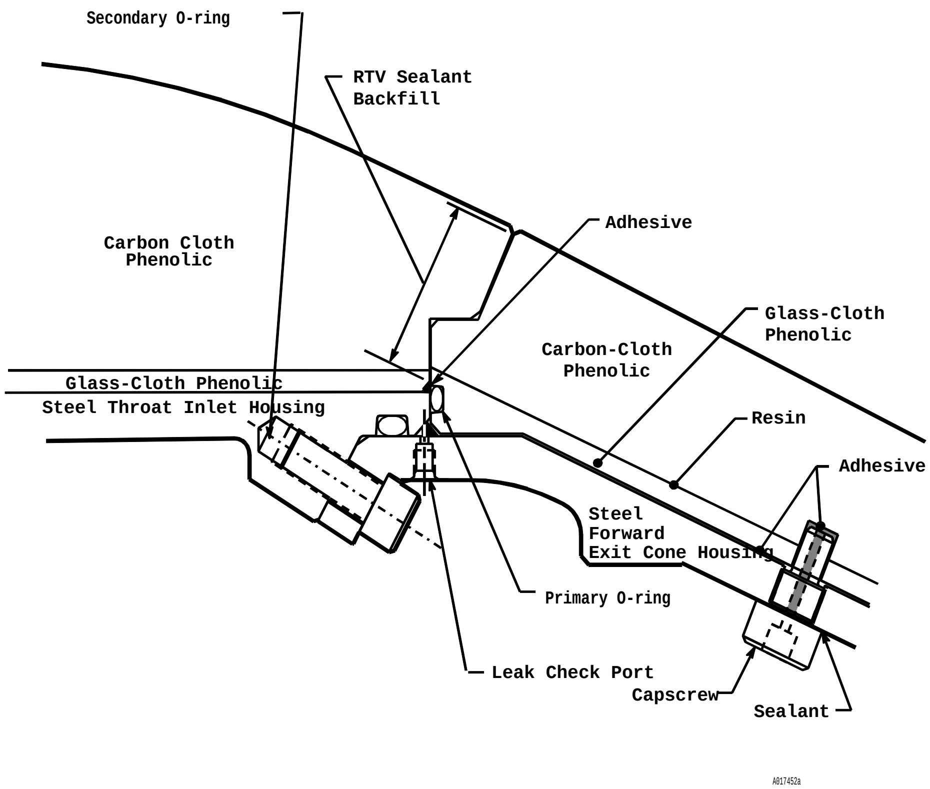

Figure 2. Throat Inlet-to-Forward Exit Cone Joint

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 a constant contact between the O-ring and mating nozzle and segment sealing surfaces.
B,D	6.	Large O-rings are per engineering that establishes geometric dimensions, design requirements, and fabrication details.
C,H	7.	Large O-rings are individually packaged per engineering.
C,H	8.	Large O-ring design allows for a minimum of stretching during installation without damage to the O-ring per engineering.
C,H	9.	Large O-rings are installed at Thiokol per engineering.
C	10.	Material selection was based in part on resistance to damage per TWR-17082.
C,H	11.	Design development testing of O-ring twisting and its effect on performance is per ETP-0153 and TWR-17991.
C,H	12.	To assure the correct O-ring is installed in its designated location, O-rings are unpackaged and installed one at a time per shop planning.
E	13.	Fluorocarbon rubber O-rings are suitable for periods of storage of up to 20 years (O-ring Handbook, ORD 5700, Copyright 1982, by Parker Seal Group, Lexington, KY). Environment and age are 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 also 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 the grease remained intact per TWR-61408 and TWR-64397.

E 19. Large O-rings and filtered grease are included in the aft segment 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. Large O-rings are kept dry and clean prior to packaging.

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. Design verification analysis of data from live firing tests per TWR-17591, TWR-17592, TWR-17991, and TWR-17992 shows that O-ring sealing surfaces are acceptable for flight per TWR-18764-09.

G 26. Sealing surface requirements during refurbishment are per engineering drawings and specifications.

I 27. Filtered grease is applied to sealing surfaces of the nozzle final assembly during final assembly processes.

I 28. Grease filtering is per engineering to control contamination.

I 29. Removal of surface contamination or corrosion is a standard shop practice used whenever contamination or corrosion is noted.

I 30. Contamination control requirements and procedures are per TWR-16564.

J 31. Large O-rings are high-temperature, low-compression set, fluid-resistant, black fluorocarbon rubber.

J 32. Temperature prior to launch is monitored for the nozzle flexible bearing and the case-to-nozzle joint and is maintained to requirements per TWR-15832. The Throat Inlet-to-Forward Exit Cone 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 33. Material properties for grease are per engineering.

K,L,M,N 34. Preparation and cleaning of 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. Surface inspection type is per shop planning.

		Preparation, cleaning, and inspection methods for aft exit cone bond lines are identified as process critical planning.
K	35.	The effect of contamination on bond strength is per TWR-16858. Surface finish of metal parts is per engineering and TWR-31719.
K	36.	Radiographic criteria are per TWR-16340.
K,L,M,O,P,R,T	37.	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 throat assembly and the forward 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	38.	Recommended time limit between grit blasting and bonding operations on steel parts is six hours per shop planning. However, this is not an engineering requirement. The manufacturing engineer is notified if the six-hour recommendation is exceeded.
L	39.	Two-part epoxy adhesive is mixed, applied, and cured per shop planning and engineering drawings.
L	40.	Laminating phenolic 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	41.	Preparation and cleaning for bonding glass-cloth phenolic insulation and the metal housing are per shop planning.
M,N	42.	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 with a card reader.
O	43.	Bond line thickness of the glass phenolic-to-metal housing is per engineering drawings.
O	44.	Dry-fit to develop bond line shim size is done with Coe-flex per shop planning.
O	45.	Preparation methods for bond line thickness are per shop planning. The type of inspection for each surface as well as the bonding process is per process critical planning.
P	46.	Material properties for epoxy adhesive are per engineering.
P	47.	Epoxy adhesive is qualified and documented per TWR-18764-09.
L,P,Q,R	48.	The two-part constituent of epoxy adhesive is provided in kit form per engineering. The material is controlled per engineering.
Q	49.	The micro-fine silicon dioxide constituent of epoxy adhesive has an unlimited storage life when stored at warehouse-ambient conditions per engineering.
Q	50.	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.

Q,S 51. Thermal analyses were performed for RSRM components during in-plant transportation and storage to determine acceptable temperature and ambient environment exposure limits per TWR-50083. Component temperatures and exposure to ambient environments during in-plant transportation or storage is per engineering.

R 52. Forward exit cone assembly manufacturing processes are per shop planning.

R 53. Manufacturing processes were used on development and qualification motors and qualified per TWR-18764-09.

R 54. Surface and subsurface defect criteria are per TWR-16340.

R 55. Forty-eight flat-bottom holes are drilled around the forward end of the forward exit cone assembly through the glass phenolic insulator into the carbon phenolic for the installation of cap screws.

R 56. Shop planning instructions minimize cracks in the phenolic material at cap screw holes by the use of:

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

S 57. Analysis was 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 58. Handling and lifting requirements established for RSRM components are similar to those for previous and current programs conducted by Thiokol per TWR-13880.

S 59. Transportation and handling of nozzle assembly items by Thiokol is per IHM 29.

S 60. 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 61. 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 62. Support equipment used to test, handle, transport, and assemble or disassemble the RSRM is certified and verified per TWR-15723.

S 63. 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	64.	Pre-assembly mismatch causing bond line stresses was shown by analysis to be within allowable limits per TWR-16975.
S	65.	The throat inlet assembly and the forward exit cone assembly are covered with protective covers and stored in a temperature-controlled building until used as parts of a larger assembly.
T	66.	Analysis is conducted by Thiokol engineering to assess dynamic, acoustic, and vibration response of RSRM nozzle operation during the boost phase per TWR-16975.
T	67.	Analysis of nozzle natural frequency and vibration response throughout motor burn is per TWR-16975.
T	68.	Environmental (thermal) conditions, similar to those during the boost phase were demonstrated on static tests per TWR-18764-09.
K	69.	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	70.	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	71.	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
	B		b.	Diameter	AEB014,AEB015,AEB018,AEB023
	A		c.	Splice is bonded over 100 percent of the scarf area	AEB133,AEB134
	A		d.	No more than five splices	AEB167,AEB169
	A		e.	Repairs	AEB265,AEB266
	A		f.	Adhesive is made from fluorocarbon rubber	AEB308,AEB311
	A		g.	Splice bond integrity	AEB317,AEB319
	A,D	(T)	h.	Subsurface indications	AEB354
	A,C,D,F		i.	Surface quality	AEB388,AEB389
	A	(T)	j.	Tensile strength	AEB401,AEB402
	A	(T)	k.	Ultimate elongation	AEB442,AEB443
	A		l.	Supplier inspection records	AEB468
	B		m.	Correct identification	AEB087,AEB100
	C		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 Nozzle Assembly, Final verify:	
	A,B,D,G,R	(T)	a.	Joint seals are pressure tested	ADR129
	C,H		b.	Installation and fit of primary O-ring	ADR196
	H,I		c.	Application of filtered grease to Exit Cone Assembly, Forward Section forward end O-ring groove prior to assembly	ADR023
	H		d.	Correct identification of primary and secondary O-ring at time of installation	ADR061
	C,H,I,S	(T)	e.	Leak test of primary seal prior to sealing compound backfill	ADR129A
	H,I		f.	Application of filtered grease to primary O-ring prior to assembly	ADR154
	H		g.	Primary and secondary O-ring are unpackaged, processed, and installed one at a time	ADR155
	C		h.	Primary O-ring is free from damage prior to installation	ADR156
	C,H		i.	Condition of primary O-ring after installation into O-ring groove	ADR000
	E		j.	Primary O-ring packaging for damage or violation at time of installation	ADR152
	E		k.	Shelf life compliance of primary O-ring	ADR225
	F		l.	Throat support housing O-ring groove is free of fungus prior to O-ring installation	ADR150
	F		m.	Secondary O-ring is free from moisture prior to installation	ADR159A
	F		n.	Primary O-ring is free from moisture prior to installation	ADR179
	F,I		o.	Housing-Throat Support, Nozzle aft end O-ring groove is free from corrosion and contamination prior to assembly	ADR180
	F		p.	Exit Cone Assembly, Fwd Section forward end primary O-ring groove is free from fungus prior to installation	ADR181
	I		q.	Housing, Exit Cone, Nozzle forward end mating surface is free from corrosion and contamination prior to assembly	ADR077
	I		r.	Housing-Throat Support, Nozzle aft end mating surface is free from corrosion and contamination prior to assembly	ADR261
	Q,S		s.	Component temperatures and exposure to ambient environments during in-plant transportation or storage	BAA028

S		t.	Exit Cone Assembly, Fwd Section forward end O-ring groove is free from damage prior to installation of primary O-ring	ADR063
S		u.	Exit Cone Assembly, Fwd Section forward end O-ring sealing surface is free from damage prior to installation of secondary O-ring	ADR064
S		v.	Housing-Throat Support, Nozzle aft end O-ring sealing surfaces are free from damage prior to assembly	ADR066
S		w.	Housing-Throat Support, Nozzle aft end O-ring groove is free from damage prior to assembly	ADR149
S		x.	Forward exit cone sealing surfaces are free from damage prior to assembly	ADR165
S		y.	Throat support housing O-ring groove is free of pitting prior to O-ring installation	ADR166
S		z.	Forward exit cone glass O-ring grooves are free of cracks, ridges and blemishes including scratches and gouges prior to O-ring installation	ADR202
S		aa.	Throat support housing sealing surfaces are free from damage prior to assembly	ADR205
	3.	For New Exit Cone Assembly, Forward Section verify:		
G		a.	O-ring groove depth	ADI113
G		b.	O-ring groove surface finish	ADI125
G		c.	O-ring groove width	ADI126
G		d.	O-ring groove diametric location	ADI114
K,M,N		e.	Free of contamination (Black light)	ADI022,ADI021
K,M,N		f.	Grit blast	ADI093
K,L,M,N		g.	With CONSCAN the steel housing bonding surfaces	ABA003
K		h.	Solvent dry wipe	ADI075
K		i.	Solvent wipe down	ADI176
K		j.	Solvent wipe dry time	ADI073A
K,L,M,N		k.	Primer application ends within specified time limit after CONSCAN	ABA004
L		l.	Adhesive (LER, Silicon filled) is mixed per planning requirements	ADI007
L,N		m.	Bonding cure	ADI067
L		n.	Phenolic is seated within the pot life of the adhesive	ADI102
L,M		o.	Adhesive is applied to bonding surfaces	ADI190
L,P (T)		p.	Cure-cup hardness tests	ADI063
K,L,M,N,P (T)		q.	Witness panel results for adhesive integrity	NCC010
N		r.	Temperature of bonding surface	ADI187
O		s.	Correct bond line-shim location	ADI052
O		t.	Correct bond line-shim size	ADI031
O		u.	Bond gap thickness	ADI109
Q		v.	Adhesive is acceptable	ANM000
R		w.	Alcohol wipe test	ADI120,SAA103
R		x.	Cap screw holes are to per blueprint	ADI034
	4.	For New Housing, Throat Support, Nozzle verify:		
G		a.	Surface finish	AFN145A,AFN146A
	5.	For Refurbished Housing, Throat Support, Nozzle verify:		
G		a.	Surface finish	AFN004
	6.	For New Throat Inlet Assembly, Nozzle verify:		
G,O,R		a.	Aft end of throat inlet assembly bond line is flush with adjacent surfaces	SAA026

K,R			b.	No unacceptable defects and surface finish of phenolic sealing surfaces of aft end - throat inlet	SAA025
K,R			c.	No unacceptable defects or sharp edges of adhesive bond line, aft end - throat inlet	SAA027
Q,S			d.	Component temperatures and exposure to ambient environments during in-plant transportation or storage	BAA034
		7.	For New Filtered Grease verify:		
I	(T)		a.	Contamination	ANO064
		8.	For New Grease verify:		
J	(T)		a.	Penetration	LAA037
J	(T)		b.	Drop point	ANO042
J	(T)		c.	Zinc concentration	LAA038
585		9.	For New Approved Solvent, verify:		
K			a.	Certificate of Conformance is complete and acceptable	AJJ007A
		10.	For New Forward Exit Cone verify:		
N			a.	Autoclave cure of glass phenolic is acceptable	AHM005
M,R	(T)		b.	Radiographic examination is acceptable	ADI136
O			c.	Acceptable completion of tape wrap per planning requirements	AHM018
		11.	For New Adhesive, LER, Silicone Filled verify:		
P	(T)		a.	Pot life	ANM025
P	(T)		b.	Tensile Adhesion Strength	ANM045
		12.	For New Adhesive, Modified Epoxy (Grey) verify:		
P	(T)		a.	Average molecular weight (epoxy paste)	ANL002
P	(T)		b.	Epoxide equivalent, epoxy resin	ANL029,ANL027
P	(T)		c.	Pot life	ANL074,ANL075
P	(T)		d.	Titratable nitrogen, curing agent	ANL159,ANL160
P	(T)		e.	Viscosity, epoxy resin	ANL176,ANL178
P	(T)		f.	Ingredient percentages	ANL045,ANL060
P	(T)		g.	Steel-to-steel tensile adhesion	ANL094
P	(T)		h.	Visual examination (workmanship)	ANL117
		13.	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
		14.	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