CRITICAL ITEMS LIST (CIL)

No. 10-02-01-19R/02

SYSTEM:	Space Shuttle RSRM 10	CRITICALITY CATEGORY:	1R
SUBSYSTEM:	Nozzle Subsystem 10-02	PART NAME:	Nose Inlet-to-Throat Joint, Thermal Protection System (Sealant and Nose Inlet/Throat Metal Interface) (1)
ASSEMBLY:	Nozzle and Aft Exit Cone 10-02-01		
FMEA ITEM NO.:	10-02-01-19R Rev N		
CIL REV NO.:	N (DCN-533)	PART NO.:	(See Section 6.0)
DATE:	10 Apr 2002	PHASE(S):	Boost(BT)
SUPERSEDES PAGE:	329-1ff.	QUANTITY:	(See Section 6.0)
DATED:	27 Jul 2001	EFFECTIVITY:	(See Table 101-6)
CIL ANALYST:	B. A. Frandsen	HAZARD REF.:	BN-03

APPROVED BY: DATE:

RELIABILITY ENGINEERING: K. G. Sanofsky 10 Apr 2002

ENGINEERING: B. H. Prescott 10 Apr 2002

1.0 FAILURE CONDITION: Failure during operation (D)

2.0 FAILURE MODE: 1.0 Thermal failure

3.0 FAILURE EFFECTS: Burn through of the primary and secondary O-rings. Burn-through of the metal housing, and loss of the nozzle, resulting in thrust imbalance between SRBs, causing loss of RSRM, SRB, crew, and vehicle.

4.0 FAILURE CAUSES (FC):

FC NO.	DESCRIPTION	FAILURE CAUSE KEY
1.1	Failure of sealant (bondline, voids, tears, cracks)	
1.1.1	Sealing compound surfaces not properly prepared or adequately cleaned	A
1.1.2	Primer and sealing compound not properly mixed, applied, or cured	B
1.1.3	Contamination	C
1.1.4	Process environments detrimental to bond strength	D
1.1.5	Nonconforming material properties	E
1.1.6	Sealing compound degradation during storage or transportation	F
1.2	Failure of the nose inlet/throat metal interface	
1.2.1	Nonconforming dimensions	G
1.2.2	Improper assembly	H
1.2.3	Corrosion	I
1.2.4	Surface defects	J
1.2.5	Improper preload	K

5.0 REDUNDANCY SCREENS:

SCREEN A: Fail--The hardware is not capable of checkout during normal ground turnaround.
SCREEN B: Fail--Loss of the thermal protection system is not detectable during flight.
SCREEN C: Pass--Loss of all redundant items in the thermal protection system can not be the result of a credible single failure cause.

6.0 ITEM DESCRIPTION:

1. Sealing compound provides thermal protection between two nozzle assembly items at their phenolic surface interface. A gap is provided between the two phenolic surfaces for the following reasons:

   a. To allow for thermal expansion the nozzle assembly parts during boost
   b. To allow for positive and full surface mate-up while providing for surface contour tolerances

2. Sealant is pressure back filled into the gap between the two nozzle assembly items after they are bolted together and the leak test was successfully performed. The assembled joint is shown on engineering drawings (Figures 1 and 2). Materials are listed in Table 1.

3. The Aluminum Nose Inlet Housing and the steel Throat Support Housing are part of the Nose-Throat Assembly. They are assembled together with screws creating a metal-to-metal joint.

TABLE 1. MATERIALS

Drawing No.	Name	Material	Specification	Quantity
1U52834	Ring, Bearing Assembly, Forward			1/motor
1U75398	Housing Assembly-Nose/Inlet, Nozzle			1/motor
1U75547	Housing, Throat Support, Nozzle			1/motor
1U78785	Forging, Throat Housing, Nozzle			1/motor
1U76756	Screw			60/motor
1U77640	Segment, Rocket Motor, Aft			1/motor
1U79145	Nose Inlet Assembly, Nozzle			1/motor
1U79146	Nose-Throat Assembly, Nozzle			1/motor
1U79144	Throat Inlet Assembly, Nozzle			1/motor
1U79324	Bearing Assembly, Nozzle Flexible			1/motor
1U79147	Nose-Throat-Bearing Assembly			1/motor
	Insert, Helical Coil		MS12XXXX NASM12XXXX	A/R
	Nozzle Assembly	Product Specification	STW3-9151	1/motor
	Primer (Adhesive-Sealant Silicone RTV)	A one-part Dilute Solution of Reactive Materials in Solvent	STW4-3875	A/R
	Sealing Compound (Sealant, Silicone, RTV)	A two-part, Room-Temp Vulcanizing Silicone Rubber, High-Temperature Pressurization Sealant and Ablative Thermal Barrier	STW5-2813	A/R

6.1 CHARACTERISTICS:

1. The unit is bolted together with silicone rubber material pressure back filled into the gap between the two nozzle assembly items acting as an ablative thermal barrier. Sealing compound is back filled into the gap deeper than the maximum expected char line.

2. Silicone rubber sealing compound provides a high-temperature flexible thermal protection between the phenolic layers that face together at the joint. The function of the sealant is to protect joint metal components from heat affect and the O-rings from erosion.

3. Suspect Discrepancy Reports were written against joint 3 sealing compound for suspected blowholes introduced during the back filling process. This action is the result of finding heat affected primary O-rings during post flight inspection of flight sets 360X044 and 360X045. These blow holes occur at closeout areas where two wave fronts of RTV converge. The blow holes are caused by entrapping air next to the O-ring and then compressing it as more sealant is added to the joint. As the trapped air is compressed it follows the path of least resistance which is at the closeout interface and typically through the least viscous material.

   All dispositions/rework/repairs for affected flight sets are handled per MRB paperwork. When NDT is not used to detect voids, the repair process consists of removing sealant down to the inflection point of the joint for the full 360 degrees, visually inspecting the residual sealant surface at the inflection point for voids, and re-back filling the joint with new sealant (except for the areas where voids are identified in the old material). After new back filled sealant is cured, edges of the RTV backfill opening, where voids were identified in the old sealant, are excavated to accommodate the backfill repair closeout. Repair closeout incorporates a vacuum assisted backfill. If no pigtail void is found, vacuum assisted backfill will be at the closeout location. When NDT is used to detect voids in the joint, the repair process consists of removing the sealant down to the inflection point of the joint at each location where a void is identified and replacing it with new sealant using vacuum assist to reduce the chance of new voids. This process was developed and tested on sub scale plexiglass test blocks and on full-up HPM and RSRM hardware joints that were then disassembled and inspected until the process was optimized. Certification was achieved using tensile adhesion tests and full-up RSRM hardware repairs. Processes used for repair work were analyzed with a process FMEA. The process FMEA systematically identified repair concerns and controls to mitigate risk. Process FMEA work is documented in TWR-73177. Flight sets affected by these Drs are 360X046 through 360X048 and 360X050 through 360X055.

4. Post flight inspection of STS-71 and STS-70 (RSRM flight sets 360X045 and 360X044) found heat affected nozzle joint 3 primary O-rings resulting from blow paths introduced during the backfill process. These blow holes occur at closeout areas where two wave fronts of RTV converge. Blow holes are caused by entrapping air next to the O-ring and then compressing it as more sealant is added to the joint. As trapped air is compressed, it follows the path of least resistance that is at the closeout interface and typically through the least viscous material thus creating a tail void.

   Until a more acceptable solution can be found to eliminate the tail void problem, the production hardware nose inlet-to-throat joint will be back filled normally (without vacuum assist) then 360-degree repaired. The repair process consists of removing sealant down to the inflection point of the joint for the full 360 degrees, visually inspecting the residual sealant surface at the inflection point for voids, and re-back filling the joint with new sealant (except for the areas where voids are identified in the old material). After new back filled sealant is cured, edges of the RTV backfill opening where voids were identified in the old sealant, are excavated to accommodate backfill repair closeout. Repair closeout incorporates a vacuum-assisted backfill. If no pigtail void is found, vacuum-assisted backfill is at the closeout location. This process was developed and tested on sub scale plexiglass test blocks and on full-up HPM and RSRM hardware joints that were then disassembled and inspected until the process was optimized. The repair process was successfully demonstrated when STS-69 (RSRM flight set 360X048) was flown. CIL CODES BFR001, BFR002, BFR003, BFR004, BFR005, BFR006, BFR007, and BFR008 were added to specifically cover this repair process.

   Flight sets affected by this repair process are 360X056 and subs.

5. There are five main joints in the nozzle support structure. This CIL describes the nose inlet-to-throat inlet joint that consists of the nose inlet housing and throat support housing, joined by the same bolt circle that also connects the flex bearing forward end ring. The throat inlet housing supports the nozzle throat assembly and connects ultimately to the forward exit cone assembly. This joint is assembled per engineering drawings.

6. The metal interface of the nose inlet-to-throat joint was added to the CIL as a contributor to the thermal protection of the joint per TWR-66503. Based on new thermal analyses, metal in the joint provides a heat sink that reduces temperature of hot gases if the gases pass the RTV per TWR-73264.

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

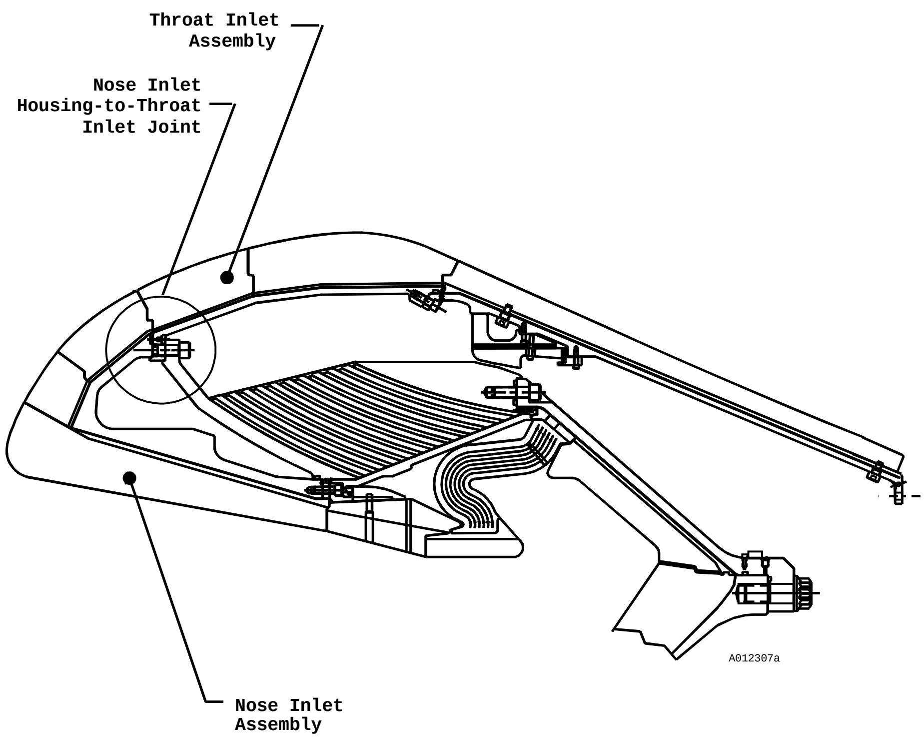

Figure 1. Nose Inlet Housing-to-Throat Inlet Housing Joint Location

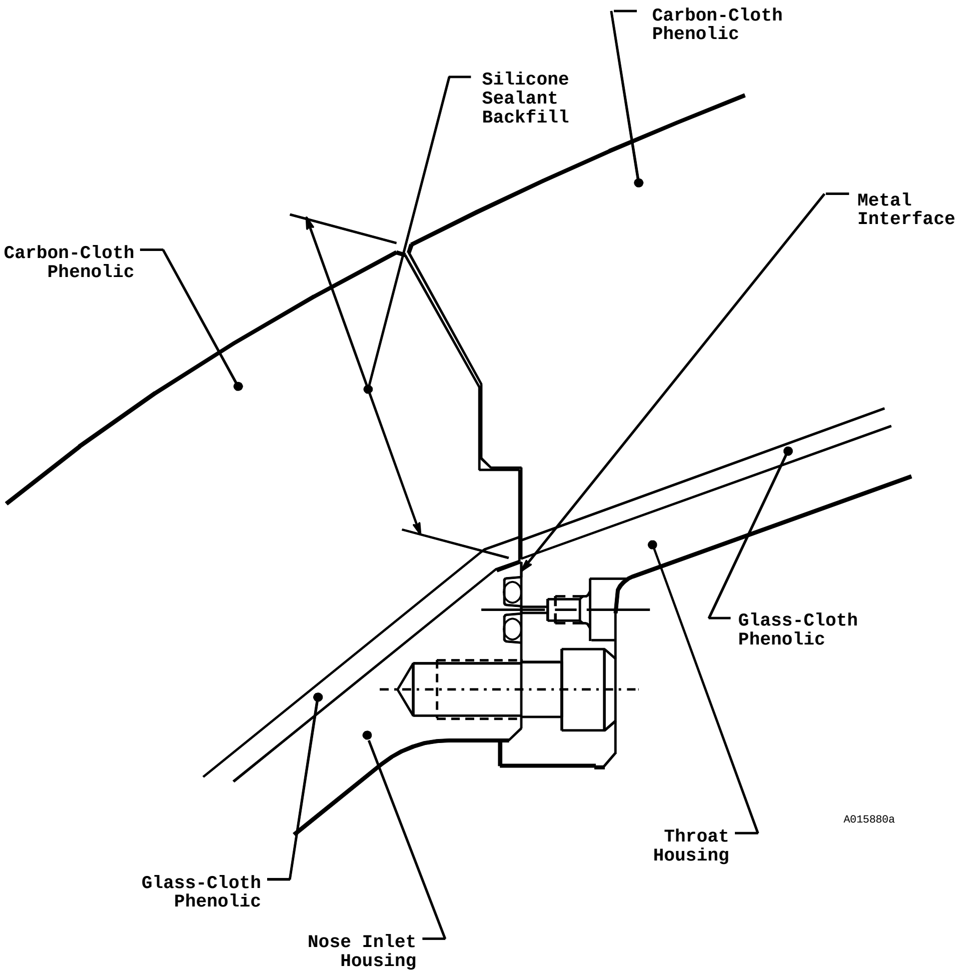

Figure 2. Nose Inlet Housing-to-Throat Inlet Housing Joint

9.0 RATIONALE FOR RETENTION:

9.1 DESIGN:

DCN FAILURE CAUSES		
A,C,D	1.	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. The type of inspection required for each surface is per shop planning. Preparation, cleaning, and inspection methods for the aft exit cone bondlines are identified as process critical planning.
A,B,C,D,E,F	2.	The sealing compound and application method was qualified through testing. Test results are documented in TWR-18764-09.
B	3.	Two-part sealing compound mix ratio is controlled per engineering and mixing instructions are per shop planning.
B	4.	Primer is prepared by the supplier per engineering.
B	5.	Primer and sealing compound application and cure are controlled per engineering drawings and process critical shop planning.
C,D,I	6.	Contamination control requirements and procedures are described in TWR-16564.
C,D	7.	Primer is a one-component Room Temperature Vulcanization (RTV) silicone per engineering.
C,D	8.	Sealing compound is a two-part RTV silicone elastomer, supplied in separate sealed containers per engineering.
C,D,I	9.	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.
E	10.	Material properties for primer are controlled per engineering
E	11.	Material properties for sealing compound are controlled per engineering.
E	12.	Sealing compound consists of a silicone rubber base and a catalyst. The supplier supplies the correct amount of each component material to achieve the proper mix ratio per engineering.
F	13.	Requirements for handling RSRM components during assembly and transportation are similar to those for previous and other current programs at Thiokol. Proof testing is required for all lifting and handling equipment per TWR-13880.
F	14.	Support equipment used to test, handle, transport, and assemble or disassemble the RSRM is certified and verified per TWR-15723.
F,G,J	15.	All components are inspected for handling damage after completion. Assembly and handling operations are controlled per shop planning and IHM 29.
F	16.	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.

F 17. The RSRM and its component parts are protected per requirements in TWR-10299 and TWR-11325. The nozzle, which is shipped as part of the aft segment, is protected from the external environment at all times by either covers or shipping containers until assembled as part of the RSRM.

F 18. 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.

F 19. 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 fifteen-year old flex bearing also showed no degradation of flex bearing material properties per TWR-63806.

F 20. 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.

21. Forward End Ring-to-Throat Joint requirements are as follows:

G a. Forward end ring dimensions are established per engineering drawings.
G b. Refurbished forward end ring dimensions are per engineering drawings and specifications.
G,I,J c. Bare surfaces of the forward end ring are protected from corrosion per engineering.
G,I,J d. Corrosion protection is provided for the forward end ring per engineering.
G,K e. Attach hardware screw dimensions are established in National Aerospace Industry Specifications and called out per engineering drawings. These are one-time-use items.
G,K f. Structural analyses documented in TWR-16975 show that all metal components of the joint have a positive margin of safety based on factors of safety on ultimate and yield.

22. Nose Inlet-to-Throat requirements are as follows:

G a. Nose inlet housing dimensions are established per engineering drawings.
G b. Refurbished nose inlet housing dimensions are controlled per engineering drawings and specifications.
G c. Throat support housing dimensions are established per engineering drawings.
G d. Refurbished throat support housing dimensions are per engineering.
G,I,J e. Corrosion protection is provided for the throat support housing per engineering.
G,K f. Attach hardware screws dimensions are specified in National Aeronautics Specifications for the nose throat assembly. These are a one-time-use item.
H,I,J g. Filtered grease is applied to interface surfaces at assembly of mating parts for the nose throat assembly.
H,I h. Nose inlet housing threads and helical inserts are coated with primer prior to insert installation for the housing assembly, nose/inlet, nozzle.
G i. Helical insert dimensions are specified for each MS part. These are one-time-use items.
G,K j. Structural analyses documented in TWR-16975 show that all metal components of the joint have a positive margin of safety based on factors of safety of 1.4 on ultimate and 1.1 on yield.

I,J	23.	The effects of galvanic corrosion due to dissimilar metal interaction are controlled per SRM-MUA-005.
I,K	24.	The nose inlet housing is made from heat treated 7075-T73 aluminum forging.
K	25.	The throat support housing and forward end ring are made of forged and heat treated D6AC steel.
I,K	26.	Screws are cadmium plated alloy steel, baked to prevent hydrogen embrittlement. Screws are not reused.
I	27.	Bolts and bolt holes are coated with filtered grease for the nose throat assembly and the nose throat bearing assembly.
I,K	28.	Bolts manufactured after 1 Jan 1987 are made to National Aeronautics Specification (NAS) standards, which includes a bake-out treatment to reduce hydrogen content. Bolts are used on the nose throat assembly and nose throat bearing assembly.
G,K	29.	The design verification analysis shows that materials and geometry of the nose inlet housing, forward end ring and throat support housing are acceptable for flight as documented in TWR-18764-09.
	30.	The nose inlet-to-throat joint consists of the following parts:
I,K		a. The nose inlet housing, a 7075-T73 aluminum forging.
K		b. The forward end ring, a D6AC steel heat treated forging.
K		c. The throat inlet housing, a D6AC steel heat treated forging.
	31.	The possibility of stress corrosion or fatigue damage to these parts during their service life was considered as follows:
		a. Nose inlet housing:
G,I,J,K		1) TWR-16975 shows the nose inlet housing to have a positive margin of safety based on a factor of safety of 1.4 ultimate and 1.1 on yield.
		b. Throat support housing:
G,I,J,K		1) This part is not controlled by TWR-16875 since stresses are low and margin of safety is high. Structural verification analysis per TWR-16975 shows the maximum stress obtained during operation to have a positive margin of safety using the factor of safety of 1.4 ultimate and 1.1 on yield.
H,I	32.	A thin coating of filtered grease is applied to the helical-coil inserts prior to installation of the socket head cap screws for the nose throat assembly.
H,K	33.	Bolt torque and tightening sequence of the nose inlet-to-throat-to-forward end ring joint is controlled per engineering drawings and shop planning.
H,K	34.	The screws used in assembling the forward end ring, nose inlet housing, and throat support housing are self-locking per engineering.
H,I,K	35.	Prior to installation all socket head cap screws must meet cleanliness requirements per shop planning.
G,H,J,K	36.	During assembly, care is taken to assure that threaded inserts are not damaged.

Damaged inserts are replaced per engineering.

37. Assembly stresses are minimized as follows:

G,H,J,K a. Mating surface flatness is controlled by inspection of machining operations.
H,I,J,K b. Threads are cleaned and lubricated prior to assembly.
H,K c. Assembly bolts are torqued in a prearranged sequence to preload values.

G,H,J,K 38. Bolt preload holds joint metal parts together to form a face contact interface. The joint is a closing joint upon pressurization. Gaps within the joint metal interface are the result of flatness conditions and localized surface defects are controlled per engineering. Temperature of the gas entering the joint is reduced as it comes in contact with the metal. Temperature reduction is a function of quantity and velocity of the gas entering the joint versus the surface area, path shape, and thermal conductivity of the metal the gas contacts in the joint.

G,H,J,K 39. Analysis per TWR-73264 covers the joint during pressurization and heating within the joint due to the entrance of chamber gases by way of single or double leak paths through the joint's RTV. Maximum surface temperature of joint steel and aluminum housings ahead of the o-rings is well below the critical temperature for the joint, but may be above the design/reuse temperature resulting in localized heat affect/degradation of the metal. Features of component metal interface surfaces ahead of the primary and secondary O-rings are controlled per engineering drawings. Based on a conservative analysis the gap will reduce hot gas temperatures into the joint but could result in primary O-ring erosion per TWR-73264. Worst case scenario could allow a gas blow hole at ignition which is mitigated by the current method of excavation and re-backfill and vacuum closeout of the RTV in joint 3.

D,H,I 40. 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.

533 D,H,I 41. 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 nose inlet assembly and the throat 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.

9.2 TEST AND INSPECTION:

DCN	FAILURE CAUSES and TESTS	(T)			CIL CODE
			1.	For New Nose-Throat Assembly, Nozzle verify:	
	A		a.	Primed bonding surfaces of nose inlet assembly are free of contamination	ADN022
	A		b.	Primed bonding surfaces of throat inlet assembly are free of contamination	ADN023
	A		c.	Surface of nose inlet assembly to be primed is free of contamination	ADN024
	A		d.	Surface of throat inlet assembly to be primed is free of contamination	ADN025
	A		e.	Dry time of nose inlet assembly prior to primer application	ADN033
	A		f.	Dry time of throat inlet assembly prior to primer application	ADN034
	A		g.	Solvent wipe of nose inlet assembly prior to primer application	ADN117
	A		h.	Solvent wipe of throat inlet assembly prior to primer application	ADN118
	B		i.	Application of silicone sealing compound to joint per shop planning	ADN016
	B		j.	Tape pressure dam is installed per planning requirements	ADN017
	B		k.	Cured sealing compound is blended to adjacent contour	ADN032
	B		l.	Phenolic surfaces are cleaned per planning requirements prior to taping backfill dam	ADN035
	B		m.	Joint sealant is free of visible cracks, inclusions, separations, and uncured material	ADN048
	B		n.	Joint sealant surface voids are acceptable	ADN052
	B		o.	Plastic-to-plastic interface surface of nose inlet assembly air dries for specified time, prior to application of silicone sealing compound	ADN083
	B		p.	Plastic-to-plastic interface surface of throat inlet assembly air dries for specified time, prior to application of silicone sealing compound	ADN084
	B		q.	Plastic-to-plastic interface surface of the nose inlet assembly is primed with RTV sealant, prior to application of silicone sealing compound	ADN085
	B		r.	Plastic-to-plastic interface surface of the throat inlet assembly is primed with RTV sealant, prior to application of silicone sealing compound	ADN086
	B		s.	Pot life of silicone sealing compound not exceeded at time of application	ADN087
	B		t.	Cure of silicone sealing compound	ADN101
	B		u.	Sealing compound (Sealant, Silicone, Two-part, RTV) is mixed per planning requirements	ADN102
	B		v.	Shelf life of primer at time of application was not exceeded	ADN106
	B,E	(T)	w.	Shore A hardness (cure cup samples) for each mix batch of silicone sealing compound	ADN112
	B		x.	Loading of silicone sealing compound into cartridges per planning requirements	ADN113
	B		y.	Stock number of primer (RTV sealant) at time of application	ADN119
	B		z.	Stock number of silicone sealing compound at time of application	ADN120
	C,D		aa.	Temperature of bonding surfaces is within specified limits prior to sealing compound application	ADN121
	B,D		ab.	Proper vacuum is maintained during all vacuum-assisted repairs/closeouts	BFR001
	E		ac.	Shelf life of sealing compound is not exceeded at time of assembly	BFR019
	E		ad.	Lot number of sealing compound at time of application	BFR020
	A,C		ae.	No loose RTV in joint gap after excavation	BFR002
	B,D		af.	Vacuum-assisted repair is done at all locations where voids were showing at the inflection point in the remaining parent RTV	BFR003

B,D		ag.	Temperature of phenolics is within limits prior to repair backfill	BFR004
A,C		ah.	No obvious contamination in joint gap prior to repair backfill	BFR005
A		ai.	No obvious damage to the joint phenolics prior to repair backfill	BFR006
B,D		aj.	Vacuum assist is used to close out the repair	BFR007
B,E		ak.	Viscosity of repair material at time of backfill is acceptable	BFR008
H,I		al.	Filtered grease is dispensed from preloaded cartridges during assembly	ADN030
H,K		am.	Socket head cap screws locking device is acceptable at installation	ADN031
G,H,K		an.	Socket head cap screws part number is acceptable at installation	ADN031A
H,I,K		ao.	Socket head cap screws are free of visible and obvious contamination prior to installation	ADN116
H,K		ap.	Tightening sequence of socket head cap screws (throat inlet-to-nose inlet) per planning requirements	ADN125
H,K		aq.	Torque value of socket head cap screws in throat inlet-to-nose inlet per planning requirements	ADN127

2. For New Adhesive-Sealant Silicone RTV verify:

C,D		a.	Containers for shipping and handling damage	ADQ220
C,D		b.	Contains no foreign matter	AIY002
C,D		c.	Material is homogeneous	AIY004
E		d.	Primer color	AIY001
E	(T)	e.	Specific gravity	AIY007
E	(T)	f.	Total solids content	AIY015

3. For New Sealant, Silicone, RTV verify:

C,D		a.	Shipping and handling damage	ADQ223
C,D		b.	Workmanship is uniform in appearance, quality and color	ANF045
E	(T)	c.	Elongation	ANF000,ANF002,ANF004
E	(T)	d.	Flow	ANF011,ANF013
E	(T)	e.	Shore A hardness	ANF021,ANF023,SAA042
E	(T)	f.	Specific gravity	ANF029,ANF031,SAA043
E	(T)	g.	Tensile strength	ANF037,ANF039,ANF040

4. For New Segment Assembly, Rocket Motor, verify:

F		a.	Nozzle assembly for handling damage and protective cover is cleaned and in place	AGJ167

5. For New Housing Assembly-Nose/Inlet, Nozzle verify:

G		a.	Flatness	AFE008,AFE009,AFE012,AFE013
G		b.	Diameter	AFE016,AFE017,AFE021,AFE022,AFE025,AFE026
G		c.	Height	AFE049,AFE050
G		d.	Profile	AFE123,AFE126
G		e.	Run out	AFE135,AFE136,AFE139,AFE140
G		f.	True position	AFE160,AFE160A,AFE161,AFE161A
K		g.	Heat treat	AFE065
K		h.	Material composition	AFE080
J	(T)	i.	Dye penetrant	AFE030
J,K	(T)	j.	Ultrasonic	AFE165
I,J,K	(T)	k.	Electrical conductivity	AFE039
K	(T)	l.	Elongation	AFE083B
K	(T)	m.	Ultimate strength	AFE083
K	(T)	n.	Yield strength	AFE083A

6. For Refurbished Housing Assembly-Nose/Inlet Nozzle verify:

G		a.	Diameter	AFE015
G		b.	Height	AFE048
G		c.	Straightness	AFE101,AFE103,AFE105,AFE107,AFE152
G		d.	Roundness	AFE130,AFE132
G		e.	Flatness	AFE154,AFE156
G		f.	Wall thickness	AFE168
J,K	(T)	g.	Dye penetrant	AFE033

7. For New Housing, Throat Support, Nozzle verify:

G,I		a.	Corrosion protection is per specification	AFN007
G		b.	Flatness	AFN030,AFN031
G		c.	Diameter	AFN043,AFN044,AFN047,AFN048
G		d.	Profile	AFN130,AFN129,AFN160,AFN161
G,K		e.	Minimum full thread	AFN164,AFN165
G,K		f.	Minor diameter max depth	AFN171,AFN172
G		g.	True position	AFN175,AFN175A,AFN175B,AFN176,AFN176A,AFN176B
G		h.	Thickness	AFN197,AFN198,AFN200,AFN201
G		i.	Run out	CIC011,CIC012,CIC013,CIC014
I,K	(T)	j.	Carburization	AFN019
I,K	(T)	k.	De-carburization	AFN033
K	(T)	l.	Reduction in area	AFN121C
K	(T)	m.	Yield strength	AFN162A
K	(T)	n.	Elongation	AFN162B
K	(T)	o.	Ultimate strength	AFN121

8. For Refurbished Housing, Throat Support, Nozzle verify:

G		a.	Diameter	AFN042,AFN046
G		b.	Height	AFN058
G		c.	Straightness	AFN126,AFN127,AFN128
G		d.	Roundness	AFN132,AFN135
G		e.	Thickness	AFN196,AFN199
J,K	(T)	f.	Magnetic particle	AFN096
G		g.	Surface B flatness per specification	AFN156

9. For New Ring, Bearing Assembly, Forward verify:

G		a.	Diameter dimension	ADF006,ADF007,ADF009,ADF010
G		b.	Thickness	ADF018,ADF019
G		c.	Height	ADF023,ADF024
G		d.	Flatness	ADF025,ADF026
G,I		e.	Corrosion protection is per specification	ADF034
G		f.	Run out	ADF060,ADF061,ADF065,ADF066,ADF068,ADF069
G		g.	True position	ADF086,ADF086A,ADF087,ADF087A
G,I		h.	Chemical composition	ADF001
K		i.	Heat treat	ADF033
J,K	(T)	j.	Magnetic-particle	ADF046,ADF044
K		k.	Material	ADF050
G	(T)	l.	Ultimate strength	ADF052
G	(T)	m.	Yield strength	ADF052A
G	(T)	n.	Elongation	ADF052B
G	(T)	o.	Reduction of area	ADF052C
K	(T)	p.	K_{IC} (fracture toughness)	ADF052D
J,K	(T)	q.	Ultrasonic inspection	ADF092,ADF090

10. For Refurbished Ring, Bearing Assembly, Forward verify:

G		a.	Diameter dimension	ADJ068,ADJ066
G		b.	Roundness	ADJ069,ADJ067
G		c.	Height	ADF022
J,K	(T)	d.	Magnetic particle	ADF039

11. For New Nose-Throat-Bearing Assembly verify:

H,K		a.	Tightening sequence of cap screws	ADO057
H,K		b.	Torque of cap screws	ADO058
H,K		c.	Cap screws locking device and part number acceptable	ADO055
G,H,I		d.	Filtered grease dispensed from preloaded cartridges	ADO018
H,K		e.	Cap screws installed properly	ADO054
H,I,K		f.	Cap screws are free of visible and obvious contamination	ADO056
G,H,I		g.	Application of filtered grease	ADF029,ADO027,HHH060,HHH065
H,I		h.	Sealant applied to and around fastener heads	ADO050

12. For New Screw, verify:

G		a.	Lot number	AFZ062
G		b.	Length from bottom of screw head to end of screw	AFZ024
G		c.	Thread form diameter (major diameter, pitch)	AFZ041
G		d.	Certificate of Conformance accompanies each screw shipment	AFZ075
G,I,K		e.	Baking	AFZ004
K		f.	Parts are manufactured from specified material	AFZ069
I,K		g.	Parts are cadmium plated	AFZ013
K	(T)	h.	Stress durability	AFZ070
K	(T)	i.	Tensile properties	AFZ058

13. For New Bearing Assembly, Nozzle Flexible verify:

G,J		a.	No handling damage prior to installation of bearing hardware	AAI014

14. For New Insert, Helical Coil, verify:

I		a.	Material is corrosion-resistant steel	RHB001

15. For New Forging, Throat Housing, Nozzle QA verify:

I,K		a.	Chemical composition	AFN024
K		b.	Grain size	AFN065
J,K		c.	Inclusion rating	AFN090
J,K		d.	Macro structure	AFN091
J,K	(T)	e.	Ultrasonic	AFN177,AFN184