CRITICAL ITEMS LIST (CIL)

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

SYSTEM:	Space Shuttle RSRM 10	CRITICALITY CATEGORY:	1
SUBSYSTEM:	Nozzle Subsystem 10-02	PART NAME:	Throat Inlet Assembly (1)
ASSEMBLY:	Nozzle and Aft Exit Cone 10-02-01	PART NO.:	(See Section 6.0)
FMEA ITEM NO.:	10-02-01-02R Rev N	PHASE(S):	Boost (BT)
CIL REV NO.:	N	QUANTITY:	(See Section 6.0)
DATE:	17 Jun 2002	EFFECTIVITY:	(See Table 101-6)
SUPERSEDES PAGE:	308-1ff.	HAZARD REF.:	BN-04
DATED:	10 Apr 2002		
CIL ANALYST:	B. A. Frandsen		
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 Thermal failure of carbon phenolic ablative liner or glass phenolic insulator components

3.0 FAILURE EFFECTS: Burn-through of throat inlet assembly, breakup and loss of nozzle causing loss of RSRM, thrust imbalance between SRBs, causing loss of SRB, crew, and vehicle

4.0 FAILURE CAUSES (FC):

FC NO.	DESCRIPTION	FAILURE CAUSE KEY
1.1	Carbon phenolic or glass phenolic material not manufactured to required thickness	A
1.2	Bond line failure of the glass phenolic-to-metal housing bond, glass phenolic-to-carbon phenolic bond, or throat inlet ring-to-throat ring radial joint	
1.2.1	Bonding surfaces not properly prepared or adequately cleaned	B
1.2.2	Bonding material not properly mixed, applied, or cured	C
1.2.3	Contamination during processing	D
1.2.4	Process environments detrimental to bond strength	E
1.2.5	Nonconforming material properties	F
1.2.6	Bond lines not to required thickness	G
1.3	Structural failure	
1.3.1	Improper ply angle orientation in phenolic components	H
1.3.2	Nonconforming raw material properties	I
1.3.3	Nonconforming manufacturing processes	J
1.3.4	Nonconforming dimensions	K

1.3.5 Improper joint angle between phenolic components L

1.4 Improper thermal characteristics due to nonconforming raw material properties M

1.5 Component degradation during assembly, handling, transportation, or storage N

1.6 Temperature, humidity, vibration, and shock during boost phase O

1.7 Porosity, voids, delaminations, inclusions, or cracks P

5.0 REDUNDANCY SCREENS:

SCREEN A: N/A
SCREEN B: N/A
SCREEN C: N/A

6.0 ITEM DESCRIPTION:

Nozzle Throat Inlet Assembly--insulator and liner

1. The RSRM nozzle Throat Inlet Assembly is one of a series of interconnected modular nozzle components (Figure 1). The Throat Inlet Assembly is attached to the nose inlet assembly and interfaces with the forward exit cone assembly and flex bearing. Figure 2 provides a sectional view of the RSRM nozzle showing the Throat Inlet Assembly. The nozzle throat inlet housing is manufactured from D6AC steel. The throat inlet is lined with glass and carbon cloth phenolic material. Figure 3 shows the Throat Inlet Assembly housing, carbon-cloth phenolic liner, glass phenolic insulator, and bond lines. Materials are listed in Table 1.

TABLE 1. MATERIALS

Drawing No.	Name	Material	Specification	Quantity
1U77640	Segment, Rocket Motor, Aft			1/motor
1U77660	Nozzle Assembly, Final			1/motor
1U79144	Throat Inlet Assembly, Nozzle			1/motor
	Throat Inlet Assembly (Test)	Product Specification	STW3-3461	A/R
5U77685	Throat/Inlet Phenolic Rings			1/motor
		Glass-Cloth Phenolic	STW5-2651	163 lbs.
		Carbon-Cloth Phenolic	STW5-3279	637 lbs.
		Cloth Phenolic, Pre-impregnated	STW5-3621	A/R
	Resin, Phenolic Laminating	Thermosetting Phenolic	MIL-R-9299	A/R
	Adhesive, TIGA 321	Adhesive, Two-part	STW5-9203	A/R
	Shims	Two-part Epoxy	STW5-9203	A/R
	Shim Adhesive	Adhesive	STW5-9205	A/R

6.1 CHARACTERISTICS:

1. Carbon-cloth phenolic is designed to char and erode away during exposure to rocket exhaust gasses at temperatures that are over 5600°F. The glass cloth pre-impregnated with phenolic resin is used to insulate the throat inlet steel shell. A change in ply lay up angle between the glass and carbon-cloth phenolics slows down or stops through de-lamination.

2. Waiver RWW0547R1 (effectivity 360X082 through 360X091), addresses the potential for reduced performance margin of safety as a result of pocketing. Post-test evaluation of FSM-09 nozzle throat and forward exit cone regions revealed pocketing in the throat with accompanied wash erosion in the forward

exit cone. This resulted in a violation of the pocketing depth (experienced 0.38 inches vs. required 0.250 inches) and performance margin of safety requirements for the nozzle throat ring (1.9 factor of safety (FS) vs. required 2.0 FS). Due to the nature of the past pocketing events, abnormal erosion may be seen in the forward portion of the forward exit cone that may also violate the performance margin of safety (1.6 FS vs. required 1.7 FS).

FSM-09 throat pocketing is similar in appearance to the condition that occurred in 1996 during flights STS-079 (RSRM-56) RH, STS-80 (RSRM-49) LH and RH, and in 1997 on STS-86 (RSRM-57) RH. All instances, including the most recent static test of FSM-09, determined that flight and static test safety was assured for a worst case bounding condition for Carbon Cloth Phenolic (CCP) performance. Even for the bounding case, some virgin CCP (not heat affected) liner thickness will remain at the end of burn. FSM-09 pocket depths are enveloped within pocket depths experience in the previous flight-pocketing occurrences, and therefore the statistical prediction made for the flight motor occurrences encompass FSM-09.

To resolve the condition of manufactured ply distortion creating local ply angles approaching ninety degrees to the flow surface, new mandrel configuration, Spacer Augmented Mandrel (SAM) was implemented at STS-106 (RSRM-75) and was used for FSM-9. This corrective action resulted in machining away ply distortions created near the flow surface as demonstrated by sectioning of five throat billets manufactured with SAM. Using this manufacturing approach, nozzle throat performance was as expected for FSM-07, FSM-08 and flight sets RSRM-75 through RSRM-81 (total of 16 nozzles). Investigation as the result of FSM-09 pocketing has yielded no evidence of ply distortion in final-machined billets, but does show evidence a “steepening” by about 5 degrees of the ply angle in SAM manufactured components.

The contribution of low fiber strength material to pocketing was not fully understood nor the exact mechanism for the resulting low fiber strengths. Extensive investigation accomplished as part of the original flight investigation and subsequent testing funded under Enhanced Sustaining Engineering Task V included Design of Experiments testing that concluded that the condition that produces materials susceptible to pocketing occurs during the carbonization process at a subtier vendor. Testing also verified the thermal analyses, which concluded that the pocketing events initiate early in motor operation. Testing also verified that the pocketing phenomenon is self-limiting for motor heat fluxes in the aft throat region.

Recent Laser Hardening Material Evaluation Laboratory (LHMEL) testing of low threshold pocketing material yielded new maximum pocketing depths for a 700 W/cm^2 heat flux. This data verified that the self-limiting behavior of the material at this heat flux (determined to be the motor flux at the forward most pocketing location). A statistical analysis determined the k-sigma pocket depth to be 1.02 inches. A bounding thermal analysis was conducted using the k-sigma pocket depth situated over the joint 4 region of the throat. Results of the analysis showed the worst case to be in the aft region of the throat ring (joint 4) and found RSRM motors have substantial remaining burn time even with the worst case ply angle and highest propensity to pocket materials.

Corrective action to help resolve this condition is being evaluated on static test motors ETM-2, FSM-10 and ETM-3.

Since certain combinations of material characteristics and manufacturing processes, the CCP forming the nozzle throat component can exhibit pocketing greater than the allowed 0.250 inches. Negative performance margins of safety on the throat and forward exit cone (FEC), including over the shear pins, CCP ablative flame front liners may be associated with this pocketing. RWW0547R1 addresses this possibility and is therefore documented in this flight hazard report. The R1 to RWW0547 is necessary for the following two reasons:

1. To change the bounding case assessment, which was previously based on a group of test results that included data from high and low threshold materials, to a grouping of data that includes low threshold materials only. The bounding case assessment has changed from 0.65 to 1.02 inches for a maximum k-sigma pocketing depth.

2. To change the rate of erosion value for pocketing regions, which are used to calculate the remaining burn time beyond normal motor operation (i.e. 123 seconds). The previous erosion rate was based on the worst-case non-pocketing erosion divided by motor operation time in seconds. The value used was 5 mils/second. The latest burn time estimate was computed using the erosion rate at the bottom of the pocket, which is less than the maximum historical erosion rate. This is due to reductions in the convective heating environment in the pocket bottom. The predicted erosion rate used was revised to 3 mils/sec, which is also the nominal erosion rate of 3 mils/sec (0.41 inch nominal erosion for 123 seconds) for the current family of CCP, and NARC HRPF, which is CCP from North American Rayon Corporation (NARC) woven at Highland Industries on a Rapier loom, carbonized at Polycarbon, and impregnated at Cytec Fiberite (HRPF).

Recognizing that throat pocketing on flight nozzles is a possibility, the following flight rationale summarizes investigation findings that support the acceptability of the risk associated with the current nozzle throat and forward exit cone phenolics:

Flight rationale:

- No out-of-family process conditions noted that would adversely impact expected CCP material performance in RSRM-82 (STS-108)
- Normal operational variation of the carbonization furnace can produce low-pocketing threshold CCP
- Low-threshold CCP with the same process pedigree as test specimens that pocketed outside of expectations has flown and pocketed [RSRM-56 (STS-79)] with adequate burn time remaining for safe flight
- If pocketing occurs, erosion and char performance of the nozzle is not expected to differ significantly from past flight and static test population
- The pocketing process is self-limiting and remaining burn time beyond 123 seconds with k-sigma bounding case pocket depth is substantial

Pocketing Table

Event	Remaining* CP Thickness (in)	Remaining** Burn Time (sec)	Safety Factor For Erosion
Nominal Erosion Performance	1.71	210	2.0 +
STS-80 LH/RH Pocketing	1.46	161	1.9
STS-79 RH Pocketing	1.34	159	1.8
FSM-9 Pocketing	1.32	175	1.9
Analysis for 0.2 Inch Deep Pocket Event	1.22	155	1.8
Analysis for Bounding Case Event (.65 inch)	1.11	105	1.4
STS-42 RH Worst Case Non-Pocketing	1.52	173	2.0 +

* Char plus Virgin CCP at station 23
** Char to carbon/glass interface
A minimum safety factor of 1.6 times erosion shall be maintained in throat and forward exit cone.

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

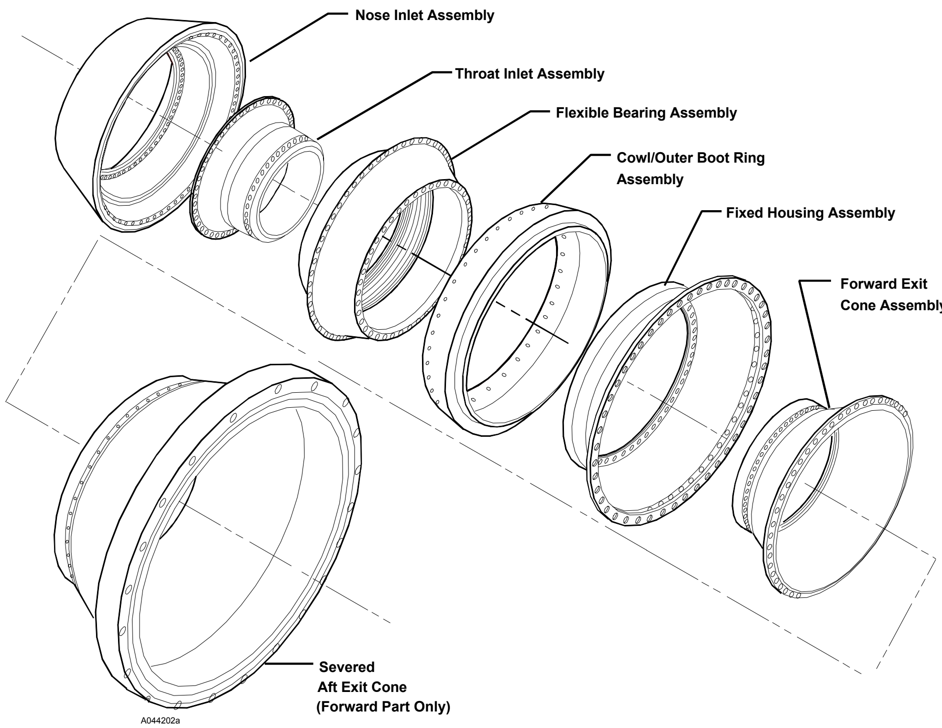

Figure 1. RSRM Nozzle Assembly Components

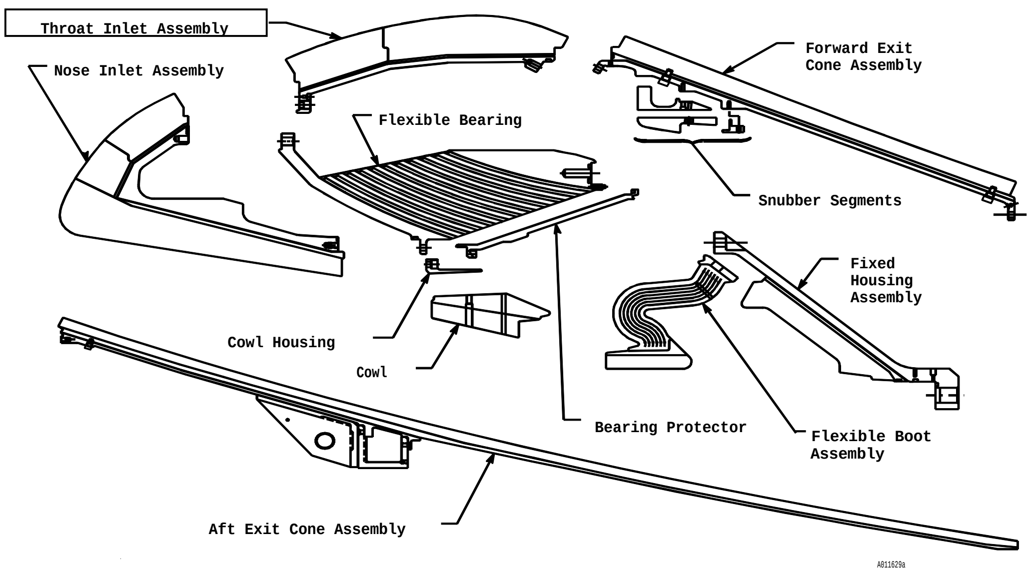

Figure 2. Exploded Section of Nozzle

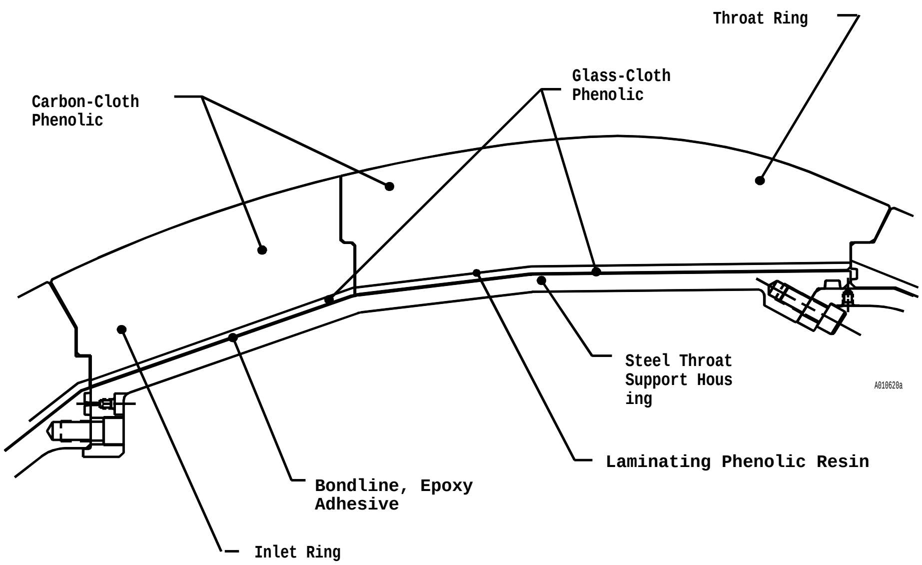

Figure 3. Throat Inlet Assembly

9.0 RATIONALE FOR RETENTION:

9.1 DESIGN:

DCN FAILURE CAUSES		
A,K	1.	The Throat Inlet Assembly design is per engineering drawings.
A,K	2.	During Throat Inlet Assembly manufacturing, control is per calibrated machinery. Mandrels control the ID profile and templates control the OD profile. After the phenolics are built up to a specified thickness and cured, they are machined to specified dimensions.
K,N	3.	Pre-assembly mismatch causing bond line stresses was shown by analysis to be within allowable limits per TWR-16975.
I,J,K,L,M,O,P	4.	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 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.
B,C,D,J	5.	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. Con scan also verifies surface condition of the bonding surfaces prior to bonding. The type of inspection required for each surface is per shop planning. Preparation, cleaning, and inspection methods for aft exit cone bond lines are per process critical planning.
B,D	6.	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, the manufacturing engineer must be notified.
C	7.	A two-part epoxy adhesive is mixed, applied, and cured per shop planning and engineering drawings.
C	8.	Laminating phenolic resin is applied to the carbon phenolic surface and the composite structure is autoclave cured per shop planning and engineering drawings.
C	9.	The material description of the adhesive relative to the shims used in the bonding process is per engineering.
D,E	10.	Contamination control requirements and procedures are per TWR-16564.
D,E	11.	The nozzle manufacturing building is a controlled environment facility with temperature and humidity controls. There is controlled access to the facility through a separate room with a card reader.
F	12.	Material properties for epoxy adhesive are per engineering.

F	13.	Material properties for laminating phenolic resin are per government specifications for Resin, Phenolic Laminating.
G	14.	Bond line thickness between the throat support housing and glass phenolic assembly is per engineering drawings.
G	15.	Bond line thickness processing between the carbon-cloth phenolic and glass-cloth phenolic is per shop planning.
G	16.	Dry-fit to develop bond line shim size is done with Coe-flex per shop planning.
G	17.	The insulation-to-liner bond line is a thin uniform layer of resin per engineering drawings.
G	18.	Throat Inlet Assembly phenolic component bond gaps are per engineering drawings.
G	19.	Preparation methods for bond line thickness are per shop planning. The type of inspection required for each surface as well as the bonding process is per process critical planning.
H	20.	Bias-cut carbon phenolic tape is wrapped on mandrels to required ply angles per engineering drawings.
H	21.	Glass-cloth phenolic is tape wrapped to the required ply angle per engineering drawings.
I,M	22.	Material properties are controlled per Thiokol or Government specifications for the following materials: a. Carbon-cloth phenolic b. Glass-cloth phenolic c. Resin, Phenolic Laminating d. Adhesive Epoxy
I,M	23.	Intermixing of equivalent materials from different suppliers within glass phenolic or carbon phenolic components is not permitted per engineering drawings.
J,P	24.	Throat Inlet Assembly manufacturing processes are per engineering drawings and shop planning.
J,P	25.	Throat Inlet Assembly manufacturing processes were demonstrated and qualified on development and qualification motors per TWR-18764-09.
L	26.	Carbon phenolic components of the Throat Inlet Assembly are fabricated per engineering drawings.
L	27.	Joint gaps are controlled by dry-fitting phenolic components to the housing. By means of shop handling equipment, a bonding fixture, impression compounds, and shims, proper bond gaps are determined. Size, number, and location of shims are per shop planning.
N,O	28.	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.

N	29.	Handling and lifting requirements for RSRM components are similar to those for previous and current programs conducted by Thiokol per TWR-13880.
N	30.	Transportation and handling of nozzle throat assembly items by Thiokol is per IHM-29.
N	31.	The throat assembly is covered with a protective cover and stored in a temperature-controlled building until used as a part of a larger assembly.
N	32.	The RSRM and its component parts, when protected per TWR-10299 and TWR-11325, are capable of being handled and transported by rail or other suitable means to and from fabrication, test, operational launch, recovery or retrieval, and refurbishment sites.
N	33.	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.
N	34.	Support equipment used to test, handle, transport, and assemble or disassemble the RSRM is certified and verified per TWR-15723.
N	35.	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.
N	36.	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.
N	37.	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 environment during in-plant transportation or storage is per engineering.
O	38.	Analysis of nozzle natural frequency and vibration response throughout motor burn is per TWR-16975.
O	39.	Environmental conditions similar to those occurring during the boost phase were demonstrated on static firings per TWR-18764-09.
P	40.	Surface and subsurface defect criteria rationale are per TWR-16340.
B	41.	A Spray-in-Air cleaning system is used to clean metal components as part of the bonding surface preparation processing sequence.

E,N,O

42. 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.

E,N,O

43. 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 Throat/Inlet Phenolic Rings verify:	
	J,P		a.	Alcohol wipe is acceptable	AHK000,AHK001
	B,J		b.	Clean phenolic surface prior to resin application	AHK006,AHK009
	A,K		c.	VBM re-calibration date	AHK019
	C,I,J,M		d.	Single source for resin	AHK026,AHK028
	C,E,J		e.	Autoclave cure of glass phenolic parts	AHK031,AHK033
	A,J,K		f.	Carbon outside diameter	AAW034,AAW035
	C,E,J		g.	Hydroclave cure of carbon phenolic parts	AHK035,AHK037
	A,H,J,K		h.	Proper mandrel for first and second wrap	AHK040,AHK041
	C,D,G,J		i.	Resin application	AHK046,AHK048
	I,J,M		j.	Single supplier lot for carbon cloth	AHK056,AHK057
	A,J,K		k.	Glass outside diameter	AAW059,AAW060
	I,J,M		l.	Shelf life and environmental history of phenolic material (carbon and glass)	AHK066,AHK067 AHK068,AHK069
	G,J		m.	Tape wrap of phenolic rings (carbon and glass)	AHK074,AHK075 AHK077,AHK078
	J		n.	Material is carbon-cloth phenolic	AHK079,AHK080
	D,J,P	(T)	o.	Radiographic examination is acceptable	AAW080,AAW083
	J		p.	Material is glass-cloth phenolic	AHK081,AHK082
	J		q.	Surface finish of all finished surfaces	AHK085B,AHK086B
	J		r.	Current recycle on mandrel	AAW086,AAW087
	B,J		s.	Clean mandrel prior to first wrap	AAW107,AAW108
	F,H,I,J,M	(T)	t.	Phenolic performance test results (plasma torch or LHMEL) are acceptable	BAF100
			2.	For New Throat Inlet Assembly, Nozzle verify:	
	B,C,D,J		a.	CONSCAN of steel housing bonding surfaces prior to bonding	ABA001
	B,C,D,J		b.	Primer application begins within specified time limit after CONSCAN	ABA002
	C		c.	Adhesive (Two-part Epoxy) is mixed per planning requirements	AOE003
	C,D		d.	Adhesive application per planning requirements	AAW004,AAW015
	J		e.	Alcohol wipe phenolic surfaces after final machining	AAW010
	G,J,L		f.	Bond gap at dry-fit	AAW020,AAW022,AAW050
	B,D,J		g.	Throat housing bonding surfaces after grit blast	AHK021,AHK021A
	J		h.	Bonding of throat inlet phenolics	AAW023,AAW025
	J,L		i.	No unacceptable defects and surface finish of phenolic sealing surfaces of aft end - throat inlet	SAA025
	J		j.	Bonding preparation for throat inlet phenolics	AAW026,AAW028
	J		k.	Aft end of Throat Inlet Assembly bond line is flush with adjacent surfaces	SAA026
	J,L		l.	No unacceptable defects or sharp edges of adhesive bond line, aft end - throat inlet	SAA027
	G,J		m.	Location and size of shims are the same as dry-fit	AAW030,AAW031,AAW069
	C		n.	Proper cure of silane primer	SAA032
	A,J,K		o.	Carbon inside diameter of the Throat Inlet Assembly (throat ring and throat inlet ring) is within tolerance	AAW033
	B,C		p.	Silane primer application on bond surfaces with minimum overlap	SAA033
	N		q.	Component temperatures and exposure to ambient environments during in-plant transportation or storage	BAA034

B,D		r.	Bonding surfaces are free of unacceptable surface contamination (black light)	AAW036
B,C,D,E,F, I,J,M	(T)	s.	Witness panel results for adhesive integrity	SAA039
C,E,J		t.	Adhesive cure per planning requirements	AAW048,AAW048B
J,L		u.	Profile of Throat Inlet Assembly is within tolerance	AAW055,AAW074B
I,M		v.	Shelf life of epoxy adhesive	AOE058
C		w.	Throat phenolic are seated within adhesive pot life	AAW097,AAW097B
I.J.M	(T)	x.	Witness panel tests for radial bond lines	AOE063

585 3. For New Approved Solvent, verify:

B,D		a.	Certificate of Conformance is complete and acceptable	AJJ007A

4. For New Adhesive, Epoxy verify:

F,I	(T)	a.	Fracture toughness (adhesive)	AOE015
F,I,M	(T)	b.	Average molecular weight (epoxy paste)	AOE020
F,I,M	(T)	c.	Ingredient percentages	AOE023,AOE028
F,I	(T)	d.	Pot life (adhesive)	AOE043,AOE046
F,I,M	(T)	e.	Epoxide equivalent (epoxy paste)	SAA044,SAA046
F,I,M	(T)	f.	Amine as nitrogen (curing agent)	SAA045,AOE096
F,I	(T)	g.	Tensile adhesion strength	AOE062
F,I	(T)	h.	Epoxy paste viscosity	AOE083,AOE086
F,I		i.	Visual examination (workmanship)	AOE099

5. For New Resin, Phenolic Laminating verify:

F,I,M	(T)	a.	Specific gravity	AJG006
F,I		b.	Data pack is complete and acceptable	AJG022
F,I	(T)	c.	Viscosity	AJG037

6. For New Carbon-Cloth Phenolic verify:

I,M	(T)	a.	Carbon filler content	AOF000
I,M	(T)	b.	Cloth content	AOD017
I	(T)	c.	Compressive strength	AOD027
I,M	(T)	d.	Density	AOD058
I,M	(T)	e.	Dry resin solids	AOD067
I	(T)	f.	Inter-laminar shear	AOD075
I,M	(T)	g.	Resin content	AOD112
I,M	(T)	h.	Resin flow--uncured	AOD140
I,M	(T)	i.	Sodium content	AOD164
I,M		j.	Supplier data pack is acceptable and complete	AOD206
I,M	(T)	k.	Volatile content--uncured	AOD222

7. For Retest Carbon-Cloth Phenolic verify:

I,M	(T)	a.	Resin flow	AOD131
I,M	(T)	b.	Volatile content	AOD236

			8.	For New Glass-Cloth Phenolic verify:		
	I,M	(T)		a.	Cloth content	AMN007
	I	(T)		b.	Compressive strength	AMN014
	I,M	(T)		c.	Density	AMN038
	I,M	(T)		d.	Dry resin solids	AMN048
	I	(T)		e.	Inter-laminar shear strength	AMN057
	I,M	(T)		f.	Resin content	AMN088
	I,M	(T)		g.	Resin flow	AMN121
	I,M	(T)		h.	Volatile content	AMN195
	I,M			i.	Supplier data pack is complete and acceptable	AMN172
			9.	For Retest Glass-Cloth Phenolic verify:		
	I,M	(T)		a.	Resin flow	AMN103
	I,M	(T)		b.	Volatile content	AMN178
			10.	For Retest Phenolic Slit Tape verify:		
	I,M	(T)		a.	Resin flow	AMN103A,AOD131A
	I,M	(T)		b.	Volatile content	AMN178A,AOD236A
			11.	For New Throat Inlet Assembly (Test) verify:		
	J	(T)		a.	Compressive strength (glass and carbon)	AAW044,AAW046
	J	(T)		b.	Residual volatiles (glass and carbon)	AAW090,AAW089
	J	(T)		c.	Resin content (glass and carbon)	AAW095,AAW093
	J	(T)		d.	Specific gravity (glass and carbon)	AAW104,AAW102
			12.	For New Segment Assembly, Rocket Motor, verify:		
585	N			a.	Approved solvent wipe	AGJ029
	N			b.	Component environments during in-plant transportation or storage	BAA030
	N			c.	Nozzle assembly for handling damage and protective cover is cleaned and in place	AGJ167
			13.	For New Nozzle Assembly, Final verify:		
	N			a.	Alcohol wipe test of nozzle insulation prior to shipment to nozzle installation operation	ADI014
	N			b.	Component temperatures and exposure to ambient environments during in-plant transportation or storage	BAA028
			14.	For Nozzle Assembly, Structural Bond line Requirements For verify:		
	B,C,D,E, F,I,J,M	(T)		a.	Phenolic-to-adhesive interface checks meet specification requirements	PPC001
			15.	KSC verifies:		
	N			a.	Nozzle rigid phenolic components for no visible damage per OMRSD File V, Vol I, B47SG0.141	OMD086