Thiokol CORPORATION
SPACE OPERATIONS

Final Postflight Hardware Evaluation Report
RSRM-32 (STS-57)

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Concurrence by:

Case Design

Joints & Seals Design

Integration Design

Nozzle Design

Igniter / Instrumentation / Electrical Design

Thermal Insulation Design

Quality, Performance Evaluation

Systems Assurance

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List of Acronyms

Acronym	Definition
CCP	Carbon Cloth Phenolic
CEI	Contract End Item
DR	Discrepancy Report
ECP	Engineering Change Proposal
ET	External Tank
GCP	Glass Cloth Phenolic
ID	Inside Diameter
IFA	In-Flight Anomaly
KSC	Kennedy Space Center
LDI	Low Density Indication
LH	Left Hand
NASA	National Aeronautics and Space Administration
OBR	Outer Boot Ring
OD	Outside Diameter
PEEP	Postflight Engineering Evaluation Plan
PFAR	Postfire Anomaly Record
PFOR	Postfire Observation Record
PR	Problem Report
RH	Right Hand
RSRM	Redesigned Solid Rocket Motor
RTV	Room Temperature Vulcanized (Rubber)
S&A	Safe and Arm Device
SCP	Silica Cloth Phenolic
SII	SRM Ignition Initiator
SPR	Significant Problem Report
STS	Space Transportation System
TWR	Thiokol Wasatch Report

1.0 INTRODUCTION

This document is the final report for the postflight assessment of the RSRM-32 (STS-57) flight set. This report presents the disassembly evaluations performed at the Thiokol facilities in Utah and is a continuation of the evaluations performed at KSC (TWR-64239).

The PEEP for this assessment is outlined in TWR-50051, Revision B. The PEEP defines the requirements for evaluating RSRM hardware. Special hardware issues pertaining to this flight set requiring additional or modified assessment are outlined in TWR-64237.

All observed hardware conditions were documented on PFORs which are included in Appendix A. Observations were compared against limits defined in the PEEP. Any observation that was categorized as Reportable or had no defined limits was documented on a Preliminary PFAR by the assessment engineers. Preliminary PFARs were reviewed by the Thiokol SPAT Executive Board to determine if elevation to PFARs was required.

2.0 REFERENCES

CPW1-3600A Prime Equipment Contract End Item Detail Specification, Part I of Two Parts; Performance, Design, and Verification Requirements, Space Shuttle Redesigned Solid Rocket Motor CPW1-3600A For Space Shuttle Solid Rocket Motor Project, Operational Flight Motors (RSRM-4 and subsequent)

TWA-1993 KSC and Clearfield Photo Log, RSRM-32 (STS-57)

TWR-50050 KSC Postflight Engineering Evaluation Plan

TWR-50051 Clearfield Postflight Engineering Evaluation Plan

TWR-64237 Postflight Hardware Special Issues, RSRM-32 (STS-57), Clearfield

TWR-64239 KSC Ten-Day Postflight Hardware Evaluation Report, RSRM-32 (STS-57)

3.0 EVALUATION SUMMARY

The engineering evaluation of the RSRM hardware showed that, in general, it performed as expected.

Table I provides a numerical summary of all postflight-related Squawks/Preliminary PFARs, PFARs, IFAs, and SPRs for RSRM-32.

Table I. RSRM-32 Summary

	Squawks/Prelim. PFARs	PFARs	IFAs	SPRs
KSC	4	3	0	0
Clearfield	2	2	0	0
Total	**6**	**5**	**0**	**0**

Table II lists all RSRM-32 problems including Squawks and Preliminary PFARs that were not elevated to PFARs.

3.1 CEI Specification Compliance

Based on hardware evaluations, as defined in the KSC and Clearfield PEEPs, all CEI (CPW1-3600A) motor performance requirements were met.

4.0 HARDWARE ASSESSMENT RESULTS

This section outlines the significant observations from the postflight hardware evaluation at Thiokol's Utah facilities. The internal nozzle joints were disassembled on July 7-9, 1993 at the Clearfield H-6 facility. The S&As were disassembled on July 9, 1993 at Final Assembly's M-66A facility. The final factory joint demate occurred on October 25, 1993.

All observations were recorded on PFORs which provide a detailed checklist for hardware conditions. The completed PFORs can be found in Appendix A. Appendices B and C contain the measurements and safety factor data for the nozzle and insulation components, respectively.

Table II. Problem Summary for RSRM-32

PFAR/SQUAWK/ PRELIM. PFAR NUMBER	TYPE	ELEVATED FROM	SPR NUMBER	IFA NUMBER	EVALUATION LOCATION	COMPONENT	SPAT/ RPRB DATE	DESCRIPTION
57-010	SQUAWK	360T032B-01	N/A	N/A	KSC	JPS/TPS	06/30/93	FOREIGN MATERIAL ON IGNITER HEATER POWER CABLE CONNECTOR
57-011	SQUAWK	360T032A-02	N/A	N/A	KSC	CASE	06/30/93	MEDIUM CORROSION ON AFT DOME TANG SKIRT STUB
57-013	SQUAWK	N/A	N/A	N/A	KSC	NOZZLE	07/01/93	SCRATCHES ON FIXED HOUSING RADIAL BOLT HOLE SPOTFACE SEALING SURFACE
57-017	SQUAWK	360T032B-03	N/A	N/A	KSC	PORTS/PLUGS	07/07/93	SCRATCH & RAISED METAL ON SEALING SURFACE OF FWD FIELD JOINT ADJUSTABLE VENT PORT PLUG (TOP PLUG)
57C-01	PRELIM.	360T032A-04	N/A	N/A	H-5/H-7	NOZZLE	07/15/93	GAS PATHS THROUGH RTV IN JOINT 2
57C-02	PRELIM.	360T032B-05	N/A	N/A	H-5/H-7	NOZZLE	07/09/93	AEC PLY LIFTING IN THE CCP
57C-03	PRELIM.	N/A	N/A	N/A	H-5/H-7	CASE	10/01/93	CORROSION/PITTING ON FORWARD DOME FACTORY JOINT TANG SEAL SURFACE
360T032B-01	PFAR	57-010	N/A	N/A	KSC	JPS/TPS	07/02/93	FOREIGN MATERIAL IN IGNITER HEATER POWER CABLE CONNECTOR
360T032A-02	PFAR	57-011	N/A	N/A	KSC	CASE	07/02/93	CORROSION/PITTING ON AFT DOME SKIRT TANG (UNPAINTED REGION)
360T032B-03	PFAR	57-017	N/A	N/A	KSC	PORTS/PLUGS	07/08/93	SCRATCH & RAISED METAL ON SEALING SURFACE OF FORWARD FIELD JOINT ADJUSTABLE VENT PORT TOP PLUG
360T032A-04	PFAR	57C-01	N/A	N/A	H-5/H-7	NOZZLE	07/15/93	GAS PATHS THROUGH RTV IN JOINT 2
360T032B-05	PFAR	57C-02	N/A	N/A	OTHER	NOZZLE	07/15/93	AFT EXIT CONE PLY LIFTING IN CCP

4.1 S&A Devices

(Reference PFORs A-1-to-A-2, A-65-to-A-66)

Both S&A devices were in good condition with no O-ring or seal surface damage observed. There was typical soot on the SII tips at both degree locations (18 and 198) for both S&As. There was typical sooting to the primary O-ring (No. 1) on both rotor shafts. There was additional sooting to the rotor and bore surfaces on the left side. There was also typical erosion and heat affect on the LH BB-to-basket and basket shower cap environmental O-rings.

4.2 Nozzle

(Reference PFORs A-7, A-71)

4.2.1 Nozzle Metal Components - Excluding Joints

All nozzle metal components were in good condition.

4.2.2 Nozzle Internal Joints

4.2.2.1 Nose Inlet-to-Flexible Bearing-to-Cowl (Joint 2)
(Reference PFORs A-8-to-A-12, A-72-to-A-76)

This is the first flight with back filled RTV in Joint 2.
LH

One anomalous condition was observed. Typical scalloped shaped soot was observed to the bolt hole circle intermittently full circumference. Soot reached the primary O-ring at two locations, 108-150 degrees and 306-330 degrees. Both locations corresponded to gas paths through the RTV. Preliminary PFAR 57C-01 was written on this condition. Soot did not go past the O-ring footprint. No O-ring or seal damage was observed. Traces of water were observed in the joint following demate.

The RTV backfill was below the char line over the full circumference to the nose inlet housing aft face. RTV did not reach the primary O-ring. Gas penetration into the joint was observed at 132.5 and 318 degrees. Heat affected paint, CCP and GCP/SCP was observed in the joint. Eroded GCP and adhesive was present at the gas path locations.

Typical corrosion was observed in the joint.

RH

The RTV backfill was below the char line over the full circumference to the nose inlet housing aft face. RTV did not reach the primary O-ring. No gas penetration into the joint was observed.

No O-ring or seal surface damage was observed.

Typical light-to-medium corrosion was observed intermittently full circumference upstream of primary O-ring between bolt holes.

No separations were observed on the cowl assembly or the nose inlet assembly.

4.2.2.2 Nose Inlet-to-Throat (Joint 3)
(Reference PFORs A-13-to-A-17, A-77-to-A-81)

LH

The RTV backfill was below the char line over the full circumference. RTV did not reach the primary O-ring. No gas penetration into the joint was observed.

No O-ring or seal surface damage was observed.

Typical light corrosion was observed inboard of the primary O-ring intermittently full circumference.

Typical postburn bondline edge separations were observed on the forward end of the throat assembly. No separations were noted on the nose inlet assembly.

RH

The RTV backfill was below the char line over the full circumference. RTV did not reach the primary O-ring. No gas penetration into the joint was observed.

No O-ring or seal surface damage was observed.

Typical light corrosion was observed inboard of the primary O-ring intermittently full circumference.

Typical postburn bondline edge separations were observed on the forward end of the throat assembly. No separations were noted on the nose inlet assembly.

4.2.2.3 Throat-to-Forward Exit Cone (Joint 4)
(Reference PFORs A-18-to-A-22, A-82-to-A-85)

LH

The RTV backfill was below the char line over the full circumference. RTV reached the primary O-ring intermittently around the circumference. No gas penetration into the joint was observed.

Light corrosion was observed on the forward exit cone housing secondary seal surface at 0-to-6 and 354 degrees. Medium-to-heavy corrosion observed on throat housing primary seal surface full circumference. This corrosion is splashdown related and is a nominal condition. No O-ring damage was observed.

Typical postburn bondline edge separations were observed on the throat assembly aft end and the forward exit cone forward end.

RH

The RTV backfill was below the char line over the full circumference. RTV reached the primary O-ring intermittently around the circumference. No gas penetration into the joint was observed.

No O-ring or seal surface damage was observed.

Typical postburn bondline edge separations were observed on the throat assembly aft end and the forward exit cone forward end.

No seal or joint anomalies were noted.

4.2.2.4 Aft End Ring-to-Fixed Housing (Joint 5)
(Reference PFORs A-23-to-A-28, A-86-to-A-91)

LH

The RTV coverage was nominal. The RTV extended forward to the aft end ring/bearing protector interface intermittently around the circumference. The RTV reached the primary O-ring at 290 degrees. Intermittent voids due to the assembly process were noted in the RTV. No gas penetration into the joint was observed.

Light corrosion was observed on the fixed housing sealing surfaces at 110 degrees. Missing paint and corrosion was observed on the aft end ring flange lip at 260 through 265 degrees. Seventy-one of the seventy-two Packings-with-Retainers had typical disassembly damage to the elastomer. No seal surface damage was observed. No O-ring damage was observed.

Typical postburn separations were observed.

RH

The RTV coverage was nominal. The RTV extended forward to the aft end ring/bearing protector interface intermittently around the circumference. The RTV reached the primary O-ring from 0-to-70 and 185-to-255 degrees. Intermittent voids due to the assembly process were noted in the RTV. No gas penetration into the joint was observed.

No anomalous conditions were observed. Medium-to-heavy corrosion observed on the aft end ring flange lip full circumference. All seventy-two Packings-with-Retainers had typical disassembly damage to the elastomer. No seal surface damage was observed. No O-ring damage was observed.

Typical postburn separations were observed.

4.2.3 Cowl Insulation Segments
(Reference PFORs A-29, A-92)

The LH and RH cowl insulation segments were in nominal condition and showed typical failure modes at removal.

4.2.4 Flexible Bearing Protector, Flexible Bearing, and Flexible Boot
(Reference PFORs A-30-to-A-31, A-93-to-A-94)

4.2.4.1 Flexible Bearing Protector

Both flexible bearing protectors were in nominal condition. No burn-through or abnormal heat effects were observed.

4.2.4.2 Flexible Bearing

Both flexible bearings were in good condition. No heat effects were observed.

4.2.4.3 Flexible Boot

The performance of the flexible boots was nominal. The flexible boot remaining plies and margins of safety are summarized in Table III.

Table III. Flexible Boot Performance Margins of Safety

	Left Hand			Right Hand		
Degree Location	Remaining Plies	Maximum Affected Depth (in.)	Margin of Safety	Remaining Plies	Maximum Affected Depth (in.)*	Margin of Safety
0	3.7	1.17	0.42	3.1	1.37	0.21
90	3.2	1.34	0.24	3.2	1.34	0.24
180	3.5	1.24	0.34	3.4	1.27	0.31
270	3.1	1.37	0.21	3.1	1.37	0.21

4.2.5 Nozzle Throat Diameter Measurement
(Reference PFORs A-32, A-95)

The average LH nozzle postfire throat diameter was 55.867 inches (erosion rate of 8.23 mils/sec based on an action time of 122.0 sec). The average RH nozzle postfire throat diameter was 55.925 inches (erosion rate of 8.47 mils/sec based on an action time of 121.9 sec). RSRM postfire throat diameters have ranged from 55.787 to 56.072 inches.

4.2.6 Nozzle Phenolic Bondlines

(Reference PFORs A–33-to-A–39, A–96-to-A–102)

All bondlines were in good condition. Primary, secondary and total bondline failure modes are recorded in Table IV. Typical adhesive voids were observed in all bondlines.

Table IV. Nozzle Phenolic Bondline Failure Mode* Summary

	Metal–to–Adhesive			Within Adhesive			Adhesive–to–GCP/SCP			Within GCP/SCP			GCP/SCP–to–CCP			Within CCP		
	P	S	T	P	S	T	P	S	T	P	S	T	P	S	T	P	S	T
Aft Exit Cone, LH	13	—	13	—	—	—	—	—	—	87	—	87	—	—	—	—	—	—
Aft Exit Cone, RH	1	—	1	—	—	—	—	—	—	99	—	99	—	—	—	—	—	—
Fwd Exit Cone, LH	61	—	61	—	—	—	39	—	39	—	—	—	—	—	—	—	—	—
Fwd Exit Cone, RH	33	—	33	—	—	—	67	—	67	—	—	—	—	—	—	—	—	—
Throat Assembly, LH	100	—	100	—	—	—	—	—	—	-	—	—	—	—	—	—	—	—
Throat Assembly, RH	99.6	—	99.6	—	—	—	0.4	—	0.4	—	—	—	—	—	—	—	—	—
Nose Inlet Rings, LH	90	—	90	—	—	—	10	—	10	—	—	—	—	—	—	—	—	—
Nose Inlet Rings, RH	96	—	96	—	—	—	4	—	4	—	—	—	—	—	—	—	—	—
Nose Cap, LH	—	36	36	—	—	—	—	64	64	—	—	—	100	—	—	—	—	—
Nose Cap, RH	—	39	39	—	—	—	—	61	61	—	—	—	100	—	—	—	—	—
Cowl, LH	4	—	4	—	—	—	95.4	—	95.4	0.6	—	—	—	—	—	—	—	—
Cowl, RH	14	—	14	—	—	—	85.5	—	85.5	0.5	—	—	—	—	—	—	—	—
Fixed Housing, LH	—	0.25	0.25	—	—	—	—	99.75	99.75	100	—	—	—	—	—	—	—	—
Fixed Housing, RH	—	1	1	—	—	—	—	99	99	100	—	—	—	—	—	—	—	—

P = Primary
S = Secondary
T = Total

* All failure modes are expressed as percentages of the total bondline.

4.2.6.1 Ultrasonic Inspection of Fixed Housing Assemblies

Ultrasonic inspection did not detected any large unbonds on either LH or RH assemblies. Several very small indications were detected. The smaller ultrasonic indications could not be verified during bondline assessment.

4.2.7 Nozzle Phenolic Sections

(Reference PFORs A–40-to-A–47, A–103-to-A–110)

Char and erosion margins of safety are summarized in Table V. Measurement stations that contain an "N/A" means that data was not available due to missing material. The LH aft exit cone liner was not recovered and therefore is not included. A small portion of the RH aft exit cone was recovered and measurement were taken. All stations showed positive margins of safety. The char and erosion data tables for each component liner can be found in Appendix B. The RH aft exit cone had evidence of ply lifting in the CCP. Preliminary PFAR 57C–02 was written on this condition.

4.3 Leak Check Port Plugs, SIIs, and Ports

(Reference PFORs A–3-to-A–6, A–48-to-A–57; A–67-to-A–70, A–111-to-A–116)

A hair–like fiber was found on the leak check plug shoulder seal (right side (B), 126 degrees). This fiber was photographed and removed for analysis. It was later determined by those present that this fiber was a result of disassembly

No anomalous conditions were observed on any of the internal nozzle joint leak check ports, plugs, or O–rings.

4.4 Case Factory Joints

(Reference PFORs A–58-to-A–64, A–121-to-A–127)

A combination of chemlock and corrosion was present on the sealing surface of the RH forward dome factory joint at 119, 186 and 297 degrees. Upon removal of the corrosion with scotchbrite, pitting was present from one to seven mils in depth. Preliminary PFAR 57C–03 was written on this condition.

All other factory joints were in good condition with no O–ring heat effect or erosion observed.

Table V. Nozzle Char and Erosion Minimum Margins of Safety Summary

Hardware	Stations*												
Forward Exit Cone, LH	**1**	**4**	**4.6**	**8**	**12**	**16**	**20**	**24**	**28**	**32**	**32.9**	**34**	
	0.30	0.26	0.22	0.22	0.12	N/A	N/A	N/A	0.07	0.20	0.27	0.33	
Forward Exit Cone, RH	**1**	**4**	**4.6**	**8**	**12**	**16**	**20**	**24**	**28**	**32**	**32.9**	**34**	
	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Throat Assembly, LH	**1**	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**	**20**	**22**	**23**
	0.15	0.13	0.11	0.08	0.04	0.18	0.23	0.27	0.31	0.33	0.39	0.39	0.21
Throat Assembly, RH	**1**	**2**	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**	**20**	**22**	**23**
	0.13	0.11	0.11	0.07	0.04	0.11	0.20	0.24	0.28	0.37	0.42	0.38	0.22
Nose Inlet Rings, LH	**28**	**30**	**32**	**34**	**36**	**38**	**39**						
	0.15	0.32	0.12	0.36	0.31	0.15	0.12						
Nose Inlet Rings, RH	**28**	**30**	**32**	**34**	**36**	**38**	**39**						
	0.15	0.28	0.17	0.35	0.33	0.21	0.15						
Nose Cap, LH	**1.5**	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**	**20**	**22**	**24**	**26**
	0.64	0.59	0.67	0.65	0.68	0.72	0.68	0.63	0.51	0.44	0.12	0.02	0.06
Nose Cap, RH	**1.5**	**4**	**6**	**8**	**10**	**12**	**14**	**16**	**18**	**20**	**22**	**24**	**26**
	0.54	0.50	0.84	0.79	0.88	0.88	0.77	0.76	0.52	0.42	0.12	0.01	0.08
Cowl/OBR, LH	**0.3**	**1**	**2**	**3**	**4**	**5**	**6**	**6.8**	**8**	**9**	**10**	**11.3**	
	0.03	0.14	0.28	0.41	0.58	0.53	0.68	0.43	0.22	0.30	0.42	0.37	
Cowl/OBR, RH	**0.3**	**1**	**2**	**3**	**4**	**5**	**6**	**6.8**	**8**	**9**	**10**	**11.3**	
	0.06	0.13	0.19	0.39	0.49	0.60	0.59	0.40	0.22	0.32	0.35	0.41	
Fixed Housing, LH	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10.75**		
	1.80	0.72	0.60	0.62	0.66	0.71	0.67	0.76	0.97	1.61	0.62		
Fixed Housing, RH	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10.75**		
	2.43	0.84	0.69	0.62	0.78	0.71	0.74	0.83	1.00	2.37	0.55		
Aft Exit Cone, LH	**84**	**90**	**96**	**102**	**108**	**114**	**119**						
	N/A	N/A	N/A	N/A	N/A	N/A	N/A						
Aft Exit Cone, RH	**84**	**90**	**96**	**102**	**108**	**114**	**119**						
	N/A	N/A	N/A	0.15	0.03	0.26	N/A						

* Station locations are shown in bold with the respective margin of safety shown below.

4.5 Insulation

As specified in the Clearfield PEEP, insulation measurements and inspections were not taken on the RSRM-32 motors internal insulation. Insulation measurements were taken on the LH and RH igniter adapters and can be found in Table 6.

4.5.1 NBR and Castable Inhibitor Debris

No significant NBR or castable inhibitor debris was found during the internal inspection at KSC.

4.5.2 NBR Inhibitor Measurement

All NBR inhibitor thickness measurements were taken and added to the database. The data is summarized in Appendix C.

4.5.3 Igniter Adapter Insulation Measurement

Igniter adapter insulation safety factors are summarized in Tables NO TAGI. All required safety factors were met.

Table VI. Igniter Adapter Insulation Safety Factor Summary

Description	Minimum Compliance Safety Factor*	Station	Degree Location	Minimum Actual Safety Factor*	Station	Degree Location
LH Adapter	3.05	11	150.0	3.65	11	150.0
RH Adapter	3.03	11	270.0	3.62	11	270.0

* Minimum required safety factor of 1.5 for the adapter acreage.

5.0 SPECIAL ISSUES SUMMARY

Special postflight hardware issues were identified based on preflight conditions documented in DRs, PRs, ECPs, IFAs, or by anomalous conditions observed in the evaluation of previous flight motors. The following section outlines, by component, the condition and postflight assessment results for the special issues identified on this flight set (reference TWR-64237).

5.1 Insulation

5.1.1 Internal Insulation

1. Condition: The RH nozzle-to-case joint flap thickness on the aft segment was identified to be below the minimum requirement intermittently over the full circumference. No repair was made on this condition.

Reference: DR 409141-01

Results: The Clearfield planning failed to include the action for this special issue and the RH aft segment was rinsed out prior to a sample of the joint flap being removed. No results were obtained.

5.1.2 Igniter Insulation

There are no Clearfield Special Issues for the igniter insulation component on this flight set.

5.2 Case, Seals, and Joints

5.2.1 Case

1. Condition: During splashdown/recovery, debris strikes the case segment interior insulation. Impacts have been observed to cut through the insulation to the case exposing bare metal. This results in corrosive pitting on the case ID at these impact regions. This is suspected to be tied into "spider pitting."

Reference: PFAR 360T030B-10

Results: This evaluation was not performed. The "spider pitting" team determined that the information would not meet the report deadline and therefore canceled the request for the data.

5.2.2 Seals

There are no Clearfield Special Issues for the Seals component on this flight set.

5.2.3 Joints

There are no Clearfield Special Issues for the Joints component on this flight set.

5.3 Nozzle

1. Condition: The LH Joint 4 primary O-ring groove in the GCP exceeds the depth requirements by 0.008 inch at 90 and 270 degrees.

Reference: DR 413107-01

Results: No abnormal conditions observed in the Joint 4 O-ring groove. Performance was nominal with the deeper groove at 90 and 270 degrees.

2. Condition: The LH inner boot ring has wetline indications on the forward end at 2-to-9.5, 13-to-16, 323-to-327 and 333-to-337 degrees. These indications are approximately 0.05 inch outboard of the bondline.

Reference: DR 410998-01

Results: There was no sign of growth in the wetline areas.

3. Condition: Part of the improvement to the Joint 2 assembly method is the complete bonding of the cowl segments to the cowl housing and cowl SCP.

Reference: ECP SRM-2756, STS-57 FRRT, page 91

Results: No unbonds or anomalous conditions were observed on either LH or RH cowl segments.

4. Condition: Part of the improvement to the Joint 2 assembly method is the changing from the "butter" application of the RTV to the backfill method of applying the RTV.

Reference: ECP SRM-2756, STS-57 FRRT, page 91

Results: The RTV backfill reached the nose inlet aft end surface on both LH and RH joints. Two gas paths were observed in the LH joint. One gas path was located 318 degrees. Soot entered the joint and extended to the primary O-ring at 306-to-330 degrees. Charred CCP, GCP and SCP were observed below the char line. Eroded GCP was observed with a maximum depth of 0.003 inch. Heat affected paint was present on forward end ring flange OD. The gas path at 132 was located at a RTV repair and is discussed in Special

Issue 5. Intermittent encapsulated voids with maximum diameter of 0.10 inch were present in the LH joint.

One large encapsulated void was present in the RH joint. The void measured 0.39 inch circumferential by 0.775 inch radial and was located at 354 degrees. This void was located at a RTV repair location. The repair depth was great enough to assure that the RTV was below the char line at this location.

5. Condition: LDI present in the LH Joint 2 RTV located at 133.5 degrees and measuring 0.150 inch circumferentially by 1.625 inches radially. It was repaired by injecting RTV into it.

Reference: DR 410545-02

Results: A gas path was observed at 132 degrees at the RTV repair. Soot entered the joint and extended to the primary O-ring at 108-to-150 degrees. Charred CCP, GCP and SCP were observed below the char line. Eroded GCP was observed with a maximum depth of 0.006 inch. Heat affected paint was present on forward end ring flange OD. This was the fist joint to have a RTV repair.

6. Condition: The RH bearing protector has nine voids that were repaired by filling the voids with silicone paste compound per process finalization procedures.

Reference: Insulation Work Center

Results: No abnormal conditions observed at the repair locations.

7. Condition: Nozzle Work Center Design Engineering (NWCDE) is gathering data relating to the correlation of bondline voids and LDIs. Evaluation of the cowl, nose cap and forward nose ring is needed for both the LH and RH nozzles.

Reference: Nozzle Work Center

Results: Nine adhesive voids were documented on the LH forward nose ring-to-nose inlet housing bondline. Five adhesive voids were documented on the LH nose cap-to-nose inlet housing bondline. No pit repair locations were documented on the LH nose inlet bondlines. No adhesive voids or pit repair locations were documented on the LH cowl bondlines.

Two adhesive voids were documented on the RH forward nose ring-to-nose inlet housing bondline. Four adhesive voids were documented on the RH nose cap-to-nose inlet housing bondline. No pit repair locations were documented on the RH nose inlet bondlines. No adhesive voids or pit repair locations were documented on the RH cowl bondlines.

8. Condition: LDIs in LH nose cap-to-forward nose ring interface at 19, 20, 27, 48, 131, 132, 149, 150, 157, 283, 299, 306 and 314 degrees.

Reference: DRs 410535-01 and 410545-01

Results: Adhesive voids were documented near the LDI locations at 27, 48, 131, 132, 149, 157, 283, 299 and 306 degrees. No indications of the LDIs were found at 19, 20, 150 and 314 degrees.

9. Condition: LDIs in the nose cap-to-nose inlet housing bondline at 1, 16, 33, 79, 163, 177 and 316 degrees.

Reference: DRs 410535-02 and 410545-03

Results: Adhesive voids were documented near the LDI locations at 1, 163, 177, and 316 degrees. No indications of the LDIs were found at 16, 33, and 79 degrees.

10. Condition: LDIs in the LH forward nose ring-to-nose inlet housing bondline. The two worst cases are located at 110 and 290 degrees on the forward end of the nose inlet housing.

Reference: DR 410535-03

Results: No indications of the LDIs were found. X-Ray assessment of the forward nose ring sections for LDIs was not performed.

11. Condition: LDIs in the RH nose cap-to-nose inlet housing bondline at 32, 128, 145, 212 and 245 degrees.

Reference: DRs 410536-01 and 413901-01

Results: Adhesive voids were documented near the LDI locations at 1, 163, 177 and 316 degrees. No indications of the LDIs were found at 16, 33 and 79 degrees.

12. Condition: LDIs in the RH nose cap-to-forward nose ring interface at 182 degrees.

Reference: DRs 410536-02 and 413901-03

Results: No indications of the LDI was found.

13. Condition: Part of the improvement to the Joint 2 assembly method is bonding of the cowl housing and the cowl SCP before joint assembly.

Reference: ECP SRM-2756, STS-57 FRRT, page 91

Results: The amount of metal-to-adhesive separation was much lower than previous cowl bondlines (typically 100 percent metal-to-adhesive). The metal-to-adhesive separations were 4 percent and 14 percent for the LH and RH, respectively.

14. Condition: LDIs in the RH aft exit cone GCP from 270-to-277 degrees and approximately 37.0 inches from the forward end. The LDI measures 4.0 inches axially by 7.97 inches circumferentially.

Reference: DR 410567-01

Results: This Special Issues was written for the aft exit cone assembly originally assigned to this flight. There was switch-out of the RH aft exit cone assembly. The original assembly was returned to Thiokol. This Special Issue will be performed when this assembly is flown. The aft exit cone assembly with DR 410567 is scheduled to flight on RSRM-38B.

15. Condition: The LH aft exit cone assembly experienced an out-of-family temperature condition of 111 degrees during in-plant transportation.

Reference: TWR-64976, S&MA Preflight Assessment, page 63

Results: No abnormal bondline separation modes observed.

16. Condition: The LH forward exit cone assembly experienced an out-of-family bondline shim-to-coeflex differential (i.e. bondline thickness smaller than the shim).

Reference: TWR-64976, S&MA Preflight Assessment, page 66

Results: The bondline separation was typical of past forward exit cones. The bondline separated 61 percent metal-to-adhesive and 39 percent adhesive-to-GCP.

The shims appeared to uniform in thickness and were measured in on location. The adjacent adhesive thickness was also measured.

Table VII. FEC Bondline Adhesive Thickness

Degree	Bondline Location of Shim	Shim Thickness	Adjacent Adhesive Thickness
0	fwd	0.063	0.063
0	aft	0.065	0..060
45	fwd	0.064	0.074
45	aft	0.065	0.062
90	fwd	0.062	0.061
90	aft	0.062	0.063
135	fwd	0.064	0.075
135	aft	0.063	N/A
180	fwd	0.062	0.061
180	aft	0.065	0.062
225	fwd	0.063	0.069
225	aft	0.065	0.0.65
270	fwd	0.063	0.0.60
270	aft	0.062	0.066

17. **Condition:** The cowl ply angle has been changed from 0 degrees to –50 degrees on both the LH and RH cowls.

Reference: ECP SRM–2674, STS–57 FRRT, page 94

Results: Erosion and char measurements were completed and are comparable to the –50 degree ply angle full RSRM static test cowl measurements (FSM–02 and FSM–03). All margin of safety calculations were positive.

Table VIII. Cowl Char and Erosion Measurements

		RSRM-32A		RSRM-32B		FSM-02		FSM-03	
Station		Max	Min	Max	Min	Max	Min	Max	Min
0.3	Erosion	0.31	0.28	0.29	0.24	0.37	0.23	0.35	0.23
	Char	0.72	0.78	0.73	0.73	0.63	0.67	0.61	0.67
1.0	Erosion	0.32	0.26	0.30	0.23	0.35	0.22	0.35	0.22
	Char	0.66	0.70	0.73	0.71	0.57	0.62	0.60	0.62
2.0	Erosion	0.27	0.22	0.30	0.24	0.26	0.16	0.36	0.16
	Char	0.69	0.67	0.72	0.72	0.58	0.67	0.57	0.67
3.0	Erosion	0.26	0.20	0.25	0.21	0.27	0.14	0.33	0.14
	Char	0.65	0.66	0.65	0.76	0.60	0.69	0.58	0.69
4.0	Erosion	0.24	0.18	0.24	0.20	0.24	0.13	0.30	0.13
	Char	0.62	0.72	0.68	0.75	0.61	0.69	0.64	0.69
5.0	Erosion	0.20	0.18	0.19	0.17	0.23	0.11	0.23	0.11
	Char	0.78	0.69	0.73	0.77	0.62	0.72	0.67	0.72
6.0	Erosion	0.16	0.14	0.17	0.15	0.21	0.13	0.20	0.13
	Char	0.70	0.76	0.69	0.80	0.59	0.75	0.82	0.75
6.8	Erosion	0.25	0.15	0.20	0.12	NA	NA	NA	NA
	Char	0.82	0.87	0.91	0.84	NA	NA	NA	NA

18. Condition: The RH aft exit cone is the first component to fly with NARC CCP.

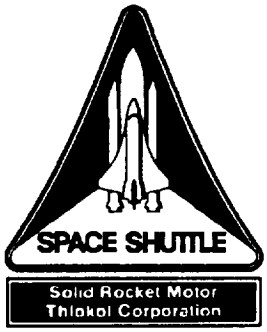
Reference: ECP SRM-1999R2, STS-57 FRRT, page 97

Results: The remaining sections of CCP attached to the housing were measured. Ply lifting was observed the full circumference and axial length of the recovered CCP. All margins of safety calculations were positive. The ply lifted region was included in the char measurements. The ply lift investigation is summarized in TWR-65606, "HPM/RSRM Aft Exit Cone Ply Lift Summary".

19. Condition: The LH aft exit cone CCP has high interlaminer double shear strength. This CCP material was dispositioned "limited use" after this AEC was manufactured. The LH AEC was then stored until the TEM-09 AEC with similar material properties was fired and performed nominally. This AEC was then dispositioned "use as is".

Reference: DRs 402834-01 and 409214-01

Results: Several sections of CCP were recovered from the inside of the LH motor. Sections were shipped to the Clearfield facility. The sections were misplaced at Clearfield and the assessment cannot be completed.



Appendix A
Postflight Observation Records (PFORs)

Final Postflight Hardware Evaluation Report RSRM-32 (STS-57)

November 1993

Prepared for:

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GEORGE C. MARSHALL SPACE FLIGHT CENTER
MARSHALL SPACE FLIGHT CENTER, ALABAMA 35812

Contract No.	**NAS8-38100**
DR No.	**4-23**
WBS No.	**4C601-04-01**
ECS No.	**SS4775**

Thiokol CORPORATION
SPACE OPERATIONS

P.O. Box 707, Brigham City, Utah 84302-0707 (801) 863-3511

REQUIRED PFOR LIST

PFOR	Side	Final Ten-Day Report Page Number
S&A Device (Barrier-Booster and Environmental Seal Regions)	LH	A-1
S&A Rotor Shaft O-rings (Detailed)	LH	A-2
SII and Port (At Removal) - 18 Degrees	LH	A-3
SII and O-rings (Detailed) - 18 Degrees	LH	A-4
SII and Port (At Removal) - 198 Degrees	LH	A-5
SII and O-rings (Detailed) - 198 Degrees	LH	A-6
Nozzle Metal Components - Excluding Joints	LH	A-7
Nozzle Internal Joint 2 (Nose Inlet-to-Flex Bearing-to-Cowl)		
Nozzle Internal Joint RTV - Joint 2	LH	A-8
Nozzle Internal Joint Phenolics - Joint 2	LH	A-9
Nozzle Internal Joint Seals and Metal - Joint 2	LH	A-10
Nozzle Internal Joint Drawing Worksheet - Joint 2	LH	A-11
Nozzle Internal Joint O-rings (Detailed) - Joint 2	LH	A-12
Nozzle Internal Joint 3 (Nose Inlet-to-Throat)		
Nozzle Internal Joint RTV - Joint 3	LH	A-13
Nozzle Internal Joint Phenolics - Joint 3	LH	A-14
Nozzle Internal Joint Seals and Metal - Joint 3	LH	A-15
Nozzle Internal Joint Drawing Worksheet - Joint 3	LH	A-16
Nozzle Internal Joint O-rings (Detailed) - Joint 3	LH	A-17
Nozzle Internal Joint 4 (Throat-to-Forward Exit Cone)		
Nozzle Internal Joint RTV - Joint 4	LH	A-18
Nozzle Internal Joint Phenolics - Joint 4	LH	A-19
Nozzle Internal Joint Seals and Metal - Joint 4	LH	A-20
Nozzle Internal Joint Drawing Worksheet - Joint 4	LH	A-21
Nozzle Internal Joint O-rings (Detailed) - Joint 4	LH	A-22

RF :ED PFOR LIST (Co t.)

PFOR	Side	Final Ten-Day Report Page Number
Nozzle Internal Joint 5 (Aft End Ring-to-Fixed Housing)		
Nozzle Internal Joint RTV – Joint 5	LH	A-23
Nozzle Internal Joint Phenolics – Joint 5	LH	A-24
Nozzle Internal Joint Seals and Metal – Joint 5	LH	A-25
Nozzle Internal Joint Drawing Worksheet – Joint 5	LH	A-26
Nozzle Internal Joint O-rings (Detailed) – Joint 5	LH	A-27
Nozzle Internal Joint Packings With Retainers (Detailed) – Joint 5	LH	A-28
Cowl Insulation Segments	LH	A-29
Flexible Bearing Protector, Flexible Bearing, and Flexible Boot	LH	A-30
Flexible Bearing Protector Measurements	LH	A-31
Nozzle Throat Diameter Measurements	LH	A-32
Nozzle Phenolic Bondlines		
Nozzle Phenolic Bondline – Aft Exit Cone Assembly	LH	A-33
Nozzle Phenolic Bondline – Forward Exit Cone Assembly	LH	A-34
Nozzle Phenolic Bondline – Throat Assembly	LH	A-35
Nozzle Phenolic Bondline – Forward Nose and Aft Inlet Rings	LH	A-36
Nozzle Phenolic Bondline – Nose Cap	LH	A-37
Nozzle Phenolic Bondline – Cowl Assembly	LH	A-38
Nozzle Phenolic Bondline – Fixed Housing Assembly	LH	A-39

REQUIRED F')R LIST

PFOR	Side	Final Ten-Day Report Page Number
Nozzle Phenoli(Sections		
Nozzle Ph :nolic Sections - Aft Exit Cone	LH	A-40
Nozzle Ph :nolic Sections - Forward Exit Cone	LH	A-41
Nozzle Ph :nolic Sections - Throat Assembly	LH	A-42
Nozzle Ph :nolic Sections - Forward Nose and Aft Inlet) ings	LH	A-43
Nozzle Ph :nolic Sections - Nose Cap	LH	A-44
Nozzle Ph :nolic Sections - Cowl	LH	A-45
Nozzle Ph :nolic Sections - Fixed Housing	LH	A-46
Nozzle Ph :nolic Sections - Outer Boot Ring and Flexible E)ot	LH	A-47
Leak Check Po t Plugs and Ports		
Barrier-Bc)ster Leak Check Port Plug and Port (At Remo 'al) - 126 Degrees	LH	A-48
Barrier-Bc)ster Leak Check Port Plug and O-ring (Detailed) - 126 Degrees	LH	A-49
Nozzle In :rnal Joint Leak Check Port Plug and Port (At Remc 'al) - Joint 2	LH	A-50
Nozzle In :rnal Joint Leak Check Port Plug and O-ring (Detailed) - Joint 2	LH	A-51
Nozzle In :rnal Joint Leak Check Port Plug and Port (At Remo 'al) - Joint 3	LH	A-52
Nozzle In :rnal Joint Leak Check Port Plug and O-ring (Detailed) - Joint 3	LH	A-53

REQUIRED PFOR LIST

PFOR	Side	Final Ten-Day Report Page Number
Leak Check Port Plugs and Ports (Cont.)		
Nozzle Internal Joint Leak Check Port Plug and Port (At Removal) - Joint 4	LH	A-54
Nozzle Internal Joint Leak Check Port Plug and O-ring (Detailed) - Joint 4	LH	A-55
Nozzle Internal Joint Leak Check Port Plug and Port (At Removal) - Joint 5	LH	A-56
Nozzle Internal Joint Leak Check Port Plug and O-ring (Detailed) - Joint 5	LH	A-57
Case Factory Joints		
Case Factory Joint - Forward Dome	LH	A-58
Case Factory Joint - Forward Cylinder/Cylinder	LH	A-59
Case Factory Joint - Forward Center	LH	A-60
Case Factory Joint - Aft Center	LH	A-61
Case Factory Joint - ET Attach/Stiffener	LH	A-62
Case Factory Joint - Stiffener/Stiffener	LH	A-63
Case Factory Joint - Aft Dome	LH	A-64
S&A Device (Barrier-Booster and Environmental Seal Regions)	RH	A-65
S&A Rotor Shaft O-rings (Detailed)	RH	A-66
SII and Port (At Removal) - 18 Degrees	RH	A-67
SII and O-rings (Detailed) - 18 Degrees	RH	A-68
SII and Port (At Removal) - 198 Degrees	RH	A-69
SII and O-rings (Detailed) - 198 Degrees	RH	A-70
Nozzle Metal Components - Excluding Joints	RH	A-71

REQUIRED PFOR LIST (Cont.)

PFOR	Side	Final Ten-Day Report Page Number
Nozzle Internal Joint 2 (Nose Inlet-to-Flex Bearing-to-Cowl)		
Nozzle Internal Joint RTV - Joint 2	RH	A-72
Nozzle Internal Joint Phenolics - Joint 2	RH	A-73
Nozzle Internal Joint Seals and Metal - Joint 2	RH	A-74
Nozzle Internal Joint Drawing Worksheet - Joint 2	RH	A-75
Nozzle Internal Joint O-rings (Detailed) - Joint 2	RH	A-76
Nozzle Internal Joint 3 (Nose Inlet-to-Throat)		
Nozzle Internal Joint RTV - Joint 3	RH	A-77
Nozzle Internal Joint Phenolics - Joint 3	RH	A-78
Nozzle Internal Joint Seals and Metal - Joint 3	RH	A-79
Nozzle Internal Joint Drawing Worksheet - Joint 3	RH	A-80
Nozzle Internal Joint O-rings (Detailed) - Joint 3	RH	A-81
Nozzle Internal Joint 4 (Throat-to-Forward Exit Cone)		
Nozzle Internal Joint Phenolics - Joint 4	RH	A-82
Nozzle Internal Joint Seals and Metal - Joint 4	RH	A-83
Nozzle Internal Joint Drawing Worksheet - Joint 4	RH	A-84
Nozzle Internal Joint O-rings (Detailed) - Joint 4	RH	A-85
Nozzle Internal Joint 5 (Aft End Ring-to-Fixed Housing)		
Nozzle Internal Joint RTV - Joint 5	RH	A-86
Nozzle Internal Joint Phenolics - Joint 5	RH	A-87
Nozzle Internal Joint Seals and Metal - Joint 5	RH	A-88
Nozzle Internal Joint Drawing Worksheet - Joint 5	RH	A-89
Nozzle Internal Joint O-rings (Detailed) - Joint 5	RH	A-90
Nozzle Internal Joint Packings With Retainers (Detailed) - Joint 5	RH	A-91

REQUIRED PFOR LIST (Cont.)

PFOR	Side	Final Ten-Day Report Page Number
Cowl Insulation Segments	RH	A-92
Flexible Bearing Protector, Flexible Bearing, and Flexible Boot	RH	A-93
Flexible Bearing Protector Measurements	RH	A-94
Nozzle Throat Diameter Measurements	RH	A-95
Nozzle Phenolic Bondlines		
Nozzle Phenolic Bondline - Aft Exit Cone Assembly	RH	A-96
Nozzle Phenolic Bondline - Forward Exit Cone Assembly	RH	A-97
Nozzle Phenolic Bondline - Throat Assembly	RH	A-98
Nozzle Phenolic Bondline - Forward Nose and Aft Inlet Rings	RH	A-99
Nozzle Phenolic Bondline - Nose Cap	RH	A-100
Nozzle Phenolic Bondline - Cowl Assembly	RH	A-101
Nozzle Phenolic Bondline - Fixed Housing Assembly	RH	A-102
Nozzle Phenolic Sections		
Nozzle Phenolic Sections - Aft Exit Cone	RH	A-103
Nozzle Phenolic Sections - Forward Exit Cone	RH	A-104
Nozzle Phenolic Sections - Throat Assembly	RH	A-105
Nozzle Phenolic Sections - Forward Nose and Aft Inlet Rings	RH	A-106
Nozzle Phenolic Sections - Nose Cap	RH	A-107
Nozzle Phenolic Sections - Cowl	RH	A-108
Nozzle Phenolic Sections - Fixed Housing	RH	A-109
Nozzle Phenolic Sections - Outer Boot Ring and Flexible Boot	RH	A-110

REQUIRED PFOR LIST

PFOR	Side	Final Ten-Day Report Page Number
Leak Check Port Plugs and Ports		
Barrier-Booster Leak Check Port Plug and Port (At Removal) - 126 Degrees	RH	A-111
Barrier-Booster Leak Check Port Plug and O-ring (Detailed) - 126 Degrees	RH	A-112
Nozzle Internal Joint Leak Check Port Plug and Port (At Removal) - Joint 2	RH	A-113
Nozzle Internal Joint Leak Check Port Plug and O-ring (Detailed) - Joint 2	RH	A-114
Nozzle Internal Joint Leak Check Port Plug and Port (At Removal) - Joint 3	RH	A-115
Nozzle Internal Joint Leak Check Port Plug and O-ring (Detailed) - Joint 3	RH	A-116
Leak Check Port Plugs and Ports (Cont.)		
Nozzle Internal Joint Leak Check Port Plug and Port (At Removal) - Joint 4	RH	A-117
Nozzle Internal Joint Leak Check Port Plug and O-ring (Detailed) - Joint 4	RH	A-118
Nozzle Internal Joint Leak Check Port Plug and Port (At Removal) - Joint 5	RH	A-119
Nozzle Internal Joint Leak Check Port Plug and O-ring (Detailed) - Joint 5	RH	A-120

REQUIRED PFOR LIST

PFOR	Side	Final Ten-Day Report Page Number
Case Factory Joints		
Case Factory Joint - Forward Dome	RH	A-121
Case Factory Joint - Forward Cylinder/Cylinder	RH	A-122
Case Factory Joint - Forward Center	RH	A-123
Case Factory Joint - Aft Center	RH	A-124
Case Factory Joint - ET Attach/Stiffener	RH	A-125
Case Factory Joint - Stiffener/Stiffener	RH	A-126
Case Factory Joint - Aft Dome	RH	A-127

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR)
S&A Device (Barrier-Booster and Environmental Seal Regions)

Motor No.: RSRM-32	Side: Left (A)	Date: 7-9-93
Assessment Engineer(s)/Inspector(s): S. Eden, M. Nolan, M. Lyon, L. MacCauley		

	Yes	No	Comment #
Barrier-Booster Bore and Rotor:			
a. Soot to or past O-rings?	✓		1
b. Sooted metal surfaces?	✓		1
c. Heat affected or eroded O-ring (installed)?		✓	
d. O-ring damage (installed)?		✓	
e. Foreign material?		✓	
f. Heat affected or eroded metal?		✓	
g. Metal damage?		✓	
h. Excessive grease?		✓	
i. Corrosion?		✓	
j. Teflon retainer damage?		✓	
Environmental Seal Regions:			
k. Environmental O-ring assembly damage (visible without magnification)?		✓	
l. Foreign material?		✓	

Notes / Comments

1- Typical soot to primary O-ring(#1) and rotor and bore surfaces.

Note: slight heat affect and erosion on both the B-B-to-basket and basket shower cap environmental O-rings. (Typical condition)

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)

S&A Rotor Shaft O-rings (Detailed)

Motor No.: RSRM-32	Side: Left (A)	Date: 7-9-93

Assessment Engineer(s)/Inspector(s): S. Eden, M. Lyon, C. Taylor, L. MacCauley

	Yes	No	Comment #
Forward Primary O-ring: #2			
a. Heat affected or eroded O-ring?		✓	
b. O-ring defects/damage?		✓	
Aft Primary O-ring: #1			
c. Heat affected or eroded O-ring?		✓	
d. O-ring defects/damage?		✓	
Forward Secondary O-ring: #4			
e. Heat affected or eroded O-ring?		✓	
f. O-ring defects/damage?		✓	
Aft Secondary O-ring: #3			
g. Heat affected or eroded O-ring?		✓	
h. O-ring defects/damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR)
SII and Port (At Removal) – 18 Degrees

Motor No.: RSRM-32	Side: Left (A)	Date: 7-9-93

Assessment Engineer(s)/Inspector(s): S. Eden, M. Lyon, C. Taylor, L. MacCauley

SII and Port:	Yes	No	Comment #
a. Soot to or past O-ring?		✓	
b. Sooted surfaces?	✓		1
c. Heat affected or eroded O-ring (installed)?		✓	
d. O-ring damage (installed)?		✓	
e. Eroded metal?		✓	
f. Foreign material?		✓	
g. Excessive grease?		✓	
h. Medium or heavy corrosion?		✓	
i. Metal damage?		✓	

Notes / Comments

1- Typical soot to tip of SII.

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)

SII and O-rings (Detailed) – 18 Degrees

Motor No.: RSRM-32	Side: Left (A)	Date: 7-9-93

Assessment Engineer(s)/Inspector(s): S. Eden, M. Lyon, C. Taylor, L. MacCauley

	Yes	No	Comment #
SII:			
a. Foreign material between the O-ring and SII?		✓	
b. Eroded metal?		✓	
c. Seal surface/thread damage?		✓	
Primary O-ring:			
d. Heat affected or eroded O-ring?		✓	
e. O-ring defects/damage?		✓	
Secondary O-ring:			
f. Heat affected or eroded O-ring?		✓	
g. O-ring defects/damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR)

SII and Port (At Removal) - 198 Degrees

Motor No.: RSRM-32	Side: Left (A)	Date: 7-9-93

Assessment Engineer(s)/Inspector(s): S. Eden, M. Lyon, C. Taylor, L. MacCauley

SII and Port:	Yes	No	Comment #
a. Soot to or past O-ring?		✓	
b. Sooted surfaces?	✓		1
c. Heat affected or eroded O-ring (installed)?		✓	
d. O-ring damage (installed)?		✓	
e. Eroded metal?		✓	
f. Foreign material?		✓	
g. Excessive grease?		✓	
h. Medium or heavy corrosion?		✓	
I. Metal damage?		✓	

Notes / Comments

1- Typical soot to tip of SII.

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)

SII and O-rings (Detailed) - 198 Degrees

Motor No.: RSRM-32	Side: Left (A)	Date: 7-9-93

Assessment Engineer(s)/Inspector(s): S. Eden, M. Lyon, C. Taylor, L. MacCauley

	Yes	No	Comment #
SII:			
a. Foreign material between the O-ring and SII?		✓	
b. Eroded metal?		✓	
c. Seal surface/thread damage?		✓	
Primary O-ring:			
d. Heat affected or eroded O-ring?		✓	
e. O-ring defects/damage?		✓	
Secondary O-ring:			
f. Heat affected or eroded O-ring?		✓	
g. O-ring defects/damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)
Nozzle Metal Components - Excluding Joints

Motor No.: RSRM-32	Side: Left (A)	Date: 9 July 93

Assessment Engineer(s)/Inspector(s): J. Passman, R. Quick, M. Clark

Metal Component (check appropriate space when evaluation is completed):

✓	Forward Exit Cone Housing	✓	Flexible Bearing
✓	Fixed Housing	✓	Throat Housing
✓	Cowl Housing	✓	Nose Inlet Housing

Metal Components:	Yes	No	Comment #
a. Metal damage?		✓	
b. Loose or missing fasteners? (including forward exit cone forward shear pins)		✓	
c. Heat affected paint (discolored and blistered)?		✓	
d. Bubbled paint?		✓	
e. Missing primer or paint not due to impact or handling?		✓	
f. Heavy corrosion?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint RTV – Joint 2

Motor No.: RSRM-32	Side: Left (A)	Date: 9 July 93

Assessment Engineer(s)/Inspector(s): JIM PASSMAN, TREVOR FRESTON, WAYNE SPERRY

Joint RTV:	Yes	No	Comment #
a. Gas penetration?	✓		(1)
b. RTV not below char line?	✓		(1)
c. Uncured/reverted RTV?		✓	
d. Voids within RTV?	✓		(2)
e. Grease inhibiting RTV backfill?		✓	
f. Foreign material?		✓	

Notes / Comments

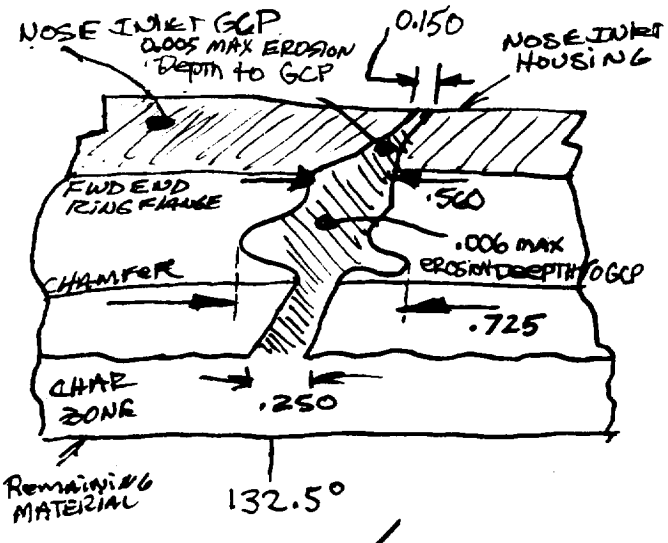
Special Issue 3.3.4 TWO GAS PATHS WERE FOUND THROUGH THE BACKFILLED RTV, ALLOWING SOOT TO REACH PRIMARY O-RING. OVERALL THE JOINT BACKFILL WAS IN GOOD CONDITION. RTV REACHED NOSE INLET HOUSING FULL CIRC AND COWL BONDLINE FULL CIRC.

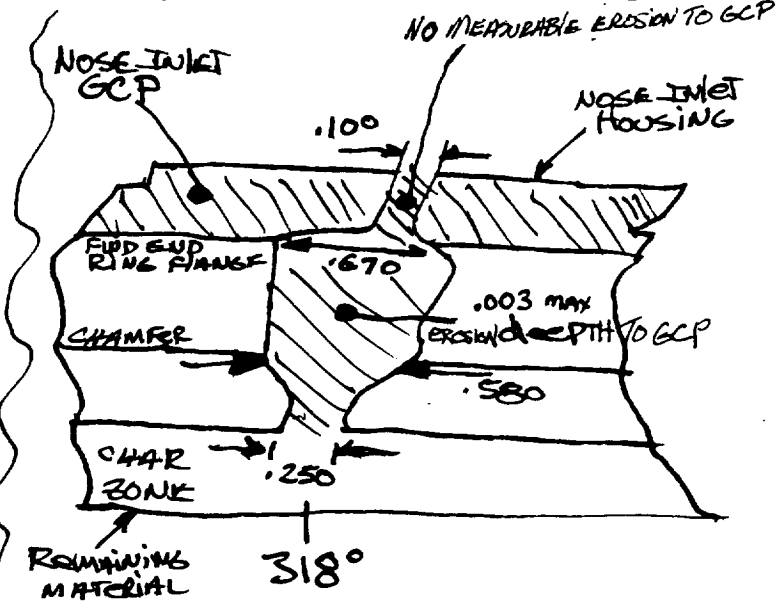
(1) GAS PATHS THROUGH RTV LOCATED AT 132.5° AND 318°, SOOT REACHED PRIMARY O-RING AT 108°-150° AND 306°-330°. HEAT AFFECTED CCP, SCP, AND GCP WAS ALSO PRESENT AT GAS PATH LOCATIONS. SEE SKETCHES BELOW FOR DIMENSIONS. EROSION TO THE GCP OCURRED AT THE GAS PATH LOCATIONS. APPROX. MEASUREMENTS ARE SHOWN BELOW.

(2) VERY FEW VOIDS OF .100 DIAM. OR LESS

Special Issue 3.3.5

A GAS PATH WAS FOUND AT CDI Repair location AT 132.5°.





Preliminary PFAR(s)? ✓ Yes ___ No

Preliminary PFAR Number(s): E7C-01

Clarification Form(s)? ___ Yes ✓ No

Number of Forms Attached: ___

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint Phenolics - Joint 2

Motor No.: RSRM-32	Side: Left (A)	Date: 9 July 93

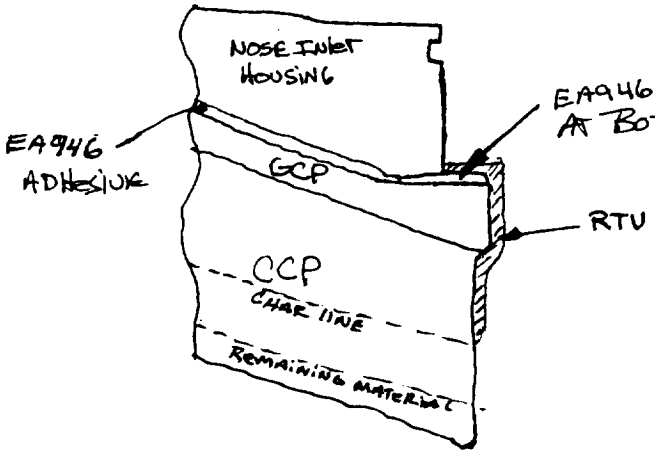
Assessment Engineer(s)/Inspector(s): Jim PASSMAN, TREVOR FRESTON, WAYNE SPERRY

Joint Phenolics:	Yes	No	Comment #
a. Heat affected or eroded CCP (below the char line), GCP/SCP, or adhesive?	✓		(2)
b. Physical damage?		✓	
c. Edge separations (metal-to-adhesive, within adhesive, adhesive-GCP/SCP, within GCP/SCP, GCP/SCP-to-CCP, or within CCP)?		✓	(1)
d. Phenolics axially displaced from the housing?		✓	

Notes / Comments

(1) RTV COVERED BONDLINE BETWEEN PHENOLICS AND NOSE INLET HOUSING, AREAS WHERE RTV WAS REMOVED SHOWED NO EDGE SEPS. NO EDGE SEPS. FOUND ON COWL BONDLINE.

(2) HEAT AFFECTED SCP, CCP AND GCP IN LINE WITH GAS PATHS AT 132.5° AND 318°. SLIGHT EROSION WAS EVIDENT ON THE GCP, SCP AND CCP. APPROX DEPTHS ON THE GCP ARE SHOWN IN SCETCHES ON PFOR A-8.



Preliminary PFAR(s)? ✓ Yes ___ No Preliminary PFAR Number(s): 57C-01

Clarification Form(s)? ___ Yes ✓ No Number of Forms Attached: ___

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint Seals and Metal – Joint 2

Motor No.: RSRM-32	Side: Left (A)	Date: 7-9-93

Assessment Engineer(s)/Inspector(s): W. Speny, M. Offelter

Joint Seals and Metal:	Yes	No	Comment #
a. Soot to or past O-rings?	✓		2
b. Sooted joint surfaces?	✓		3
c. Heat affected or eroded O-rings (installed)?		✓	
d. O-ring damage (installed)?		✓	
e. Heat affected or eroded metal?		✓	
f. RTV to primary O-ring?		✓	
g. RTV past primary O-ring?		✓	
h. Foreign material?	✓		1
i. Excessive grease? (including in threaded and through bolt holes)		✓	
j. Metal damage? (including index pin and bolt holes (through, threaded/ helical coil inserts))		✓	
k. Bent or broken bolts?		✓	

Notes / Comments

271, 311, 312, 298, 288 degree locations

1 – Aluminum Oxide Corrosion downstream of secondary O-ring on both mating surfaces at

2- Soot to primary O-ring at two locations (gas paths) 108°–150° and 306°–330°

3- Soot upstream of primary O-ring full circumference with corresponding light intermittent corrosion.

4- HEAT AFFECTED PAINT WAS FOUND ON BEARING FWD END RING FLANGE O.D. IN LINE WITH GAS PATHS AT 132.5° AND 318°.

Preliminary PFAR(s)? ✓ Yes ___ No Preliminary PFAR Number(s): 57C-01

Clarification Form(s)? ✓ Yes ___ No Number of Forms Attached: 1

Thiokol CORPORATION
SPACE OPERATIONS

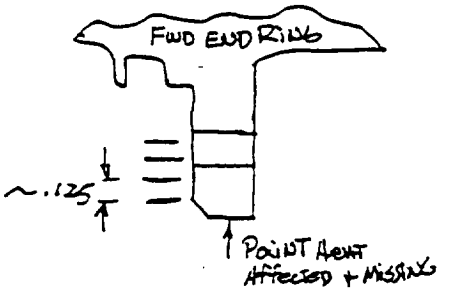
PFOR CLARIFICATION FORM

General

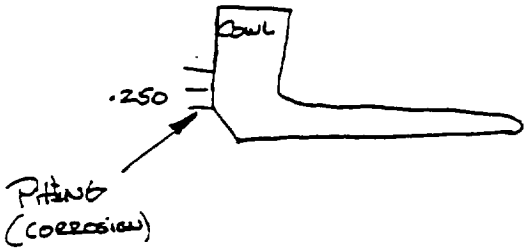
Motor No.: RSRM-32	Side: ☑ Left (A) ☐ Right (B)	Date: 7-13-93
Assessment Engineer(s)/Inspector(s): J. Passman, T. Freston, V. Gunther		
Description: Hardness & Electrical Conductivity Test Results on metal surfaces at Gaspaths in joints		

Sketch Observations Below (include locations and sizes of sketched features):

HARDNESS TESTING OF JOINT METAL SURFACES IN GAS PATH REGIONS:



DEGREE LOCATION	RADIAL LOCATION FROM CHAMFER	Rockwell C HARDNESS
132.5°	.125	45
	.250	44
	.375	44
318°	.125	45
	.250	44
	.375	44



		Rockwell B
132.5°	.250	86
	.500	88
318°	.25°	88
	.500	88

ELECTRICAL CONDUCTIVITY TESTING OF METAL SURFACES: %IACS

COWL	132.5°	41.4	41.2	40.4	41.3	41.4	41.5
	318°	41.2	41.4	40.5	39.3	41.2	41.1
NOSE INLET	132.5°	39.0	38.9	38.9	39.5	38.8	39.1
	318°	39.4	39.6	34.3	39.6	39.4	39.3

NOTE: Rockwell 'C' hardness of 44 is acceptable for D6AC steel
Rockwell 'B' hardness of 88 is acceptable for 7075-T73 aluminum
Electrical conductivity of 38 and above is acceptable for 7075-T73 aluminum

POSTFLIGHT OBSERVATION RECORD (PFOR)

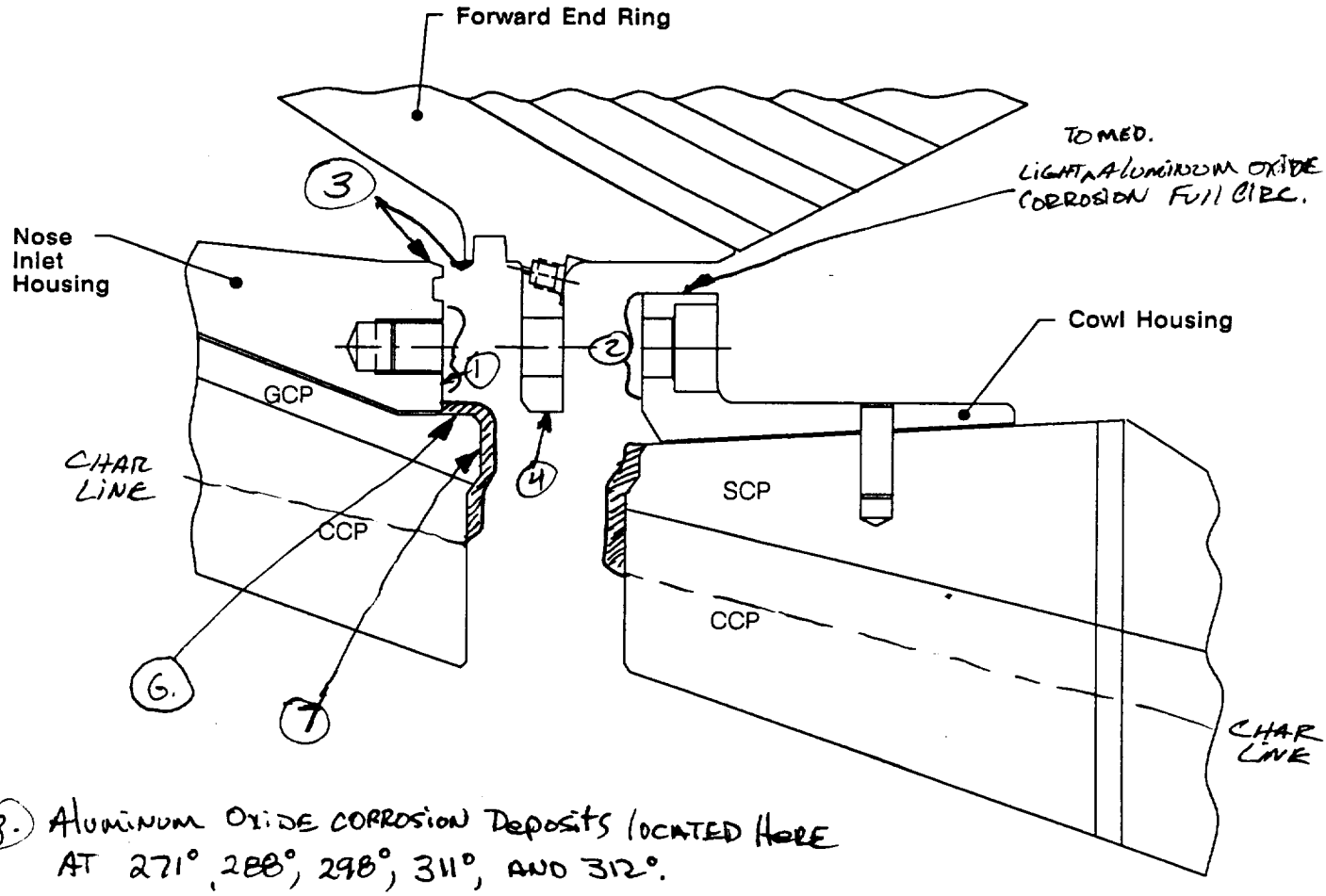
Nozzle Internal Joint Drawing Worksheet - Joint 2

Motor No.: RSRM-32	Side: Left (A)	Date: 9 July 93
Assessment Engineer(s)/Inspector(s):	Jim Passman, Trevor Freston, Wayne Sperry	

Sketch Observations Below (include locations and sizes of sketched features):

(1) Soot into joint surface from gas paths with intermittent full circumference light-med. corrosion.

(2.) Light to med corrosion int. full circumference.



(3.) Aluminum oxide corrosion deposits located hole at 271°, 288°, 298°, 311°, and 312°.

(4.) Intermittent sooting from gas paths, heat affected paint at gas path locations.

(5.) Gas paths through RTV located at 132.5° and 318°. Soot entered joint and reached primary O-ring at 108°-150° and 306°-330°.

(6.) EA946 adhesive located on this surface was eroded away in line with ~~Blue~~ gas path at 132.5° (.025 inch thickness erosion). EA946 was also eroded to glass cloth phenolic at 318° (.023 inch). GCP erosion to .005 depth present at 132.5°

(7.) Glass cloth-phenolic erosion in this area 132.5°-0.005 inch, 318°-0.003 inch.

POSTFLIGHT OBSERVATION RECORD (PFOR)
Nozzle Internal Joint O-rings (Detailed) – Joint 2

Motor No.: RSRM-32	Side: Left (A)	Date: 7-9-93

Assessment Engineer(s)/Inspector(s): W. Sperry, M. Affolter, B. Ferguson

	Yes	No	Comment #
Primary O-ring:			
a. Heat affected or eroded O-ring?		✓	
b. O-ring defects/damage?		✓	
Secondary O-ring:			
c. Heat affected or eroded O-ring?		✓	
d. O-ring defects/damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint RTV - Joint 3

Motor No.: RSRM-32	Side: Left (A)	Date: 9 July 95

Assessment Engineer(s)/Inspector(s): R. Quick P. Milcer, W. Sperry

Joint RTV:	Yes	No	Comment #
a. Gas penetration?		✓	
b. RTV not below char line?		✓	
c. Uncured/reverted RTV?		✓	
d. Voids within RTV?		✓	
e. Grease inhibiting RTV backfill?		✓	
f. Foreign material?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint Phenolics - Joint 3

Motor No.: RSRM-32	Side: Left (A)	Date: 9 JULY 93

Assessment Engineer(s)/Inspector(s): R. Quick P. Miller W. Sperry

Joint Phenolics:	Yes	No	Comment #
a. Heat affected or eroded CCP (below the char line), GCP, or adhesive?		✓	
b. Physical damage?		✓	
c. Edge separations (metal-to-adhesive, within adhesive, adhesive-GCP, within GCP, GCP-to-CCP, or within CCP)?	✓		1&2
d. Phenolics axially displaced from the housing?		✓	

Notes / Comments

(1) ADHESIVE TO HOUSING SEPARATION ON THROAT FULL CIRCUM MAX GAP = .019

(2) ADHESIVE TO HOUSING SEPARATION NOSE INLET HOUSING FROM 835 - 350° MAX GAP - .005

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint Seals and Metal - Joint 3

Motor No.: RSRM-32	Side: Left (A)	Date: 7-9-93

Assessment Engineer(s)/Inspector(s): W. Sperry, M. Offolter

Joint Seals and Metal:	Yes	No	Comment #
a. Soot to or past O-rings?		✓	
b. Sooted joint surfaces?		✓	
c. Heat affected or eroded O-rings (installed)?		✓	
d. O-ring damage (installed)?		✓	
e. Heat affected or eroded metal?		✓	
f. RTV to primary O-ring?		✓	
g. RTV past primary O-ring?		✓	
h. Foreign material?		✓	
i. Excessive grease? (including in threaded and through bolt holes)		✓	
j. Metal damage? (including index pin and bolt holes (through, threaded/ helical coil inserts))		✓	
k. Bent or broken bolts?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

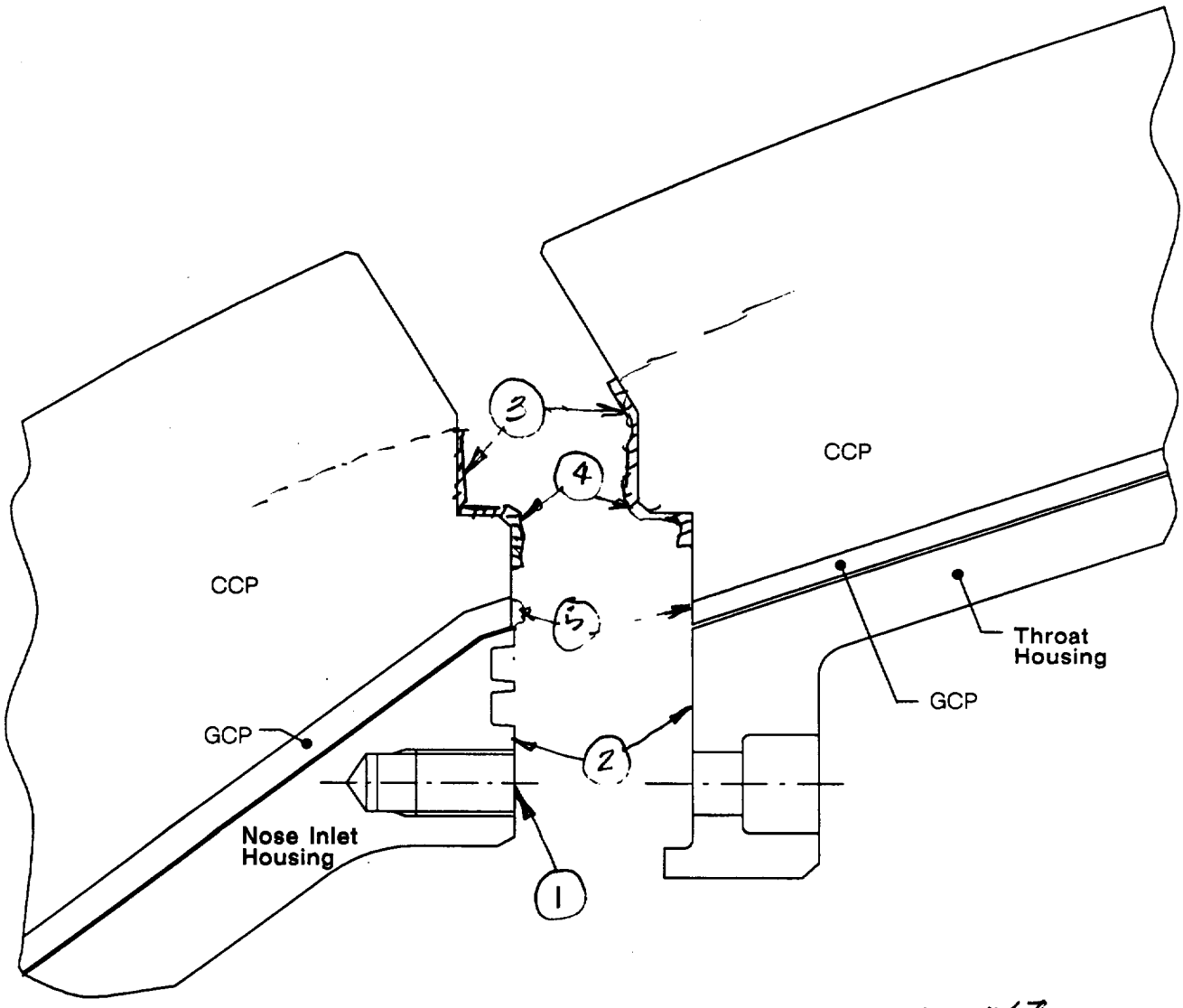
Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint Drawing Worksheet – Joint 3

Motor No.: RSRM-32	Side: Left (A)	Date: 9 JULY 93
Assessment Engineer(s)/Inspector(s): R. Quick W. Sperry P. Miller		

Sketch Observations Below (include locations and sizes of sketched features):



(1) NO EXCESS GREASE IN HOLES
(2) GREASE COVERAGE NOMINAL
(3) ETV BELOW CHAR LINE 360°
(4) ETV FROM 0°-75° & 180°-0°
(5) APPEARS TO BE SALT DEPOSIT FULL CIRCUM

POSTFLIGHT OBSERVATION RECORD (PFOR)
Nozzle Internal Joint O-rings (Detailed) - Joint 3

Motor No.: RSRM-32	Side: Left (A)	Date: 7-9-93

Assessment Engineer(s)/Inspector(s): W. Sperry, M. Offelter, B Ferguson

	Yes	No	Comment #
Primary O-ring:			
a. Heat affected or eroded O-ring?		✓	
b. O-ring defects/damage?		✓	
Secondary O-ring:			
c. Heat affected or eroded O-ring?		✓	
d. O-ring defects/damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint RTV – Joint 4

Motor No.: RSRM-32	Side: Left (A)	Date: 7 JULY 93

Assessment Engineer(s)/Inspector(s): R. QUICK P. MILLER A. CARLISLE

Joint RTV:	Yes	No	Comment #
a. Gas penetration?		✓	
b. RTV not below char line?		✓	
c. Uncured/reverted RTV?		✓	
d. Voids within RTV?		✓	
e. Grease inhibiting RTV backfill?		✓	
f. Foreign material?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint Phenolics - Joint 4

Motor No.: RSRM-32	Side: Left (A)	Date: 7 JULY 93

Assessment Engineer(s)/Inspector(s): R. QUICK P. MILLER A. CARLISLE

Joint Phenolics:	Yes	No	Comment #
a. Heat affected or eroded CCP (below the char line), GCP, or adhesive?		✓	
b. Physical damage?		✓	
c. Edge separations (metal-to-adhesive, within adhesive, adhesive-GCP, within GCP, GCP-to-CCP, or within CCP)?	✓		1 & 2
d. Phenolics axially displaced from the housing?		✓	

Notes / Comments

1- SEPARATION BETWEEN GCP AND FEC HOUSING FULL CIRCUM MAX GAP = .015

2- SEPARATION BETWEEN GCP AND THROAT HOUSING FULL CIRCUM MAX GAP = .021 & ONE SEPARATION WITHIN GCP AT 180° x .70 CIRCUM X .002 RADIAL

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint Seals and Metal - Joint 4

Motor No.: RSRM-32	Side: Left (A)	Date: 7 JULY 93

Assessment Engineer(s)/Inspector(s): R. QUICK P. MILLER H. CARLISLE

Joint Seals and Metal:	Yes	No	Comment #
a. Soot to or past O-rings?		✓	
b. Sooted joint surfaces?		✓	
c. Heat affected or eroded O-rings (installed)?		✓	
d. O-ring damage (installed)?		✓	
e. Heat affected or eroded metal?		✓	
f. RTV to primary O-ring?	✓		1
g. RTV past primary O-ring?		✓	
h. Foreign material?		✓	
i. Excessive grease? (including in threaded and through bolt holes)		✓	
j. Metal damage? (including index pin and bolt holes (through, threaded/ helical coil inserts))		✓	
k. Bent or broken bolts?		✓	

Notes / Comments

Special Issue 3.3.1 NO CONDITIONS FOUND AT 90° & 270° AND NO APPARENT FUNCTIONAL PROBLEMS

(1) RTV TO PRIMARY O-RING INTERMITTENTLY 360°

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

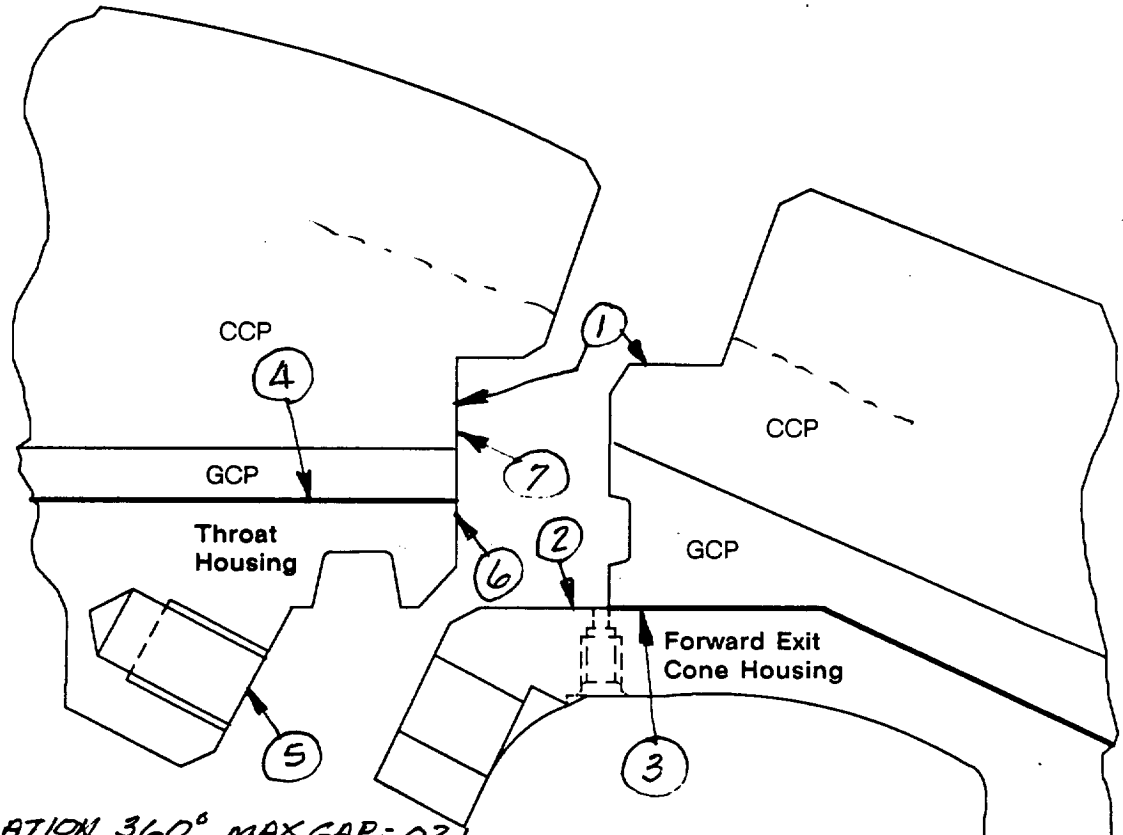
POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint Drawing Worksheet – Joint 4

Motor No.: RSRM-32	Side: Left (A)	Date: 7 JULY 93
Assessment Engineer(s)/Inspector(s): R. QUICK P. MILLER A. CARLISLE		

Sketch Observations Below (include locations and sizes of sketched features):

(1) RTV TO PRIMARY O-RING INTERMITTENTLY 360°
(2) LIGHT CORROSION ON FWD EXIT CONE AT 354° & 0°-6°
(3) SEPARATION INTERMITTENTLY 360° MAX = .015



(4) SEPARATION 360° MAX GAP = .02
(5) NO EXCESS GREASE IN HOLES AND GREASE COVERAGE WAS NOMINAL
(6) MEDIUM TO HEAVY COVERAGE FULL CIRCUM
(7) RTV DISCOLORED FROM SALT WATER FROM 345° THRU 0° TO 98°

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint O-rings (Detailed) - Joint 4

Motor No.: RSRM-32	Side: Left (A)	Date: 7 July 1993

Assessment Engineer(s)/Inspector(s): A. Carlisle, B. Quick, M. Lyons, J. Richards

	Yes	No	Comment #
Primary O-ring:			
a. Heat affected or eroded O-ring?		✓	
b. O-ring defects/damage?		✓	
Secondary O-ring:			
c. Heat affected or eroded O-ring?		✓	
d. O-ring defects/damage?		✓	

Notes / Comments

Preliminary PFAR(s)? _____ Yes ✓ No Preliminary PFAR Number(s): _____

Clarification Form(s)? _____ Yes ✓ No Number of Forms Attached: _____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint RTV - Joint 5

Motor No.: RSRM-32	Side: Left (A)	Date: 8 JULY 93

Assessment Engineer(s)/Inspector(s): R. QUICK P. MILLER A. CARLISLE

Joint RTV:	Yes	No	Comment #
a. Gas penetration?		✓	
b. RTV not below char line?		✓	
c. Uncured/reverted RTV?		✓	
d. Voids within RTV?	✓		1
e. Foreign material?		✓	

Notes / Comments

1- INTERMITTENT VOIDS 360° LARGEST VOID AT 13°-20° APPROX .02 DP

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Verification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint Phenolics – Joint 5

Motor No.: RSRM-32	Side: Left (A)	Date: 8 JULY 93

Assessment Engineer(s)/Inspector(s): R. QUICK, P. MILLER, A. CARLISLE

Joint Phenolics:	Yes	No	Comment #
a. Heat affected or eroded CCP (below the char line), GCP, or adhesive?		✓	
b. Physical damage?		✓	
c. Edge separations (metal-to-adhesive, within adhesive, adhesive-GCP, within GCP, GCP-to-CCP, or within CCP)?		✓	
d. Phenolics axially displaced from the housing?		✓	

Notes / Comments

Special Issue 3.3.2 PHENOLIC NOT ACCESSABLE, SPECIAL ISSUE TO BE ADDRESSED DURING WASHOUT ON PFOR A-46

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

ification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR)
Nozzle Internal Joint Seals and Metal - Joint 5

Motor No.: RSRM-32	Side: Left (A)	Date: 8 JULY 93

Assessment Engineer(s)/Inspector(s): R. QUICK P. MILLER A. CARLISLE

Joint Seals and Metal:	Yes	No	Comment #
a. Soot to or past O-rings?		✓	
b. Sooted joint surfaces?		✓	
c. Heat affected or eroded O-rings (installed)?		✓	
d. O-ring damage (installed)?		✓	
e. Heat affected or eroded metal?		✓	
f. RTV to primary O-ring?	✓		1
g. RTV past primary O-ring?		✓	
h. Foreign material?		✓	
i. Excessive grease? (including in threaded and through bolt holes)		✓	
j. Metal damage? (including index pin and bolt holes (through, threaded/ helical coil inserts))		✓	
k. Bent or broken bolts?		✓	

es / Comments
- RTV TO PRIMARY O-RING AT 290° CENTER ABOUT BOLT HOLE FOR 1.0 IN. CIRCUM.

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

ification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint Drawing Worksheet – Joint 5

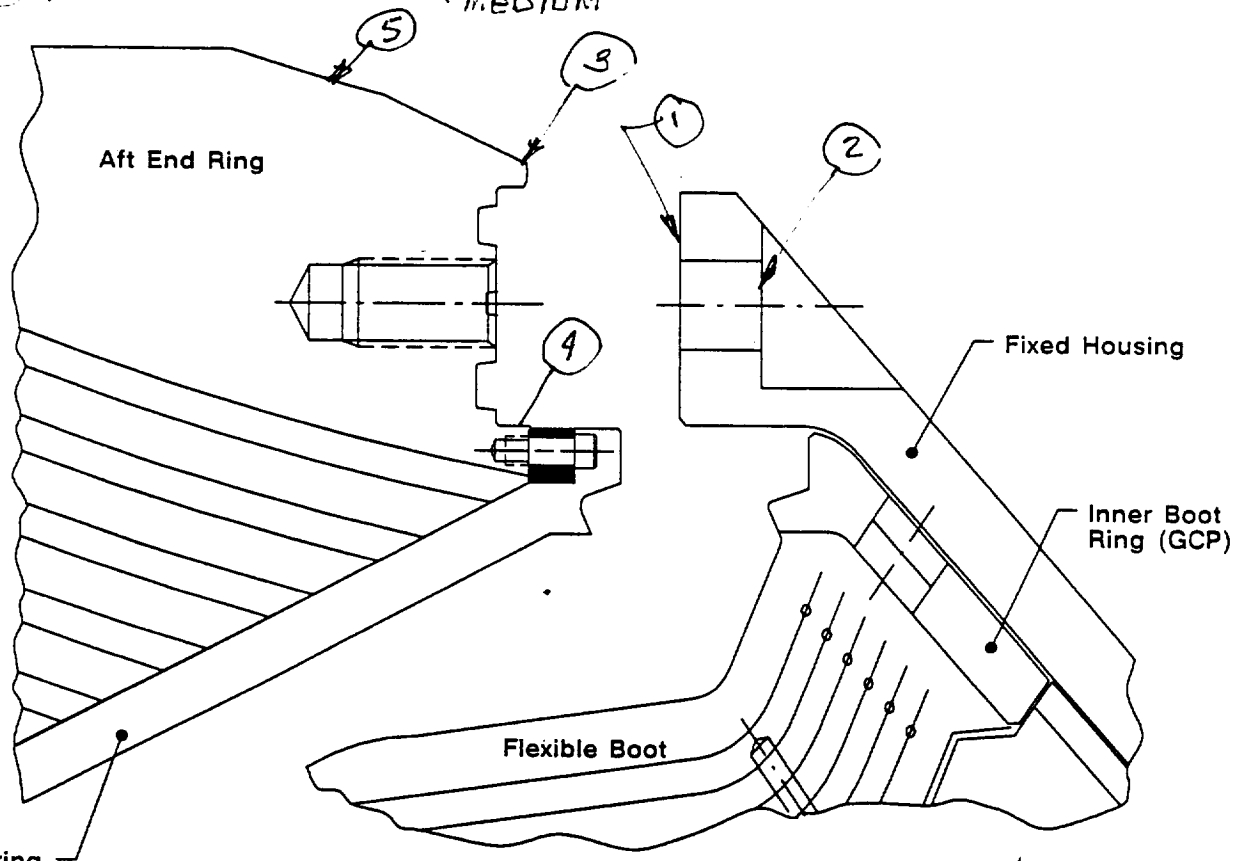
Motor No.: RSRM-32	Side: Left (A)	Date: 8 JULY 93
Assessment Engineer(s)/Inspector(s): R. QUICK, P. MILLER A. CARLISLE		

Sketch Observations Below (include locations and sizes of sketched features):

(1) NOMINAL GREASE COVERAGE

(2) LIGHT CORROSION ON PACKING RING SEAL SURFACE AT 110°

(3) MISSING PAINT AND CORROSION AT 260°-265° MEDIUM



(4) RTV REACHED AER AT LOCATIONS 90°, 100°-105°, 235°-240° 246-295

(5) SNUBBER CONTACT ON AER FROM 175-335 MAX AXIAL DISTANCE 6.2 IN.

POSTFLIGHT OBSERVATION RECORD (PFOR)
Nozzle Internal Joint O-rings (Detailed) - Joint 5

Motor No.: RSRM-32	Side: Left (A)	Date: 8 July 1993

Assessment Engineer(s)/Inspector(s): A. Carlisle, M. Lyons, J Richards

	Yes	No	Comment #
Primary O-ring:			
a. Heat affected or eroded O-ring?		✓	
b. O-ring defects/damage?		✓	
Secondary O-ring:			
c. Heat affected or eroded O-ring?		✓	
d. O-ring defects/damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint Packings With Retainers (Detailed) - Joint 5

Motor No.: RSRM-32	Side: Left (A)	Date: 8 July 1993

Assessment Engineer(s)/Inspector(s): A. Carlisle, M. Lyons, J. Richards

Packings With Retainers:	Yes	No	Comment #
a. Heat affected or eroded seal or retainer?		✓	
b. Seal or retainer defects/damage?	✓		1
c. Medium or heavy corrosion?		✓	

Notes / Comments

1) Typical disassembly rubber damage to >1 of >2 packing with retainers

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR)
Cowl Insulation Segments

Motor No.: RSRM-32	Side: Left (A)	Date: 9 July 93

Assessment Engineer(s)/Inspector(s): Jim PASSMAN Bob Quick

Cowl Insulation Segments:	Yes	No	Comment #
a. Abnormal heat effects or erosion?		✓	
b. Soot between the cowl segment and cowl housing/SCP?		✓	
c. Uncured adhesive (silicone)?		✓	

Bondline Failure Mode Percentage:

	Degree Location								
	0-45	45-90	90-135	135-180	180-225	225-270	270-315	315-0	Total
Metal-to-Adhesive	10	5	25	20	25	20	2	5	
Within Adhesive									
Adhesive-to-SCP	5	2	5	7	5	5	5	2	
Adhesive-to-segment	85	93	70	73	70	75	93	93	
Within segment									

Notes / Comments

Special Issue 3.3.3

THE COWL INSULATION SEGMENTS WERE IN EXCELENT CONDITION NO UNBONDING OR OTHER ANOMALOUS CONDITIONS WERE FOUND.

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR)
Flexible Bearing Protector, Flexible Bearing, and Flexible Boot

Motor No.: RSRM-32	Side: Left (A)	Date: 9 July 93

Assessment Engineer(s)/Inspector(s): Jim Passman, Bob Quick

Flexible Bearing Protector, Bearing, and Boot:	Yes	No	Comment #
a. Abnormal bearing protector heat effects or erosion? (including burn-through)		✓	
b. Cracks through the bearing protector?		✓	
c. Soot between the bearing protector and flexible bearing?		✓	
d. Heat effects to the flexible bearing?		✓	
e. Bent or broken bearing protector bolts?		✓	
f. Flexible boot burn-through?		✓	
g. Abnormal heat effects or erosion to flexible boot ID?		✓	
h. Foreign material in the boot cavity?		✓	

Notes / Comments

Special Issue 3.3.6 NO ABNORMAL CONDITION OBSERVED

eliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

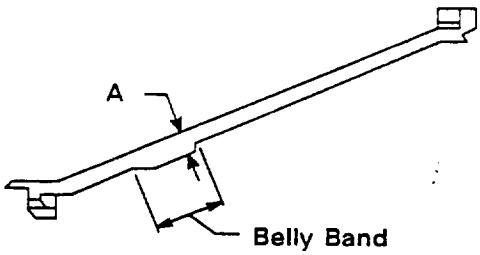
POSTFLIGHT OBSERVATION RECORD (PFOR)

Flexible Bearing Protector Measurements (Data Collection Only)

Motor No.: RSRM-32	Side: Left (A)	Date: 14 JUL 1993
Assessment Engineer(s)/Inspector(s):		

Flexible Bearing Protector Gas Impingement Area Thickness Measurements (see figure):

Degree Location	Thickness Measurement A* (inches)	Degree Location	Thickness Measurement A* (inches)	Degree Location	Thickness Measurement A* (inches)
0	.765	120	.738	240	.723
10	.715	130	.74[illegible]	250	.725
20	.73[illegible]	140	.735	260	.715
30	.735	150	.73[illegible]	270	.761
40	.74[illegible]	160	.72[illegible]	280	.71[illegible]
50	.765	170	.715	290	.725
60	.75[illegible]	180	.721	300	.73[illegible]
70	.74[illegible]	190	.73[illegible]	310	.74[illegible]
80	.732	200	.73[illegible]	320	.72[illegible]
90	.73[illegible]	210	.728	330	.725
100	.728	220	.73[illegible]	340	.72[illegible]
110	.735	230	.72[illegible]	350	.73[illegible]



* "A" is the minimum thickness of the bearing protector belly band in-line with the cowl vent holes. It corresponds to the deepest gas impingement location.

Notes / Comments

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Clarification Form(s)? _____ Yes ✓ No Number of Forms Attached: _____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Throat Diameter Measurements (Data Collection Only)

Motor No.: RSRM-32	Side: Left (A)	Date: 07-19-93

Assessment Engineer(s)/Inspector(s): MIGUEL ENRIQUEZ ; RICK GALLEGOS

Nozzle Throat Diameter Measurements:

Degree Location	Diameter Measurement (inches)
0	55.869"
45	55.857"
90	55.871"
135	55.876"

Notes / Comments

Avg. Throat Diameter = 55.867 inches

..arification Form(s)? _____ Yes ___✓___ No Number of Forms Attached: _____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Phenolic Bondline – Aft Exit Cone Assembly

Motor No.: RSRM-32	Side: Left (A)	Date: 13 JULY 93

Assessment Engineer(s)/Inspector(s): T. FRESTON

Metal Housing Bondline Surface:	Yes	No	Comment #
a. Soot?		✓	
b. Heat affected or eroded metal?		✓	
c. Voids in adhesive greater than 0.5 inch in any direction?		✓	
d. Corrosion?		✓	
e. Foreign material?		✓	

Note: Axial cuts may be relocated + or – 10 degrees only. Document if any cuts were relocated.

Primary Bondline/Phenolic Failure Mode Percentage (After Hydrolase and Wedge Removal):

	Degree Location							
	0-45	45-90	90-135	135-180	180-225	225-270	270-315	315-0
Metal-to-Adhesive	10	20	35	10	10	5	8	8
Within Adhesive								
Adhesive-to-GCP								
Within GCP	90	80	65	90	90	95	92	92
GCP-to-CCP								
Within CCP								

Secondary Bondline Failure Mode Percentage (After Removal of Remaining Phenolics):

	Degree Location							
Metal-to-Adhesive								
Within Adhesive								
Adhesive-to-GCP								

Phenolic Removal Method: NYLON WEDGE

Notes / Comments

Special Issue 3.3.15 No abnormal bondline separation modes.

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Phenolic Bondline – Forward Exit Cone Assembly

Motor No.: RSRM-32	Side: Left (A)	Date: 19-July 1993

Assessment Engineer(s)/Inspector(s): Jim PASSMAN, TREVOR CROSTON

Metal Housing Bondline Surface:	Yes	No	Comment #
a. Soot?		✓	
b. Heat affected or eroded metal?		✓	
c. Voids in adhesive greater than 0.5 inch in any direction?	✓		(1)
d. Corrosion?	✓		(2)
e. Foreign material?		✓	

Note: Axial cuts may be relocated + or – 10 degrees only. Document if any cuts were relocated.

Primary Bondline/Phenolic Failure Mode Percentage (After Hydrolase and Wedge Removal):

	Degree Location								
	0-45	45-90	90-135	135-180	180-225	225-270	270-315	315-0	Total
Metal-to-Adhesive	60	55	50	60	70	60	55	75	61
Within Adhesive									
Adhesive-to-GCP	40	45	50	40	30	40	45	25	39
Within GCP									
GCP-to-CCP									
Within CCP									

Secondary Bondline Failure Mode Percentage (After Removal of Remaining Phenolics):

	Degree Location							
Metal-to-Adhesive	N							
Within Adhesive			A					
Adhesive-to-GCP								

Phenolic Removal Method: _____

Notes / Comments

Special Issue 3.3.16 THE BONDLINE WAS IN NORMAL CONDITION.

DEGREE	SHIM LOCATION	THICKNESS	ADJACENT ADH THICK
0	FWD	.063	.063
0	AFT	.065	.060
90	FWD	.062	.061

DEGREE	SHIM LOCATION	THICK	ADJ ADH THK
90	AFT	.062	.063
180	FWD	.062	.061
180	AFT	.065	.062
270	FWD	.063	.060
270	AFT	.062	.066
45	FWD	.064	.074
45	AFT	.065	.062

(1) SEE CLARIFICATION FORM A-34A.

(2) MED – HEAVY CORROSION IN METAL-ADHESIVE FAILURE AREAS.

Preliminary PFAR(s)? _____ Yes ✓ No Preliminary PFAR Number(s): _____

Clarification Form(s)? ✓ Yes _____ No Number of Forms Attached: A-34A

135	FWD	.064	.075
135	AFT	.063	N/A
225	FWD REVISION ___	.063	.069
225	AFT	.065	.065

Thiokol CORPORATION
SPACE OPERATIONS

Nozzle Subassembly Bondline Adhesive Void Clarification Form

Motor No.: RSRM-32	Side: ☑ Left (A) ☐ Right (B)	Date: 19-JUL-93
Assessment Engineer(s)/Inspector(s):	TREVOR PRESTON JIM PASSMAN	
Nozzle Subassembly:	FWD EXIT CONE	

Record Bondline Adhesive Void Measurements and Locations Below:

Degree Location	Void Size Axial	Void Size Circ.	Location on Bonding Surface Distance From Fwd	Location on Bonding Surface Distance From Aft
78°	3.00	1.25	—	7.4
77°	0.90	0.40	—	11.2
189°	1.50	0.56	—	5.1
271°	1.10	0.55	—	13.6
274°	1.00	0.40	—	16.4
288	0.50	0.40	—	18.6

Notes / Comments

Corresponding Comment Number(s): (1)

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR)
Nozzle Phenolic Bondline – Throat Assembly

Motor No.: RSRM-32	Side: Left (A)	Date: 21 July 93

Assessment Engineer(s)/Inspector(s): JIM PASSMAN TREVOL FRESTON

Metal Housing Bondline Surface:	Yes	No	Comment #
a. Soot?		✓	
b. Heat affected or eroded metal?		✓	
c. Voids in adhesive greater than 0.5 inch in any direction?		✓	(1)
d. Corrosion?	✓		(2)
e. Foreign material?		✓	

Note: Axial cuts may be relocated + or – 10 degrees only. Document if any cuts were relocated.

Primary Bondline/Phenolic Failure Mode Percentage (After Hydrolase and Wedge Removal):

	Degree Location							
	0-360°							
Metal-to-Adhesive	100							
Within Adhesive								
Adhesive-to-GCP								
Within GCP								
GCP-to-CCP								
Within CCP								

Secondary Bondline Failure Mode Percentage (After Removal of Remaining Phenolics):

	Degree Location							
			N					
Metal-to-Adhesive								
Within Adhesive			A					
Adhesive-to-GCP								

Phenolic Removal Method: _____

Notes / Comments

(1) FEW VOIDS ~ .20 DIA.

(2) HEAVY CORROSION ENTIRE SURFACE.

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): _____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: _____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Phenolic Bondline – Forward Nose and Aft Inlet Rings

Motor No.: RSRM-32	Side: Left (A)	Date: 7/22/93

Assessment Engineer(s)/Inspector(s): R. Quick T. Freston

Metal Housing Bondline Surface:	Yes	No	Comment #
a. Soot?		✓	
b. Heat affected or eroded metal?		✓	
c. Voids in adhesive greater than 0.5 inch in any direction?	✓		1
d. Corrosion?	✓		SEE A-36A
e. Foreign material?		✓	

Note: Axial cuts may be relocated + or – 10 degrees only. Document if any cuts were relocated.

Primary Bondline/Phenolic Failure Mode Percentage (After Hydrolase and Wedge Removal):

	Degree Location							
	0-45	45-90	90-135	135-180	180-225	225-270	270-315	315-0
Metal-to-Adhesive	100%	100%	60%	60%	100%	100%	100%	100%
Within Adhesive								
Adhesive-to-GCP			40%	40%				
Within GCP								
GCP-to-CCP								
Within CCP								

Secondary Bondline Failure Mode Percentage (After Removal of Remaining Phenolics):

	Degree Location							
Metal-to-Adhesive								
Within Adhesive								
Adhesive-to-GCP								

Phenolic Removal Method: _____

Notes / Comments THE 40% ADHESIVE REMAINING WAS ON THE AFT INLET RING AREA 1- MEDIUM TO HEAVY CORROSION INTERMITTENT FULL CIRCUM

Special Issue 3.3.7 Nine voids documented on clarification form A-36A

Special Issue 3.3.10 SEE CLARIFICATION FORM A-36A

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): _____

Clarification Form(s)? ✓ Yes ____ No Number of Forms Attached: A-36A, A-36B

Thiokol CORPORATION
SPACE OPERATIONS

Nozzle Subassembly Bondline Adhesive Void Clarification Form

Motor No.: RSRM-32	Side: ☒ Left (A) ☐ Right (B)	Date: 7/22/93
Assessment Engineer(s)/Inspector(s): R. Quick T. Freston		
Nozzle Subassembly: Forward Nose And Aft Inlet Ring		

Record Bondline Adhesive Void Measurements and Locations Below:

Degree Location	Void Size Axial	Void Size Circ.	Location on Bonding Surface Distance From Fwd FACE OF NOSE RING	Location on Bonding Surface Distance From Aft
2°	.52	.27	.95	
110°	.37	.26	1.70	
122°	.48	.30	.90	
127°	.36	.21	1.95	
220°	.60	.32	.34	
222°	.41	.28	1.66	
255°	.42	.25	2.30	
318°	.35	.21	.90	
359°	.37	.25	2.20	

Notes / Comments

Corresponding Comment Number(s): _____

Thiokol CORPORATION
SPACE OPERATIONS

PFOR CLARIFICATION FORM

General

Motor No.: RSRM-32	Side: ☒ Left (A) ☐ Right (B)	Date: 7-22-93
Assessment Engineer(s)/Inspector(s): R. Quick, M. Clark		
Description: LDI Datasheet		

Sketch Observations Below (include locations and sizes of sketched features):

NOSE CAP TO HOUSING BONDLINE
(Left Hand)

Degree Location Recorded	Degree Location Actual	Distance[1] Recorded	Distance[1] Actual	~~Void or~~ Repair	Axial Length	Circ. Width	Other Info.
1	E 1	11.30	6.70	~~NO~~ NOT FOUND VOID	.38	.25	
16		10.80					NOT FOUND
33		16.85					NOT FOUND
79		7.60					NOT FOUND
163	163	11.10	6.40	VOID	.80	.45	
177	177	10.84	7.85	VOID	.43	.32	
316	316	9.20	8.40	VOID	.45	.40	

NOSE CAP TO FNR BONDLINE
(Left Hand)

Degree Location Recorded	Degree Location Actual	Distance[2] Recorded	Distance[2] Actual	~~Void or~~ Repair	Axial Length	Circ. Width	Other Info.
19		1.77					NOT FOUND
20		1.70					NOT FOUND
27		2.08	1.20	VOID	.30	.20	
48		1.98	1.20	VOID	.30	.20	
131		1.95	1.30	VOID	.40	.20	
132		2.32	1.70	VOID	.30	.20	
149		2.78	2.00	VOID	.25	.20	
150		1.90					NOT FOUND
157		3.70	1.30	VOID	.20	.10	
283		1.86	1.10	VOID	.30	.20	
306		2.24	1.40	VOID	.30	.20	
314		1.16					NOT FOUND
299		3.12	2.10	VOID	.15	.10	

FNR TO HOUSING BONDLINE
(Left Hand)

Degree Location Recorded	Degree Location Actual	Distance[3] Recorded	Distance[3] Actual	Void or Repair	Axial Length	Circ. Width	Other Info.
110		0.00					NOT FOUND
290		0.00					NOT FOUND

[1] Distance from fwd tip of nose cap glass
[2] Distance from flame surface
[3] Distance from FNR - nose cap - housing interface

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Phenolic Bondline – Nose Cap

Motor No.: RSRM-32	Side: Left (A)	Date: 7/22/93

Assessment Engineer(s)/Inspector(s): R. Quick T. Freston

Metal Housing Bondline Surface:	Yes	No	Comment #
a. Soot?		✓	
b. Heat affected or eroded metal?		✓	
c. Voids in adhesive greater than 0.5 inch in any direction?	✓		
d. Corrosion?	✓	1 & 2	
e. Foreign material?		✓	

Note: Axial cuts may be relocated + or – 10 degrees only. Document if any cuts were relocated.

Primary Bondline/Phenolic Failure Mode Percentage (After Hydrolase and Wedge Removal):

	Degree Location							
	0-45	45-90	90-135	135-180	180-225	225-270	270-315	315-0
Metal-to-Adhesive								
Within Adhesive								
Adhesive-to-GCP								
Within GCP								
GCP-to-CCP	100%	100%	100%	100%	100%	100%	100%	100%
Within CCP								

Secondary Bondline Failure Mode Percentage (After Removal of Remaining Phenolics):

	Degree Location								
	0-45	45-90	90-135	135-180	180-225	225-270	270-315	315-0	total
Metal-to-Adhesive	30%	40%	35%	40%	45%	30%	30%	40%	36
Within Adhesive									
Adhesive-to-GCP	70%	60%	65%	60%	55%	70%	70%	60%	64

Phenolic Removal Method: NYLON WEDGE

Notes / Comments 1-LIGHT TO MEDIUM CORROSION INTERMITTENT FULL CIRCUM
2-HYDROLAZE EROSION ON AXIAL CUT FWD TIP AT 10° & 250°

Special Issue 3.3.7 NO REPAIRS FOUND, 5 Voids found see below.

Special Issue 3.3.8 VOID AT 132° 1.25" FROM NOSE CAP FACE .43 AXIAL x .20 CIRCUM
3 SMALL VOIDS AT 283°

Special Issue 3.3.9 VOID AT 10 6.7 FROM ~~AFT~~ FORWARD x .38 AXIAL x .25 CIRCUM, 163° 6.4 FROM FWD END .8 AXIAL x .45 CIRCUM, 177° 7.85 FROM FWD END .43 AXIAL x .32 CIRCUM

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): 316°-8.4 x .45 AXIAL x .4 CIR

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Phenolic Bondline - Cowl Assembly

Motor No.: RSRM-32	Side: Left (A)	Date: 7/21/91

Assessment Engineer(s)/Inspector(s): JIM PASSMAN, TREVOR PRESTON

Metal Housing Bondline Surface:	Yes	No	Comment #
a. Soot?		✓	
b. Heat affected or eroded metal?		✓	
c. Voids in adhesive greater than 0.5 inch in any direction?		✓	
d. Corrosion?		✓	
e. Foreign material?		✓	

Note: Axial cuts may be relocated + or - 10 degrees only. Document if any cuts were relocated.

Primary Bondline/Phenolic Failure Mode Percentage (After Hydrolase and Wedge Removal):

	Degree Location							
	0-45°	45°-90°	90-135°	135-180	180-225	225-270	270-315°	315-360
Metal-to-Adhesive	15	5	2	2	2	5	0	0
Within Adhesive								
Adhesive-to-SCP	85	95	98	93	98	95	100	100
Within SCP				5				
SCP-to-CCP								
Within CCP								

Secondary Bondline Failure Mode Percentage (After Removal of Remaining Phenolics):

	Degree Location							
			N					
Metal-to-Adhesive			A					
Within Adhesive								
Adhesive-to-SCP								

Phenolic Removal Method: _____

Notes / Comments: ADHESIVE TO METAL FAILURES WERE LOCATED AT SHIMS OR HYDROLAZE CUTS.

Special Issue 3.3.7: NO VOIDS WERE FOUND.

Special Issue 3.3.13: BONDLINE WAS IN GOOD SHAPE, VERY LOW (~4%) METAL TO ADHESIVE FAILURE MODE, 95% ADHESIVE-TO-SCP.

Preliminary PFAR(s)? _____ Yes ✓ No Preliminary PFAR Number(s): _____

Clarification Form(s)? _____ Yes ✓ No Number of Forms Attached: _____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Phenolic Bondline – Fixed Housing Assembly

Motor No.: RSRM-32	Side: Left (A)	Date: 14 JULY 93

Assessment Engineer(s)/Inspector(s): R. Quick P. Miller

Metal Housing Bondline Surface:	Yes	No	Comment #
a. Soot?		✓	
b. Heat affected or eroded metal?		✓	
c. Voids in adhesive greater than 0.5 inch in any direction?	✓		1
d. Corrosion?		✓	
e. Foreign material?		✓	

Note: Axial cuts may be relocated + or – 10 degrees only. Document if any cuts were relocated.

Primary Bondline/Phenolic Failure Mode Percentage (After Hydrolase and Wedge Removal):

	Degree Location							
	0-45	45-90	90-135	135-180	180-225	225-270	270-315	315-0
Metal-to-Adhesive								
Within Adhesive								
Adhesive-to-GCP								
Within GCP	100%	100%	100%	100%	100%	100%	100%	100%
GCP-to-CCP								
Within CCP								

Secondary Bondline Failure Mode Percentage (After Removal of Remaining Phenolics):

	Degree Location								Total
Metal-to-Adhesive					2%				0.25
Within Adhesive									
Adhesive-to-GCP	100%	100%	100%	100%	98%	100%	100%	100%	99.75

Phenolic Removal Method: NYLON WEDGE

Notes / Comments

1.60% .4 FROM AFT END 2.6 AXIAL x .60 CIRCUM

90° 1.6 FROM AFT END 1.0 AXIAL x .30 CIRCUM

Special Issue 3.3.2 There was no sign of growth in the areas of the wetlines

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Phenolic Sections - Aft Exit Cone

Motor No.: RSRM-32	Side: Left (A)	Date: 8-27-93
Assessment Engineer(s)/Inspector(s): M. Clark		

Phenolic Sections:

	Yes	No	Comment #
a. Cross-ply cracking in virgin material?			
b. Ply lifting?			

Aft Exit Cone Char and Erosion Measurements:

Station Location	0° Erosion	0° Char	90° Erosion	90° Char	180° Erosion	180° Char	270° Erosion	270° Char
73.77	①							
77.77								
83.77				NA				
89.77								
95.77				NA				
101.77								
107.77								
113.77								
118.77								

Negative Margin of Safety? _____ Yes _____ No Station: _____ Degree: _____

Notes / Comments

Special Issue 3.3.19 Pieces recovered at KSC have been misplaced and have not been assessed

①None of the CCP remained attached to housing to allow measurements to be taken

Preliminary PFAR(s)? _____ Yes ✓ No Preliminary PFAR Number(s): _____

Clarification Form(s)? _____ Yes ✓ No Number of Forms Attached: _____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Phenolic Sections – Forward Exit Cone

Motor No.: RSRM-32	Side: Left (A)	Date: 8-26-93
Assessment Engineer(s)/Inspector(s): L.E. WILKES		

Phenolic Sections:	Yes	No	Comment #
a. Cross-ply cracking in virgin material?		✓	
b. Ply lifting?		✓	

Forward Exit Cone Char and Erosion Measurements:

Station	0°		90°		180°		270°	
Location	Erosion	Char	Erosion	Char	Erosion	Char	Erosion	Char
1.0	.37	.75	.37	.76	.33	.78	.36	.76
4.0	.36	.73	.35	.76	.34	.74	.37	.74
4.6	.37	.71	.37	.72	.36	.75	.36	.77
8.0	.35	.71	.37	.68	.35	.70	.35	.74
12.0	.35	.76	.32	.73	.33	.70	.33	.65
16.0	NA	NA	NA	NA	NA	NA	NA	NA
20.0	↓	↓	↓	↓	↓	↓	↓	↓
24.0	NA	NA	↓	↓	↓	↓	↓	↓
28.0	.30	.70	NA	NA	.28	.70	.25	
32.0	.21	.75	.19	.78	.25	.68	.19	.82
32.9	.18	.70	.19	.75	.16	.71	.15	.81
34.0	.15	.67	.15	.75	.17	.74	.14	.82

Negative Margin of Safety? _____ Yes ✓ No Station: _____ Degree: _____

Notes / Comments

Preliminary PFAR(s)? _____ Yes ✓ No Preliminary PFAR Number(s): _____

larification Form(s)? _____ Yes ✓ No Number of Forms Attached: _____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Phenolic Sections - Throat Assembly

Motor No.: RSRM-32	Side: Left (A)	Date: 8-[illegible]
Assessment Engineer(s)/Inspector(s): L.E. WILKES		

Phenolic Sections:

	Yes	No	Comment #
a. Cross-ply cracking in virgin material?		✓	
b. Ply lifting?		✓	

Throat Inlet Ring and Throat Ring Char and Erosion Measurements:

Station	0°		90°		180°		270°	
Location	Erosion	Char	Erosion	Char	Erosion	Char	Erosion	Char
1.0	1.07	.62	1.06	.62	1.06	.68	1.03	.62
2.0	1.11	.71	1.08	.61	1.09	.66	1.07	.67
4.0	1.17	.68	1.14	.68	1.16	.59	1.12	.68
6.0	1.23	.63	1.20	.64	1.20	.64	1.19	.70
8.0	1.24	.50	1.21	.56	1.27	.50	1.23	.[illegible]
10.0	1.18	.56	1.19	.54	1.18	.[illegible]	1.15	.55
12.0	1.15	.60	1.16	.57	1.14	.62	1.13	.60
14.0	1.13	.62	1.16	.58	1.15	.59	1.13	.56
16.0	1.06	.69	1.05	.68	1.10	.65	1.14	.73
18.0	.96	.78	.95	.76	.96	.68	.94	.66
20.0	.76	.80	.78	.71	.77	.75	.72	.77
22.0	.[illegible]	.80	.51	.81	.51	.81	.47	.84
23.0	.44	.82	.47	.80	.44	.80	.41	82

Negative Margin of Safety? _____ Yes ✓ No Station: _____ Degree: _____

Notes / Comments

Preliminary PFAR(s)? _____ Yes ✓ No Preliminary PFAR Number(s): _____

larification Form(s)? _____ Yes ✓ No Number of Forms Attached: _____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Phenolic Sections - Forward Nose and Aft Inlet Rings

Motor No.: RSRM-32	Side: Left (A)	Date: 8/26/93

Assessment Engineer(s)/Inspector(s): CLARK, PASSMAN, QUICK, WILKES

Phenolic Sections:	Yes	No	Comment #
a. Cross-ply cracking in virgin material?		✓	
b. Ply lifting?		✓	

Forward Nose Ring Char and Erosion Measurements:

Station	0°		90°		180°		270°	
Location	Erosion	Char	Erosion	Char	Erosion	Char	Erosion	Char
28.0	.122	.66	.110	.58	N/A		.115	.67
30.0	.93	.60	.87	.67	.82	.66	.93	.64
32.0	.93	.64	.90	.59	.92	.55	1.01	.66

Negative Margin of Safety? _____ Yes ✓ No Station: _____ Degree: _____

Aft Inlet Ring Char and Erosion Measurements:

Station	0°		90°		180°		270°	
Location	Erosion	Char	Erosion	Char	Erosion	Char	Erosion	Char
34.0	.88	.61	.83	.60	.90	.53	.87	.63
36.0	.90	.60	.86	.59	.92	.55	.91	.67
38.0	.96	.53	.94	.64	.98	.56	.98	.72
39.0	.99	.56	.94	.56	1.00	.61	1.01	.70

Negative Margin of Safety? _____ Yes ✓ No Station: _____ Degree: _____

Notes / Comments

Preliminary PFAR(s)? _____ Yes ✓ No Preliminary PFAR Number(s): _____

larification Form(s)? _____ Yes ✓ No Number of Forms Attached: _____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Phenolic Sections – Nose Cap

Motor No.: RSRM-32	Side: Left (A)	Date: 8/25/93

Assessment Engineer(s)/Inspector(s): CLARK, FASSMAN, QUICK, WILKES

Phenolic Sections:	Yes	No	Comment #
a. Cross-ply cracking in virgin material?		✓	
b. Ply lifting?		✓	

Nose Cap Char and Erosion Measurements:

Station Location	0° Erosion	0° Char	90° Erosion	90° Char	180° Erosion	180° Char	270° Erosion	270° Char
1.5	.29	.50	.74*		.70*		.85*	
4.0	.40	.48	.40	.43	.32	.51	.33	.56
6.0	.41	.53	.42	.48	.33	.53	.37	.47
8.0	.49	.51	.44	.49	.44	.39	.43	.49
10.0	.56	.47	.50	.48	.45	.45	.49	.50
12.0	.58	.51	.48	.49	.45	.49	.49	.50
14.0	.70	.44	.65	.51	.58	.42	.59	.48
16.0	.78	.46	.69	.43	.61	.46	.62	.45
18.0	.94	.44	.81	.38	.76	.41	.71	.47
20.0	1.15	.51	1.05	.39	.93	.47	.95	.47
22.0	1.79	.63	1.69	.55	1.57	.63	1.49	.88
24.0	1.94	.70	1.79	.71	1.76	.78	1.85	.89
26.0	1.40	.70	1.27	.76	1.30	.77	1.45	.79

Negative Margin of Safety? ____ Yes ✓ No Station: ____ Degree: ____

Notes / Comments * DENOTES MAX AFFECTE DEPTH

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

larification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Phenolic Sections - Cowl

Motor No.: RSRM-32	Side: Left (A)	Date: [illegible]

Assessment Engineer(s)/Inspector(s): L. E. [illegible]

Phenolic Sections:

	Yes	No	Comment #
a. Cross-ply cracking in virgin material?		✓	
b. Ply lifting?		✓	

Cowl Char and Erosion Measurements:

Station Location	0° Erosion	0° Char	90° Erosion	90° Char	180° Erosion	180° Char	270° Erosion	270° Char
0.3	.30	.80	.31	.72	.30	.71	.28	.78
1.0	.27	.73	.32	.66	.27	.68	.26	.70
2.0	.27	.69	.25	.68	.23	.62	.22	[illegible]
3.0	.26	.65	.22	.69	.20	.66	.21	.71
4.0	.24	.62	.19	.68	.18	.63	.18	.72
5.0	.20	.78	.18	.72	.15	.69	.16	.71
6.0	.16	.70	.15	.67	.14	.76	.14	.70
6.8	[illegible]	.82	.15	.87	.18	.82	.23	.82

Negative Margin of Safety? ______ Yes ______ No Station: ______ Degree: ______

Notes / Comments

Special Issue 3.3.17 [illegible]

Preliminary PFAR(s)? ______ Yes ✓ No Preliminary PFAR Number(s): ______

larification Form(s)? ______ Yes ✓ No Number of Forms Attached: ______

REVISION ____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Phenolic Sections – Fixed Housing

Motor No.: RSRM-32	Side: Left (A)	Date: 8-26-93

Assessment Engineer(s)/Inspector(s): L.E. WILKES

Phenolic Sections:	Yes	No	Comment #
a. Cross-ply cracking in virgin material?		✓	
b. Ply lifting?		✓	

Fixed Housing Char and Erosion Measurements:

Station	0°		90°		180°		270°	
Location	Erosion	Char	Erosion	Char	Erosion	Char	Erosion	Char
0.0	.08	1.20	.05	1.12	.04	1.13	.00	1.21
1.0	.04	1.13	.06	1.06	.02	1.03	.01	1.08
2.0	.00	1.07	.01	.96	.02	1.10	.04	1.00
3.0	.03	.97	.01	.97	.05	1.13	.03	1.05
4.0	.03	1.01	.01	.93	.01	1.07	.04	1.02
5.0	.01	1.00	.01	.91	.00	1.04	.03	1.01
6.0	.01	1.04	.00	.[illegible]	.00	1.04	.05	1.00
7.0	.01	1.02	.00	.92	.01	.99	.00	.96
8.0	.00	.92	.00	.78	.00	.86	.00	.73
9.0	.05	.93	N/A	.73*	.00	.83	.00	.78
10.75	.02	1.84	N/A	1.84*	.15	1.45	.00	1.73

Negative Margin of Safety? ____ Yes ✓ No Station: ____ Degree: ____

Notes / Comments * TOTAL HEAT AFFECTED DEPTH (CHAR LINE)

Special Issue 3.3.2 SEE PFOR PAGE A-24.

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Phenolic Sections - Outer Boot Ring and Flexible Boot

Motor No.: RSRM-32	Side: Left (A)	Date: 8-24-93

Assessment Engineer(s)/Inspector(s): L.E. WHITE

Phenolic Sections:	Yes	No	Comment #
a. Cross-ply cracking in virgin material?		✓	
b. Ply lifting?		✓	
Flexible Boot/Outer Boot Ring Interface:			
c. Separations?	✓		1
d. Heat effects in separations (if present)?		✓	

Outer Boot Ring Char and Erosion Measurements:

Station	0°		90°		180°		270°	
Location	Erosion	Char	Erosion	Char	Erosion	Char	Erosion	Char
8.0	.10	.92	.10	.82	.07	.87	.14	.92
9.0	.09	.91	.10	.80	.03	.94	.05	1.01
10.0	.05	.90	.05	.79	.01	.92	.04	.94
11.3	.07	.92	.07	.81	.00	.87	.05	

Negative Margin of Safety? _____ Yes ✓ No Station: _____ Degree: _____

Number of Plies Remaining on the Flexible Boot:

Degree Location	Plies Remaining
0	3.7
90	3.2
180	3.5
270	3.1

Negative Margin of Safety? _____ Yes _____ No Degree: _____

Notes / Comments ① SEPARATIONS WERE OBSERVED AT 0° AND 270° SECTIONS BUT NO HEAT EFFECTS WERE FOUND IN SEPARATIONS

Preliminary PFAR(s)? _____ Yes ✓ No Preliminary PFAR Number(s): _____

Clarification Form(s)? _____ Yes ✓ No Number of Forms Attached: _____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Barrier-Booster Leak Check Port Plug and Port (At Removal) – 126 Degrees

Motor No.: RSRM-32	Side: Left (A)	Date: 7-9-93

Assessment Engineer(s)/Inspector(s): S. Eden, M. Lyon, C. Taylor, L. MacCauley

Leak Check Port Plug and Port:	Yes	No	Comment #
a. Soot to or past O-ring?		✓	
b. Sooted surfaces?		✓	
c. Heat affected or eroded O-ring (installed)?		✓	
d. O-ring damage (installed)?		✓	
e. Heat affected or eroded metal?		✓	
f. Foreign material?		✓	
g. Excessive grease?		✓	
h. Medium or heavy corrosion?		✓	
i. Metal damage?		✓	

Notes / Comments

Preliminary PFAR(s)? _____ Yes ✓ No Preliminary PFAR Number(s): _____

Clarification Form(s)? _____ Yes ✓ No Number of Forms Attached: _____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Barrier-Booster Leak Check Port Plug and O-ring (Detailed) - 126 Degrees

Motor No.: RSRM-32	Side: Left (A)	Date: 7-9-93

Assessment Engineer(s)/Inspector(s): S. Eden, M. Lyon, C. Taylor, L. MacCauley

	Yes	No	Comment #
Leak Check Port Plug:			
a. Foreign material between the O-ring and plug?		✓	
b. Heat affected or eroded metal?		✓	
c. Seal surface/thread damage?		✓	
Secondary O-ring:			
d. Heat affected or eroded O-ring?		✓	
e. O-ring defects/damage?		✓	

Notes / Comments

Preliminary PFAR(s)? _____ Yes ✓ No Preliminary PFAR Number(s): _____

Clarification Form(s)? _____ Yes ✓ No Number of Forms Attached: _____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint Leak Check Port Plug and Port (At Removal) – Joint 2

Motor No.: RSRM-32	Side: Left (A)	Date: 7-9-93

Assessment Engineer(s)/Inspector(s): W. Sperry, M. Offolter

Leak Check Port Plug and Port:	Yes	No	Comment #
a. Soot to or past O-ring?		✓	
b. Sooted surfaces?		✓	
c. Heat affected or eroded O-ring (installed)?		✓	
d. O-ring damage (installed)?		✓	
e. Heat affected or eroded metal?		✓	
f. Foreign material?		✓	
g. Excessive grease?		✓	
h. Medium or heavy corrosion?		✓	
i. Metal damage?		✓	

Plug Break-away and Running Torques (inch-lbs): Break-away: 35
Running: 7

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint Leak Check Port Plug and O-ring (Detailed) - Joint 2

Motor No.: RSRM-32	Side: Left (A)	Date: 7-9-93

Assessment Engineer(s)/Inspector(s): W. Sperry, M. Offolter

	Yes	No	Comment #
Leak Check Port Plug:			
a. Foreign material between the O-ring and plug?		✓	
b. Heat affected or eroded metal?		✓	
c. Seal surface/thread damage?		✓	
Secondary O-ring:			
d. Heat affected or eroded O-ring?		✓	
e. O-ring defects/damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint Leak Check Port Plug and Port (At Removal) - Joint 3

Motor No.: RSRM-32	Side: Left (A)	Date: 7-9-93

Assessment Engineer(s)/Inspector(s): W. SPERRY, M. OFFOLTER

Leak Check Port Plug and Port:	Yes	No	Comment #
a. Soot to or past O-ring?		✓	
b. Sooted surfaces?		✓	
c. Heat affected or eroded O-ring (installed)?		✓	
d. O-ring damage (installed)?		✓	
e. Heat affected or eroded metal?		✓	
f. Foreign material?		✓	
g. Excessive grease?		✓	
h. Medium or heavy corrosion?		✓	
i. Metal damage?		✓	

Plug Break-away and Running Torques (inch-lbs): Break-away: 40 in-lb
Running: 10

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint Leak Check Port Plug and O-ring (Detailed) - Joint 3

Motor No.: RSRM-32	Side: Left (A)	Date: 7-9-93

Assessment Engineer(s)/Inspector(s): W. Speny, M. Offolter, B. Ferguson

	Yes	No	Comment #
Leak Check Port Plug:			
a. Foreign material between the O-ring and plug?		✓	
b. Heat affected or eroded metal?		✓	
c. Seal surface/thread damage?		✓	
Secondary O-ring:			
d. Heat affected or eroded O-ring?		✓	
e. O-ring defects/damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint Leak Check Port Plug and Port (At Removal) – Joint 4

Motor No.: RSRM-32	Side: Left (A)	Date: 7 July 1993

Assessment Engineer(s)/Inspector(s): A. Carlisle, B. Quick, M. Lyons, T. Richards

Leak Check Port Plug and Port:	Yes	No	Comment #
a. Soot to or past O-ring?		✓	
b. Sooted surfaces?		✓	
c. Heat affected or eroded O-ring (installed)?		✓	
d. O-ring damage (installed)?		✓	
e. Heat affected or eroded metal?		✓	
f. Foreign material?		✓	
g. Excessive grease?		✓	
h. Medium or heavy corrosion?		✓	
i. Metal damage?		✓	

Plug Break-away and Running Torques (inch-lbs): Break-away: 42 Running: 5

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint Leak Check Port Plug and O-ring (Detailed) – Joint 4

Motor No.: RSRM-32	Side: Left (A)	Date: 7 JUL 1993

Assessment Engineer(s)/Inspector(s): A. Carlisle, B. Quick, M. Lyons, T. Richards

	Yes	No	Comment #
Leak Check Port Plug:			
a. Foreign material between the O-ring and plug?		✓	
b. Heat affected or eroded metal?		✓	
c. Seal surface/thread damage?		✓	
Secondary O-ring:			
d. Heat affected or eroded O-ring?		✓	
e. O-ring defects/damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint Leak Check Port Plug and Port (At Removal) - Joint 5

Motor No.: RSRM-32	Side: Left (A)	Date: 8 July 1993

Assessment Engineer(s)/Inspector(s): A. Cachitte, M. Lyons, J. Richards

Leak Check Port Plug and Port:	Yes	No	Comment #
a. Soot to or past O-ring?		√	
b. Sooted surfaces?		√	
c. Heat affected or eroded O-ring (installed)?		√	
d. O-ring damage (installed)?		√	
e. Heat affected or eroded metal?		√	
f. Foreign material?		√	
g. Excessive grease?		√	
h. Medium or heavy corrosion?		√	
i. Metal damage?		√	

Plug Break-away and Running Torques (inch-lbs): Break-away: 31

Running: 10

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint Leak Check Port Plug and O-ring (Detailed) - Joint 5

Motor No.: RSRM-32	Side: Left (A)	Date: 8/4/1993
Assessment Engineer(s)/Inspector(s): A. Carlisle, M. Lyons, J. Richards		

	Yes	No	Comment #
Leak Check Port Plug:			
a. Foreign material between the O-ring and plug?		✓	
b. Heat affected or eroded metal?		✓	
c. Seal surface/thread damage?		✓	
Secondary O-ring:			
d. Heat affected or eroded O-ring?		✓	
e. O-ring defects/damage?		✓	

Notes / Comments

Preliminary PFAR(s)? _____ Yes ✓ No Preliminary PFAR Number(s): _____

Clarification Form(s)? _____ Yes ✓ No Number of Forms Attached: _____

POSTFLIGHT OBSERVATION RECORD (PFOR)
Case Factory Joint - Forward Dome

Motor No.: RSRM-32	Side: Left (A)	Date: 21 SEP 1993

Assessment Engineer(s)/Inspector(s): Birch

Joint Seals and Metal:	Yes	No	Comment #
a. Heat affected or eroded O-ring?		X	
b. Heavy corrosion (pitting) in joint?		X	
c. Heavy corrosion (pitting) in leak check port?		X	

Note: Remove corrosion to determine if pitting has occurred. Care should be taken not to damage the hardware. Solvent and/or green Scotch-Brite® pads may be used to remove the corrosion. Corrosion removal is to be done in a circumferential direction only.

Notes / Comments

Preliminary PFAR(s)? ____ Yes X No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes X No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)
Case Factory Joint - Forward Cylinder/Cylinder

Motor No.: RSRM-32	Side: Left (A)	Date: 21 SEP 1993

Assessment Engineer(s)/Inspector(s): Birch

Joint Seals and Metal:

	Yes	No	Comment #
a. Heat affected or eroded O-ring?		X	
b. Heavy corrosion (pitting) in joint?		X	
c. Heavy corrosion (pitting) in leak check port?		X	

Note: Remove corrosion to determine if pitting has occurred. Care should be taken not to damage the hardware. Solvent and/or green Scotch-Brite® pads may be used to remove the corrosion. Corrosion removal is to be done in a circumferential direction only.

Notes / Comments

Preliminary PFAR(s)? ____ Yes X No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes X No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Case Factory Joint - Forward Center

Motor No.: RSRM-32	Side: Left (A)	Date: 09-28-93

Assessment Engineer(s)/Inspector(s): H. ZAREMBA

Joint Seals and Metal:	Yes	No	Comment #
a. Heat affected or eroded O-ring?		X	
b. Heavy corrosion (pitting) in joint?		X	
c. Heavy corrosion (pitting) in leak check port?		X	

Note: Remove corrosion to determine if pitting has occurred. Care should be taken not to damage the hardware. Solvent and/or green Scotch-Brite® pads may be used to remove the corrosion. Corrosion removal is to be done in a circumferential direction only.

Notes / Comments

Preliminary PFAR(s)? ____ Yes X No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes X No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Case Factory Joint – Aft Center

Motor No.: RSRM-32	Side: Left (A)	Date: 9-22-93

Assessment Engineer(s)/Inspector(s): G RICH

Joint Seals and Metal:	Yes	No	Comment #
a. Heat affected or eroded O-ring?		✓	
b. Heavy corrosion (pitting) in joint?		✓	
c. Heavy corrosion (pitting) in leak check port?		✓	

Note: Remove corrosion to determine if pitting has occurred. Care should be taken not to damage the hardware. Solvent and/or green Scotch-Brite® pads may be used to remove the corrosion. Corrosion removal is to be done in a circumferential direction only.

Notes / Comments

NONE

Preliminary PFAR(s)? _____ Yes ✓ No Preliminary PFAR Number(s): _____

Clarification Form(s)? _____ Yes ✓ No Number of Forms Attached: _____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Case Factory Joint - ET Attach/Stiffener

Motor No.: RSRM-32	Side: Left (A)	Date: 9-1-93
Assessment Engineer(s)/Inspector(s): C. Rich		

Joint Seals and Metal:	Yes	No	Comment #
a. Heat affected or eroded O-ring?		✓	
b. Heavy corrosion (pitting) in joint?		-	
c. Heavy corrosion (pitting) in leak check port?		✓	

Note: Remove corrosion to determine if pitting has occurred. Care should be taken not to damage the hardware. Solvent and/or green Scotch-Brite® pads may be used to remove the corrosion. Corrosion removal is to be done in a circumferential direction only.

Notes / Comments

Preliminary PFAR(s)? _____ Yes ✓ No Preliminary PFAR Number(s): _____

Clarification Form(s)? _____ Yes ✓ No Number of Forms Attached: _____

POSTFLIGHT OBSERVATION RECORD (PFOR)
Case Factory Joint - Stiffener/Stiffener

Motor No.: RSRM-32	Side: Left (A)	Date: 9-1-93

Assessment Engineer(s)/Inspector(s): G RICH

Joint Seals and Metal:	Yes	No	Comment #
a. Heat affected or eroded O-ring?		✓	
b. Heavy corrosion (pitting) in joint?		✓	
c. Heavy corrosion (pitting) in leak check port?		✓	

Note: Remove corrosion to determine if pitting has occurred. Care should be taken not to damage the hardware. Solvent and/or green Scotch-Brite® pads may be used to remove the corrosion. Corrosion removal is to be done in a circumferential direction only.

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)
Case Factory Joint - Aft Dome

Motor No.: RSRM-32	Side: Left (A)	Date: 09.01.93

Assessment Engineer(s)/Inspector(s): Schenck

Joint Seals and Metal:	Yes	No	Comment #
a. Heat affected or eroded O-ring?		✓	
b. Heavy corrosion (pitting) in joint?		✓	
c. Heavy corrosion (pitting) in leak check port?		✓	

Note: Remove corrosion to determine if pitting has occurred. Care should be taken not to damage the hardware. Solvent and/or green Scotch-Brite® pads may be used to remove the corrosion. Corrosion removal is to be done in a circumferential direction only.

Notes / Comments

Preliminary PFAR(s)? _____ Yes ✓ No Preliminary PFAR Number(s): _____

Clarification Form(s)? _____ Yes ✓ No Number of Forms Attached: _____

POSTFLIGHT OBSERVATION RECORD (PFOR)

S&A Device (Barrier-Booster and Environmental Seal Regions)

Motor No.: RSRM-32	Side: Right (B)	Date: 7/9/93
Assessment Engineer(s)/Inspector(s): Eden / Nolan		

	Yes	No	Comment #
Barrier-Booster Bore and Rotor:			
a. Soot to or past O-rings?	✓		(1)
b. Sooted metal surfaces?	✓		(1)
c. Heat affected or eroded O-ring (installed)?		✓	
d. O-ring damage (installed)?		✓	
e. Foreign material?		✓	
f. Heat affected or eroded metal?		✓	
g. Metal damage?		✓	
h. Excessive grease?		✓	
i. Corrosion?		✓	
j. Teflon retainer damage?		✓	
Environmental Seal Regions:			
k. Environmental O-ring assembly damage (visible without magnification)?		✓	
l. Foreign material?		✓	

Notes / Comments

(1) Typical pressure to primary O-ring #1 with associated sooting.

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)

S&A Rotor Shaft O-rings (Detailed)

Motor No.: RSRM-32	Side: Right (B)	Date: 7/9/93

Assessment Engineer(s)/Inspector(s): Eden / Nolan

	Yes	No	Comment #
Forward Primary O-ring:			
a. Heat affected or eroded O-ring?		✓	
b. O-ring defects/damage?		✓	
Aft Primary O-ring:			
c. Heat affected or eroded O-ring?		✓	
d. O-ring defects/damage?		✓	
Forward Secondary O-ring:			
e. Heat affected or eroded O-ring?		✓	
f. O-ring defects/damage?		✓	
Aft Secondary O-ring:			
g. Heat affected or eroded O-ring?		✓	
h. O-ring defects/damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)

SII and Port (At Removal) - 18 Degrees

Motor No.: RSRM-32	Side: Right (B)	Date: 7/9/93

Assessment Engineer(s)/Inspector(s): Eden / Nolan

SII and Port:	Yes	No	Comment #
a. Soot to or past O-ring?		✓	
b. Sooted surfaces?	✓		(1)
c. Heat affected or eroded O-ring (installed)?		✓	
d. O-ring damage (installed)?		✓	
e. Eroded metal?		✓	
f. Foreign material?		✓	
g. Excessive grease?		✓	
h. Medium or heavy corrosion?		✓	
i. Metal damage?		✓	

Notes / Comments

(1) typical soot to the 2nd thread and tip of SII.

Preliminary PFAR(s)? _____ Yes ✓ No Preliminary PFAR Number(s): _____

Clarification Form(s)? _____ Yes ✓ No Number of Forms Attached: _____

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SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR)

SII and O-rings (Detailed) - 18 Degrees

Motor No.: RSRM-32	Side: Right (B)	Date: 7/9/93

Assessment Engineer(s)/Inspector(s): Eden / Nolan

	Yes	No	Comment #
SII:			
a. Foreign material between the O-ring and SII?		✓	
b. Eroded metal?		✓	
c. Seal surface/thread damage?		✓	
Primary O-ring:			
d. Heat affected or eroded O-ring?		✓	
e. O-ring defects/damage?		✓	
Secondary O-ring:			
f. Heat affected or eroded O-ring?		✓	
g. O-ring defects/damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)

SII and Port (At Removal) - 198 Degrees

Motor No.: RSRM-32	Side: Right (B)	Date: 7/9/93

Assessment Engineer(s)/Inspector(s): Eden / Nolan

SII and Port:	Yes	No	Comment #
a. Soot to or past O-ring?		✓	
b. Sooted surfaces?	✓	✓	1
c. Heat affected or eroded O-ring (installed)?		✓	
d. O-ring damage (installed)?		✓	
e. Eroded metal?		✓	
f. Foreign material?		✓	
g. Excessive grease?		✓	
h. Medium or heavy corrosion?		✓	
i. Metal damage?		✓	

Notes / Comments

1- Typical soot to tip of SII.

Preliminary PFAR(s)? _____ Yes ✓ No Preliminary PFAR Number(s): _____

Clarification Form(s)? _____ Yes ✓ No Number of Forms Attached: _____

POSTFLIGHT OBSERVATION RECORD (PFOR)

SII and O-rings (Detailed) – 198 Degrees

Motor No.: RSRM-32	Side: Right (B)	Date: 7/9/93

Assessment Engineer(s)/Inspector(s): Eden / Nolan

	Yes	No	Comment #
SII:			
a. Foreign material between the O-ring and SII?		✓	
b. Eroded metal?		✓	
c. Seal surface/thread damage?		✓	
Primary O-ring:			
d. Heat affected or eroded O-ring?		✓	
e. O-ring defects/damage?		✓	
Secondary O-ring:			
f. Heat affected or eroded O-ring?		✓	
g. O-ring defects/damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Metal Components – Excluding Joints

Motor No.: RSRM-32	Side: Right (B)	Date: 9 Jul, 93

Assessment Engineer(s)/Inspector(s): J. Passman, R. Quick, M. Clark

Metal Component (check appropriate space when evaluation is completed):

✓	Forward Exit Cone Housing	✓	Flexible Bearing
✓	Fixed Housing	✓	Throat Housing
✓	Cowl Housing	✓	Nose Inlet Housing

Metal Components:	Yes	No	Comment #
a. Metal damage?		✓	
b. Loose or missing fasteners? (including forward exit cone forward shear pins)		✓	
c. Heat affected paint (discolored and blistered)?		✓	
d. Bubbled paint?		✓	
e. Missing primer or paint not due to impact or handling?		✓	
f. Heavy corrosion?		✓	

Notes / Comments

Preliminary PFAR(s)? _____ Yes ✓ No Preliminary PFAR Number(s): _____

Clarification Form(s)? _____ Yes ✓ No Number of Forms Attached: _____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint RTV - Joint 2

Motor No.: RSRM-32	Side: Right (B)	Date: 9 JULY 93

Assessment Engineer(s)/Inspector(s): J. PASSMAN R. QUICK

Joint RTV:	Yes	No	Comment #
a. Gas penetration?		✓	
b. RTV not below char line?		✓	
c. Uncured/reverted RTV?		✓	
d. Voids within RTV?		✓	
e. Grease inhibiting RTV backfill?		✓	
f. Foreign material?		✓	

Notes / Comments

Special Issue 3.3.4 NO ABNORMAL CONDITIONS OBSERVED, BACKFILL WAS EXCEPTIONAL.

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint Phenolics – Joint 2

Motor No.: RSRM-32	Side: Right (B)	Date:

Assessment Engineer(s)/Inspector(s):

Joint Phenolics:	Yes	No	Comment #
a. Heat affected or eroded CCP (below the char line), GCP/SCP, or adhesive?		✓	
b. Physical damage?		✓	
c. Edge separations (metal-to-adhesive, within adhesive, adhesive-GCP/SCP, within GCP/SCP, GCP/SCP-to-CCP, or within CCP)?		✓	
d. Phenolics axially displaced from the housing?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint Seals and Metal – Joint 2

Motor No.: RSRM-32	Side: Right (B)	Date: 7-9-93

Assessment Engineer(s)/Inspector(s): W. Speary, M. Offolter

Joint Seals and Metal:	Yes	No	Comment #
a. Soot to or past O-rings?		✓	
b. Sooted joint surfaces?		✓	
c. Heat affected or eroded O-rings (installed)?		✓	
d. O-ring damage (installed)?		✓	
e. Heat affected or eroded metal?		✓	
f. RTV to primary O-ring?		✓	
g. RTV past primary O-ring?		✓	
h. Foreign material?		✓	
i. Excessive grease? (including in threaded and through bolt holes)		✓	
j. Metal damage? (including index pin and bolt holes (through, threaded/ helical coil inserts))		✓	
k. Bent or broken bolts?		✓	

Notes / Comments

1- light to medium corrosion upstream of primary O-ring between bolt holes full circumference.

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint Drawing Worksheet - Joint 2

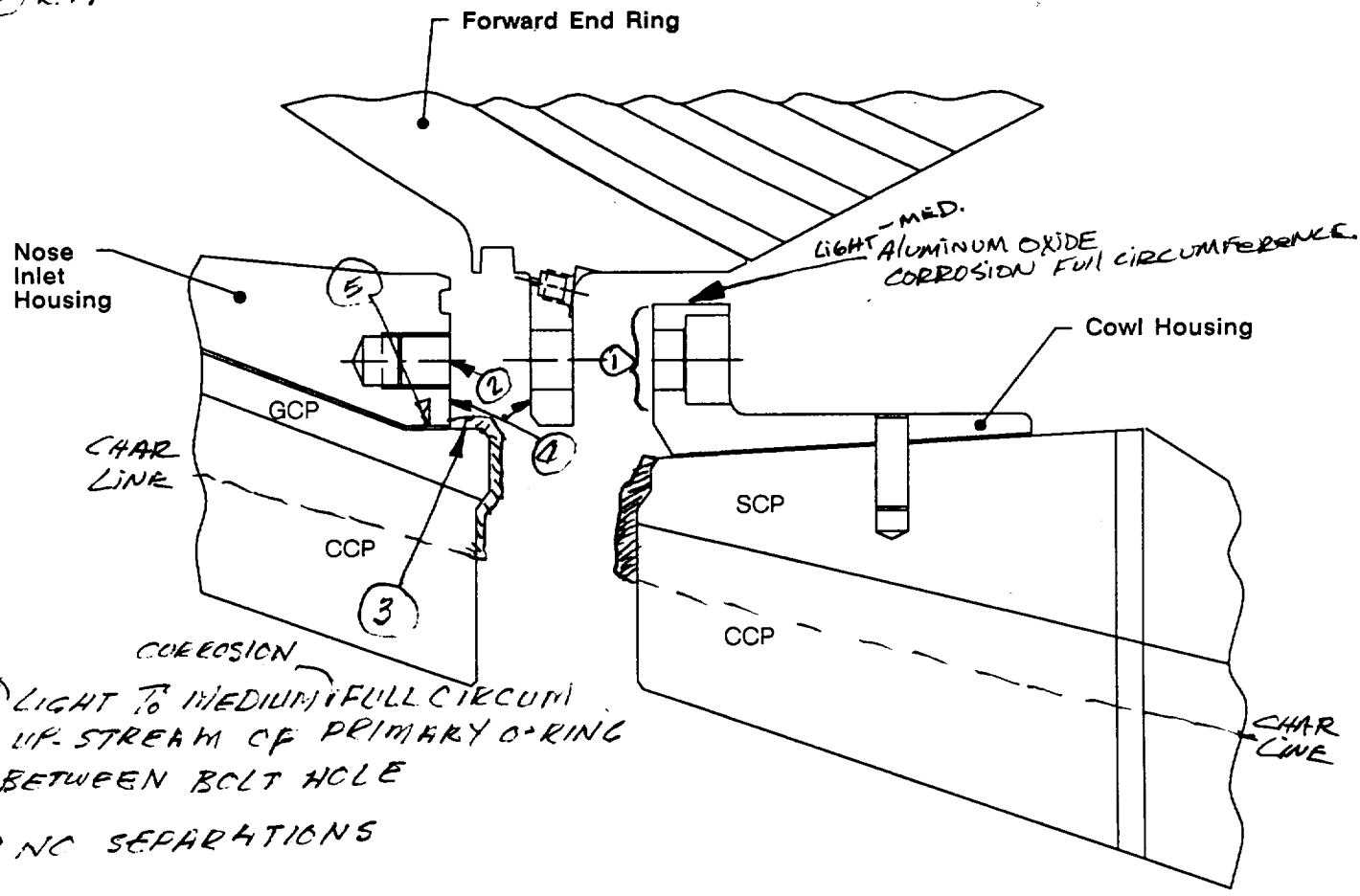
Motor No.: RSRM-32	Side: Right (B)	Date: 9 JULY 93
Assessment Engineer(s)/Inspector(s): J. PASSMAN R. QUICK		

Sketch Observations Below (include locations and sizes of sketched features):

(1) INTERMITTENT LIGHT - MED CORROSION IN THIS AREA

(2) NO EXCESS GREASE IN BOLT HOLES

(3) RTV TO INLET HSG FULL CIRCUM



(4) LIGHT TO MEDIUM FULL CIRCUM UP-STREAM OF PRIMARY O-RING BETWEEN BOLT HOLE

(5) NO SEPARATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint O-rings (Detailed) - Joint 2

Motor No.: RSRM-32	Side: Right (B)	Date: 7-9-93

Assessment Engineer(s)/Inspector(s): W. Speny, M. Offelter, B. Ferguson

	Yes	No	Comment #
Primary O-ring:			
a. Heat affected or eroded O-ring?		✓	
b. O-ring defects/damage?		✓	
Secondary O-ring:			
c. Heat affected or eroded O-ring?		✓	
d. O-ring defects/damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint RTV - Joint 3

Motor No.: RSRM-32	Side: Right (B)	Date: 9 July 93

Assessment Engineer(s)/Inspector(s): K. Guick W. Sperry P. Miller

Joint RTV:	Yes	No	Comment #
a. Gas penetration?		✓	
b. RTV not below char line?		✓	
c. Uncured/reverted RTV?		✓	
d. Voids within RTV?		✓	
e. Grease inhibiting RTV backfill?		✓	
f. Foreign material?		✓	

Notes / Comments

Preliminary PFAR(s)? _____ Yes ___✓___ No Preliminary PFAR Number(s): _____

Clarification Form(s)? _____ Yes ___✓___ No Number of Forms Attached: _____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint Phenolics – Joint 3

Motor No.: RSRM-32	Side: Right (B)	Date: 9 July 93

Assessment Engineer(s)/Inspector(s): R. Quick W. Sperry F. Miller

Joint Phenolics:	Yes	No	Comment #
a. Heat affected or eroded CCP (below the char line), GCP, or adhesive?		✓	
b. Physical damage?		✓	
c. Edge separations (metal-to-adhesive, within adhesive, adhesive-GCP, within GCP, GCP-to-CCP, or within CCP)?	✓		SEE Pg A-86
d. Phenolics axially displaced from the housing?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint Seals and Metal – Joint 3

Motor No.: RSRM-32	Side: Right (B)	Date: 7-9-93

Assessment Engineer(s)/Inspector(s): W. Sperry, M. Offolter

Joint Seals and Metal:	Yes	No	Comment #
a. Soot to or past O-rings?		✓	
b. Sooted joint surfaces?		✓	
c. Heat affected or eroded O-rings (installed)?		✓	
d. O-ring damage (installed)?		✓	
e. Heat affected or eroded metal?		✓	
f. RTV to primary O-ring?		✓	
g. RTV past primary O-ring?		✓	
h. Foreign material?		✓	
i. Excessive grease? (including in threaded and through bolt holes)		✓	
j. Metal damage? (including index pin and bolt holes (through, threaded/ helical coil inserts))		✓	
k. Bent or broken bolts?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

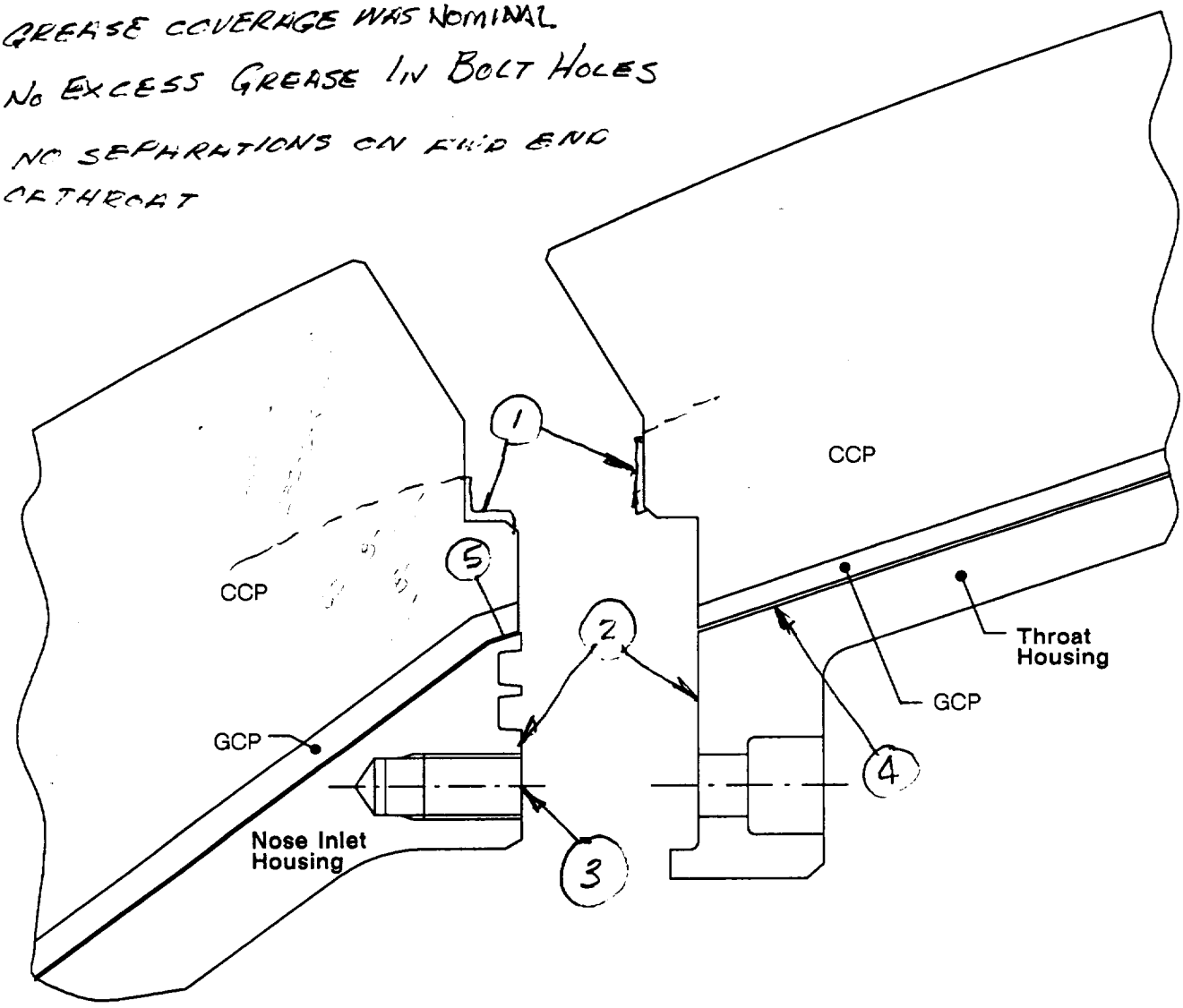
POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint Drawing Worksheet - Joint 3

Motor No.: RSRM-32	Side: Right (B)	Date: 9 JULY 93
Assessment Engineer(s)/Inspector(s): R. QUICK W. SPERRY K. MILLER		

Sketch Observations Below (include locations and sizes of sketched features):

(1) RTV BELOW CHAR LINE FULL CIRCUM
(2) GREASE COVERAGE WAS NOMINAL
(3) NO EXCESS GREASE IN BOLT HOLES
(4) NO SEPARATIONS ON FWD END OF THROAT



(5) SEPARATIONS BETWEEN INLET HSG AND AFT INLET RING AT 110°-157° = .005, 162°-187° = .005, 232°-245° = .005 AND 300°-340° = .005

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint O-rings (Detailed) – Joint 3

Motor No.: RSRM-32	Side: Right (B)	Date: 7-9-93

Assessment Engineer(s)/Inspector(s): W. Sperry, M. Offelter, B Ferguson

	Yes	No	Comment #
Primary O-ring:			
a. Heat affected or eroded O-ring?		✓	
b. O-ring defects/damage?		✓	
Secondary O-ring:			
c. Heat affected or eroded O-ring?		✓	
d. O-ring defects/damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

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SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint RTV – Joint 4

Motor No.: RSRM-32	Side: Right (B)	Date: 7 JULY 93

Assessment Engineer(s)/Inspector(s): K. QUICK A. CARLISLE P. MILLER

Joint RTV:	Yes	No	Comment #
a. Gas penetration?		✓	
b. RTV not below char line?		✓	
c. Uncured/reverted RTV?		✓	
d. Voids within RTV?		✓	
e. Grease inhibiting RTV backfill?		✓	
f. Foreign material?		✓	

Notes / Comments

Preliminary PFAR(s)? _____ Yes ✓ No Preliminary PFAR Number(s): _____

Clarification Form(s)? _____ Yes ✓ No Number of Forms Attached: _____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint Phenolics – Joint 4

Motor No.: RSRM-32	Side: Right (B)	Date: 9 JULY 93

Assessment Engineer(s)/Inspector(s): K. QUICK A. CARLISLE P. MILLER

Joint Phenolics:	Yes	No	Comment #
a. Heat affected or eroded CCP (below the char line), GCP, or adhesive?		✓	
b. Physical damage?	✓		1
c. Edge separations (metal-to-adhesive, within adhesive, adhesive-GCP, within GCP, GCP-to-CCP, or within CCP)?	✓		2
d. Phenolics axially displaced from the housing?			

Notes / Comments

1- GCP BROKE DURING DISASSEMBLY FROM 90°-135°

2- SEPARATION ON AFT END OF THROAT FULL CIRCUM MAX GAP = .021

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint Seals and Metal – Joint 4

Motor No.: RSRM-32	Side: Right (B)	Date: 7 JULY 93

Assessment Engineer(s)/Inspector(s): R. QUICK A. CARLISLE P. MILLER

Joint Seals and Metal:	Yes	No	Comment #
a. Soot to or past O-rings?		✓	
b. Sooted joint surfaces?		✓	
c. Heat affected or eroded O-rings (installed)?		✓	
d. O-ring damage (installed)?		✓	
e. Heat affected or eroded metal?		✓	
f. RTV to primary O-ring?	✓		1
g. RTV past primary O-ring?		✓	
h. Foreign material?		✓	
i. Excessive grease? (including in threaded and through bolt holes)		✓	
j. Metal damage? (including index pin and bolt holes (through, threaded/ helical coil inserts))		✓	
k. Bent or broken bolts?		✓	

Notes / Comments
1-RTV TO PRIMARY O-RING FROM 45°-80° & 240°-270°

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)

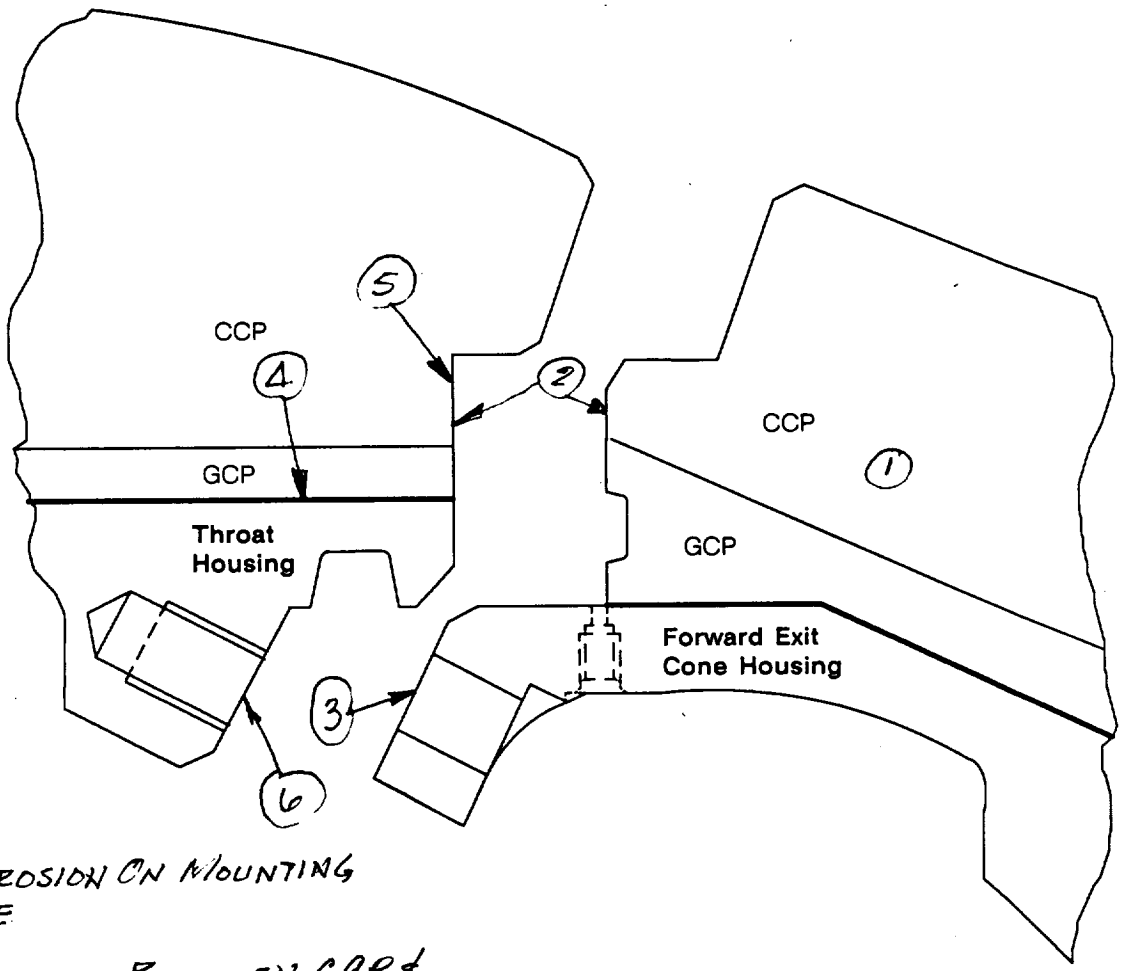
Nozzle Internal Joint Drawing Worksheet – Joint 4

Motor No.: RSRM-32	Side: Right (B)	Date: 7 JULY 93
Assessment Engineer(s)/Inspector(s): R. Quick A. Carlisle P. Miller		

Sketch Observations Below (include locations and sizes of sketched features):

(1) ALL CHARBON MISSING EXCEPT FROM 198°-265°

(2) RTV BELOW CHAR LINE FULL CIRCUM



(3) NO CORROSION ON MOUNTING FLANGE

(4) SEPARATION BETWEEN GBP & HOUSING FULL CIRCUM

(5) RTV DISCOLORED FROM SEA WATER FROM 198°-265°

(6) NO EXCESS GREASE IN HOLES

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint O-rings (Detailed) – Joint 4

Motor No.: RSRM-32	Side: Right (B)	Date: 1 JUL 1993

Assessment Engineer(s)/Inspector(s): A. Carlisle, B. Quick, M. Lyons, J. Richards

	Yes	No	Comment #
Primary O-ring:			
a. Heat affected or eroded O-ring?		✓	
b. O-ring defects/damage?		✓	
Secondary O-ring:			
c. Heat affected or eroded O-ring?		✓	
d. O-ring defects/damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR)
Nozzle Internal Joint RTV - Joint 5

Motor No.: RSRM-32	Side: Right (B)	Date: 8 JULY 93

Assessment Engineer(s)/Inspector(s): R. QUICK A. CARLISLE P. MILLER

Joint RTV:	Yes	No	Comment #
a. Gas penetration?		✓	
b. RTV not below char line?		✓	
c. Uncured/reverted RTV?		✓	
d. Voids within RTV?	✓		1
e. Foreign material?		✓	

Notes / Comments
1) TWO SMALL VOIDS AT LOCATION 140° AND 320°

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Verification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR)
Nozzle Internal Joint Phenolics – Joint 5

Motor No.: RSRM-32	Side: Right (B)	Date: 8 JULY 93

Assessment Engineer(s)/Inspector(s): R. Guick A. Carlisle D. Miller

Joint Phenolics:	Yes	No	Comment #
a. Heat affected or eroded CCP (below the char line), GCP, or adhesive?		✓	
b. Physical damage?		✓	
c. Edge separations (metal-to-adhesive, within adhesive, adhesive-GCP, within GCP, GCP-to-CCP, or within CCP)?		✓	
d. Phenolics axially displaced from the housing?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR)
Nozzle Internal Joint Seals and Metal – Joint 5

Motor No.: RSRM-32	Side: Right (B)	Date: 8 JULY

Assessment Engineer(s)/Inspector(s): R. Quick P. Miller A. Carlisle

Joint Seals and Metal:	Yes	No	Comment #
a. Soot to or past O-rings?		✓	
b. Sooted joint surfaces?		✓	
c. Heat affected or eroded O-rings (installed)?		✓	
d. O-ring damage (installed)?		✓	
e. Heat affected or eroded metal?		✓	
f. RTV to primary O-ring?	✓		1
g. RTV past primary O-ring?		✓	
h. Foreign material?		✓	
i. Excessive grease? (including in threaded and through bolt holes)		✓	
j. Metal damage? (including index pin and bolt holes (through, threaded/ helical coil inserts))		✓	
k. Bent or broken bolts?		✓	

es / Comments
1) RTV TO PRIMARY O-RING FROM ~~[illegible]~~° 0°-70°, 185°-255°

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint Drawing Worksheet – Joint 5

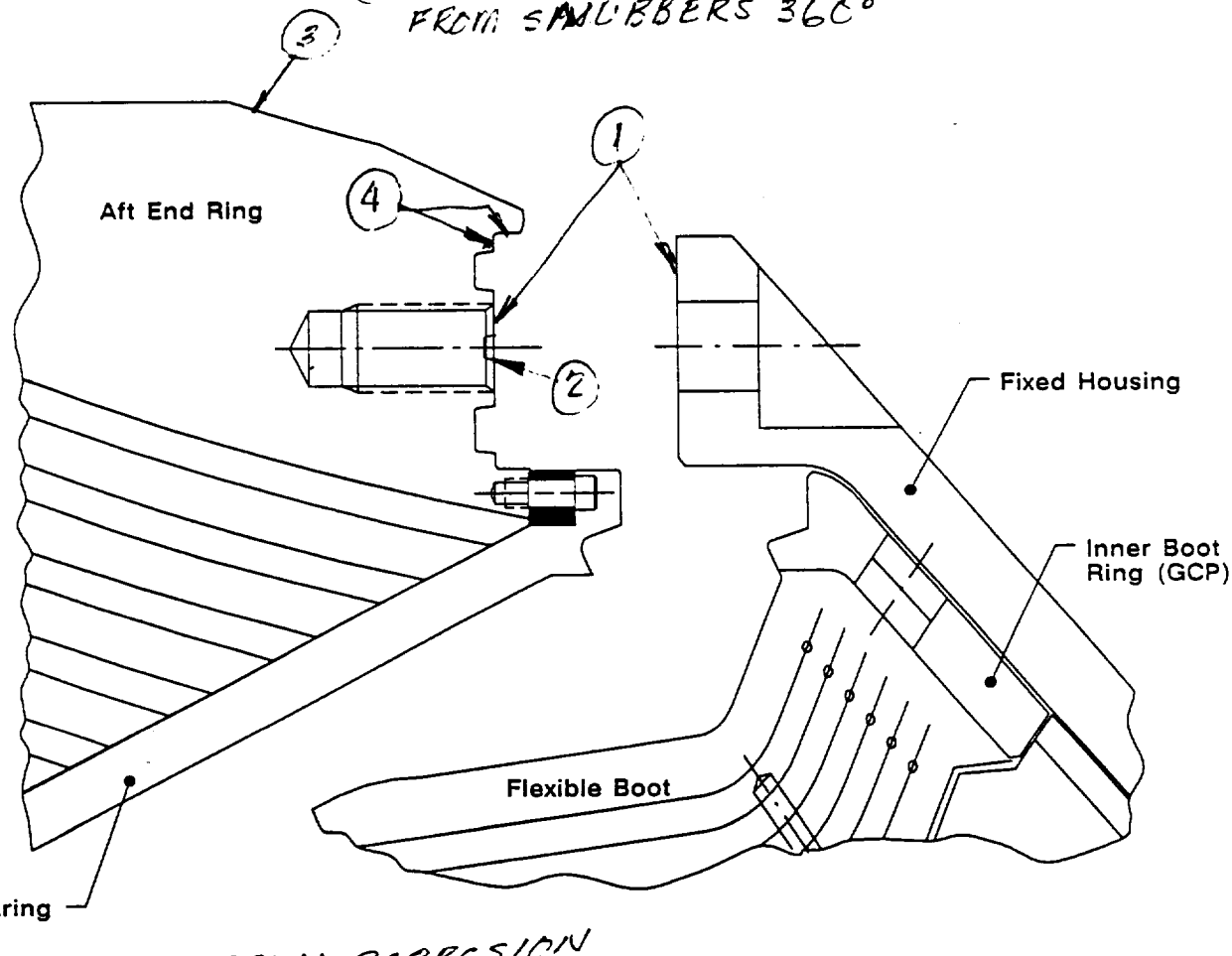
Motor No.: RSRM-32	Side: Right (B)	Date: 8 JULY 93
Assessment Engineer(s)/Inspector(s): R. QUICK A. CARLISLE F. MILLER		

Sketch Observations Below (include locations and sizes of sketched features):

(1) NOMINAL GREASE COVERAGE

(2) NO EXCESS GREASE IN ECLT HOLES

(3) LIGHT INTERMITTENT SCARFE MARKS FROM SNUBBERS 360°



(4) MEDIUM TO HEAVY CORROSION INTERMITTENTLY FULL CIRCUM

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR)
Nozzle Internal Joint O-rings (Detailed) - Joint 5

Motor No.: RSRM-32	Side: Right (B)	Date: 8 July, 1993

Assessment Engineer(s)/Inspector(s): A. Carliste, W. Ferguson

	Yes	No	Comment #
Primary O-ring:			
a. Heat affected or eroded O-ring?		✓	
b. O-ring defects/damage?		✓	
Secondary O-ring:			
c. Heat affected or eroded O-ring?		✓	
d. O-ring defects/damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint Packings With Retainers (Detailed) – Joint 5

Motor No.: RSRM-32	Side: Right (B)	Date: 6 July 1993

Assessment Engineer(s)/Inspector(s): A. Carlisle, N. Lyons, J. Richards

Packings With Retainers:	Yes	No	Comment #
a. Heat affected or eroded seal or retainer?		✓	
b. Seal or retainer defects/damage?	✓		1
c. Medium or heavy corrosion?		✓	

Notes / Comments

1) Typical disassembly rubber damage to >2 of >2 Packing with Retainers

Preliminary PFAR(s)? _____ Yes ✓ No Preliminary PFAR Number(s): _____

Clarification Form(s)? _____ Yes ✓ No Number of Forms Attached: _____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR)

Cowl Insulation Segments

Motor No.: RSRM-32	Side: Right (B)	Date: 9 Jul 93

Assessment Engineer(s)/Inspector(s): Jim PASSMAN Bob Quick

Cowl Insulation Segments:	Yes	No	Comment #
a. Abnormal heat effects or erosion?		✓	
b. Soot between the cowl segment and cowl housing/SCP?		✓	
c. Uncured adhesive (silicone)?		✓	

Bondline Failure Mode Percentage:

	Degree Location							
	0-45	45-90	90-135	135-180	180-225	225-270	270-315	315-0
Metal-to-Adhesive	25	30	40	50	60	30	40	60
Within Adhesive	2	5	2	2	3	3	2	5
Adhesive-to-SCP	2	2	5	2	7	2	2	2
Adhesive-to-segment	71	63	53	46	30	65	56	33
Within segment								

Notes / Comments

Special Issue 3.3.3

THE COWL INSULATION SEGMENTS WERE IN EXCELLENT CONDITION. NO UNBONDING OR OTHER ANOMALOUS CONDITIONS WERE FOUND.

Preliminary PFAR(s)? _____ Yes ✓ No Preliminary PFAR Number(s): _____

Clarification Form(s)? _____ Yes ✓ No Number of Forms Attached: _____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR)
Flexible Bearing Protector, Flexible Bearing, and Flexible Boot

Motor No.: RSRM-32	Side: Right (B)	Date: 9 JUN 93

Assessment Engineer(s)/Inspector(s): JIM PASSMAN BOB QUICK

Flexible Bearing Protector, Bearing, and Boot:	Yes	No	Comment #
a. Abnormal bearing protector heat effects or erosion? (including burn-through)		✓	
b. Cracks through the bearing protector?		✓	
c. Soot between the bearing protector and flexible bearing?		✓	
d. Heat effects to the flexible bearing?		✓	
e. Bent or broken bearing protector bolts?		✓	
f. Flexible boot burn-through?		✓	
g. Abnormal heat effects or erosion to flexible boot ID?		✓	
h. Foreign material in the boot cavity?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

Thiokol CORPORATION
SPACE OPERATIONS

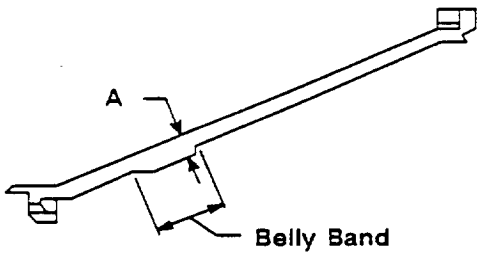
POSTFLIGHT OBSERVATION RECORD (PFOR)

Flexible Bearing Protector Measurements (Data Collection Only)

Motor No.: RSRM-32	Side: Right (B)	Date: 14 JUL 1993
Assessment Engineer(s)/Inspector(s): R L HASTEDT		

Flexible Bearing Protector Gas Impingement Area Thickness Measurements (see figure):

Degree Location	Thickness Measurement A* (inches)	Degree Location	Thickness Measurement A* (inches)	Degree Location	Thickness Measurement A* (inches)
0	.718	120	.738	240	.231
10	.722	130	.715	250	.654
20	.727	140	.718	260	.735
30	.736	150	.725	270	.721
40	.732	160	.721	280	.736
50	.733	170	.733	290	.726
60	.735	180	.726	300	.715
70	.737	190	.738	310	.649
80	.715	200	.736	320	.71
90	.725	210	.675	330	.732
100	.698	220	.736	340	.715
110	.763	230	.732	350	.722



* "A" is the minimum thickness of the bearing protector belly band in-line with the cowl vent holes. It corresponds to the deepest gas impingement location.

Notes / Comments

Clarification Form(s)? _____ Yes _____ No Number of Forms Attached: _____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Throat Diameter Measurements (Data Collection Only)

Motor No.: RSRM-32	Side: Right (B)	Date: 07-12-93

Assessment Engineer(s)/Inspector(s): MIGUEL ENRIQUEZ, RICK GALLEGOS

Nozzle Throat Diameter Measurements:

Degree Location	Diameter Measurement (inches)
0	55.940"
45	55.925"
90	55.894"
135	55.940

Notes / Comments

Avg. Throat Diameter = 55.925"

Clarification Form(s)? _____ Yes ___✓___ No Number of Forms Attached: _____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Phenolic Bondline – Aft Exit Cone Assembly

Motor No.: RSRM-32	Side: Right (B)	Date: 8 July 93

Assessment Engineer(s)/Inspector(s): E. Guick F. Miller

Metal Housing Bondline Surface:	Yes	No	Comment #
a. Soot?		✓	
b. Heat affected or eroded metal?		✓	
c. Voids in adhesive greater than 0.5 inch in any direction?	✓		1
d. Corrosion?		✓	
e. Foreign material?		✓	

Note: Axial cuts may be relocated + or – 10 degrees only. Document if any cuts were relocated.

Primary Bondline/Phenolic Failure Mode Percentage (After Hydrolase and Wedge Removal):

	Degree Location							
	0-45	45-90	90-135	135-180	180-225	225-270	270-315	315-0
Metal-to-Adhesive		2%	5%					
Within Adhesive								
Adhesive-to-GCP								
Within GCP	100%	98%	95%	100%	100%	100%	100%	100%
GCP-to-CCP								
Within CCP								

Secondary Bondline Failure Mode Percentage (After Removal of Remaining Phenolics):

	Degree Location							
Metal-to-Adhesive								
Within Adhesive								
Adhesive-to-GCP								

Phenolic Removal Method: _____

Notes / Comments 1- VOID 22.1 FROM FWD END 1.1 AXIALLY, 6 CIRCUM @ LOC 198°

2- SMALL VOIDS IN POLYSULFIDE FULL CIRCUM

Preliminary PFAR(s)? _____ Yes ___1___ No Preliminary PFAR Number(s): _____

Clarification Form(s)? _____ Yes ___X___ No Number of Forms Attached: _____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Phenolic Bondline – Forward Exit Cone Assembly

Motor No.: RSRM-32	Side: Right (B)	Date: 7-19-[illegible]

Assessment Engineer(s)/Inspector(s): M. Clark, P. Miller

Metal Housing Bondline Surface:	Yes	No	Comment #
a. Soot?		✓	
b. Heat affected or eroded metal?		✓	
c. Voids in adhesive greater than 0.5 inch in any direction?	✓		1
d. Corrosion?	✓		2
e. Foreign material?		✓	

Note: Axial cuts may be relocated + or – 10 degrees only. Document if any cuts were relocated.

Primary Bondline/Phenolic Failure Mode Percentage (After Hydrolase and Wedge Removal):

	Degree Location								
	[illegible]-22.5	[illegible]	67.5-112.5	112.5-157.5	157.5-202.5	202.5-247.5	247.5-292.5	292.5-[illegible]	[illegible]
Metal-to-Adhesive	20	25	40	30	65	20	15	45	35
Within Adhesive									
Adhesive-to-GCP	80	75	60	70	35	80	85	55	65
Within GCP									
GCP-to-CCP									
Within CCP									

Secondary Bondline Failure Mode Percentage (After Removal of Remaining Phenolics):

	Degree Location							
	NA							
Metal-to-Adhesive								
Within Adhesive								
Adhesive-to-GCP								

Phenolic Removal Method: _____

Notes / Comments
1) Voids documented on page A-104A and A-104B

Preliminary PFAR(s)? _____ Yes ✓ No Preliminary PFAR Number(s): _____

Clarification Form(s)? ✓ Yes _____ No Number of Forms Attached: A-104A, A-104B

Thiokol CORPORATION
SPACE OPERATIONS

Nozzle Subassembly Bondline Adhesive Void Clarification Form

Motor No.: RSRM-32	Side: ☐ Left (A) ☒ Right (B)	Date: 7-19-93
Assessment Engineer(s)/Inspector(s):	M. Clark, P. Miller	
Nozzle Subassembly:	Fwd Exit Cone	

Record Bondline Adhesive Void Measurements and Locations Below:

Degree Location	Void Size Axial	Void Size Circ.	Location on Bonding Surface Distance From Fwd	Location on Bonding Surface Distance From Aft
18.75	.7	.4		8.9
26.25	.7	.4		10.7
30	2.3	.6		6.9
31.9	1.4	.4		11.8
[illegible]	2.7	.7		7.7
[illegible]	.7	.3		16.2
[illegible]	.8	.3		17.0
[illegible]	1.9	.9		21.5
56.3	.9	.4		26.3
65.6	.7	.6		30.7
69.4	.7	.4		5.4
16.9	.6	.2		18.4
11.9	.7	.4		22.9

Notes / Comments

Corresponding Comment Number(s): _____

Thiokol CORPORATION
SPACE OPERATIONS

Nozzle Subassembly Bondline Adhesive Void Clarification Form

Motor No.: RSRM-32	Side: ☐ Left (A) ☒ Right (B)	Date: 7-19-93
Assessment Engineer(s)/Inspector(s): M. Clark, P. Miller		
Nozzle Subassembly: Fwd Exit Cone		

Record Bondline Adhesive Void Measurements and Locations Below:

Degree Location	Void Size Axial	Void Size Circ.	Location on Bonding Surface Distance From Fwd	Location on Bonding Surface Distance From Aft
123.8	3.6	.4		14.9
127.5	.6	.4		9.7
127.5	5.4	2.2		22.9
129.4	1.7	.9		21.6
221.3	.9	.5		21.1
235.8	.5	.5		33.0
244.4	1.5	.4		15.1
246.3	.6	.4		31.6
277.5	1.1	.4		30.4
309.4	.6	.5		21.4
321.3	.7	.6		35.7

Notes / Comments

Corresponding Comment Number(s): _____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Phenolic Bondline – Throat Assembly

Motor No.: RSRM-32	Side: Right (B)	Date: 21 July 93

Assessment Engineer(s)/Inspector(s): JIM PASSMAN, TREVOR FRESTON

Metal Housing Bondline Surface:	Yes	No	Comment #
a. Soot?		✓	
b. Heat affected or eroded metal?		✓	
c. Voids in adhesive greater than 0.5 inch in any direction?		✓	(1)
d. Corrosion?	✓		(2)
e. Foreign material?		✓	

Note: Axial cuts may be relocated + or – 10 degrees only. Document if any cuts were relocated.

Primary Bondline/Phenolic Failure Mode Percentage (After Hydrolase and Wedge Removal):

	Degree Location								
	0-45	45-90	90-135	135-180	180-225	225-270	270-315	315-360°	Total
Metal-to-Adhesive	100	99	100	100	98	100	100	100	99.6
Within Adhesive									
Adhesive-to-GCP		1			2				.4
Within GCP									
GCP-to-CCP									
Within CCP									

Secondary Bondline Failure Mode Percentage (After Removal of Remaining Phenolics):

	Degree Location							
Metal-to-Adhesive		N						
Within Adhesive			A					
Adhesive-to-GCP								

Phenolic Removal Method: _____

Notes / Comments

(1) NUMEROUS SMALL VOIDS ~ .20 DIA INTERMITTENTLY THROUGHOUT BONDLINE.

(2) MEDIUM-LIGHT CORROSION ON FIRST 9" FROM FWD END, MED-HEAVY CORROSION NEXT 12" TOAFT END.

Preliminary PFAR(s)? _____ Yes ✓ No Preliminary PFAR Number(s): _____

Clarification Form(s)? _____ Yes ✓ No Number of Forms Attached: _____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR)
Nozzle Phenolic Bondline – Forward Nose and Aft Inlet Rings

Motor No.: RSRM-32	Side: Right (B)	Date: 7-22-93

Assessment Engineer(s)/Inspector(s): R. Quick T. Freston

Metal Housing Bondline Surface:	Yes	No	Comment #
a. Soot?		✓	
b. Heat affected or eroded metal?		✓	
c. Voids in adhesive greater than 0.5 inch in any direction?	✓		1
d. Corrosion?	✓		2
e. Foreign material?		✓	

Note: Axial cuts may be relocated + or – 10 degrees only. Document if any cuts were relocated.

Primary Bondline/Phenolic Failure Mode Percentage (After Hydrolase and Wedge Removal):

	Degree Location							
	0-45	45-90	90-135	135-180	180-225	225-270	270-315	315-0
Metal-to-Adhesive	70%	100%	100%	100%	100%	100%	100%	100%
Within Adhesive								
Adhesive-to-GCP	30%							
Within GCP								
GCP-to-CCP								
Within CCP								

Secondary Bondline Failure Mode Percentage (After Removal of Remaining Phenolics):

	Degree Location							
Metal-to-Adhesive								
Within Adhesive								
Adhesive-to-GCP								

Phenolic Removal Method: _____

Notes / Comments: THE 30% REMAINING ADHESIVE WAS ON THE AFT INLET RING AREA
NO VOIDS GREATER THAN .25Ø

Special Issue 3.3.7

1. SEE PG A-106A

2. MEDIUM TO HEAVY CORROSION INTERMITTENT FULL CIRCUM

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): _____

Clarification Form(s)? ✓ Yes ____ No Number of Forms Attached: A-106A

Thiokol CORPORATION
SPACE OPERATIONS

Nozzle Subassembly Bondline Adhesive Void Clarification Form

Motor No.: RSRM-32	Side: ☐ Left (A) ☒ Right (B)	Date: 7/22/93
Assessment Engineer(s)/Inspector(s): R. QUICK T. FREESTON		
Nozzle Subassembly: FWD NOSE RING		

Record Bondline Adhesive Void Measurements and Locations Below:

Degree Location	Void Size Axial	Void Size Circ.	Location on Bonding Surface Distance From Fwd	Location on Bonding Surface Distance From Aft
125	1.18	.46	.63	
275	1.42	.90	2.00	

Notes / Comments

Corresponding Comment Number(s): _____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR)
Nozzle Phenolic Bondline – Nose Cap

Motor No.: RSRM-32	Side: Right (B)	Date: 7/22/93

Assessment Engineer(s)/Inspector(s): R. Quick T. Freeston

Metal Housing Bondline Surface:	Yes	No	Comment #
a. Soot?		✓	
b. Heat affected or eroded metal?		✓	
c. Voids in adhesive greater than 0.5 inch in any direction?	2		
d. Corrosion?	1		
e. Foreign material?		✓	

Note: Axial cuts may be relocated + or – 10 degrees only. Document if any cuts were relocated.

Primary Bondline/Phenolic Failure Mode Percentage (After Hydrolase and Wedge Removal):

	Degree Location							
	0-45	45-90	90-135	135-180	180-225	225-270	270-315	315-0
Metal-to-Adhesive								
Within Adhesive								
Adhesive-to-GCP								
Within GCP								
GCP-to-CCP	100%	100%	100%	100%	100%	100%	100%	100%
Within CCP								

Secondary Bondline Failure Mode Percentage (After Removal of Remaining Phenolics):

	Degree Location								
	0-45	45-90	90-135	135-180	180-225	225-270	270-315	315-0	Total
Metal-to-Adhesive	40%	35%	50%	40%	35%	35%	40%	35%	39
Within Adhesive									
Adhesive-to-GCP	60%	65%	50%	60%	65%	65%	60%	65%	61

Phenolic Removal Method: NYLON WEDGE

Notes / Comments
1. MEDIUM TO HEAVY CORROSION INTERMITTENT FULL CIRCUM
Special Issue 3.3.7

(2) Special Issue 3.3.11 32° 6.5 FROM AFT 1.0 AXIAL x .18 CIRUM. 128° 8.2 FROM AFT .70 AXIAL x .45 CIRCUM 145° 14.55 FROM AFT x .45 AXIAL x .25 CIRUM, 208° 10.7 FROM AFT x .45 AXIAL x .28 CIRUM, 245° NO IND.
Special Issue 3.3.12 NO INDICATION AT 182°

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ✓ Yes ____ No Number of Forms Attached: 1 (A-107A)

PFOR CLARIFICATION FORM
General

Motor No.: RSRM-32	Side: ☐ Left (A) ☑ Right (B)	Date: 7-22-93
Assessment Engineer(s)/Inspector(s): R. Quick, M. Clark		
Description: LDI Datasheet		

Sketch Observations Below (include locations and sizes of sketched features):

NOSE CAP TO HOUSING BONDLINE
(Right Hand)

Degree Location Recorded	Degree Location Actual	Distance[1] Recorded	Distance[1] Actual	Void or Repair	Axial Length	Circ. Width	Other Info.
32		11.52	6.5*	Void	1.00	1.80	
128		8.10	8.3*	Void	.70	.45	
145		4.50	4.55*	Void	.45	.25	
212	208	15.50	10.70*	Void	.45	.28	
245		12.80					NOTHING Found

NOSE CAP TO FNR BONDLINE
(Right Hand)

Degree Location Recorded	Degree Location Actual	Distance[2] Recorded	Distance[2] Actual	Void or Repair	Axial Length	Circ. Width	Other Info.
182		1.14					NOTHING FOUND

[1] Distance from fwd tip of nose cap glass
[2] Distance from flame surface
[3] Distance from FNR - nose cap - housing interface

* MEASURED FROM AFT END OF NOSE CAP

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Phenolic Bondline – Cowl Assembly

Motor No.: RSRM-32	Side: Right (B)	Date: 7/21/93

Assessment Engineer(s)/Inspector(s): JIM PASSMAN, TREVOR FRESTON

Metal Housing Bondline Surface:	Yes	No	Comment #
a. Soot?		✓	
b. Heat affected or eroded metal?		✓	
c. Voids in adhesive greater than 0.5 inch in any direction?		✓	
d. Corrosion?		✓	
e. Foreign material?		✓	

Note: Axial cuts may be relocated + or – 10 degrees only. Document if any cuts were relocated.

Primary Bondline/Phenolic Failure Mode Percentage (After Hydrolase and Wedge Removal):

	Degree Location								
	0-45	45-90	90-135	135-180	180-225	225-270	270-315	315-360	Total
Metal-to-Adhesive		1	25	30	3	2	50	2	14
Within Adhesive									
Adhesive-to-SCP	98	99	75	70	95	98	50	98	85.5
Within SCP	2				2				0.5
SCP-to-CCP									
Within CCP									

Secondary Bondline Failure Mode Percentage (After Removal of Remaining Phenolics):

	Degree Location							
Metal-to-Adhesive		N/A						
Within Adhesive								
Adhesive-to-SCP			A					

Phenolic Removal Method: _____

Notes / Comments ADHESIVE TO METAL FAILURES WERE LOCATED AT SHIMS OR HYDROLAZE CUTS.

Special Issue 3.3.7 NO VOIDS WERE FOUND.

Special Issue 3.3.13 BONDLINE WAS IN GOOD SHAPE. VERY LOW ADHESIVE TO METAL FAILURE (14%); 85% ADHESIVE TO SCP.

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): _____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: _____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Phenolic Bondline – Fixed Housing Assembly

Motor No.: RSRM-32	Side: Right (B)	Date: 7-15-93

Assessment Engineer(s)/Inspector(s): M. Clark, P Miller

Metal Housing Bondline Surface:	Yes	No	Comment #
a. Soot?		✓	
b. Heat affected or eroded metal?		✓	1
c. Voids in adhesive greater than 0.5 inch in any direction?		✓	
d. Corrosion?		✓	
e. Foreign material?		✓	

Note: Axial cuts may be relocated + or – 10 degrees only. Document if any cuts were relocated.

Primary Bondline/Phenolic Failure Mode Percentage (After Hydrolase and Wedge Removal):

	Degree Location							
	0-45	45-90	90-125	125-180	180-225	225-270	270-315	315-360
Metal-to-Adhesive								
Within Adhesive								
Adhesive-to-GCP								
Within GCP	100	100	100	100	100	100	100	100
GCP-to-CCP								
Within CCP								

Secondary Bondline Failure Mode Percentage (After Removal of Remaining Phenolics):

	Degree Location								Total
Metal-to-Adhesive	2	2							1
Within Adhesive									
Adhesive-to-GCP	98	98	100	100	100	100	100	100	99

Phenolic Removal Method: Wedges & Hammers

Notes / Comments
1) Intermittent voids, 0.30" or smaller

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Phenolic Sections - Aft Exit Cone

Motor No.: RSRM-32	Side: Right (B)	Date: 7-9-93

Assessment Engineer(s)/Inspector(s): M. Clark

Phenolic Sections:

	Yes	No	Comment #
a. Cross-ply cracking in virgin material?		✓	
b. Ply lifting?	✓		1

Aft Exit Cone Char and Erosion Measurements:

Station	0°		90°		180°		270°	
Location	Erosion	Char	Erosion	Char	Erosion	Char	Erosion	Char
73.77	NA	NA	NA	NA	NA	NA	NA	NA
77.77	↓	↓	↓	↓	↓	↓	↓	↓
83.77	↓	↓	↓	↓	↓	↓	↓	↓
89.77	↓	↓	↓	↓	↓	↓	↓	↓
95.77	↓	↓	↓	↓	↓	↓	↓	↓
101.77	0.17	0.61	0.19	0.55	↓	↓	↓	↓
107.77	NA	NA	0.17	0.58	↓	↓	0.21	0.58
113.77	↓	↓	NA	NA	↓	↓	NA	NA
118.77	↓	↓	↓	↓	↓	↓	↓	↓

Negative Margin of Safety? ____ Yes ✓ No Station: ____ Degree: ____

Notes / Comments

2) An increase in the erosion depth was observed at approx. 12" from the fwd end (station 107.77)

1) Special Issue 3.3.18

Preliminary PFAR 57C-02 was written for the Ply lifting

All margins of safety calculations were positive. Ply lifting was observed around the full circ. and axial length on the portion that remained attached to the housing (forward 22"-28"). None of the CCP was recovered from the aft segment. The Ply lifting is summarized on page A-110D

Preliminary PFAR(s)? ✓ Yes ____ No Preliminary PFAR Number(s): 57C-02

Clarification Form(s)? ✓ Yes ____ No Number of Forms Attached: A-110A, A-110B, A-110C, A-110D

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Phenolic Sections – Aft Exit Cone

Motor No.: RSRM-32	Side: Right (B)	Date: 7-9-93

Assessment Engineer(s)/Inspector(s): M. Clark, T. Freston

Phenolic Sections:

	Yes	No	Comment #
a. Cross-ply cracking in virgin material?		✓	
b. Ply lifting?	✓		

Aft Exit Cone Char and Erosion Measurements:

Station Location	15° Erosion	15° Char	30° Erosion	30° Char	60° Erosion	60° Char	165° Erosion	165° Char
73.77	NA	NA	NA	NA	NA	NA	NA	NA
77.77	↓	↓	↓	↓	↓	↓	↓	↓
83.77	↓	↓	↓	↓	↓	↓	↓	↓
89.77	↓	↓	↓	↓	↓	↓	↓	↓
95.77	↓	↓	↓	↓	↓	↓	↓	↓
101.77	↓	↓	0.19	0.56	↓	↓	0.16	0.54
107.77	0.27	0.54	NA	NA	0.11	0.59	0.12	0.60
113.77	NA	NA	0.19	0.51	NA	NA	NA	NA
118.77	↓	↓	NA	NA	↓	↓	↓	↓

Negative Margin of Safety? ____ Yes ✓ No Station: ____ Degree: ____

Notes / Comments

Preliminary PFAR(s)? ✓ Yes ____ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Phenolic Sections – Aft Exit Cone

Motor No.: RSRM-32	Side: Right (B)	Date: 7-9-93
Assessment Engineer(s)/Inspector(s):	M. Clark, T. Freston	

Phenolic Sections:

	Yes	No	Comment #
a. Cross-ply cracking in virgin material?		✓	
b. Ply lifting?	✓		

Aft Exit Cone Char and Erosion Measurements:

Station Location	195° Erosion	195° Char	210° Erosion	210° Char	255° Erosion	255° Char	285° Erosion	285° Char
73.77	NA	NA	NA	NA	NA	NA	NA	NA
77.77	↓	↓	↓	↓	↓	↓	↓	↓
83.77	↓	↓	↓	↓	↓	↓	↓	↓
89.77	↓	↓	↓	↓	↓	↓	↓	↓
95.77	↓	↓	↓	↓	↓	↓	↓	↓
101.77	↓	↓	↓	↓	↓	↓	0.19	0.59
107.77	0.17	0.63	0.18	0.56	0.34	0.49	NA	NA
113.77	NA	NA	NA	NA	0.16	0.55	0.18	0.57
118.77	↓	↓	↓	↓	NA	NA	NA	NA

Negative Margin of Safety? ____ Yes ✓ No Station: ____ Degree: ____

Notes / Comments

Preliminary PFAR(s)? ✓ Yes ____ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Phenolic Sections – Aft Exit Cone

Motor No.: RSRM-32	Side: Right (B)	Date: 7-9-93

Assessment Engineer(s)/Inspector(s): M. Clark, T. Freston

Phenolic Sections:

	Yes	No	Comment #
a. Cross-ply cracking in virgin material?		✓	
b. Ply lifting?	✓		

Aft Exit Cone Char and Erosion Measurements:

Station Location	300° Erosion	300° Char	330° Erosion	330° Char	345° Erosion	345° Char	° Erosion	° Char
73.77	NA	NA	NA	NA	NA	NA		
77.77	↓	↓	↓	↓	↓	↓		
83.77	↓	↓	↓	↓	↓	↓		
89.77	↓	↓	↓	↓	↓	↓		
95.77	↓	↓	↓	↓	↓	↓		
101.77	0.18	0.57	0.20	0.57	C	C		
107.77	0.20	0.51	NA	NA	0.07	0.62		
113.77	0.21	0.53	↓	↓	NA	NA		
118.77	NA	NA	↓	↓	↓	↓		

Negative Margin of Safety? ____ Yes ✓ No Station: ____ Degree: ____

Notes / Comments

Preliminary PFAR(s)? ✓ Yes ____ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

PFOR CLARIFICATION FORM

General

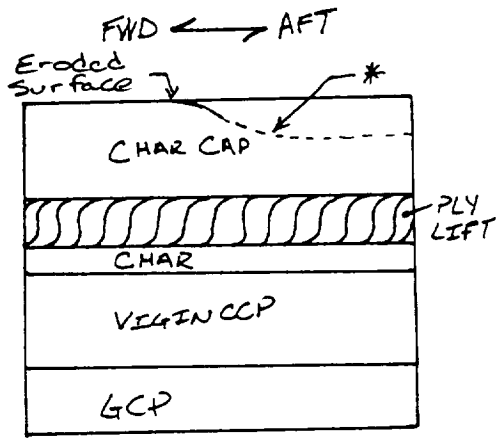
Motor No.: RSRM-32	Side: ☐ Left (A) ☒ Right (B)	Date: 7-9-93
Assessment Engineer(s)/Inspector(s): M. Clark		
Description: AEC Ply Lifting		

Sketch Observations Below (include locations and sizes of sketched features):

RSRM-32B Aft Exit Cone Ply Lifting

DEGREE	DISTANCE FROM FWD END	CHAR CAP	PLY LIFT	CHAR	VIRGIN CCP
0	7	0.40	0.18	[0.10]	0.46
	10	0.39	0.17	0.09	0.43
	15	0.34	0.18	0.08	0.41
	18	[0.33]	0.19	0.06	[0.41]
30	6	0.42	0.19	0.04	0.50
	10	0.40	0.20	[0.00]	0.55
	18	0.34	0.19	0.01	0.49
60	7	0.40	0.13	0.00	[0.57]
	10	0.41	0.15	0.00	0.55
90	15	0.43	0.16	0.00	0.48
	18	0.38	0.19	0.00	0.50
165	6	0.37	0.16	0.00	0.54
	10	0.42	0.18	0.00	0.52
	15	0.40	0.18	0.00	0.50
180	7	0.45	0.15	0.05	0.50
	10	0.38	0.15	0.03	0.50
	15	0.37	0.15	0.05	0.50
195	7	0.40	0.14	0.00	0.55
	10	0.40	0.15	0.00	0.55
	15	0.39	0.18	0.00	0.53
210	7	[0.45]	0.10	0.00	0.55
	10	0.42	0.15	0.00	0.55
255	6	0.37	0.2	0	0.54
	10	0.39	0.18	0	0.52
270	10	0.37	0.16	0	0.52
	15	0.37	0.2	0	0.5
	18	0.37	0.18	0	0.5
285	6	0.42	0.15	0.00	0.52
	10	0.42	0.15	0.00	0.53
	15	0.40	0.15	0.00	0.54
	18	0.40	0.17	0.00	0.50
300	6	0.40	[0.08]	0.03	0.52
	10	0.43	0.10	0.04	0.49
	15	0.44	0.11	0.00	0.50
	18	0.45	0.10	0.06	0.42
330	10	0.37	0.16	0.00	0.53
345	6	0.37	0.18	0.00	0.53
	10	0.39	0.22	0.00	0.51
	15	0.37	[0.23]	0.00	0.51

* An increase in the amount of erosion was observed at approx. station 107.77 possible wash area intermittent around the circumference.



AEC PHENOLIC CROSS-SECTION

☐ Max. and Min. Values

No surface ply lifting was observed

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Phenolic Sections - Forward Exit Cone

Motor No.: RSRM-32	Side: Right (B)	Date: 8-27-93

Assessment Engineer(s)/Inspector(s): M. Clark

Phenolic Sections:	Yes	No	Comment #
a. Cross-ply cracking in virgin material?			
b. Ply lifting?			

Forward Exit Cone Char and Erosion Measurements:

Station Location	0° Erosion	0° Char	90° Erosion	90° Char	180° Erosion	180° Char	270° Erosion	270° Char
1.0								
4.0								
4.6								
8.0								
12.0				N				
16.0								
20.0								
24.0				A				
28.0								
32.0								
32.9								
34.0								

Negative Margin of Safety? _____ Yes _____ No Station: _____ Degree: _____

Notes / Comments

Very small section left attached on fwd end was not recovered at wash. No measurements made.

Preliminary PFAR(s)? _____ Yes _____ No Preliminary PFAR Number(s): _____

Clarification Form(s)? _____ Yes _____ No Number of Forms Attached: _____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR)
Nozzle Phenolic Sections - Throat Assembly

Motor No.: RSRM-32	Side: Right (B)	Date: 8-26-93
Assessment Engineer(s)/Inspector(s): L.E. WILKES		

Phenolic Sections:	Yes	No	Comment #
a. Cross-ply cracking in virgin material?		✓	
b. Ply lifting?		✓	

Throat Inlet Ring and Throat Ring Char and Erosion Measurements:

Station	0°		90°		180°		270°	
Location	Erosion	Char	Erosion	Char	Erosion	Char	Erosion	Char
1.0	1.10	.64	1.11	.62	1.05	.64	1.07	.68
2.0	1.10	.66	1.15	.66	1.07	.70	1.11	.65
4.0	1.16	.57	1.18	.67	1.14	.59	1.16	.68
6.0	1.21	.55	1.23	.66	1.20	.63	1.21	.67
8.0	1.19	.58	1.25	.61	1.23	.63	1.21	.57
10.0	1.16	.54	1.23	.65	1.16	.58	1.22	.56
12.0	1.13	.55	1.19	.58	1.15	.58	1.18	.58
14.0	1.12	.56	1.17	.63	1.12	.59	1.17	.59
16.0	1.04	.63	1.10	.58	1.15	.63	1.09	.65
18.0	.93	.64	.95	.71	.93	.71	.93	.75
20.0	.73	.76	.74	.80	.75	.78	.73	.81
22.0	.52	.75	.50	.83	.49	.81	.55	.77
23.0	.41	.78	.40	.85	.41	.79	.46	.81

Negative Margin of Safety? _____ Yes ✓ No Station: _____ Degree: _____

Notes / Comments

Preliminary PFAR(s)? _____ Yes ✓ No Preliminary PFAR Number(s): _____

Clarification Form(s)? _____ Yes ✓ No Number of Forms Attached: _____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Phenolic Sections - Forward Nose and Aft Inlet Rings

Motor No.: RSRM-32	Side: Right (B)	Date: 8/26/93

Assessment Engineer(s)/Inspector(s): CLARK, PASSMAN, QUICK, WILKES

Phenolic Sections:

	Yes	No	Comment #
a. Cross-ply cracking in virgin material?		✓	
b. Ply lifting?		✓	

Forward Nose Ring Char and Erosion Measurements:

Station Location	0° Erosion	0° Char	90° Erosion	90° Char	180° Erosion	180° Char	270° Erosion	270° Char
28.0	1.07	.73	1.04	.66	1.22	.66	1.11	.66
30.0	.90	.64	.80	.78	.95	.69	.90	.65
32.0	.95	.60	.90	.65	.98	.59	.96	.56

Negative Margin of Safety? _____ Yes ✓ No Station: _____ Degree: _____

Aft Inlet Ring Char and Erosion Measurements:

Station Location	0° Erosion	0° Char	90° Erosion	90° Char	180° Erosion	180° Char	270° Erosion	270° Char
34.0	.84	.66	.85	.65	.90	.60	.88	.53
36.0	.86	.64	.87	.71	.89	.63	.89	.63
38.0	.92	.61	.94	.67	.98	.56	.95	.65
39.0	.96	.63	.98	.67	1.00	.64	.97	.67

Negative Margin of Safety? _____ Yes ✓ No Station: _____ Degree: _____

Notes / Comments

Preliminary PFAR(s)? _____ Yes ✓ No Preliminary PFAR Number(s): _____

Clarification Form(s)? _____ Yes ✓ No Number of Forms Attached: _____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Phenolic Sections - Nose Cap

Motor No.: RSRM-32	Side: Right (B)	Date: 8/26/93

Assessment Engineer(s)/Inspector(s): CLARK, PASSMAN, QUICK, WILKES

Phenolic Sections:	Yes	No	Comment #
a. Cross-ply cracking in virgin material?		✓	
b. Ply lifting?		✓	

Nose Cap Char and Erosion Measurements:

Station Location	0° Erosion	0° Char	90° Erosion	90° Char	180° Erosion	180° Char	270° Erosion	270° Char
1.5	.78*		.32	.51	.84*		.72*	
4.0	.37	.47	.33	.51	.47	.42	.29	.53
6.0	.37	.44	.33	.51	.38	.46	.33	.52
8.0	.41	.46	.39	.49	.41	.41	.41	.55
10.0	.49	.41	.45	.45	.48	.37	.47	.48
12.0	.51	.45	.48	.44	.57	.39	.54	.45
14.0	.59	.48	.60	.44	.61	.43	.64	.46
16.0	.71	.37	.66	.46	.73	.41	.66	.44
18.0	.80	.49	.79	.45	.94	.42	.75	.49
20.0	1.02	.64	.97	.55	1.15	.55	.95	.58
22.0	1.61	.78	1.64	.69	1.73	.73	1.52	.81
24.0	1.89	.85	1.80	.76	1.90	.84	1.80	.85
26.0	1.45	.73	1.34	.75	1.41	.74	1.39	.84

Negative Margin of Safety? ____ Yes ✓ No Station: ____ Degree: ____

Notes / Comments * DENOTES MAX AFFECTED DEPTH

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Phenolic Sections – Cowl

Motor No.: RSRM-32	Side: Right (B)	Date: 8-24-93

Assessment Engineer(s)/Inspector(s): L.E. WILLIES

Phenolic Sections:

	Yes	No	Comment #
a. Cross-ply cracking in virgin material?		✓	
b. Ply lifting?		✓	

Cowl Char and Erosion Measurements:

Station	0°		90°		180°		270°	
Location	Erosion	Char	Erosion	Char	Erosion	Char	Erosion	Char
0.3	.29	.73	.28	.80	NF	1.07*	.24	.73
1.0	.30	.64	.27	.75	.30	.73	.23	.71
2.0	.29	.60	.24	.65	.30	.72	.24	.72
3.0	.25	.65	.21	.67	.24	.71	.21	.76
4.0	.24	.65	.20	.71	.21	.74	.20	.75
5.0	.[illegible]	.73	.18	.77	.18	.73	.17	.77
6.0	.17	.69	.16	.71	.15	.72	.15	.80
6.8	.20	.91	.16	.84	NA	1.05+	.12	.84

Negative Margin of Safety? _____ Yes ✓ No Station: _____ Degree: _____

Notes / Comments * TOTAL HEAT AFFECTED DEPTH (CHAR LINE)

Special Issue 3.3.17 POSTFIRE COWL CCP CONFIRMS APPEARS TYPICAL OF PAST FLIGHT MOTOR NOZZLES. NO PROBLEMS.

Preliminary PFAR(s)? _____ Yes ✓ No Preliminary PFAR Number(s): _____

larification Form(s)? _____ Yes ✓ No Number of Forms Attached: _____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Phenolic Sections – Fixed Housing

Motor No.: RSRM-32	Side: Right (B)	Date: 8-26-93
Assessment Engineer(s)/Inspector(s): L.E. WILKES		

Phenolic Sections:	Yes	No	Comment #
a. Cross-ply cracking in virgin material?		✓	
b. Ply lifting?		✓	

Fixed Housing Char and Erosion Measurements:

Station	0°		90°		180°		270°	
Location	Erosion	Char	Erosion	Char	Erosion	Char	Erosion	Char
0.0	.03	1.05	.06	.95	.03	1.05	.02	1.03
1.0	.02	1.09	.00	.90	.02	.94	.01	1.04
2.0	.01	1.05		1.00	.00	.87	.00	1.08
3.0	.03	1.07		.91	.03	.86		1.05
4.0	NA	1.08*		.88	.00	.88		1.03
5.0	.00	1.07		.84		.87		.98
6.0	.00	1.05		.87		.87		1.00
7.0	.00	1.00		.85		.84		.98
8.0	.00	.92		.84	.00	.73	.00	.82
9.0	NA	.70*	.00	.72	NA	.71*	NA	.78*
10.75	.44	1.09	.15	1.63	NA	1.66*	NA	1.52*

Negative Margin of Safety? ____ Yes ✓ No Station: ____ Degree: ____

Notes / Comments * TOTAL LOST AFFECTED DEPTH (CHAR + E).

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

larification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Phenolic Sections – Outer Boot Ring and Flexible Boot

Motor No.: RSRM-32	Side: Right (B)	Date: 8-24-93

Assessment Engineer(s)/Inspector(s): L.E. WILKES

	Yes	No	Comment #
Phenolic Sections:			
a. Cross-ply cracking in virgin material?		✓	
b. Ply lifting?		✓	
Flexible Boot/Outer Boot Ring Interface:			
c. Separations?	✓		1
d. Heat effects in separations (if present)?		✓	

Outer Boot Ring Char and Erosion Measurements:

Station	0°		90°		180°		270°	
Location	Erosion	Char	Erosion	Char	Erosion	Char	Erosion	Char
8.0	.06	1.02	.05	.93	.08	.91	N/A	.89 *
9.0	.04	1.01	.02	.90	.05	.87	.04	.86
10.0	.01	1.03	.03	.87	.01	.87	.06	.56
11.3	.00	1.01	.06	.88	.00	.92	.04	.92

Negative Margin of Safety? _____ Yes ✓ No Station: _____ Degree: _____

Number of Plies Remaining on the Flexible Boot:

Degree Location	Plies Remaining
0	3.1
90	3.2
180	3.4
270	3.1

Negative Margin of Safety? _____ Yes _____ No Degree: _____

Notes / Comments * TOTAL HEAT AFFECTED DEPTH (CHAR LINE)
① SEPARATIONS AT 0° & 270°, NO HEAT AFFECTS.

Preliminary PFAR(s)? _____ Yes ✓ No Preliminary PFAR Number(s): _____

Clarification Form(s)? _____ Yes ✓ No Number of Forms Attached: _____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Barrier-Booster Leak Check Port Plug and Port (At Removal) - 126 Degrees

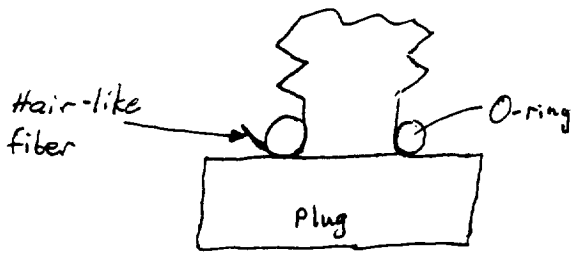
Motor No.: RSRM-32	Side: Right (B)	Date: 7/9/93

Assessment Engineer(s)/Inspector(s): Eden / Nolan

Leak Check Port Plug and Port:	Yes	No	Comment #
a. Soot to or past O-ring?		✓	
b. Sooted surfaces?		✓	
c. Heat affected or eroded O-ring (installed)?		✓	
d. O-ring damage (installed)?		✓	
e. Heat affected or eroded metal?		✓	
f. Foreign material?	✓		①
g. Excessive grease?		✓	
h. Medium or heavy corrosion?		✓	
i. Metal damage?		✓	

Notes / Comments

① Hairlike fiber found on Leak check plug Shoulder seal. Hair was removed. It was photographed before it was removed. No evidence to indicate that hair was in place before firing. (Hair-like fiber was a result of disassembly).



Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Barrier-Booster Leak Check Port Plug and O-ring (Detailed) - 126 Degrees

Motor No.: RSRM-32	Side: Right (B)	Date: 7/9/93

Assessment Engineer(s)/Inspector(s): Eden / Nolan

	Yes	No	Comment #
Leak Check Port Plug:			
a. Foreign material between the O-ring and plug?		✓	
b. Heat affected or eroded metal?		✓	
c. Seal surface/thread damage?		✓	
Secondary O-ring:			
d. Heat affected or eroded O-ring?		✓	
e. O-ring defects/damage?		✓	

Notes / Comments

Preliminary PFAR(s)? _____ Yes ✓ No Preliminary PFAR Number(s): _____

Clarification Form(s)? _____ Yes ✓ No Number of Forms Attached: _____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint Leak Check Port Plug and Port (At Removal) - Joint 2

Motor No.: RSRM-32	Side: Right (B)	Date: 7-9-93

Assessment Engineer(s)/Inspector(s): M. Offoiler, W. Steury

Leak Check Port Plug and Port:	Yes	No	Comment #
a. Soot to or past O-ring?		✓	
b. Sooted surfaces?		✓	
c. Heat affected or eroded O-ring (installed)?		✓	
d. O-ring damage (installed)?		✓	
e. Heat affected or eroded metal?		✓	
f. Foreign material?		✓	
g. Excessive grease?		✓	
h. Medium or heavy corrosion?		✓	
i. Metal damage?		✓	

Plug Break-away and Running Torques (inch-lbs): Break-away: 8 Running: 4

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint Leak Check Port Plug and O-ring (Detailed) - Joint 2

Motor No.: RSRM-32	Side: Right (B)	Date: 7-9-93

Assessment Engineer(s)/Inspector(s): W. Sperry, M. Offolter, B. Ferguson

	Yes	No	Comment #
Leak Check Port Plug:			
a. Foreign material between the O-ring and plug?		✓	
b. Heat affected or eroded metal?		✓	
c. Seal surface/thread damage?		✓	
Secondary O-ring:			
d. Heat affected or eroded O-ring?		✓	
e. O-ring defects/damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint Leak Check Port Plug and Port (At Removal) – Joint 3

Motor No.: RSRM-32	Side: Right (B)	Date: 7-9-93

Assessment Engineer(s)/Inspector(s): W. Sperry, M. Offolter

Leak Check Port Plug and Port:	Yes	No	Comment #
a. Soot to or past O-ring?		✓	
b. Sooted surfaces?		✓	
c. Heat affected or eroded O-ring (installed)?		✓	
d. O-ring damage (installed)?		✓	
e. Heat affected or eroded metal?		✓	
f. Foreign material?		✓	
g. Excessive grease?		✓	
h. Medium or heavy corrosion?		✓	
i. Metal damage?		✓	

Plug Break-away and Running Torques (inch-lbs): Break-away: 17
Running: 5

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint Leak Check Port Plug and O-ring (Detailed) – Joint 3

Motor No.: RSRM-32	Side: Right (B)	Date: 9-9-93

Assessment Engineer(s)/Inspector(s): W. Sperry, M. Offolter, B. Ferguson

	Yes	No	Comment #
Leak Check Port Plug:			
a. Foreign material between the O-ring and plug?		✓	
b. Heat affected or eroded metal?		✓	
c. Seal surface/thread damage?		✓	
Secondary O-ring:			
d. Heat affected or eroded O-ring?		✓	
e. O-ring defects/damage?		✓	

Notes / Comments

Preliminary PFAR(s)? _____ Yes ✓ No Preliminary PFAR Number(s): _____

Clarification Form(s)? _____ Yes ✓ No Number of Forms Attached: _____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint Leak Check Port Plug and Port (At Removal) - Joint 4

Motor No.: RSRM-32	Side: Right (B)	Date: 7 July 1993

Assessment Engineer(s)/Inspector(s): A Carlisle, B. Quick, M. Lyons, J. Richards

Leak Check Port Plug and Port:	Yes	No	Comment #
a. Soot to or past O-ring?		✓	
b. Sooted surfaces?		✓	
c. Heat affected or eroded O-ring (installed)?		✓	
d. O-ring damage (installed)?		✓	
e. Heat affected or eroded metal?		✓	
f. Foreign material?		✓	
g. Excessive grease?		✓	
h. Medium or heavy corrosion?		✓	
i. Metal damage?		✓	

Plug Break-away and Running Torques (inch-lbs): Break-away: 37

Running: 5

Notes / Comments

Preliminary PFAR(s)? _____ Yes ✓ No Preliminary PFAR Number(s): _____

Clarification Form(s)? _____ Yes ✓ No Number of Forms Attached: _____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint Leak Check Port Plug and O-ring (Detailed) - Joint 4

Motor No.: RSRM-32	Side: Right (B)	Date: 7 JULY 1993

Assessment Engineer(s)/Inspector(s): A. Carlisle, B. Quick, M. Lyons, J. Richards

	Yes	No	Comment #
Leak Check Port Plug:			
a. Foreign material between the O-ring and plug?		✓	
b. Heat affected or eroded metal?		✓	
c. Seal surface/thread damage?		✓	
Secondary O-ring:			
d. Heat affected or eroded O-ring?		✓	
e. O-ring defects/damage?		✓	

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint Leak Check Port Plug and Port (At Removal) - Joint 5

Motor No.: RSRM-32	Side: Right (B)	Date: 8 July 1993

Assessment Engineer(s)/Inspector(s): A. Carlisle, M. Lyons, J. Richards

Leak Check Port Plug and Port:	Yes	No	Comment #
a. Soot to or past O-ring?		✓	
b. Sooted surfaces?		✓	
c. Heat affected or eroded O-ring (installed)?		✓	
d. O-ring damage (installed)?		✓	
e. Heat affected or eroded metal?		✓	
f. Foreign material?		✓	
g. Excessive grease?		✓	
h. Medium or heavy corrosion?		✓	
i. Metal damage?		✓	

Plug Break-away and Running Torques (inch-lbs): Break-away: 42 Running: 5

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Nozzle Internal Joint Leak Check Port Plug and O-ring (Detailed) - Joint 5

Motor No.: RSRM-32	Side: Right (B)	Date: 8 July 1993

Assessment Engineer(s)/Inspector(s): A. Carlisle, M. Lyons, J. Richards

	Yes	No	Comment #
Leak Check Port Plug:			
a. Foreign material between the O-ring and plug?		✓	
b. Heat affected or eroded metal?		✓	
c. Seal surface/thread damage?		✓	
Secondary O-ring:			
d. Heat affected or eroded O-ring?		✓	
e. O-ring defects/damage?		✓	

Notes / Comments

Preliminary PFAR(s)? _____ Yes ✓ No Preliminary PFAR Number(s): _____

Clarification Form(s)? _____ Yes ✓ No Number of Forms Attached: _____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR)

Case Factory Joint - Forward Dome

Motor No.: RSRM-32	Side: Right (B)	Date: 29 SEP 1993

Assessment Engineer(s)/Inspector(s): Birch

Joint Seals and Metal:	Yes	No	Comment #
a. Heat affected or eroded O-ring?		X	
b. Heavy corrosion (pitting) in joint?	X		1
c. Heavy corrosion (pitting) in leak check port?		X	

Note: Remove corrosion to determine if pitting has occurred. Care should be taken not to damage the hardware. Solvent and/or green Scotch-Brite® pads may be used to remove the corrosion. Corrosion removal is to be done in a circumferential direction only.

Notes / Comments FWD Dome Tang Joint

1 - At Approximately 119°, Corrosion Was Removed With Green Scotchbrite, Revealing Some Pitting,

At Approximately 297°, Chemlock Was Removed With Green Scotchbrite, Revealing A Large Pit In The Tang Sealing Zone,

At Approximately 186°, Chemlock/Corrosion Combination Was Removed With Green Scotchbrite Revealing Some Pitting In The Tang Seal Zone

Preliminary PFAR(s)? ✓ Yes ____ No Preliminary PFAR Number(s): 57C-03

Clarification Form(s)? ____ Yes ____ No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Case Factory Joint – Forward Cylinder/Cylinder

Motor No.: RSRM-32	Side: Right (B)	Date: 29 Sept 93

Assessment Engineer(s)/Inspector(s): Birch

Joint Seals and Metal:	Yes	No	Comment #
a. Heat affected or eroded O-ring?		X	
b. Heavy corrosion (pitting) in joint?		X	
c. Heavy corrosion (pitting) in leak check port?		X	

Note: Remove corrosion to determine if pitting has occurred. Care should be taken not to damage the hardware. Solvent and/or green Scotch-Brite® pads may be used to remove the corrosion. Corrosion removal is to be done in a circumferential direction only.

Notes / Comments

Preliminary PFAR(s)? ____ Yes X No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes X No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Case Factory Joint - Forward Center

Motor No.: RSRM-32	Side: Right (B)	Date: 10-25-93

Assessment Engineer(s)/Inspector(s): H. ZAREMBA

Joint Seals and Metal:	Yes	No	Comment #
a. Heat affected or eroded O-ring?		✓	
b. Heavy corrosion (pitting) in joint?		✓	
c. Heavy corrosion (pitting) in leak check port?		✓	

Note: Remove corrosion to determine if pitting has occurred. Care should be taken not to damage the hardware. Solvent and/or green Scotch-Brite® pads may be used to remove the corrosion. Corrosion removal is to be done in a circumferential direction only.

Notes / Comments

Preliminary PFAR(s)? _____ Yes ✓ No Preliminary PFAR Number(s): _____

Clarification Form(s)? _____ Yes ✓ No Number of Forms Attached: _____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Case Factory Joint - Aft Center

Motor No.: RSRM-32	Side: Right (B)	Date: 10-15-92

Assessment Engineer(s)/Inspector(s): ERIC HAY

Joint Seals and Metal:	Yes	No	Comment #
a. Heat affected or eroded O-ring?		✓	
b. Heavy corrosion (pitting) in joint?		✓	
c. Heavy corrosion (pitting) in leak check port?		✓	

Note: Remove corrosion to determine if pitting has occurred. Care should be taken not to damage the hardware. Solvent and/or green Scotch-Brite® pads may be used to remove the corrosion. Corrosion removal is to be done in a circumferential direction only.

Notes / Comments

~~NONE~~ 31696 IW 15 OCT 1992 ERROR

NONE

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): N/A

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Case Factory Joint - ET Attach/Stiffener

Motor No.: RSRM-32	Side: Right (B)	Date: 8-23-93

Assessment Engineer(s)/Inspector(s): G. Rich

Joint Seals and Metal:	Yes	No	Comment #
a. Heat affected or eroded O-ring?		✓	
b. Heavy corrosion (pitting) in joint?		✓	
c. Heavy corrosion (pitting) in leak check port?		✓	

Note: Remove corrosion to determine if pitting has occurred. Care should be taken not to damage the hardware. Solvent and/or green Scotch-Brite® pads may be used to remove the corrosion. Corrosion removal is to be done in a circumferential direction only.

Notes / Comments

Preliminary PFAR(s)? ____ Yes ✓ No Preliminary PFAR Number(s): ____

Clarification Form(s)? ____ Yes ✓ No Number of Forms Attached: ____

POSTFLIGHT OBSERVATION RECORD (PFOR)

Case Factory Joint – Stiffener/Stiffener

Motor No.: RSRM-32	Side: Right (B)	Date: 08 20 93

Assessment Engineer(s)/Inspector(s): DARRYL MARBLE

Joint Seals and Metal:	Yes	No	Comment #
a. Heat affected or eroded O-ring?		✓	
b. Heavy corrosion (pitting) in joint?		✓	
c. Heavy corrosion (pitting) in leak check port?		✓	

Note: Remove corrosion to determine if pitting has occurred. Care should be taken not to damage the hardware. Solvent and/or green Scotch-Brite® pads may be used to remove the corrosion. Corrosion removal is to be done in a circumferential direction only.

Notes / Comments

STIFF TO STIFF JOINT

Preliminary PFAR(s)? _____ Yes ✓ No Preliminary PFAR Number(s): _____

Clarification Form(s)? _____ Yes ✓ No Number of Forms Attached: _____

Thiokol CORPORATION
SPACE OPERATIONS

POSTFLIGHT OBSERVATION RECORD (PFOR)

Case Factory Joint - Aft Dome

Motor No.: RSRM-32	Side: Right (B)	Date: 08-20-93

Assessment Engineer(s)/Inspector(s): DARRYL MARBLE

Joint Seals and Metal	Yes	No	Comment #
a. Heat affected or eroded O-ring?		✓	
b. Heavy corrosion (pitting) in joint?		✓	
c. Heavy corrosion (pitting) in leak check port?		✓	

Note: Remove corrosion to determine if pitting has occurred. Care should be taken not to damage the hardware. Solvent and/or green Scotch-Brite® pads may be used to remove the corrosion. Corrosion removal is to be done in a circumferential direction only.

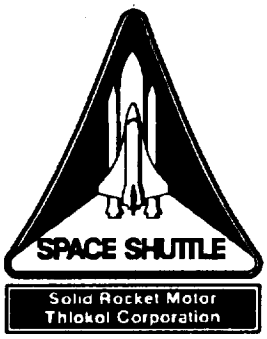
Notes / Comments

NONE

Preliminary PFAR(s)? _____ Yes ✓ No Preliminary PFAR Number(s): _____

Clarification Form(s)? _____ Yes ✓ No Number of Forms Attached: _____

TWR-64240



Appendix B
Nozzle Postfire Data

Final Postflight Hardware Evaluation Report RSRM-32 (STS-57)

November 1993

Prepared for:

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GEORGE C. MARSHALL SPACE FLIGHT CENTER
MARSHALL SPACE FLIGHT CENTER, ALABAMA 35812

Contract No.	NAS8-38100
DR No.	4-23
WBS No.	4C601-04-01
ECS No.	SS4775

Thiokol CORPORATION
SPACE OPERATIONS

P.O. Box 707, Brigham City, Utah 84302-0707 (801) 863-3511

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RSRM-32A Forward Exit Cone Assembly Erosion and Char Data

Angular Location	Stations											
0 degrees	1.0	4.0	4.6	8.0	12.0	16.0	20.0	24.0	28.0	32.0	32.9	34.0
Measured Erosion	0.37	0.36	0.37	0.36	0.35	NA	NA	NA	0.30	0.21	0.18	0.15
Measured Char	0.75	0.73	0.71	0.71	0.76	NA	NA	NA	0.70	0.75	0.70	0.67
Adjusted Char *	0.60	0.58	0.57	0.57	0.61	NA	NA	NA	0.56	0.60	0.56	0.54
Denomenator	1.38	1.34	1.12	1.32	1.36	NA	NA	NA	1.21	1.11	0.83	0.93
RSRM Liner Thickness	1.807	1.731	1.411	1.629	1.524	NA	NA	NA	1.328	1.372	1.127	1.408
Margin of Safety	0.31	0.29	0.26	0.23	0.12	NA	NA	NA	0.10	0.24	0.36	0.52
90 degrees												
Measured Erosion	0.37	0.35	0.37	0.37	0.32	NA	NA	NA	NA	0.19	0.19	0.15
Measured Char	0.76	0.76	0.72	0.68	0.73	NA	NA	NA	NA	0.78	0.75	0.75
Adjusted Char *	0.61	0.61	0.58	0.54	0.58	NA	NA	NA	NA	0.62	0.60	0.60
Denomenator	1.39	1.36	1.13	1.31	1.27	NA	NA	NA	NA	1.10	0.89	1.01
RSRM Liner Thickness	1.807	1.731	1.411	1.629	1.524	NA	NA	NA	1.328	1.372	1.127	1.408
Margin of Safety	0.30	0.28	0.25	0.24	0.20	NA	NA	NA	NA	0.24	0.27	0.40
180 degrees												
Measured Erosion	0.33	0.34	0.36	0.35	0.33	NA	NA	NA	0.28	0.25	0.18	0.15
Measured Char	0.78	0.74	0.75	0.70	0.70	NA	NA	NA	0.70	0.68	0.71	0.74
Adjusted Char *	0.62	0.59	0.60	0.56	0.56	NA	NA	NA	0.56	0.54	0.57	0.59
Denomenator	1.34	1.32	1.14	1.29	1.26	NA	NA	NA	1.18	1.10	0.84	0.99
RSRM Liner Thickness	1.807	1.731	1.411	1.629	1.524	NA	NA	NA	1.328	1.372	1.127	1.408
Margin of Safety	0.35	0.31	0.24	0.26	0.21	NA	NA	NA	0.13	0.24	0.34	0.42
270 degrees												
Measured Erosion	0.36	0.37	0.36	0.35	0.33	NA	NA	NA	0.28	0.19	0.15	0.14
Measured Char	0.76	0.74	0.77	0.74	0.65	NA	NA	NA	0.77	0.82	0.81	0.82
Adjusted Char *	0.61	0.59	0.62	0.59	0.52	NA	NA	NA	0.62	0.66	0.65	0.66
Denomenator	1.37	1.37	1.16	1.33	1.21	NA	NA	NA	1.25	1.14	0.87	1.06
RSRM Liner Thickness	1.807	1.731	1.411	1.629	1.524	NA	NA	NA	1.328	1.372	1.127	1.408
Margin of Safety	0.32	0.26	0.22	0.22	0.26	NA	NA	NA	0.07	0.20	0.29	0.33

Minimum margin of safety is 0.07 at station 28.00 degree 270.00
Maximum margin of safety is 0.52 at station 34.00 degree 0.00

* Measured char adjusted to end of action time

$$\text{Margin of Safety} = \frac{\text{minimum liner thickness}}{1.70 \text{ X erosion} + 1.25 \text{ X adj char *}} - 1$$

RSRM-32A Throat Assembly Erosion and Char Data

Angular Location	Stations												
0 degrees	1.0	2.0	4.0	6.0	8.0	10.0	12.0	14.0	16.0	18.0	20.0	22.0	23.0
Measured Erosion	1.07	1.11	1.17	1.23	1.29	1.18	1.15	1.13	1.08	0.96	0.76	0.53	0.44
Measured Char	0.62	0.71	0.68	0.63	0.50	0.56	0.60	0.62	0.69	0.78	0.80	0.80	0.82
Adjusted Char *	0.47	0.53	0.51	0.47	0.38	0.42	0.45	0.47	0.52	0.62	0.64	0.64	0.66
Denomenator	2.72	2.89	2.98	3.05	3.05	2.88	2.86	2.84	2.81	2.70	2.32	1.86	1.70
RSRM Liner Thickness	3.174	3.247	3.314	3.280	3.183	3.397	3.517	3.626	3.710	3.586	3.231	2.583	2.110
Margin of Safety	0.17	0.13	0.11	0.08	0.04	0.18	0.23	0.28	0.32	0.33	0.39	0.39	0.24
90 degrees													
Measured Erosion	1.06	1.08	1.14	1.20	1.21	1.19	1.16	1.16	1.05	0.95	0.78	0.51	0.47
Measured Char	0.62	0.61	0.68	0.64	0.56	0.54	0.57	0.58	0.68	0.76	0.71	0.81	0.80
Adjusted Char *	0.47	0.46	0.51	0.48	0.42	0.41	0.43	0.43	0.51	0.61	0.57	0.65	0.64
Denomenator	2.70	2.73	2.92	3.00	2.94	2.89	2.85	2.86	2.74	2.66	2.27	1.83	1.74
RSRM Liner Thickness	3.174	3.247	3.314	3.280	3.183	3.397	3.517	3.626	3.710	3.586	3.231	2.583	2.110
Margin of Safety	0.18	0.19	0.14	0.09	0.08	0.18	0.23	0.27	0.36	0.35	0.42	0.41	0.21
180 degrees													
Measured Erosion	1.06	1.09	1.16	1.20	1.25	1.18	1.14	1.15	1.10	0.96	0.77	0.51	0.44
Measured Char	0.68	0.66	0.59	0.64	0.50	0.55	0.62	0.59	0.65	0.68	0.75	0.81	0.80
Adjusted Char *	0.51	0.50	0.44	0.48	0.38	0.41	0.47	0.44	0.49	0.54	0.60	0.65	0.64
Denomenator	2.76	2.80	2.87	3.00	2.97	2.88	2.86	2.85	2.81	2.60	2.29	1.83	1.68
RSRM Liner Thickness	3.174	3.247	3.314	3.280	3.183	3.397	3.517	3.626	3.710	3.586	3.231	2.583	2.110
Margin of Safety	0.15	0.16	0.15	0.09	0.07	0.18	0.23	0.27	0.32	0.38	0.41	0.41	0.26
270 degrees													
Measured Erosion	1.03	1.07	1.12	1.19	1.23	1.15	1.13	1.13	1.14	0.94	0.72	0.47	0.41
Measured Char	0.62	0.65	0.68	0.70	0.55	0.55	0.60	0.56	0.58	0.66	0.77	0.84	0.82
Adjusted Char *	0.47	0.49	0.51	0.53	0.41	0.41	0.45	0.42	0.43	0.53	0.62	0.67	0.66
Denomenator	2.64	2.75	2.88	3.04	2.98	2.82	2.82	2.78	2.82	2.54	2.21	1.78	1.64
RSRM Liner Thickness	3.174	3.247	3.314	3.280	3.183	3.397	3.517	3.626	3.710	3.586	3.231	2.583	2.110
Margin of Safety	0.20	0.18	0.15	0.08	0.07	0.21	0.25	0.30	0.31	0.41	0.46	0.45	0.29

Minimum margin of safety is 0.04 at station 8.00 degree 0.00
Maximum margin of safety is 0.46 at station 20.00 degree 270.00

* Measured char adjusted to end of action time

$$\text{Margin of Safety} = \frac{\text{minimum liner thickness}}{\text{2.00 X erosion + 1.25 X adj char *}} - 1$$

RSRM-32B Throat Assembly Erosion and Char Data

Angular Location	Stations												
0 degrees	1.0	2.0	4.0	6.0	8.0	10.0	12.0	14.0	16.0	18.0	20.0	22.0	23.0
Measured Erosion	1.10	1.10	1.16	1.21	1.19	1.18	1.13	1.12	1.04	0.93	0.73	0.52	0.41
Measured Char	0.64	0.66	0.57	0.55	0.58	0.54	0.55	0.56	0.63	0.64	0.76	0.75	0.78
Adjusted Char *	0.48	0.50	0.43	0.41	0.43	0.41	0.41	0.42	0.47	0.51	0.61	0.60	0.62
Denomenator	2.80	2.82	2.85	2.94	2.92	2.87	2.78	2.77	2.67	2.50	2.22	1.79	1.60
RSRM Liner Thickness	3.174	3.247	3.314	3.280	3.183	3.397	3.517	3.626	3.710	3.586	3.231	2.583	2.110
Margin of Safety	0.13	0.15	0.16	0.12	0.09	0.19	0.27	0.31	0.39	0.43	0.46	0.44	0.32
90 degrees													
Measured Erosion	1.11	1.15	1.18	1.23	1.25	1.23	1.19	1.17	1.10	0.95	0.74	0.50	0.40
Measured Char	0.62	0.66	0.67	0.66	0.61	0.65	0.58	0.63	0.58	0.71	0.80	0.83	0.85
Adjusted Char *	0.47	0.50	0.50	0.50	0.46	0.49	0.43	0.47	0.43	0.57	0.64	0.66	0.68
Denomenator	2.80	2.92	2.99	3.08	3.07	3.07	2.92	2.93	2.74	2.61	2.28	1.83	1.65
RSRM Liner Thickness	3.174	3.247	3.314	3.280	3.183	3.397	3.517	3.626	3.710	3.586	3.231	2.583	2.110
Margin of Safety	0.13	0.11	0.11	0.07	0.04	0.11	0.20	0.24	0.35	0.37	0.42	0.41	0.28
180 degrees													
Measured Erosion	1.05	1.07	1.14	1.20	1.23	1.16	1.15	1.12	1.15	0.93	0.75	0.49	0.41
Measured Char	0.64	0.70	0.59	0.63	0.63	0.58	0.58	0.59	0.63	0.71	0.78	0.81	0.79
Adjusted Char *	0.48	0.53	0.44	0.47	0.47	0.43	0.43	0.44	0.47	0.57	0.62	0.65	0.63
Denomenator	2.70	2.80	2.83	2.99	3.05	2.86	2.84	2.79	2.89	2.57	2.28	1.79	1.61
RSRM Liner Thickness	3.174	3.247	3.314	3.280	3.183	3.397	3.517	3.626	3.710	3.586	3.231	2.583	2.110
Margin of Safety	0.18	0.16	0.17	0.10	0.04	0.19	0.24	0.30	0.28	0.40	0.42	0.44	0.31
270 degrees													
Measured Erosion	1.07	1.11	1.16	1.21	1.21	1.22	1.18	1.17	1.09	0.93	0.73	0.55	0.46
Measured Char	0.68	0.65	0.68	0.67	0.57	0.56	0.58	0.59	0.65	0.75	0.81	0.77	0.81
Adjusted Char *	0.51	0.49	0.51	0.50	0.43	0.42	0.43	0.44	0.49	0.60	0.65	0.62	0.65
Denomenator	2.78	2.83	2.96	3.05	2.95	2.96	2.90	2.89	2.79	2.61	2.27	1.87	1.73
RSRM Liner Thickness	3.174	3.247	3.314	3.280	3.183	3.397	3.517	3.626	3.710	3.586	3.231	2.583	2.110
Margin of Safety	0.14	0.15	0.12	0.08	0.08	0.15	0.21	0.25	0.33	0.37	0.42	0.38	0.22

Minimum margin of safety is 0.04 at station 8.00 degree 90.00
Maximum margin of safety is 0.46 at station 20.00 degree 0.00

* Measured char adjusted to end of action time

$$\text{Margin of Safety} = \frac{\text{minimum liner thickness}}{2.00 \times \text{erosion} + 1.25 \times \text{adj char}^{*}} - 1$$

RSRM-32A Nose Inlet Assembly Erosion and Char Data

Angular Location	Stations												
0 degrees	1.5	4.0	6.0	8.0	10.0	12.0	14.0	16.0	18.0	20.0	22.0	24.0	26.0
Measured Erosion	0.29	0.40	0.41	0.49	0.56	0.58	0.70	0.78	0.94	1.15	1.79	1.94	1.40
Measured Char	0.50	0.48	0.53	0.51	0.47	0.51	0.44	0.46	0.44	0.51	0.63	0.70	0.70
Adjusted Char *	0.40	0.38	0.42	0.41	0.38	0.41	0.35	0.37	0.35	0.41	0.50	0.56	0.53
Denomenator	1.08	1.28	1.35	1.49	1.59	1.67	1.84	2.02	2.32	2.81	4.21	4.58	3.46
RSRM Liner Thickness	1.776	2.038	2.248	2.458	2.668	2.878	3.088	3.298	3.507	4.055	4.713	4.691	3.863
Margin of Safety	0.64	0.59	0.67	0.65	0.68	0.72	0.68	0.63	0.51	0.44	0.12	0.02	0.12
90 degrees													
Measured Erosion	NA	0.40	0.42	0.44	0.50	0.48	0.65	0.69	0.81	1.05	1.69	1.79	1.27
Measured Char	NA	0.43	0.48	0.49	0.48	0.49	0.51	0.43	0.38	0.39	0.55	0.71	0.76
Adjusted Char *	NA	0.34	0.38	0.39	0.38	0.39	0.41	0.34	0.30	0.31	0.44	0.57	0.57
Denomenator	NA	1.23	1.32	1.37	1.48	1.45	1.81	1.81	2.00	2.49	3.93	4.29	3.25
RSRM Liner Thickness	1.776	2.038	2.248	2.458	2.668	2.878	3.088	3.298	3.507	4.055	4.713	4.691	3.863
Margin of Safety	NA	0.66	0.70	0.79	0.80	0.98	0.71	0.82	0.75	0.63	0.20	0.09	0.19
180 degrees													
Measured Erosion	NA	0.32	0.33	0.44	0.45	0.45	0.58	0.61	0.76	0.93	1.57	1.76	1.30
Measured Char	NA	0.51	0.53	0.39	0.45	0.49	0.42	0.46	0.41	0.47	0.63	0.78	0.77
Adjusted Char *	NA	0.41	0.42	0.31	0.36	0.39	0.34	0.37	0.33	0.38	0.50	0.62	0.58
Denomenator	NA	1.15	1.19	1.27	1.35	1.39	1.58	1.68	1.93	2.33	3.77	4.30	3.32
RSRM Liner Thickness	1.776	2.038	2.248	2.458	2.668	2.878	3.088	3.298	3.507	4.055	4.713	4.691	3.863
Margin of Safety	NA	0.77	0.89	0.94	0.98	1.07	0.95	0.96	0.82	0.74	0.25	0.09	0.16
270 degrees													
Measured Erosion	NA	0.33	0.37	0.43	0.49	0.49	0.59	0.62	0.71	0.95	1.49	1.85	1.45
Measured Char	NA	0.56	0.47	0.49	0.50	0.50	0.48	0.45	0.47	0.47	0.88	0.89	0.79
Adjusted Char *	NA	0.45	0.38	0.39	0.40	0.40	0.38	0.36	0.38	0.38	0.70	0.71	0.59
Denomenator	NA	1.22	1.21	1.35	1.48	1.48	1.66	1.69	1.89	2.37	3.86	4.59	3.64
RSRM Liner Thickness	1.776	2.038	2.248	2.458	2.668	2.878	3.088	3.298	3.507	4.055	4.713	4.691	3.863
Margin of Safety	NA	0.67	0.86	0.82	0.80	0.94	0.86	0.95	0.86	0.71	0.22	0.02	0.06

Minimum margin of safety is 0.02 at station 24.00 degree 270.00
Maximum margin of safety is 1.07 at station 12.00 degree 180.00

* Measured char adjusted to end of action time

$$\text{Margin of Safety} = \frac{\text{minimum liner thickness}}{2.00 \times \text{erosion} + 1.25 \times \text{adj char}^{*}} - 1$$

RSRM-32A Nose Inlet Assembly Erosion and Char Data
Forward Nose Ring and Aft Inlet Ring

Angular Location	Stations						
0 degrees	28.0	30.0	32.0	34.0	36.0	38.0	39.0
Measured Erosion	1.22	0.93	0.93	0.88	0.90	0.96	0.99
Measured Char	0.66	0.60	0.64	0.61	0.60	0.53	0.56
Adjusted Char *	0.50	0.45	0.48	0.46	0.45	0.40	0.42
Denomenator	3.06	2.42	2.46	2.33	2.36	2.42	2.50
RSRM Liner Thickness	3.508	3.252	2.950	3.182	3.200	3.026	3.000
Margin of Safety	0.15	0.34	0.20	0.36	0.35	0.25	0.20
90 degrees							
Measured Erosion	1.10	0.87	0.90	0.83	0.86	0.94	0.94
Measured Char	0.58	0.67	0.59	0.60	0.59	0.64	0.56
Adjusted Char *	0.43	0.50	0.44	0.45	0.44	0.48	0.42
Denomenator	2.74	2.37	2.35	2.22	2.27	2.48	2.40
RSRM Liner Thickness	3.508	3.252	2.950	3.182	3.200	3.026	3.000
Margin of Safety	0.28	0.37	0.25	0.43	0.41	0.22	0.25
180 degrees							
Measured Erosion	NA	0.82	0.92	0.90	0.92	0.98	1.00
Measured Char	NA	0.66	0.55	0.53	0.55	0.56	0.61
Adjusted Char *	NA	0.50	0.41	0.40	0.41	0.42	0.46
Denomenator	NA	2.26	2.36	2.30	2.36	2.48	2.57
RSRM Liner Thickness	3.508	3.252	2.950	3.182	3.200	3.026	3.000
Margin of Safety	NA	0.44	0.25	0.39	0.36	0.22	0.17
270 degrees							
Measured Erosion	1.15	0.93	1.01	0.87	0.91	0.98	1.01
Measured Char	0.67	0.64	0.66	0.63	0.67	0.72	0.70
Adjusted Char *	0.50	0.48	0.50	0.47	0.50	0.54	0.53
Denomenator	2.93	2.46	2.64	2.33	2.45	2.64	2.68
RSRM Liner Thickness	3.508	3.252	2.950	3.182	3.200	3.026	3.000
Margin of Safety	0.20	0.32	0.12	0.37	0.31	0.15	0.12

* Measured char adjusted to end of action time

$$\text{Margin of Safety} = \frac{\text{minimum liner thickness}}{2.00 \text{ X erosion} + 1.25 \text{ X adj char *}} - 1$$

RSRM-32B Nose Inlet Assembly Erosion and Char Data

Angular Location	Stations												
0 degrees	1.5	4.0	6.0	8.0	10.0	12.0	14.0	16.0	18.0	20.0	22.0	24.0	26.0
Measured Erosion	NA	0.37	0.37	0.41	0.49	0.51	0.59	0.71	0.80	1.02	1.61	1.89	1.45
Measured Char	NA	0.47	0.44	0.46	0.41	0.45	0.48	0.37	0.49	0.64	0.78	0.85	0.73
Adjusted Char *	NA	0.38	0.35	0.37	0.33	0.36	0.38	0.30	0.39	0.51	0.62	0.68	0.55
Denomenator	NA	1.21	1.18	1.28	1.39	1.47	1.66	1.79	2.09	2.68	4.00	4.63	3.58
RSRM Liner Thickness	1.776	2.038	2.248	2.458	2.668	2.878	3.088	3.298	3.507	4.055	4.713	4.691	3.863
Margin of Safety	NA	0.68	0.91	0.92	0.92	0.96	0.86	0.84	0.68	0.51	0.18	0.01	0.08
90 degrees													
Measured Erosion	0.32	0.33	0.33	0.39	0.45	0.48	0.60	0.66	0.79	0.97	1.64	1.80	1.34
Measured Char	0.51	0.51	0.51	0.49	0.45	0.44	0.44	0.46	0.45	0.55	0.69	0.76	0.75
Adjusted Char *	0.41	0.41	0.41	0.39	0.36	0.35	0.35	0.37	0.36	0.44	0.55	0.61	0.56
Denomenator	1.15	1.17	1.17	1.27	1.35	1.40	1.64	1.78	2.03	2.49	3.97	4.36	3.38
RSRM Liner Thickness	1.776	2.038	2.248	2.458	2.668	2.878	3.088	3.298	3.507	4.055	4.713	4.691	3.863
Margin of Safety	0.54	0.74	0.92	0.94	0.98	1.06	0.88	0.85	0.73	0.63	0.19	0.08	0.14
180 degrees													
Measured Erosion	NA	0.47	0.38	0.41	0.48	0.57	0.61	0.73	0.94	1.15	1.73	1.90	1.41
Measured Char	NA	0.42	0.46	0.41	0.37	0.39	0.43	0.41	0.42	0.55	0.73	0.84	0.74
Adjusted Char *	NA	0.34	0.37	0.33	0.30	0.31	0.34	0.33	0.34	0.44	0.58	0.67	0.56
Denomenator	NA	1.36	1.22	1.23	1.33	1.53	1.65	1.87	2.30	2.85	4.19	4.64	3.51
RSRM Liner Thickness	1.776	2.038	2.248	2.458	2.668	2.878	3.088	3.298	3.507	4.055	4.713	4.691	3.863
Margin of Safety	NA	0.50	0.84	1.00	1.01	0.88	0.87	0.76	0.52	0.42	0.12	0.01	0.10
270 degrees													
Measured Erosion	NA	0.29	0.33	0.41	0.47	0.54	0.64	0.66	0.75	0.95	1.52	1.80	1.39
Measured Char	NA	0.53	0.52	0.55	0.48	0.45	0.46	0.44	0.49	0.58	0.81	0.85	0.84
Adjusted Char *	NA	0.42	0.42	0.44	0.38	0.36	0.37	0.35	0.39	0.46	0.65	0.68	0.63
Denomenator	NA	1.11	1.18	1.37	1.42	1.53	1.74	1.76	1.99	2.48	3.85	4.45	3.57
RSRM Liner Thickness	1.776	2.038	2.248	2.458	2.668	2.878	3.088	3.298	3.507	4.055	4.713	4.691	3.863
Margin of Safety	NA	0.84	0.91	0.79	0.88	0.88	0.77	0.87	0.76	0.64	0.22	0.05	0.08

Minimum margin of safety is 0.01 at station 24.00 degree 180.00
Maximum margin of safety is 1.06 at station 12.00 degree 90.00

* Measured char adjusted to end of action time

$$\text{Margin of Safety} = \frac{\text{minimum liner thickness}}{2.00 \times \text{erosion} + 1.25 \times \text{adj char}^{*}} - 1$$

RSRM-32B Nose Inlet Assembly Erosion and Char Data
Forward Nose Ring and Aft Inlet Ring

Angular Location	Stations						
0 degrees	28.0	30.0	32.0	34.0	36.0	38.0	39.0
Measured Erosion	1.07	0.90	0.95	0.84	0.86	0.92	0.96
Measured Char	0.73	0.64	0.60	0.66	0.64	0.61	0.63
Adjusted Char *	0.55	0.48	0.45	0.50	0.48	0.46	0.47
Denomenator	2.82	2.40	2.46	2.30	2.32	2.41	2.51
RSRM Liner Thickness	3.508	3.252	2.950	3.182	3.200	3.026	3.000
Margin of Safety	0.24	0.35	0.20	0.38	0.38	0.25	0.19
90 degrees							
Measured Erosion	1.04	0.80	0.90	0.85	0.87	0.94	0.98
Measured Char	0.66	0.78	0.65	0.65	0.71	0.67	0.67
Adjusted Char *	0.50	0.59	0.49	0.49	0.53	0.50	0.50
Denomenator	2.70	2.33	2.41	2.31	2.41	2.51	2.59
RSRM Liner Thickness	3.508	3.252	2.950	3.182	3.200	3.026	3.000
Margin of Safety	0.30	0.39	0.22	0.38	0.33	0.21	0.16
180 degrees							
Measured Erosion	1.22	0.95	0.98	0.90	0.89	0.98	1.00
Measured Char	0.66	0.69	0.59	0.60	0.63	0.56	0.64
Adjusted Char *	0.50	0.52	0.44	0.45	0.47	0.42	0.48
Denomenator	3.06	2.55	2.51	2.36	2.37	2.48	2.60
RSRM Liner Thickness	3.508	3.252	2.950	3.182	3.200	3.026	3.000
Margin of Safety	0.15	0.28	0.17	0.35	0.35	0.22	0.15
270 degrees							
Measured Erosion	1.11	0.90	0.96	0.88	0.89	0.95	0.97
Measured Char	0.66	0.65	0.56	0.53	0.63	0.65	0.67
Adjusted Char *	0.50	0.49	0.42	0.40	0.47	0.49	0.50
Denomenator	2.84	2.41	2.44	2.26	2.37	2.51	2.57
RSRM Liner Thickness	3.508	3.252	2.950	3.182	3.200	3.026	3.000
Margin of Safety	0.24	0.35	0.21	0.41	0.35	0.21	0.17

* Measured char adjusted to end of action time

$$\text{Margin of Safety} = \frac{\text{minimum liner thickness}}{2.00 \times \text{erosion} + 1.25 \times \text{adj char}^{*}} - 1$$

RSRM-32A Cowl, Outer Boot Ring Assembly Erosion and Char Data

Angular Location	Stations											
0 degrees	0.3	1.0	2.0	3.0	4.0	5.0	6.0	6.8	8.0	9.0	10.0	11.3
Measured Erosion	0.30	0.29	0.27	0.26	0.24	0.20	0.16	0.25	0.10	0.09	0.05	0.07
Measured Char	0.80	0.73	0.69	0.65	0.62	0.78	0.70	0.82	0.92	0.91	0.90	0.92
Adjusted Char *	0.64	0.58	0.55	0.52	0.50	0.62	0.56	0.66	0.74	0.73	0.72	0.74
Denomenator	1.40	1.31	1.23	1.17	1.10	1.18	1.08	1.36	1.25	1.23	1.16	1.21
RSRM Liner Thickness	1.438	1.499	1.577	1.655	1.733	1.811	1.889	1.943	1.600	1.674	1.687	1.703
Margin of Safety	0.03	0.14	0.28	0.41	0.58	0.53	0.75	0.43	0.28	0.36	0.46	0.41
90 degrees												
Measured Erosion	0.31	0.32	0.25	0.22	0.19	0.18	0.15	0.15	0.10	0.10	0.08	0.07
Measured Char	0.72	0.66	0.68	0.69	0.68	0.72	0.67	0.87	0.82	0.80	0.79	0.81
Adjusted Char *	0.58	0.53	0.54	0.55	0.54	0.58	0.54	0.70	0.66	0.64	0.63	0.65
Denomenator	1.34	1.30	1.18	1.13	1.06	1.08	1.03	1.27	1.13	1.11	1.07	1.08
RSRM Liner Thickness	1.438	1.499	1.577	1.655	1.733	1.811	1.889	1.943	1.600	1.674	1.687	1.703
Margin of Safety	0.07	0.15	0.34	0.46	0.63	0.68	0.84	0.53	0.41	0.51	0.58	0.58
180 degrees												
Measured Erosion	0.30	0.27	0.23	0.20	0.18	0.15	0.14	0.18	0.07	0.03	0.01	0.00
Measured Char	0.71	0.68	0.62	0.66	0.63	0.69	0.76	0.82	0.95	0.94	0.92	0.90
Adjusted Char *	0.57	0.54	0.50	0.53	0.50	0.55	0.61	0.66	0.76	0.75	0.74	0.72
Denomenator	1.31	1.22	1.08	1.06	0.99	0.99	1.12	1.25	1.25	1.17	1.12	1.08
RSRM Liner Thickness	1.438	1.499	1.577	1.655	1.733	1.811	1.889	1.943	1.600	1.674	1.687	1.703
Margin of Safety	0.10	0.23	0.46	0.56	0.75	0.83	0.68	0.55	0.29	0.43	0.51	0.58
270 degrees												
Measured Erosion	0.28	0.26	0.22	0.21	0.18	0.16	0.14	0.23	0.14	0.05	0.04	0.05
Measured Char	0.78	0.70	0.67	0.71	0.72	0.71	0.70	0.82	0.92	1.01	0.94	0.97
Adjusted Char *	0.62	0.56	0.54	0.57	0.58	0.57	0.56	0.66	0.74	0.81	0.75	0.78
Denomenator	1.34	1.22	1.11	1.13	1.08	1.03	1.05	1.33	1.31	1.29	1.19	1.24
RSRM Liner Thickness	1.438	1.499	1.577	1.655	1.733	1.811	1.889	1.943	1.600	1.674	1.687	1.703
Margin of Safety	0.07	0.23	0.42	0.46	0.60	0.76	0.80	0.46	0.22	0.30	0.42	0.37

Minimum margin of safety is 0.03 at station 0.30 degree 0.00
Maximum margin of safety is 0.84 at station 6.00 degree 90.00

* Measured char adjusted to end of action time

$$\text{Margin of Safety} = \frac{\text{minimum liner thickness}}{1.50 \times \text{erosion} + 1.50 \times \text{adj char}^{*}} - 1$$

RSRM-32B Cowl, Outer Boot Ring Assembly Erosion and Char Data

Angular Location	Stations											
0 degrees	0.3	1.0	2.0	3.0	4.0	5.0	6.0	6.8	8.0	9.0	10.0	11.3
Measured Erosion	0.29	0.30	0.29	0.25	0.24	0.19	0.17	0.20	0.06	0.04	0.01	0.00
Measured Char	0.73	0.64	0.60	0.65	0.68	0.73	0.69	0.91	1.02	1.01	1.03	1.01
Adjusted Char *	0.58	0.51	0.48	0.52	0.54	0.58	0.55	0.73	0.82	0.81	0.82	0.81
Denomenator	1.31	1.24	1.18	1.15	1.16	1.11	1.08	1.39	1.31	1.27	1.25	1.21
RSRM Liner Thickness	1.438	1.499	1.577	1.655	1.733	1.811	1.889	1.943	1.600	1.674	1.687	1.703
Margin of Safety	0.10	0.21	0.34	0.44	0.49	0.63	0.74	0.40	0.22	0.32	0.35	0.41
90 degrees												
Measured Erosion	0.28	0.27	0.24	0.21	0.20	0.18	0.16	0.16	0.05	0.02	0.03	0.06
Measured Char	0.80	0.75	0.65	0.67	0.71	0.77	0.71	0.84	0.93	0.90	0.87	0.88
Adjusted Char *	0.64	0.60	0.52	0.54	0.57	0.62	0.57	0.67	0.74	0.72	0.70	0.70
Denomenator	1.36	1.29	1.13	1.09	1.11	1.13	1.09	1.25	1.19	1.11	1.09	1.15
RSRM Liner Thickness	1.438	1.499	1.577	1.655	1.733	1.811	1.889	1.943	1.600	1.674	1.687	1.703
Margin of Safety	0.06	0.16	0.40	0.52	0.56	0.60	0.73	0.56	0.34	0.51	0.55	0.49
180 degrees												
Measured Erosion	NA	0.30	0.30	0.24	0.21	0.18	0.15	NA	0.08	0.05	0.01	0.00
Measured Char	NA	0.73	0.72	0.71	0.74	0.73	0.72	NA	0.91	0.87	0.87	0.92
Adjusted Char *	NA	0.58	0.58	0.57	0.59	0.58	0.58	NA	0.73	0.70	0.70	0.74
Denomenator	NA	1.33	1.32	1.19	1.16	1.09	1.09	NA	1.21	1.12	1.06	1.10
RSRM Liner Thickness	1.438	1.499	1.577	1.655	1.733	1.811	1.889	1.943	1.600	1.674	1.687	1.703
Margin of Safety	NA	0.13	0.19	0.39	0.49	0.66	0.73	NA	0.32	0.50	0.59	0.54
270 degrees												
Measured Erosion	0.24	0.23	0.24	0.21	0.20	0.17	0.15	0.12	NA	0.04	0.06	0.04
Measured Char	0.73	0.71	0.72	0.76	0.75	0.77	0.80	0.84	NA	0.86	0.86	0.92
Adjusted Char *	0.58	0.57	0.58	0.61	0.60	0.62	0.64	0.67	NA	0.69	0.69	0.74
Denomenator	1.21	1.17	1.20	1.18	1.15	1.11	1.19	1.19	NA	1.09	1.12	1.16
RSRM Liner Thickness	1.438	1.499	1.577	1.655	1.733	1.811	1.889	1.943	1.600	1.674	1.687	1.703
Margin of Safety	0.19	0.28	0.31	0.40	0.51	0.63	0.59	0.64	NA	0.53	0.50	0.46

Minimum margin of safety is 0.06 at station 0.30 degree 90.00
Maximum margin of safety is 0.74 at station 6.00 degree 0.00

* Measured char adjusted to end of action time

$$\text{Margin of Safety} = \frac{\text{minimum liner thickness}}{1.50 \times \text{erosion} + 1.50 \times \text{adj char}^{*}} - 1$$

RSRM-32A Fixed Housing Assembly Erosion and Char Data

Angular Location	Stations										
0 degrees	0.00	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.75
Measured Erosion	0.08	0.04	0.00	0.03	0.03	0.01	0.01	0.01	0.00	0.00	0.02
Measured Char	1.20	1.13	1.07	0.97	1.01	1.00	1.04	1.02	0.92	0.93	1.84
Adjusted Char *	0.96	0.90	0.86	0.78	0.81	0.80	0.83	0.82	0.74	0.74	1.47
Denomenator	1.36	1.21	1.07	1.03	1.07	1.02	1.06	1.04	0.92	0.93	1.88
RSRM Liner Thickness	3.807	2.081	1.825	1.827	1.829	1.831	1.832	1.834	1.836	2.426	3.048
Margin of Safety	1.80	0.72	0.71	0.77	0.71	0.80	0.73	0.76	1.00	1.61	0.62
90 degrees											
Measured Erosion	0.05	0.06	0.01	0.01	0.01	0.01	0.00	0.00	0.00	NA	NA
Measured Char	1.12	1.06	0.96	0.97	0.93	0.91	0.95	0.92	0.78	NA	NA
Adjusted Char *	0.90	0.85	0.77	0.78	0.74	0.73	0.76	0.74	0.62	NA	NA
Denomenator	1.22	1.18	0.98	0.99	0.95	0.93	0.95	0.92	0.78	NA	NA
RSRM Liner Thickness	3.807	2.081	1.825	1.827	1.829	1.831	1.832	1.834	1.836	2.426	3.048
Margin of Safety	2.12	0.76	0.86	0.85	0.93	0.97	0.93	0.99	1.35	NA	NA
180 degrees											
Measured Erosion	0.04	0.02	0.02	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.15
Measured Char	1.13	1.03	1.10	1.13	1.07	1.04	1.04	0.99	0.86	0.83	1.45
Adjusted Char *	0.90	0.82	0.88	0.90	0.86	0.83	0.83	0.79	0.69	0.66	1.16
Denomenator	1.21	1.07	1.14	1.13	1.09	1.04	1.04	1.01	0.86	0.83	1.75
RSRM Liner Thickness	3.807	2.081	1.825	1.827	1.829	1.831	1.832	1.834	1.836	2.426	3.048
Margin of Safety	2.15	0.94	0.60	0.62	0.68	0.76	0.76	0.82	1.13	1.92	0.74
270 degrees											
Measured Erosion	0.00	0.01	0.04	0.03	0.04	0.03	0.05	0.00	0.00	0.00	0.00
Measured Char	1.21	1.08	1.00	1.05	1.02	1.01	1.00	0.96	0.93	0.78	1.73
Adjusted Char *	0.97	0.86	0.80	0.84	0.82	0.81	0.80	0.77	0.74	0.62	1.38
Denomenator	1.21	1.10	1.08	1.11	1.10	1.07	1.10	0.96	0.93	0.78	1.73
RSRM Liner Thickness	3.807	2.081	1.825	1.827	1.829	1.831	1.832	1.834	1.836	2.426	3.048
Margin of Safety	2.15	0.89	0.69	0.65	0.66	0.71	0.67	0.91	0.97	2.11	0.76

Minimum margin of safety is 0.60 at station 2.00 degree 180.00
Maximum margin of safety is 2.15 at station 0.00 degree 180.00

* Measured char adjusted to end of action time

$$\text{Margin of Safety} = \frac{\text{minimum liner thickness}}{2.00 \times \text{erosion} + 1.25 \times \text{adj char}^{*}} - 1$$

RSRM-32B Fixed Housing Assembly Erosion and Char Data

Angular Location	Stations										
0 degrees	0.00	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.75
Measured Erosion	0.03	0.02	0.01	0.03	NA	0.00	0.00	0.00	0.00	NA	0.44
Measured Char	1.05	1.09	1.05	1.07	NA	1.07	1.05	1.00	0.92	NA	1.09
Adjusted Char *	0.84	0.87	0.84	0.86	NA	0.86	0.84	0.80	0.74	NA	0.87
Denomenator	1.11	1.13	1.07	1.13	NA	1.07	1.05	1.00	0.92	NA	1.97
RSRM Liner Thickness	3.807	2.081	1.825	1.827	1.829	1.831	1.832	1.834	1.836	2.426	3.048
Margin of Safety	2.43	0.84	0.71	0.62	NA	0.71	0.74	0.83	1.00	NA	0.55
90 degrees											
Measured Erosion	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15
Measured Char	0.95	0.90	1.00	0.91	0.88	0.84	0.87	0.85	0.84	0.72	1.63
Adjusted Char *	0.76	0.72	0.80	0.73	0.70	0.67	0.70	0.68	0.67	0.58	1.30
Denomenator	1.07	0.90	1.00	0.91	0.88	0.84	0.87	0.85	0.84	0.72	1.93
RSRM Liner Thickness	3.807	2.081	1.825	1.827	1.829	1.831	1.832	1.834	1.836	2.426	3.048
Margin of Safety	2.56	1.31	0.82	1.01	1.08	1.18	1.11	1.16	1.19	2.37	0.58
180 degrees											
Measured Erosion	0.03	0.02	0.00	0.03	0.00	0.00	0.00	0.00	0.00	NA	NA
Measured Char	1.05	0.94	0.87	0.86	0.88	0.87	0.87	0.84	0.73	NA	NA
Adjusted Char *	0.84	0.75	0.70	0.69	0.70	0.70	0.70	0.67	0.58	NA	NA
Denomenator	1.11	0.98	0.87	0.92	0.88	0.87	0.87	0.84	0.73	NA	NA
RSRM Liner Thickness	3.807	2.081	1.825	1.827	1.829	1.831	1.832	1.834	1.836	2.426	3.048
Margin of Safety	2.43	1.12	1.10	0.99	1.08	1.10	1.11	1.18	1.52	NA	NA
270 degrees											
Measured Erosion	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	NA	NA
Measured Char	1.03	1.04	1.08	1.05	1.03	0.98	1.00	0.98	0.82	NA	NA
Adjusted Char *	0.82	0.83	0.86	0.84	0.82	0.78	0.80	0.78	0.66	NA	NA
Denomenator	1.07	1.06	1.08	1.05	1.03	0.98	1.00	0.98	0.82	NA	NA
RSRM Liner Thickness	3.807	2.081	1.825	1.827	1.829	1.831	1.832	1.834	1.836	2.426	3.048
Margin of Safety	2.56	0.96	0.69	0.74	0.78	0.87	0.83	0.87	1.24	NA	NA

Minimum margin of safety is 0.55 at station 10.75 degree 0.00
Maximum margin of safety is 2.56 at station 0.00 degree 90.00

* Measured char adjusted to end of action time

$$\text{Margin of Safety} = \frac{\text{minimum liner thickness}}{\text{2.00 X erosion + 1.25 X adj char *}} - 1$$

RSRM-32B Aft Exit Cone Assembly Erosion and Char Data

Angular Location	Stations												
0 degrees	1.00	6.00	18.00	30.00	42.00	54.00	64.00	73.77	77.77	83.77	89.77	95.77	101.77
Measured Erosion	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.17
Measured Char	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.61
Adjusted Char *	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.52
Denomenator	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.94
RSRM Liner Thickness	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.095
Margin of Safety	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.17
15 degrees													
Measured Erosion	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Measured Char	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Adjusted Char *	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Denomenator	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
RSRM Liner Thickness	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.095
Margin of Safety	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
30 degrees													
Measured Erosion	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.19
Measured Char	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.56
Adjusted Char *	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.48
Denomenator	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.92
RSRM Liner Thickness	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.095
Margin of Safety	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.19
60 degrees													
Measured Erosion	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Measured Char	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Adjusted Char *	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Denomenator	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
RSRM Liner Thickness	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.095
Margin of Safety	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
90 degrees													
Measured Erosion	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.19
Measured Char	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.55
Adjusted Char *	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.47
Denomenator	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.91
RSRM Liner Thickness	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.095
Margin of Safety	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.21
165 degrees													
Measured Erosion	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.16
Measured Char	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.54
Adjusted Char *	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.46
Denomenator	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.85
RSRM Liner Thickness	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.095
Margin of Safety	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.29

RSRM-32B Aft Exit Cone Assembly Erosion and Char Data

Angular Location	Stations		
0 degrees	107.77	113.77	118.77
Measured Erosion	NA	NA	NA
Measured Char	NA	NA	NA
Adjusted Char *	NA	NA	NA
Denomenator	NA	NA	NA
RSRM Liner Thickness	1.131	1.160	NA
Margin of Safety	NA	NA	NA
15 degrees			
Measured Erosion	0.27	NA	NA
Measured Char	0.54	NA	NA
Adjusted Char *	0.46	NA	NA
Denomenator	1.03	NA	NA
RSRM Liner Thickness	1.131	1.160	NA
Margin of Safety	0.10	NA	NA
30 degrees			
Measured Erosion	NA	0.19	NA
Measured Char	NA	0.51	NA
Adjusted Char *	NA	0.43	NA
Denomenator	NA	0.86	NA
RSRM Liner Thickness	1.131	1.160	NA
Margin of Safety	NA	0.34	NA
60 degrees			
Measured Erosion	0.11	NA	NA
Measured Char	0.59	NA	NA
Adjusted Char *	0.50	NA	NA
Denomenator	0.81	NA	NA
RSRM Liner Thickness	1.131	1.160	NA
Margin of Safety	0.39	NA	NA
90 degrees			
Measured Erosion	0.17	NA	NA
Measured Char	0.58	NA	NA
Adjusted Char *	0.49	NA	NA
Denomenator	0.91	NA	NA
RSRM Liner Thickness	1.131	1.160	NA
Margin of Safety	0.25	NA	NA
165 degrees			
Measured Erosion	0.12	NA	NA
Measured Char	0.60	NA	NA
Adjusted Char *	0.51	NA	NA
Denomenator	0.84	NA	NA
RSRM Liner Thickness	1.131	1.160	NA
Margin of Safety	0.34	NA	NA

RSRM-32B Aft Exit Cone Assembly Erosion and Char Data

Angular Location	Stations												
195 degrees													
Measured Erosion	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Measured Char	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Adjusted Char *	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Denomenator	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
RSRM Liner Thickness	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.095
Margin of Safety	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
210 degrees													
Measured Erosion	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Measured Char	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Adjusted Char *	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Denomenator	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
RSRM Liner Thickness	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.095
Margin of Safety	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
255 degrees													
Measured Erosion	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Measured Char	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Adjusted Char *	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Denomenator	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
RSRM Liner Thickness	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.095
Margin of Safety	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
270 degrees													
Measured Erosion	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Measured Char	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Adjusted Char *	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Denomenator	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
RSRM Liner Thickness	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.095
Margin of Safety	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
285 degrees													
Measured Erosion	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.19
Measured Char	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.59
Adjusted Char *	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.50
Denomenator	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.95
RSRM Liner Thickness	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.095
Margin of Safety	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.15
300 degrees													
Measured Erosion	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.18
Measured Char	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.57
Adjusted Char *	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.48
Denomenator	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.91
RSRM Liner Thickness	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.095
Margin of Safety	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.20

RSRM-32B Aft Exit Cone Assembly Erosion and Char Data

Angular Location	Stations		
195 degrees			
Measured Erosion	0.17	NA	NA
Measured Char	0.63	NA	NA
Adjusted Char *	0.54	NA	NA
Denomenator	0.96	NA	NA
RSRM Liner Thickness	1.131	1.160	NA
Margin of Safety	0.18	NA	NA
210 degrees			
Measured Erosion	0.18	NA	NA
Measured Char	0.56	NA	NA
Adjusted Char *	0.48	NA	NA
Denomenator	0.90	NA	NA
RSRM Liner Thickness	1.131	1.160	NA
Margin of Safety	0.26	NA	NA
255 degrees			
Measured Erosion	0.34	0.16	NA
Measured Char	0.49	0.55	NA
Adjusted Char *	0.42	0.47	NA
Denomenator	1.10	0.86	NA
RSRM Liner Thickness	1.131	1.160	NA
Margin of Safety	0.03	0.35	NA
270 degrees			
Measured Erosion	0.21	NA	NA
Measured Char	0.58	NA	NA
Adjusted Char *	0.49	NA	NA
Denomenator	0.97	NA	NA
RSRM Liner Thickness	1.131	1.160	NA
Margin of Safety	0.16	NA	NA
285 degrees			
Measured Erosion	NA	0.18	NA
Measured Char	NA	0.57	NA
Adjusted Char *	NA	0.48	NA
Denomenator	NA	0.91	NA
RSRM Liner Thickness	1.131	1.160	NA
Margin of Safety	NA	0.27	NA
300 degrees			
Measured Erosion	0.20	0.21	NA
Measured Char	0.51	0.53	NA
Adjusted Char *	0.43	0.45	NA
Denomenator	0.88	0.92	NA
RSRM Liner Thickness	1.131	1.160	NA
Margin of Safety	0.28	0.26	NA

RSRM-32B Aft Exit Cone Assembly Erosion and Char Data

Angular Location	Stations												
330 degrees													
Measured Erosion	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.20
Measured Char	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.57
Adjusted Char *	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.48
Denomenator	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.95
RSRM Liner Thickness	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.095
Margin of Safety	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0.16
345 degrees													
Measured Erosion	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Measured Char	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Adjusted Char *	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Denomenator	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
RSRM Liner Thickness	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.095
Margin of Safety	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Minimum margin of safety is 0.03 at station 107.77 degree 255.00
Maximum margin of safety is 0.45 at station 107.77 degree 345.00

* Measured char adjusted to end of action time

$$\text{Margin of Safety} = \frac{\text{minimum liner thickness}}{1.70 \times \text{erosion} + 1.25 \times \text{adj char}^{*}} - 1$$

RSRM-32B Aft Exit Cone Assembly Erosion and Char Data

Angular Location	Stations		
330 degrees			
Measured Erosion	NA	NA	NA
Measured Char	NA	NA	NA
Adjusted Char *	NA	NA	NA
Denomenator	NA	NA	NA
RSRM Liner Thickness	1.131	1.160	NA
Margin of Safety	NA	NA	NA
345 degrees			
Measured Erosion	0.07	NA	NA
Measured Char	0.62	NA	NA
Adjusted Char *	0.53	NA	NA
Denomenator	0.78	NA	NA
RSRM Liner Thickness	1.131	1.160	NA
Margin of Safety	0.45	NA	NA

* Measured char adjusted to end of action time

$$\text{Margin of Safety} = \frac{\text{minimum liner thickness}}{1.70 \times \text{erosion} + 1.25 \times \text{adj char}^{*}} - 1$$

C-3

TWR-64240

Appendix C
Insulation Postfire Data

Final Postflight Hardware Evaluation Report
RSRM-32 (STS-57)

November 1993

Prepared for:

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GEORGE C. MARSHALL SPACE FLIGHT CENTER
MARSHALL SPACE FLIGHT CENTER, ALABAMA 35812

Contract No.	NAS8-38100
DR No.	4-23
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Thiokol CORPORATION
SPACE OPERATIONS

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RSRM-32A IGNITER CHAMBER AND ADAPTER INSULATION PERFORMANCE

CHAMBER PART NO. 1U75162-02
CHAMBER SERIAL NO. 0000013
ADAPTER PART NO. 1U77392-01
ADAPTER SERIAL NO. 0000020

PREFIRE MEASUREMENTS
INCHES

STATION (NO.)	DEGREE LOCATION 0.0	60.0	90.0	150.0	180.0	240.0	270.0	330.0	MEDIAN	MINIMUM
1.0										
2.0										
3.0										
4.0										
5.0										
6.0										
7.0										
8.0										
9.0										
10.0										
11.0	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540

A BLANK INDICATES NO DATA WAS TAKEN AT THAT STATION

CHAMBER PART NO. N/A
CHAMBER SERIAL NO. 0000000
ADAPTER PART NO. 1U77547-01
ADAPTER SERIAL NO. 0000003

POSTFIRE MEASUREMENTS
INCHES

STATION (NO.)	DEGREE LOCATION 0.0	60.0	90.0	150.0	180.0	240.0	270.0	330.0	MEDIAN	MINIMUM
1.0										
2.0										
3.0										
4.0										
5.0										
6.0										
7.0										
8.0										
9.0										
10.0										
11.0	0.405	0.404	0.407	0.392	0.411	0.406	0.406	0.400	0.405	0.392

A BLANK INDICATES NO DATA WAS TAKEN AT THAT STATION

RSRM-32A IGNITER CHAMBER AND ADAPTER INSULATION PERFORMANCE

COMPLIANCE SAFETY FACTORS (CSF)

STATION (NO.)	DEGREE LOCATION 0.0	60.0	90.0	150.0	180.0	240.0	270.0	330.0	MINIMUM	PLANE
1.0										
2.0										
3.0										
4.0										
5.0										
6.0										
7.0										
8.0										
9.0										
10.0										
11.0	3.35	3.32	3.40	3.05	3.50	3.37	3.37	3.23	3.05	150.0

SF= + INDICATES THAT NEGLIGIBLE MDD OCCURRED

A BLANK INDICATES NO DATA AVAILABLE FOR THAT STATION

ACTUAL SAFETY FACTORS (ASF)

STATION (NO.)	DEGREE LOCATION 0.0	60.0	90.0	150.0	180.0	240.0	270.0	330.0	MINIMUM	PLANE
1.0										
2.0										
3.0										
4.0										
5.0										
6.0										
7.0										
8.0										
9.0										
10.0										
11.0	4.00	3.97	4.06	3.65	4.19	4.03	4.03	3.86	3.65	150.0

SF= + INDICATES THAT NEGLIGIBLE MDD OCCURRED

A BLANK INDICATES NO DATA AVAILABLE FOR THAT STATION

RSRM-32A IGNITER CHAMBER AND ADAPTER INSULATION PERFORMANCE

MATERIAL DECOMPOSITION DEPTH (MDD)
(INCHES)

STATION (NO.)	DEGREE LOCATION 0.0	60.0	90.0	150.0	180.0	240.0	270.0	330.0	MEDIAN	MAXIMUM
1.0										
2.0										
3.0										
4.0										
5.0										
6.0										
7.0										
8.0										
9.0										
10.0										
11.0	0.135	0.136	0.133	0.148	0.129	0.134	0.134	0.140	0.135	0.148

A BLANK INDICATES NO DATA AVAILABLE FOR THAT STATION

MATERIAL DECOMPOSITION RATE (MDR)
(MILS/SEC)

STATION (NO.)	DEGREE LOCATION 0.0	60.0	90.0	150.0	180.0	240.0	270.0	330.0	AVERAGE
1.0									
2.0									
3.0									
4.0									
5.0									
6.0									
7.0									
8.0									
9.0									
10.0									
11.0	1.1	1.1	1.1	1.2	1.1	1.1	1.1	1.1	1.1

MOTOR ACTION (EXPOSURE) TIME = 122.20 SEC

A MDR=0 INDICATES THAT MDR < .1 MIL/SEC

A BLANK INDICATES NO DATA AVAILABLE FOR THAT STATION

RSRM-32B IGNITER CHAMBER AND ADAPTER INSULATION PERFORMANCE

CHAMBER PART NO. 1U75162-02
CHAMBER SERIAL NO. 0000014
ADAPTER PART NO. 1U77392-01
ADAPTER SERIAL NO. 0000021

PREFIRE MEASUREMENTS
INCHES

STATION (NO.)	DEGREE LOCATION 0.0	60.0	90.0	150.0	180.0	240.0	270.0	330.0	MEDIAN	MINIMUM
1.0										
2.0										
3.0										
4.0										
5.0										
6.0										
7.0										
8.0										
9.0										
10.0										
11.0	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540	0.540

A BLANK INDICATES NO DATA WAS TAKEN AT THAT STATION

CHAMBER PART NO. N/A
CHAMBER SERIAL NO. 0000000
ADAPTER PART NO. 1U77457-01
ADAPTER SERIAL NO. 0000004

POSTFIRE MEASUREMENTS
INCHES

STATION (NO.)	DEGREE LOCATION 0.0	60.0	90.0	150.0	180.0	240.0	270.0	330.0	MEDIAN	MINIMUM
1.0										
2.0										
3.0										
4.0										
5.0										
6.0										
7.0										
8.0										
9.0										
10.0										
11.0	0.401	0.394	0.414	0.402	0.399	0.398	0.391	0.406	0.400	0.391

A BLANK INDICATES NO DATA WAS TAKEN AT THAT STATION

COMPLIANCE SAFETY FACTORS (CSF)

STATION (NO.)	DEGREE LOCATION 0.0	60.0	90.0	150.0	180.0	240.0	270.0	330.0	MINIMUM	PLANE
1.0										
2.0										
3.0										
4.0										
5.0										
6.0										
7.0										
8.0										
9.0										
10.0										
11.0	3.25	3.10	3.59	3.28	3.21	3.18	3.03	3.37	3.03	270.0

SF= + INDICATES THAT NEGLIGIBLE MDD OCCURRED

A BLANK INDICATES NO DATA AVAILABLE FOR THAT STATION

ACTUAL SAFETY FACTORS (ASF)

STATION (NO.)	DEGREE LOCATION 0.0	60.0	90.0	150.0	180.0	240.0	270.0	330.0	MINIMUM	PLANE
1.0										
2.0										
3.0										
4.0										
5.0										
6.0										
7.0										
8.0										
9.0										
10.0										
11.0	3.88	3.70	4.29	3.91	3.83	3.80	3.62	4.03	3.62	270.0

SF= + INDICATES THAT NEGLIGIBLE MDD OCCURRED

A BLANK INDICATES NO DATA AVAILABLE FOR THAT STATION

MATERIAL DECOMPOSITION DEPTH (MDD)
(INCHES)

STATION (NO.)	DEGREE LOCATION 0.0	60.0	90.0	150.0	180.0	240.0	270.0	330.0	MEDIAN	MAXIMUM
1.0										
2.0										
3.0										
4.0										
5.0										
6.0										
7.0										
8.0										
9.0										
10.0										
11.0	0.139	0.146	0.126	0.138	0.141	0.142	0.149	0.134	0.140	0.149

A BLANK INDICATES NO DATA AVAILABLE FOR THAT STATION

MATERIAL DECOMPOSITION RATE (MDR)
(MILS/SEC)

STATION (NO.)	DEGREE LOCATION 0.0	60.0	90.0	150.0	180.0	240.0	270.0	330.0	AVERAGE
1.0									
2.0									
3.0									
4.0									
5.0									
6.0									
7.0									
8.0									
9.0									
10.0									
11.0	1.1	1.2	1.0	1.1	1.2	1.2	1.2	1.1	1.1

MOTOR ACTION (EXPOSURE) TIME = 122.10 SEC

A MDR=0 INDICATES THAT MDR < .1 MIL/SEC

A BLANK INDICATES NO DATA AVAILABLE FOR THAT STATION

Tables 3, 4, 5, 6

C-III

RSRM-32A FORWARD CENTER NBR INHBITOR MEASUREMENTS

DEGREE LOCATION	INCH STATION						
	4.2	4.7	10.7	15.7	18.7	23.7	26.6
0	0.764	0.757	0.712	0.572	0.529	0.423	0.418
60	0.890	0.895	0.761	0.723	0.572	0.416	N/A
120	0.863	0.878	0.715	0.634	0.478	0.399	N/A
180	0.869	0.852	0.748	0.695	0.581	0.500	N/A
240	0.863	0.848	0.718	0.616	0.474	N/A	N/A
300	0.899	0.905	0.798	0.648	0.509	0.365	N/A

*NOTE: AN N/A INDICATES INHIBITOR ERODED PAST INCH STATION

C-IV

RSRM-32B FORWARD CENTER NBR INHBITOR MEASUREMENTS

DEGREE LOCATION	INCH STATION						
	4.2	4.7	10.7	15.7	18.7	23.7	26.6
0	0.920	0.887	0.862	0.697	0.642	0.566	N/A
60	0.945	0.952	0.823	0.838	0.660	0.519	N/A
120	0.992	0.997	0.982	0.690	0.582	0.515	N/A
180	0.890	0.887	0.833	0.706	0.734	0.563	N/A
240	0.941	0.960	0.811	0.694	0.612	N/A	N/A
300	0.955	0.968	0.802	0.860	0.614	0.445	N/A

*NOTE: AN N/A INDICATES INHIBITOR ERODED PAST INCH STATION

C-V

RSRM-32A AFT CENTER NBR INHBITOR MEASUREMENTS

DEGREE LOCATION	INCH STATION						
	4.2	4.7	10.7	15.7	18.7	23.7	26.6
0	0.696	0.666	0.400	N/A	N/A	N/A	N/A
60	0.729	0.718	0.397	N/A	N/A	N/A	N/A
120	0.702	0.661	0.415	N/A	N/A	N/A	N/A
180	0.709	0.675	0.470	N/A	N/A	N/A	N/A
240	0.740	0.707	0.415	N/A	N/A	N/A	N/A
300	0.702	0.669	N/A	N/A	N/A	N/A	N/A

*NOTE: AN N/A INDICATES INHIBITOR ERODED PAST INCH STATION

C-VI

RSRM-32B AFT CENTER NBR INHBITOR MEASUREMENTS

DEGREE LOCATION	INCH STATION						
	4.2	4.7	10.7	15.7	18.7	23.7	26.6
0	0.762	0.745	0.418	N/A	N/A	N/A	N/A
60	0.770	0.765	0.370	N/A	N/A	N/A	N/A
120	0.803	0.770	0.499	N/A	N/A	N/A	N/A
180	0.825	0.790	0.455	N/A	N/A	N/A	N/A
240	0.794	0.772	0.457	N/A	N/A	N/A	N/A
300	0.796	0.792	0.414	N/A	N/A	N/A	N/A

*NOTE: AN N/A INDICATES INHIBITOR ERODED PAST INCH STATION

Tables 7, 8

C-VII

RSRM-32A AFT NBR INHBITOR MEASUREMENTS

DEGREE LOCATION	INCH STATION	
	3.9	4.9
0	0.510	0.369
60	0.428	0.051
120	0.430	N/A
180	0.253	N/A
270	0.405	N/A
315	0.413	N/A

*NOTE: AN N/A INDICATES INHIBITOR ERODED PAST INCH STATION

C-VIII

RSRM-32B AFT NBR INHBITOR MEASUREMENTS

DEGREE LOCATION	INCH STATION	
	3.9	4.9
0	N/A	N/A
60	N/A	N/A
120	0.513	0.365
180	N/A	N/A
270	0.437	N/A
315	N/A	N/A

*NOTE: AN N/A INDICATES INHIBITOR ERODED PAST INCH STATION