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FLIGHT SET 360T004 (STS-30)
INSULATION COMPONENT FINAL REPORT
VOLUME III
INTERIM RELEASE

27 June 1989

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ABSTRACT

Volume III of this postfire report deals with the insulation component of the RSRM. The report is released twice for each flight set. The interim release contract date is on or before 45 days after the last field joint or nozzle to case joint is disassembled at KSC and contains the results of the KSC visual evaluation. The data contained in the Volume III interim release supersedes the insulation data presented in the KSC 10 day report. The final release contract date is on or before 45 days after the last factory joint is disassembled at the Clearfield H-7 facility and contains the results of all visual evaluations and a thermal safety factor analysis. The data contained in the Volume III final release supersedes the interim release and the insulation data presented in the Clearfield 10 day report.

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ACRONYM LIST

ASF	-	Actual Safety Factor
CEI	-	Contract End Item
CF/EPDM	-	Carbon Fiber Filled EPDM
CSF	-	Compliance Safety Factor
DFI	-	Development Flight Instrumentation
DR	-	Discrepancy Report
EMT	-	Engineering Management Team
EPDM	-	Ethylene Propylene Diene Monomer
ET	-	External Tank
E.T.	-	Exposure Time
FRR	-	Flight Readiness Review
HPM	-	High Performance Motor
I.D.	-	Inside Diameter
IFA	-	In Flight Anomaly
KSC	-	Kennedy Space Center
M + 3σ	-	Median Plus Three Times The Standard Deviation
MDD	-	Material Decomposition Depth
MDR	-	Material Decomposition Rate
MDT	-	Minimum Design Thickness
NBR	-	Acrylonitrile Butadiene Rubber
PEEL	-	Postfire Engineering Evaluation Limits
PEEP	-	Postfire Engineering Evaluation Plan
PFAR	-	Postfire Anomaly Record
PR	-	Problem Report
PSI	-	Pounds Per Square Inch
RPRB	-	Redesign Program Review Board
RSRM	-	Redesigned Solid Rocket Motor
SRB	-	Solid Rocket Booster
SRM	-	Solid Rocket Motor
STS	-	Space Transportation System
TPS	-	Thermal Protection System

1.0 INTRODUCTION

STS-30 was launched from KSC pad 39B on 4 May 1989. Two of the Redesigned Solid Rocket Motors were part of the launch system and were designated RSRM-4A (360T004A) and RSRM-4B (360T004B). Both motors incorporated the redesigned nozzle to case joint and case field joint as shown on Figure 1. Following booster separation and splashdown, the motors were recovered and returned to Cape Canaveral Hangar AF for disassembly and inspection.

In an attempt to standardize and document the evaluation of flight RSRM's, a Postflight Engineering Evaluation Plan has been written (Reference 1). The PEEP outlines the basic evaluations to be performed. Appropriate procedures contained in this plan were used to evaluate the internal and external insulation. An addendum to the PEEP was written which outlines additional evaluations to be performed on the RSRM-4A and RSRM-4B motors to assess conditions documented on prefire discrepancy reports (Reference 2). The intent of these procedures was to insure that all pertinent evaluation points were examined and documented in a consistent and complete manner.

2.0 OBJECTIVE

The objective of this report is to document the postflight condition of the internal and external insulation as noted during the evaluation of the nozzle to case joints, the case field joints, the igniter to case joints, and the acreage insulation which made up RSRM-4A and RSRM-4B. An additional objective is to discuss all observations which were written up as Squawks and Problem Reports as well as discuss the Insulation Component Program Team assessment of the observations.

3.0 SUMMARY

A summary of the RSRM-4A and RSRM-4B external and internal insulation condition is found below. A detailed description of the results can be found in Sections 6.0 and 7.0, respectively.

3.1 EXTERNAL INSULATION

3.1.1 Factory Joint Weatherseals

The factory joint weatherseals appeared to be in good condition. Normal heat effects and discoloration were evident on both aft segment weatherseals.

The weatherseal on the RSRM-4A aft segment stiffener to stiffener factory joint was unbonded on the aft edge in fourteen separate places. The largest unbond extended 35.0 inches circumferentially. Most of the unbonds extended axially to the pin retainer band. All of the unbonded areas exhibited adhesive failure at the Chemlok 205 to case interface. The pin retainer band was also stretched and displaced, leaving the pins visible in several locations. The total unbond area covered approximately 31 percent of the circumference on the aft edge. One similar unbond was present on the aft edge of the RSRM-4A aft dome factory joint weatherseal. It was located at 278° and measured 3.75 inches circumferentially and extended axially to the pin retainer band. Another unbond was found on the aft edge of the RSRM-4A forward center segment factory joint weatherseal. It was located at 28° and measured 1.2 inches circumferentially and 0.40 inch axially. The unbonding occurred at splashdown and appears to be the result of a weakened bondline caused by a surface finish which was too smooth.

Moisture was found dripping from under the weatherseal on the RSRM-4A forward center segment factory joint. The water appeared to have entered the weatherseal at the locations where insulation cure thermocouple wires were routed between the weatherseal and the case. The unbond described above was adjacent to the wires, but, the unbond was small and did not extend to the pin retainer band. The weatherseal was very well bonded in all other areas. This same condition was noted on multiple segments of the RSRM-2 flight set and one segment of the RSRM-3 flight set. The closeout of the wire exit locations has been changed to reduce or eliminate problems on future flights. No significant areas of missing EPDM insulation were noted on any factory joint weatherseal.

3.1.2 Stiffener Stubs and Rings

The insulation over the stiffener stubs and rings was in good condition. Normal heat effects and discoloration were evident on all surfaces, and there were no significant areas of missing material. The EPDM was well bonded to the stiffener stubs and appeared to be well bonded to the stiffener rings as evidenced by a tap test of all exposed surfaces prior to and after hydrolazing. The only exceptions were on the RSRM-4A motor where the stiffener rings were buckled due to splashdown loads, and the insulation was visibly unbonded. K5NA was present on the ends of the ring segments after removal, indicating that hydrolazing was less severe than on previous flights. Hydrolazing is believed to have caused unbonds on RSRM-2 and RSRM-3.

3.2 NOZZLE TO CASE JOINTS

Based on the visual evaluation, both nozzle to case joints performed well. No gas paths through the polysulfide adhesive or any other anomalous conditions were identified. The polysulfide adhesive on the RSRM-4A joint had only two measurable voids; both were at and aft of the insulation step. The largest void was 1.02 inch axially by 0.40 inch circumferentially. There were also several smaller voids (0.15 inch axially by 0.10 inch circumferentially) forward of the step on the RSRM-4A joint. There were approximately 10 to 15 smaller voids (0.15 inch axial by 0.10 inch circumferentially) on the RSRM-4B joint aft of the insulation step. None of the voids on either joint received hot gas.

The RSRM-4A and RSRM-4B polysulfide bondlines exhibited good cohesive failure of the polysulfide bondline upon disassembly (70% on RSRM-4A, 85% on RSRM-4B). The average polysulfide vent slot fill was 68% on RSRM-4A and 64% on RSRM-4B. These were within the expected range.

3.3 FIELD JOINTS

The internal insulation in all six of the case field joints performed as designed, and no anomalous conditions were identified. J-leg tip contact was evident full circumference at each joint. Wet soot deposits extending down the bondline were noted on all of the RSRM-4

field joints to a fairly uniform depth 0.3 to 0.4 inch into the bondline (outboard from the remaining material). Similar wet sooting was noted further into the bondline on the RSRM-1 forward field joints and extended to the radius region. Wet sooting was also noted on RSRM-2 and RSRM-3. This sooting is believed to occur at re-entry or splashdown during joint flexing.

There were no clevis edge separations that were recordable (over 0.10 inch depth). This hardware was the first flight set yielding no edge separations exceeding criteria upon disassembly at KSC. It is also the second flight set to incorporate grit blasting of the inner clevis leg. The process appears to have significantly improved the postfire edge separation condition. Some tang edge separations were visible on two field joints. These will be further evaluated when the segments reach the Clearfield H-7 facility.

Clevis insulation cracks and crazing were noted on the radius region insulation of both aft segments and both aft center segments. The noted conditions did not have any effect on the function of the joint. Cracks and crazing will be further evaluated when the segments reach the Clearfield H-7 facility.

3.4 IGNITER TO CASE JOINTS

The condition of the igniter boss insulation was excellent. An evaluation of both RSRM-4A and RSRM-4B insulation to case interfaces revealed no edge separations. The molded insulation surface was in good condition, and both joints exhibited normal erosion on the inboard surface. One blowhole through the putty on each igniter was present. No adverse effects on the performance of the joint resulted from either of the blowholes.

3.5 INTERNAL ACREAGE INSULATION

The acreage insulation, including the internal insulation over each of the factory joints, appeared in good condition during the preliminary evaluation. No evidence of hot gas penetration through the insulation or severe erosion was identified.

3.5.1 Aft Segments

The aft segment NBR inhibitor stubs exhibited normal erosion over approximately one-half of the circumference, but there was an area of uneven erosion on each. These areas had a very short inhibitor stub with intermittent inhibitor pieces taller than adjacent areas. A similar condition was also noted on the RSRM-2 and RSRM-3 aft segments. There was one circumferential inhibitor tear (3.2 inches long) and one radial tear (3.1 inches long) in the RSRM-4A inhibitor. No charring or erosion was evident in the tear, indicating that the tear occurred after motor burn. The aft segment acreage and aft dome insulation was in normal condition. There was one small gouge caused by splashdown debris, but no other areas of blisters, separations, gouges, cuts, missing material, or excessive erosion.

3.5.2 Center Segments

One inhibitor tear greater than 3 inches radially was noted in the RSRM-4B aft center segment inhibitor stub. Some radial tears were also noted in the forward center segment NBR inhibitor stubs (six on RSRM-4A and five on RSRM-4B). The tears in the forward center segments ranged from 5.5 to 14.4 inches radially. The radial extent and frequency of the tears identified in the inhibitor stubs are within the range of tears noted on past flight motors. The edges of the tears demonstrated no material loss or erosion. This indicated that the tears occurred after motor burn. The flap and acreage insulation exhibited normal erosion. The castable inhibitor was completely missing on all four center segments. The flap and CF/EPDM was completely eroded to the flap bulb on the aft center segments and partially eroded on the forward center segments.

3.5.3 Forward Segments

The stress relief flap was present full circumference on both forward segments but was heat affected and eroded. The castable inhibitors were completely missing full circumference. Some axial tears were identified on the remaining heat affected flaps of both segments, similar to RSRM-1 and RSRM-3B forward segments which had numerous flap

tears. The edges of the tears demonstrated no material loss or erosion, indicating that the tears occurred after motor burn. The acreage insulation was in normal condition. The eleven point star pattern was easily distinguishable in the liner.

A final evaluation of the thermal performance of the insulation will be accomplished after the internal insulation thicknesses are measured at the Clearfield H-7 facility.

4.0 CONCLUSIONS

During the KSC evaluation, Squawk forms were generated to report and track observations which violated the Postflight Engineering Evaluation Limits (Reference 3). The Squawks were reviewed by the SRB/SRM Postflight Assessment Team, and some of the Squawks were elevated to PR's. The PR's and Squawks are contained in Reference 4. Only two Squawks, which were both elevated to PR's, were generated against the RSRM-4 insulation component.

Following the inspection, the Insulation Component Program Team met to determine which observations were 'potential anomalies'. The observations documented on PR's and Squawks were automatically termed 'potential anomalies'. One other observation was classified as a 'potential anomaly'. The Insulation Component Program Team then classified each of the 'potential anomalies' as a 'critical', 'major', or 'minor' anomaly or 'remains observation' as defined per the Table 1 RPRB criteria.

The two 'potential anomalies' found were classified as follows:

'MINOR ANOMALY'

1. Fourteen unbonds were noted on the RSRM-4A aft segment stiffener to stiffener factory joint weatherseal. The unbonds all exhibited adhesive failure between the case and Chemlok 205 and spanned approximately 30.9% of the weatherseal aft edge circumference. Most of the unbonds extended axially to the pin retainer band. One similar, but smaller (3.75 in. circ.) unbond was found on the aft dome weatherseal. The following documentation was written against these conditions:
   KSC Squawk I.D. number 30-009
   KSC PR P-V6-128773
   KSC IFA STS-30-M-1
   PFAR 360T004A-02
   SPR DR4-5/151

One unbond was found on the forward center segment factory joint weatherseal. The unbond exhibited adhesive failure between the case and Chemlok 205. The unbond measured 1.2 in. circumferentially and 0.40 in. axially. The following documentation was written against this condition:

KSC Squawk I.D. number 30-008
KSC PR P-V6-128775
KSC IFA STS-30-M-1
PFAR 360T004A-01
SPR DR4-5/151

These conditions are believed to be a result of poor surface finish conditions (too smooth) and are believed to have occurred at splashdown. The condition was classified as a 'minor' anomaly.

'REMAINS OBSERVATION'

2. Moisture was found dripping from under the factory joint weatherseal on the RSRM-4A forward center segment factory joint. The water penetrated the weatherseal at the location where thermocouple wires are routed between the weatherseal and the case. This condition was noted previously on the RSRM-2 and RSRM-3 flight sets. A PFAR was written for the condition on RSRM-2 but not on RSRM-3. Corrective action has been implemented effective on RSRM-5, and the condition is not a flight safety issue; it involves a hardware re-use issue only in regard to metal corrosion. The moisture under the weatherseal was classified as 'remains observation'.

The Insulation Component Program Team presented their assessment of the observations shown in this document to the RPRB on 24 May 1989. The RPRB accepted the insulation team's classifications as presented.

Insulation Design has concluded that the RSRM-4A and RSRM-4B insulation systems performed as designed.

5.0 RECOMMENDATIONS

The following recommendations are based on the results of the RSRM-4 postflight inspection:

1. Increased controls should be implemented in the processing of the factory joint weatherseals to eliminate contamination and ensure adequate bond strengths are achieved.

2. Surface finish requirements for the factory joint weatherseal bonding area should be reviewed and implemented to eliminate weak bonding as a result of a smooth surface finish.

3. The NJAD-3 test should continue and evaluate methods of eliminating voids in the nozzle to case joint bondline.

6.0 RSRM-4A DISCUSSION

During the postflight evaluation, Insulation Design documented the condition of the external factory joint weatherseals, stiffener rings, stiffener stubs, nozzle to case joint, case field joints, igniter to case joint, segment acreage insulation, NBR inhibitors, and stress relief flap regions. A copy of this documentation for RSRM-4A can be found in Appendix A. The condition of the RSRM-4A insulation components is discussed in the following subsections.

6.1 RSRM-4A EXTERNAL INSULATION

6.1.1 RSRM-4A Factory Joint Weatherseals

Each factory joint weatherseal was visually inspected, and the condition is recorded in Tables A-1 through A-7. No significant areas of missing EPDM insulation were noted on any factory joint weatherseal. Several small areas of missing EPDM from debris impact were noted on the aft edge of the center segments. The deepest area was on the forward center segment at 263° and measured 1.2 inch circumferentially, 0.90 inch axially, and 0.20 inch deep.

Moisture was evident under the weatherseal on the forward center segment factory joint. Water was leaking from underneath the weatherseal near the 30° location where insulation cure thermocouple wires were routed between the weatherseal and the case. This same condition was noted on multiple segments of the RSRM-2 flight set and one segment of the RSRM-3 flight set. The closeout of the wire exit locations has been changed to reduce or eliminate problems beginning on RSRM-5. By RSRM-8, all thermocouples and wire leads will have been deleted from the weatherseal layup to eliminate re-occurrence of this problem.

The weatherseals on all three aft segment factory joints were slightly heat affected from a maximum of 190°-270°-360° due to the plume radiation from the solid rocket motors and shuttle main engines. The heaviest heat effects occurred near 270°. This is a normal occurrence that had no effect on the performance of the weatherseals.

The weatherseal on the RSRM-4A aft segment stiffener to stiffener factory joint was unbonded on the aft edge in fourteen separate places. Unbonds extended axially to the edge of the pin retainer band (Figure 2).

The largest unbond extended 35.0 inches circumferentially. The pin retainer band was displaced, leaving the pins visible under some of the unbonded areas. The total unbond area covered approximately 31 percent of the circumference on the aft edge. One similar unbond was present on the aft dome factory joint weatherseal aft edge near 278°. This unbonded area measured 3.75 inches circumferentially and extended axially to the pin retainer band. An aft edge unbond was also found on the forward center segment factory joint weatherseal near 28°. This unbond was smaller, measuring 1.2 inches circumferentially and only extending 0.40 inch axially, not to the pin retainer band. All of the unbonds exhibited adhesive failure at the Chemlok 205 to case interface. Light rust contamination existed on the case underneath the unbonds. No evidence on sooting or heat effects were present under the unbonded areas.

After evaluating the case surface finish at the weatherseal bonding area for RSRM-3 through RSRM-7, it has been determined that the surface finish for the aft edge of the RSRM-4A aft segment factory joints were among the smoothest in the database of the the joints surveyed. Smooth surface finish constitutes a strong cause for bondline failure.

Research of the manufacturing logs for all of the RSRM flight factory joint weatherseals revealed that the Conscan readings for the RSRM-4A aft segment and forward center segment weatherseals were above current planning requirements. This indicates that surface contamination was not a contributor to the unbonding.

The unbonds are believed to have occurred at splashdown since no sooting or heat effects were present underneath the unbonded regions. Splashdown/cavity collapse represents the highest loading induced on the bondline and is a probable explanation for multiple separate unbonds. The extent of corrosion was also consistent with the exposure duration which would occur at splashdown and was not consistent with extended exposure to the elements. This was evidenced by comparison with the dissection at KSC of RSRM-2 weatherseals which experienced water intrusion.

It is the opinion of Insulation Design that the unbonds occurred at splashdown and do not represent a flight concern. However, steps are being taken to prevent weatherseal unbonds on future flights. These steps were discussed in Section 5.0.

6.1.2 RSRM-4A Stiffener Stubs and Rings

The condition of the insulation over the stiffener stubs and rings is recorded in Tables A-8 through A-12. The insulation was in good condition with normal heat effects and discoloration on all surfaces. The heaviest heat effects occurred from 200°-270°-350° due to the plume radiation from the solid rocket motors and shuttle main engines. Minor tears and gouges with missing material were noted on all three stiffener rings from 240°-270°-290° due to splashdown impact.

The EPDM was well bonded to the stiffener stubs and appeared to be well bonded to the stiffener rings as evidenced by a tap test of all exposed ring surfaces prior to hydrolazing. The insulation was inspected and tap tested again after the rings were removed from the case. Again, no unbonds were detected. The only exceptions were at the locations where the three stiffener rings were buckled due to impact loads, and the insulation was visibly unbonded. Significant amounts of K5NA remained on most of the ring segment ends which indicates hydrolazing was less severe than on RSRM-2 and RSRM-3. Insulation Design believes that hydrolazing was the major contributor to unbonds that were seen on RSRM-2 and RSRM-3.

6.2 RSRM-4A NOZZLE TO CASE JOINT

The nozzle to case joint insulation condition is recorded in Table A-13. The nozzle to case joint performed as expected with no polysulfide blowholes identified across the bondline. Approximately 10 to 15 small voids in the polysulfide adhesive were found forward of the step region. These were in a size range of 0.15 inch axial by 0.10 inch circumferential. Two larger voids were located in the step region. The largest void was identified at 40° and measured 0.18 inch axially down the face of the step, 1.02 inches axially aft of the step, and had a maximum circumferential width of 0.40 inch. All of the voids were caused

by entrapped air in the adhesive during assembly. None of the voids extended across the entire bondline or were exposed to hot gas. The size and location of the larger voids are contained in Table A-13.

The failure mode of the polysulfide bondline at disassembly was approximately 70% cohesive within the polysulfide and 30% adhesive at the NBR to polysulfide interface. The vent slots showed an average polysulfide fill of 68% with values ranging from 0% to 100% fill. The vent slot fill is in the expected range.

The bondline around the circumference demonstrated erosion similar to that observed on previous RSRM motors. The polysulfide was decomposed further into the joint than the flap erosion. For approximately 0.40 inch aft of the erosion, the polysulfide was partially decomposed and bubbled. Although the material was partially decomposed, no gas flow occurred in the adhesive bondline decomposed region.

The insulation erosion in the joint region was similar to the condition of previous RSRM flight motors. The NBR flap and baffle appeared to be bonded in place and in excellent shape with normal heat effects and erosion.

6.3 RSRM-4A FIELD JOINTS

6.3.1 RSRM-4A Aft Field Joint

The joint insulation configuration performed as designed. The joint insulation surfaces exhibited normal charring and erosion. Measurements of the tang material char depths and heat affected depths are provided in Table A-14.

The general appearance of the pressure sensitive adhesive was noted. Contact within the joint was based on the matted appearance and flat texture of the adhesive, and non-contact was based on the glossy appearance of the adhesive. The joint appeared to have made contact full circumference at the tip of the J-leg. The bondline contact was measured at 0°, 90°, 180°, and 270°. The average contact was 0.89 inch.

No evidence of motor chamber gas leakage to the o-rings or past the J-joint insulation was identified.

Wet sooting into the joint bondline was essentially uniform full circumference to 0.30 inch outboard from the remaining material. Deeper penetration was seen from 74°-78° where the maximum was 0.70 inch outboard of the material remaining. Wet sooting similar to this has been seen on previous flight sets and is believed to occur during motor re-entry or splashdown when the joint may flex and allow soot into the bondline.

Tape adhesive residue was noted intermittently on the tang insulation surface near the capture feature o-ring. Tape is used to mask the insulation surfaces while the metal is being greased prior to stacking. The residue did not affect the function of the joint.

Cracks and crazing were also noted on the clevis insulation in the radius region. The worst condition occurred from 300° to 316° and measured approximately 0.05 inch deep. Cracks and crazing will be further evaluated when the segment reaches the Clearfield H-7 facility.

The clevis insulation to case interface was probed during postflight inspection to detect edge separations. No edge separations were found with an axial depth greater than 0.10 inch. A detailed mapping of the tang and clevis edge separations will be performed at the H-7 Clearfield facility.

6.3.2 RSRM-4A Center Field Joint

The joint insulation configuration performed as designed. The joint insulation surfaces exhibited normal charring and erosion. Measurements of the tang material char depths and heat affected depths are provided in Table A-15.

The general appearance of the pressure sensitive adhesive was noted. Contact and non-contact within the joint was based on the matted appearance and flat texture, or the glossy appearance of the adhesive. The joint appeared to have made contact full circumference at the tip of the J-leg. The bondline contact was measured at 0°, 90°, 180°, and 270°. The average contact was 1.25 inches.

No evidence of motor chamber gas leakage to the O-rings or past the J-joint insulation was identified.

Wet sooting into the joint bondline was essentially uniform full circumference to 0.30 inch outboard from the remaining material similar to the aft field joint. Wet sooting is believed to occur during motor re-entry or splashdown when the joint may flex and allow soot into the bondline.

Tape adhesive residue was noted intermittently on both the tang and clevis insulation surfaces and had no effect on the joint.

Cracks and crazing were also noted on the clevis insulation in the radius region. Cracks and crazing will be further evaluated when the segment reaches the Clearfield H-7 facility.

The clevis insulation to case interface was probed during postflight inspection to detect edge separations. No edge separations were found with an axial depth greater than 0.10 inch. A detailed mapping of the tang and clevis edge separations will be performed at the H-7 Clearfield facility.

6.3.3 RSRM-4A Forward Field Joint

The joint insulation configuration performed as designed. The joint insulation surfaces exhibited normal charring and erosion. Measurements of the tang material char depths and heat affected depths are provided in Table A-16.

The general appearance of the pressure sensitive adhesive was noted. The joint appeared to have made contact full circumference at the tip of the J-leg. The contact area appeared matted with a flat texture. The bondline contact was measured at 0°, 90°, 180°, and 270°. The average contact was 1.18 inches.

No evidence of motor chamber gas leakage to the O-rings or past the J-joint insulation was identified. No evidence of cracks or crazing was identified on the joint insulation bondline surfaces.

Wet sooting into the joint bondline was essentially uniform full circumference to 0.30 inch outboard from the remaining material similar to the aft and center field joints.

The clevis insulation to case interface was probed during postflight inspection to detect edge separations. No edge separations deeper than 0.10 inch were noted. A detailed mapping of the tang and clevis edge separations will be performed at the H-7 Clearfield facility.

6.4 RSRM-4A IGNITER TO CASE JOINT

The condition of the igniter to case joint insulation is recorded in Tables A-17 and A-18. The condition of the igniter boss insulation was excellent. An evaluation of the insulation to case interface revealed no edge separations or insulation flashing. The molded insulation surface was in good condition with normal erosion on the inboard surface.

The overall condition of the putty was good. The color of the putty was a consistent light olive green. The putty exhibited cohesive failure and good tack for the full circumference. There was one blowhole present through the putty at 225°. The blowhole was 1.5 inches circumferentially and resulted in soot on the putty from 190°-270°-0°. A terminated putty blowhole in the adapter to chamber joint was noted at 35° that was approximately 0.15 inch wide. No soot was found in the outer gasket. Putty blowholes are a common phenomenon seen in both RSRM and HPM igniter to case joints.

The igniter chamber internal and external insulation was in normal condition. No areas of blistering or abnormal erosion were present.

6.5 RSRM-4A ACREAGE INSULATION

6.5.1 RSRM-4A Aft Segment Acreage Insulation

The aft segment internal insulation was in excellent condition and is recorded in Tables A-19 through A-21.

The forward facing NBR inhibitor stub exhibited normal erosion over approximately one-half of the circumference, but there was an area of uneven erosion from approximately 140°-310°. This area had a very short inhibitor stub with intermittent inhibitor pieces taller than adjacent areas. A similar condition was also noted on the RSRM-2 and RSRM-3 aft segments. Measurements of the remaining inhibitor stub were taken every 30° and are contained in Table A-20. The inhibitor height ranged from 5.0 to 8.8 inches. Although the erosion was uneven, the remaining

inhibitor stub heights for this segment were within the expected tolerance band for past flight motors based on a statistical analysis of the historical database (Reference 5).

There was one circumferential inhibitor tear greater than 3 inches in length. The tear extended 3.2 inches circumferentially. One radial tear over 3.0 inches existed at 110°. It was located 4.5 inches inboard of the clevis I.D. surface and was 3.1 inches long. The edges of both of these tears showed no signs of charring or erosion indicating the tears occurred after motor burn. The tear is documented in Table A-21.

Several patches of thick liner were noted on the aft facing inhibitor radius. Although small thin patches are common in this region, the thicker liner condition was a result of a prefire DR repair where extra liner was added in this area. Postfire evaluation indicated that the repair functioned properly. The rest of the segment had no liner remaining. This condition is common for an aft segment.

The erosion in the aft dome was similar to past flight motors. The insulation in the aft dome did not appear to be eroded as severely as previous RSRM static motors. This variation between flight and static motors has been common throughout the history of the SRM program.

One small gouge caused by splashdown debris was noted at 340° in the stiffener to ET attach factory joint region. No other evidence of blisters, separations, gouges, cuts, missing material, or excessive erosion was identified in the aft segment.

6.5.2 RSRM-4A Aft Center Segment Acreage Insulation

The condition of the aft center segment internal insulation is recorded in Tables A-22 through A-25.

The forward facing NBR inhibitor stub exhibited uniform erosion full circumference. Measurements of the remaining NBR inhibitor stub were taken every 30° and are contained in Table A-23. The inhibitor stub heights ranged from 12.3 to 15.2 inches for this segment, which is within the expected tolerance band.

There were no inhibitor tears greater than 3 inches in length noted on this segment.

Liner coverage in the aft center segment was heavy near the clevis end and generally missing aft of the factory joint. Due to the poor lighting condition and the coating of wet char inside of the motor segment, the exact pattern and termination points of the liner material could not readily be determined. The diagram of the liner pattern will be obtained after the segments have arrived at the Clearfield H-7 facility and the char has been rinsed from the insulation surface.

The condition of the flap region is recorded in Table A-25. The castable inhibitor was completely missing full circumference, and the stress relief flap was eroded back to the flap bulb full circumference. Both of these conditions are typical of an aft center segment. The CF/EPDM under the flap was eroded away full circumference. The exposed NBR under the flap appeared to be heat affected.

One cut due to splashdown debris was present at 80° near the factory joint. No other evidence of blisters, separations, gouges, cuts, missing material, or excessive erosion was identified in the aft center segment.

6.5.3 RSRM-4A Forward Center Segment Acreage Insulation

The condition of the forward center segment internal insulation is recorded in Tables A-26 through A-29.

The forward facing NBR inhibitor stub exhibited uniform erosion full circumference. Measurements of the remaining NBR inhibitor stub were taken every 30° and are contained in Table A-27. The inhibitor stub heights for this segment ranged from 21.7 to 26.0 inches for this segment, which is within the expected tolerance band.

Six radial tears greater than 3 inches long were noted. The longest tear was 11.8 inches and extended radially outward to approximately 10.2 inches inboard of the clevis I.D. surface. The edges of the tears demonstrated no material loss or erosion. This indicated that the tears occurred after motor burn. The location and length of the tears are contained in Table A-28. The tears are believed to be a result of re-entry or splashdown loads.

Liner coverage for the forward center segment was heavy near the clevis end and completely missing from 24 inches aft of the factory joint to the tang end of the segment. A diagram of the liner pattern will be obtained after the segments have arrived at the Clearfield H-7 facility and the char has been rinsed from the insulation surface.

The castable inhibitor was completely missing full circumference, which is typical of a forward center segment. The stress relief flap had from 9.7 to 10.5 inches of its length missing. Axial measurements were taken every 90° and are shown in Table A-29. There were no flap tears. The CF/EPDM under the flap was present but slightly eroded and heat affected full circumference.

No evidence of blisters, separations, gouges, cuts, missing material, or excessive erosion was identified in the forward center segment.

6.5.4 RSRM-4A Forward Segment Acreage Insulation

The condition of the forward segment internal insulation is recorded in Tables A-30 and A-31.

The eleven point star pattern in the liner was easily distinguishable at the aft face of the factory joint, and the star and non-star liner termination points were comparable to past flight motors. Liner was present from the star pattern to the flap region and was completely missing forward of the star pattern. A diagram of the liner pattern will be obtained after the segments have arrived at the Clearfield H-7 facility and the char has been rinsed from the insulation surface.

The castable inhibitor was completely missing full circumference. The stress relief flap had from 3.5 to 6.5 inches of its length missing. Axial measurements were taken every 90° and are shown in Table A-31. The flap was scalloped and curled back. Axial tears were present intermittently at the edge of the remaining flap. This was a condition similar to both RSRM-1 forward segments and the RSRM-3B forward segment. It is believed to have occurred at splashdown. The NBR under the flap was heat affected full circumference as has been seen on all previous RSRM forward segments.

Several cuts due to splashdown debris were present in the forward dome insulation near 230°. The longest was 7.0 in. in length. No other evidence of blisters, separations, gouges, cuts, missing material, or excessive erosion was identified in the forward segment.

7.0 RSRM-4B DISCUSSION

The condition of the RSRM-4B insulation components is discussed in the following subsections. A copy of the inspection documentation can be found in Appendix B.

7.1 RSRM-4B EXTERNAL INSULATION

7.1.1 RSRM-4B Factory Joint Weatherseals

The condition of the factory joint weatherseals is recorded in Tables B-1 through B-7. No significant areas of missing EPDM insulation were noted on any factory joint weatherseal. No edge separations were noted on any of the RSRM-4B weatherseals. The weatherseals on all three aft segment factory joints were slightly heat affected generally from 200°-270°-350° due to the plume radiation from the solid rockets motor and shuttle main engines. The heaviest heat effects occurred near 270°. This is a normal occurrence that had no effect on the performance of the weatherseals.

The forward center segment had K5NA present near 272° on the aft edge of the weatherseal for 3.75 inches circumferentially and 0.65 inch axially. This was the result of a thermocouple wire lead closeout. No moisture was identified under the weatherseal or leaking from the repaired area, indicating the closeout performed as intended. This was the first thermocouple wire closeout implemented. This will be effective for RSRM-5 through RSRM-7. The wires will be removed on RSRM-8. Another area of K5NA was also present from 175° to 185° and extending axially from the aft edge to the forward edge of the weatherseal. This was a result of a prefire repair of a low area on the insulation. The repaired area was in good condition postfire.

7.1.2 RSRM-4B Stiffener Stubs and Rings

The condition of the insulation over the stiffener stubs and rings is recorded in Tables B-8 through B-12. The insulation was in good condition with normal heat effects and discoloration on all surfaces. The heaviest heat effects occurred from 210°-270°-340° due to the plume radiation from the solid rocket motors and shuttle main engines.

The EPDM was well bonded to the stiffener stubs and appeared to be well bonded to the stiffener rings as evidenced by a tap test of all exposed ring surfaces prior to hydrolazing. The insulation was inspected and tap tested again after the rings were removed from the case. Again, no unbonds were detected. Similar to RSRM-4A, significant amounts of K5NA remained on most of the ring segment ends which again indicates hydrolazing was less severe than on RSRM-2 and RSRM-3. Insulation Design believes that hydrolazing was the major contributor to unbonds that were seen on RSRM-2 and RSRM-3.

7.2 RSRM-4B NOZZLE TO CASE JOINT

The nozzle to case joint insulation condition is recorded in Table B-13. The nozzle to case joint performed as expected with no polysulfide blowholes identified across the bondline. Approximately 10 to 15 small voids in the polysulfide adhesive were present aft of the step region. These were in a size range of 0.15 inch axial by 0.10 inch circumferential. Three larger voids were noted aft of the step region. Two of the three were located at the wiper o-ring. The largest void was identified at 230° and measured 0.45 inch axial by 0.20 inch maximum circumferential. All of the voids were caused by entrapped air in the adhesive during assembly. None of the voids extended across the entire bondline or were exposed to hot gas. The size and location of the larger voids are contained in Table B-13.

The failure mode of the polysulfide bondline at disassembly was approximately 85% cohesive within the polysulfide and 15% adhesive at the NBR to polysulfide interface. The vent slots showed an average polysulfide fill of 64% with values ranging from 0% to 100% fill. This vent slot fill is in the expected range.

The bondline around the circumference demonstrated erosion similar to that observed on RSRM static test motors. The polysulfide was decomposed further into the joint than the flap erosion. For approximately 0.4 inch further aft, the polysulfide was partially decomposed and bubbled. Although the material was partially decomposed, no gas flow occurred in the adhesive bondline decomposed region.

The insulation erosion in the joint region was similar to the condition of previous RSRM flight motors. The NBR flap and baffle appeared to be bonded in place and in excellent shape with normal heat effects and erosion.

7.3 RSRM-4B Field Joints

7.3.1 RSRM-4B Aft Field Joint

The joint insulation configuration performed as designed. The joint insulation surfaces exhibited normal charring and erosion. Measurements of the tang material char depths and heat affected depths are provided in Table B-14.

The general appearance of the pressure sensitive adhesive was noted. Contact and non-contact within the joint was based on the matted appearance and flat texture, or the glossy appearance of the adhesive. The joint appeared to have made contact full circumference at the tip of the J-leg. The bondline contact was measured at 0°, 90°, 180°, and 270°. The average contact was 1.06 inches.

No evidence of motor chamber gas leakage to the O-rings or past the J-joint insulation was identified. Wet sooting extending down the bondline was identified from 80° to 180° to a depth of 0.30 inch outboard of the remaining material. Wet sooting is believed to occur during motor re-entry or splashdown when the joint may flex and allow soot into the bondline.

Tape adhesive residue was noted intermittently on both the tang and clevis insulation surfaces and had no effect on the joint. The residue did not affect the function of the joint.

Cracks and crazing were noted on the clevis insulation in the radius region. A complete evaluation of this condition will be performed at the Clearfield H-7 facility.

The clevis insulation to case interface was probed during postflight inspection to detect edge separations. No clevis edge separations were found with an axial depth greater than 0.10 inch. Several tang insulation edge separations were visible near the capture feature o-ring. A detailed mapping of the tang and clevis edge separations will be performed at the H-7 Clearfield facility.

7.3.2 RSRM-4B Center Field Joint

The joint insulation configuration performed as designed. The joint insulation surfaces exhibited normal charring and erosion. Measurements of the tang material char depths and heat affected depths are provided in Table B-15.

The general appearance of the pressure sensitive adhesive was noted. Contact and non-contact within the joint was based on the matted appearance and flat texture, or the glossy appearance of the adhesive. The joint appeared to have made contact full circumference at the tip of the J-leg. The bondline contact was measured at 0°, 90°, 180°, and 270°. The average contact was 1.22 inches.

No evidence of motor chamber gas leakage to the O-rings or past the J-joint insulation was identified. Wet sooting into the joint bondline was essentially uniform full circumference to 0.30 inch outboard from the remaining material.

Minor cracks and crazing were noted on the clevis insulation in the radius region. Cracks and crazing will be further evaluated when the segment reaches the Clearfield H-7 facility.

The clevis insulation to case interface was probed during postflight inspection to detect edge separations. No clevis edge separations deeper than 0.10 inch were found. Several tang insulation edge separations were visible near the capture feature o-ring. A detailed mapping of the tang and clevis edge separations will be performed at the H-7 Clearfield facility.

7.3.3 RSRM-4B Forward Field Joint

The joint insulation configuration performed as designed. The joint insulation surfaces exhibited normal charring and erosion. Measurements of the tang material char depths and heat affected depths are provided in Table B-16.

The general appearance of the pressure sensitive adhesive was noted. The joint appeared to have made contact full circumference at the tip of the J-leg. The contact area appeared matted with a flat texture. The bondline contact was measured at 0°, 90°, 180°, and 270°. The average contact was 1.09 inches.

No evidence of motor chamber gas leakage to the O-rings or past the J-joint insulation was identified. Wet sooting into the joint bondline was essentially uniform full circumference to 0.40 inch outboard from the remaining material. No evidence of cracks or crazing was identified within the joint insulation bondline surfaces.

Two small gouges were present on the tang insulation surface in the ramp region. The largest gouge was located at 84° and measured 0.15 inch radial length by 0.10 inch circumferential width and 0.05 inch in depth. The gouges had no adverse effect on the performance of the joint.

Tape adhesive residue was noted intermittently on both the tang and clevis insulation surfaces and had no effect on the joint.

The clevis insulation to case interface was probed during postflight inspection to detect edge separations. No edge separations deeper than 0.10 inch were found. A detailed mapping of the tang and clevis edge separations will be performed at the H-7 Clearfield facility.

7.4 RSRM-4B IGNITER TO CASE JOINT

The condition of the igniter to case joint insulation is recorded in Tables B-17 and B-18. The condition of the igniter boss insulation was excellent. An evaluation of the insulation to case interface revealed no edge separations or insulation flashing. The molded insulation surface was in good condition with normal erosion on the inboard surface.

The overall condition of the putty was good. The color of the putty was a consistent light olive green. The putty exhibited cohesive failure and good tack for the full circumference. There was one blowhole present

through the putty at 265°. The blowhole had a maximum circumferential width of 0.60 inch. Resulting soot was present on the putty from 225° - 270° and on the aft face of the gasket from 175°-270°. The soot did not extend past the primary seal. Putty blowholes are a common phenomenon seen in both RSRM and HPM igniter to case joints.

The igniter chamber internal and external insulation was in normal condition. No areas of blistering or abnormal erosion were present.

7.5 RSRM-4B ACREAGE INSULATION

7.5.1 RSRM-4B Aft Segment Acreage Insulation

The aft segment internal insulation was in excellent condition and is recorded in Tables B-19 through B-21.

The forward facing NBR inhibitor stub exhibited normal erosion over approximately two-thirds of the circumference, but there was an area of uneven erosion from approximately 210°-320°. This area had a very short inhibitor stub with intermittent inhibitor pieces taller than adjacent areas. This is a condition that was previously seen on both RSRM-2 aft segments as well as the RSRM-3A and RSRM-4A aft segments. Measurements of the remaining inhibitor stub were taken every 30° and are contained in Table B-20. The inhibitor height ranged from 4.3 to 8.3 inches. Although the inhibitor erosion was uneven, the remaining inhibitor stub heights for this segment were within the expected tolerance band for past flight motors based on a statistical analysis of the historical database (Reference 5).

There were no inhibitor tears greater than 3 inches in length noted on this segment.

A few small patches of liner were noted on the aft facing inhibitor radius. The rest of the segment had no liner remaining. This condition is normal for an aft segment.

The erosion in the aft dome was similar to past flight motors. The insulation in the aft dome did not appear to be eroded as severely as previous RSRM static motors.

No evidence of blisters, separations, gouges, cuts, missing material, or excessive erosion was identified.

7.5.2 RSRM-4B Aft Center Segment Acreage Insulation

The aft center segment internal insulation condition is recorded in Tables B-22 through B-25.

The forward facing NBR inhibitor stub exhibited uniform erosion full circumference. Measurements of the remaining NBR inhibitor stub were taken every 30° and are contained in Table B-23. The inhibitor stub heights ranged from 12.9 to 15.7 inches for this segment, which is within the expected tolerance band.

One radial tear greater than 3 inches long was noted. The tear measured 6.0 inches long and extended radially outward to approximately 7.2 inches inboard of the clevis I.D. surface. The edges of the tear demonstrated no material loss or erosion. This indicated that the tear occurred after motor burn. The location and length of the tear is shown in Table B-24.

Liner coverage in the aft center segment was heavy near the clevis end and generally missing aft of the factory joint. The diagram of the liner pattern will be obtained after the segments have arrived at the Clearfield H-7 facility and the char has been rinsed from the insulation surface.

The condition of the flap region is recorded in Table B-25. The castable inhibitor was completely missing full circumference, and the stress relief flap was eroded back to the flap bulb full circumference. Both of these conditions are typical of an aft center segment. The CF/EPDM under the flap was missing full circumference, and the NBR underneath it was heat affected and slightly eroded.

One small gouge caused by splashdown debris was identified on the aft edge of the factory joint at the 185° location. Small scuffed areas also caused by splashdown debris were present in the forward end of the segment near the NBR inhibitor at the 0° location. No other evidence of blisters, separations, gouges, cuts, missing material, or excessive erosion was identified.

7.5.3 RSRM-4B Forward Center Segment Acreage Insulation

The condition of forward center segment internal insulation is recorded in Tables B-26 through B-29.

The forward facing NBR inhibitor stub exhibited uniform erosion full circumference. Measurements of the remaining NBR inhibitor were taken every 30° and are contained in Table B-27. The inhibitor stub heights for this segment ranged from 23.8 to 26.1 inches, which is within the expected tolerance band.

Five radial tears greater than 3 inches long were noted. The longest tear was 14.4 inches and extended radially outward to approximately 10.0 inches inboard of the clevis I.D. surface. The edges of the tears demonstrated no material loss or erosion. This indicated that the tears occurred after motor burn. The location and length of the tears are contained in Table B-28. The tears are believed to be a result of re-entry or splashdown loads. The radial extent and frequency of the tears identified in the inhibitor stubs on all the RSRM-4 segments were within the range of tears noted on past flight motors.

Liner coverage for the forward center segment was heavy near the clevis end and generally missing aft of the factory joint. A diagram of the liner pattern will be obtained after the segments have arrived at the Clearfield H-7 facility and the char has been rinsed from the insulation surface.

The castable inhibitor was completely missing full circumference which is typical of a forward center segment. The stress relief flap had from 8.0 to 10.8 inches of its length missing. Axial measurements were taken every 90° and are shown in Table B-29. There were no flap tears noted. The CF/EPDM under the flap was present and heat affected and slightly eroded full circumference.

No evidence of blisters, separations, gouges, cuts, missing material, or excessive erosion was identified.

7.5.4 RSRM-4B Forward Segment Acreage Insulation

The condition of forward segment internal insulation is recorded in Tables B-30 and B-31.

The eleven point star pattern in the liner was easily distinguishable, and the star and non-star liner termination points were comparable to past flight motors. A diagram of the liner pattern will be obtained after the segments have arrived at the Clearfield H-7 facility and the char has been rinsed from the insulation surface.

The castable inhibitor was completely missing full circumference. The stress relief flap had from 4.5 to 11.0 inches of its length missing. Axial measurements were taken every 90° and are shown in Table B-31. The flap was scalloped and curled back full circumference. Axial tears were noted intermittently in the heat affected flap material. This was a condition similar to that noted on both RSRM-1 forward segments and on the RSRM-3B forward segment. It is believed to have occurred at splashdown. The NBR under the flap was heat affected as has been seen on all previous RSRM forward segments.

No evidence of blisters, separations, gouges, cuts, missing material, or excessive erosion was identified.

REFERENCES

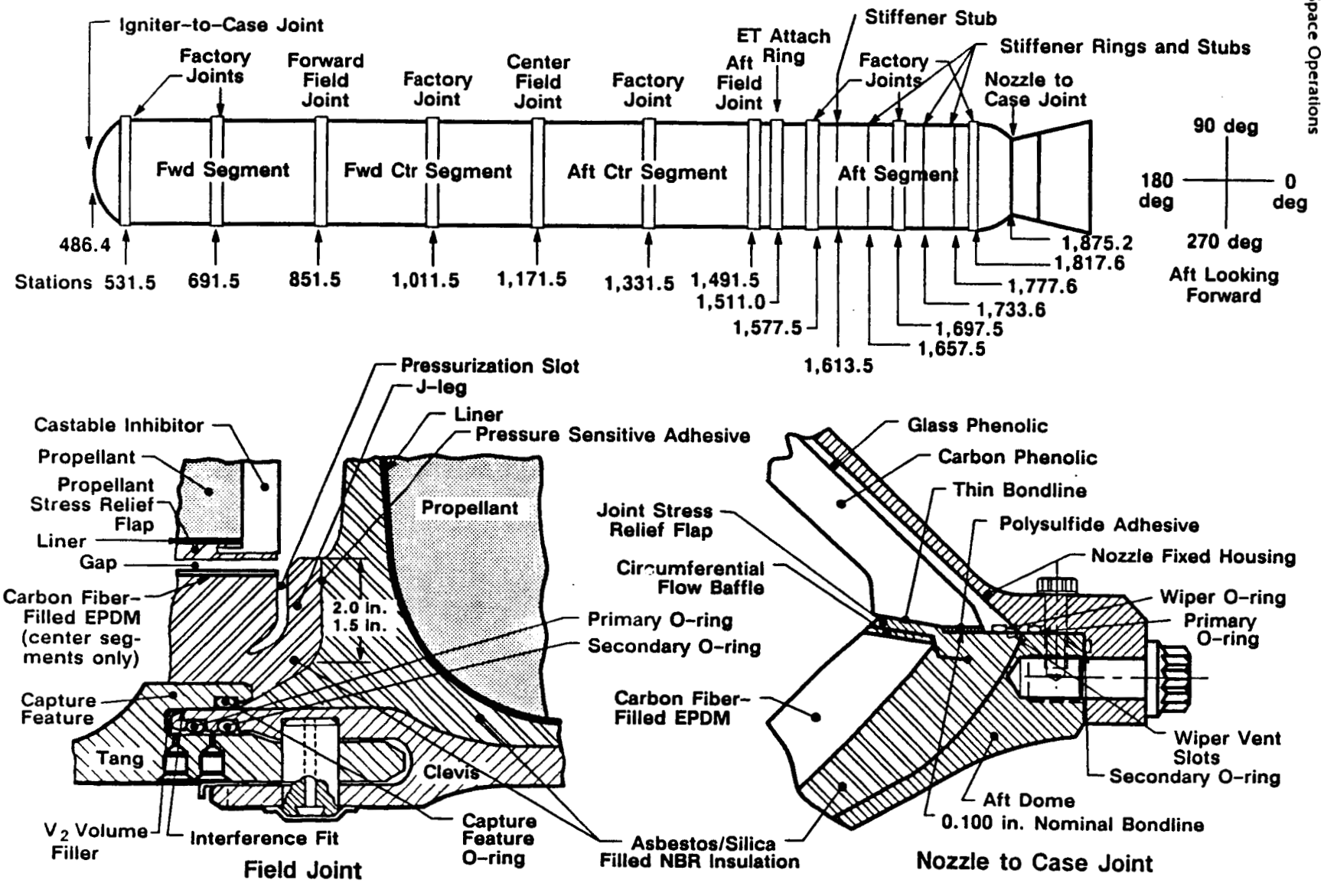
1. TWR-16475 VOL III, Book 1, Rev. A, 'KSC Postflight Engineering Evaluation Plan', S. Olson and V. Chandler, 23 November 1988.

2. TWR-16475 VOL III Addendum C, 'RSRM-4 Unique Postfire Evaluation', J. Passman, 17 April 1989.

3. TWR-18680 VOL III, Rev. D, 'KSC Postfire Engineering Evaluation Limits, Insulation Component', M. Bradford and S. Manz, 18 April 1989.

4. TWR-19237, '360T004 (RSRM-4, STS-30) Squawks and Problem Reports from KSC Postflight Evaluation', M. Bradford, May 1989.

5. Memo L232-FY89-M059, 'Inhibitor Database', B. Cannon, November 1988.



RSRM Motor Configuration

Figure 1

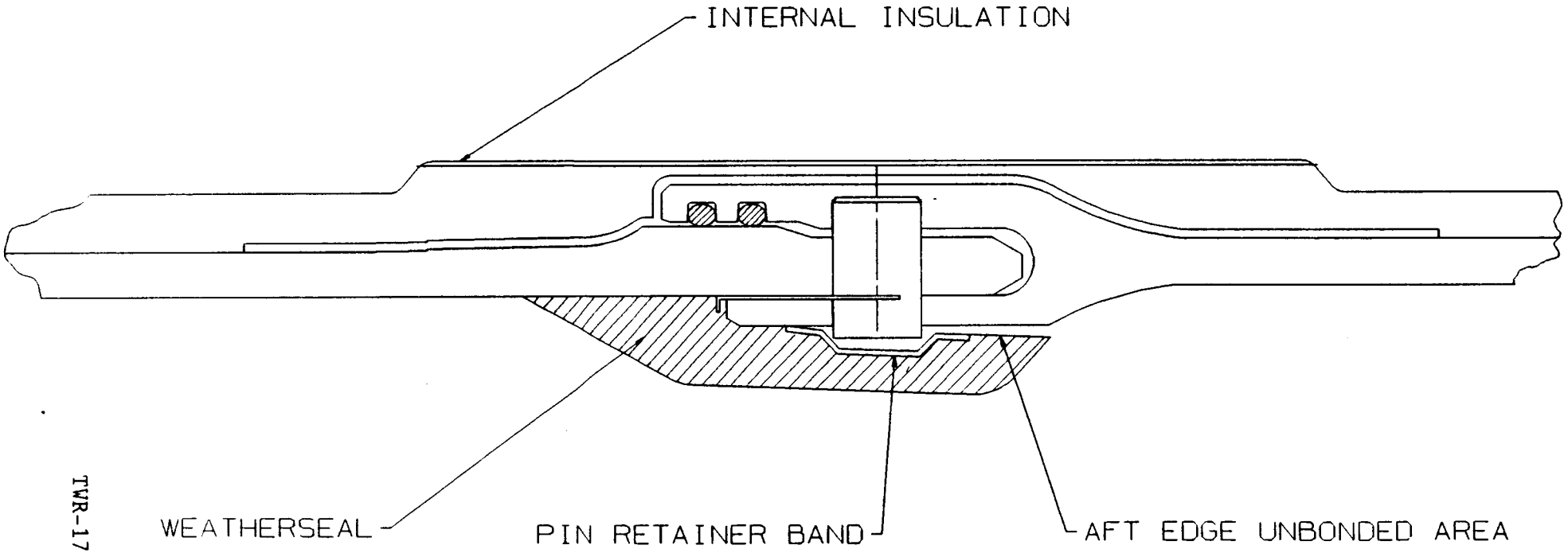


FIGURE 2

RSRM-4A AFT SEGMENT STIFFENER TO STIFFENER
FACTORY JOINT WEATHERSEAL UNBONDS

TABLE I
CRITERIA FOR CLASSIFYING POTENTIAL ANOMALIES

Remains Observation	Anomaly		
	Minor	Major	Critical
• Requires no specific action	• Requires corrective action, but has no impact on: —Motor Performance —Program Schedule • Does not reduce usability of part for its intended function • Could cause damage preventing reuse of hardware in combination with other anomaly • Significant departure from the historical data base	• Could cause failure in combination with other anomaly • Could cause damage preventing reuse of hardware • Program acceptance of cause, corrective action, and risk assessment required before subsequent static test/flight	• Violates CEI spec requirements • Could cause failure and possible loss of mission/life • Mandatory resolution before subsequent static test/flight

Note: This criteria is to be applied to the specific observed potential anomaly as it relates to the observed article and as it relates to subsequent articles

Appendix A

Table A-1
RSRM-4A Aft Dome Factory Joint Weatherseal Evaluation

Motor No.: RSRM-4A	Date: 7 May 1989	Time: 0945
Inspector(s): Jim Passman		

Weatherseal Condition					Comment Numbers
A. Discolored?	X	yes		no	1
B. Charred Material?	X	yes		no	1
C. Moisture Under Seal?	X	yes		no	2
D. Missing Material?		yes	X	no	
E. Edge Separation?	X	yes		no	2
F. Impact Damage?	X	yes		no	2

Notes/Comments:

1. Normal heat affected material was present from 190° - 360° on the aft and forward facing insulation surfaces.

2. One unbond was present on the aft edge at 278°. It measured 3.75 in. circumferentially, extended axially to the pin retainer band, and was 0.10 in. radially separated from the case. The unbond was adhesive failure between the Chemlok 205 and the case. Rust contamination was present underneath which indicates that moisture was present. The aft edge was heat affected, however, no heat effects or sooting was found underneath.

Table A-2
RSRM-4A Aft Segment Stiffener to Stiffener Factory Joint Weatherseal Evaluation

Motor No.: RSRM-4A	Date: 7 May 1989	Time: 0820
Inspector(s): Jim Passman		

Weatherseal Condition						Comment Numbers
A. Discolored?	X	yes		no		1
B. Charred Material?	X	yes		no		1
C. Moisture Under Seal?	X	yes		no		2
D. Missing Material?		yes	X	no		
E. Edge Separation?	X	yes		no		2
F. Impact Damage?	X	yes		no		2

Notes/Comments:

1. Normal heat affected material was present from 200° - 340° on the aft and forward facing insulation surfaces.

2. Several unbonds were present on the aft edge located intermittently full circumference. Most of the unbonds extended axially to the pin retainer band. The unbonds were separated a maximum of 0.20 in. radially from the case. The pins were visible under several of the unbonds. Rust contamination was present underneath. All unbonds were adhesive failure between the Chemlok 205 and the case. The aft edge of the unbond at 270° was heat affected, however, no heat effects or sooting was present underneath. Moisture was present underneath.

   Unbonds were present on the aft edge of the factory joint weatherseal as shown in the table below:

Degree Location	Circumferential Length (inches)	Axial Depth (inches)
35°-36°	3.0	To pin retainer band
38°-64°	35.0	To pin retainer band
70°-80°	13.0	To pin retainer band
270°-272°	4.0	To pin retainer band, also received heat effects on the edge
276°-279°	10.5	To pin retainer band
280°-285°	6.75	To pin retainer band
286°-291°	12.0	To pin retainer band
292°-294°	4.2	0.50
295°-300°	10.0	To pin retainer band
301°-302°	2.0	To pin retainer band
305°-310°	10.0	To pin retainer band
311°-312°	2.0	To pin retainer band
315°-320°	6.0	To pin retainer band
325°-345°	23.0	To pin retainer band

Table A-3
RSRM-4A Aft Segment ET Attach to Stiffener Factory Joint Weatherseal Evaluation

Motor No.: RSRM-4A	Date: 7 May 1989	Time: 0950
Inspector(s): Jim Passman		

Weatherseal Condition					Comment Numbers
A. Discolored?	X	yes		no	1
B. Charred Material?	X	yes		no	1
C. Moisture Under Seal?		yes	X	no	
D. Missing Material?		yes	X	no	
E. Edge Separation?		yes	X	no	
F. Impact Damage?		yes	X	no	

Notes/Comments:

1. Normal heat affected material was present from 220° - 320° on the aft and forward facing insulation surfaces.

Table A-4
RSRM-4A Aft Center Segment Factory Joint Weatherseal Evaluation

Motor No.: RSRM-4A	Date: 7 May 1989	Time: 0955
Inspector(s): Jim Passman		

Weatherseal Condition					Comment Numbers
A. Discolored?		yes	X	no	
B. Charred Material?		yes	X	no	
C. Moisture Under Seal?		yes	X	no	
D. Missing Material?		yes	X	no	
E. Edge Separation?		yes	X	no	
F. Impact Damage?	X	yes		no	1

Notes/Comments:

1. Several small cuts, gouges, and scratches on aft edge near 200°. Maximum gouge measures 0.30 in. circumferentially, 0.60 in. axially, and 0.07 in. deep. Caused by splashdown impact damage.

Table A-5
RSRM-4A Forward Center Segment Factory Joint Weatherseal Evaluation

Motor No.: RSRM-4A	Date: 7 May 1989	Time: 1000
Inspector(s): Jim Passman		

Weatherseal Condition					Comment Numbers
A. Discolored?		yes	X	no	
B. Charred Material?		yes	X	no	
C. Moisture Under Seal?	X	yes		no	1
D. Missing Material?	X	yes		no	2
E. Edge Separation?	X	yes		no	3
F. Impact Damage?	X	yes		no	2

Notes/Comments:

1. Water was found leaking from the thermocouple wires near 30° (4.0 in. circ. from the unbond).

2. Impact damage from splashdown at 263°. Gouge on aft edge measuring 0.90 in. axial, 1.2 in. circ., and 0.20 in. deep. Also, near 290°, small scuff mark on aft edge 2.74 in circ., 0.50 in. axial, and 0.01 max. depth.

3. Small unbond noted near 28°, 1.2 in. circ., 0.40 in. max. depth, and separated 0.05 in. from case. The unbond was adhesive failure between the Chemlok 205 and the case. Rust contamination was present underneath indicating moisture was present. No heat effects were present.

Table A-6
RSRM-4A Forward Segment Cylinder to Cylinder Factory Joint Weatherseal Evaluation

Motor No.: RSRM-4A	Date: 7 May 1989	Time: 1005
Inspector(s): Jim Passman		

Weatherseal Condition					Comment Numbers
A. Discolored?		yes	X	no	
B. Charred Material?		yes	X	no	
C. Moisture Under Seal?		yes	X	no	
D. Missing Material?		yes	X	no	
E. Edge Separation?		yes	X	no	
F. Impact Damage?		yes	X	no	

Notes/Comments:

Table A-7
RSRM-4A Forward Dome Factory Joint Weatherseal Evaluation

Motor No.: RSRM-4A	Date: 7 May 1989	Time: 1010
Inspector(s): Jim Passman		

Weatherseal Condition					Comment Numbers
A. Discolored?	____	yes	X	no	____
B. Charred Material?	____	yes	X	no	____
C. Moisture Under Seal?	____	yes	X	no	____
D. Missing Material?	____	yes	X	no	____
E. Edge Separation?	____	yes	X	no	____
F. Impact Damage?	____	yes	X	no	____

Notes/Comments:

Table A-8
RSRM-4A Aft Stiffener Ring TPS Evaluation Before Ring Removal

Motor No.: RSRM-4A	Date: 7 May 1989	Time: 1340
Inspector(s): Jim Passman		

Stiffener Ring TPS Condition					Comment Numbers
A. Discolored?	X	yes	____	no	1
B. Blistered Paint?	____	yes	____	no	N/A
C. Heat Affected/Charred Material?	X	yes	____	no	1
D. Missing Material/Gouges?	X	yes	____	no	2
E. Insulation to Case Separations?	X	yes	____	no	2
F. Tears?	X	yes	____	no	2
G. Impact Damage?	X	yes	____	no	2

Notes/Comments:

1. Normal heat affected and discolored insulation was present from 200° - 350°.

2. Missing insulation, with tears, gouges, and unbonds due to damage from splashdown impact were present in the 240° - 290° area.

3. Tap testing revealed no unbonds other than those caused by impact, adjacent to buckling in stiffener ring.

Table A-9
RSRM-4A Center Stiffener Ring TPS Evaluation Before Ring Removal

Motor No.: RSRM-4A	Date: 7 May 1989	Time: 1345
Inspector(s): Jim Passman		

Stiffener Ring TPS Condition					Comment Numbers
A. Discolored?	X	yes	____	no	1
B. Blistered Paint?	____	yes	____	no	N/A
C. Heat Affected/Charred Material?	X	yes	____	no	1
D. Missing Material/Gouges?	X	yes	____	no	2
E. Insulation to Case Separations?	X	yes	____	no	2
F. Tears?	X	yes	____	no	2
G. Impact Damage?	X	yes	____	no	2

Notes/Comments:

1. Normal heat affected and discolored insulation was present from 220° - 320°.

2. Missing material, tears, gouges, and unbonds due to damage from splashdown impact were present in the 240° - 290° area.

3. Tap testing revealed no unbonds other than those caused by impact (ring buckling).

Table A-10
RSRM-4A Forward Stiffener Ring TPS Evaluation Before Ring Removal

Motor No.: RSRM-4A	Date: 7 May 1989	Time: 1355
Inspector(s): Jim Passman		

Stiffener Ring TPS Condition					Comment Numbers
A. Discolored?	X	yes		no	1
B. Blistered Paint?		yes		no	N/A
C. Heat Affected/Charred Material?	X	yes		no	1
D. Missing Material/Gouges?	X	yes		no	2
E. Insulation to Case Separations?	X	yes		no	2
F. Tears?	X	yes		no	2
G. Impact Damage?	X	yes		no	2

Notes/Comments:

1. Normal heat affected and discolored insulation was present from 220° - 320°.

2. Missing material, tears, gouges, and unbonds due to damage from splashdown impact were present in the 240° - 290° area.

3. Tap testing revealed no unbonds other than those caused by impact (ring buckling).

Table A-11
RSRM-4A Forward Stiffener Stub TPS Evaluation

Motor No.: RSRM-4A	Date: 7 May 1989	Time: 1400
Inspector(s): Jim Passman		

Stiffener Stub TPS Condition						Comment Numbers
A. Discolored?	X	yes		no		1
B. Blistered Paint?		yes		no		N/A
C. Heat Affected/Charred Material?	X	yes		no		1
D. Missing Material/Gouges?		yes	X	no		
E. Insulation to Case Separations?		yes	X	no		2
F. Tears?		yes	X	no		
G. Impact Damage?		yes	X	no		

Notes/Comments:

1. Normal heat affected and discolored insulation was present from 220° - 320°.

2. Tap testing revealed no unbonds.

Table A-12
RSRM-4A Stiffener Ring Segment TPS Evaluation After Ring Removal

Motor No.: RSRM-4A	Date: 11 May 1989	Time: 1100
Inspector(s): Jim Passman		

Stiffener Ring TPS Condition						Comment Numbers
A. Discolored?		yes		no		N/A
B. Blistered Paint?		yes		no		N/A
C. Heat Affected/Charred Material?		yes		no		N/A
D. Missing Material/Gouges?		yes		no		N/A
E. Insulation to Case Separations?	X	yes		no		1
F. Tears?		yes		no		N/A
G. Impact Damange?		yes		no		N/A

Notes/Comments:

1. Small unbonds were found adjacent to some of the buckle location (splashdown impact) as previously documented. No unbonds were found from tap testing on all 36 inside corners and none were found on all 18 outside edges. Most of the ring segment edges had K5NA remaining. This indicates that hydrolazing wasn't as severe as seen in the past.

Table A-13
RSRM-4A Nozzle to Case Joint Insulation Evaluation

Motor No.: RSRM-4A	Date: 13 May 1989	Time: 0945

Inspector(s): Jim Passman, Norm Eddy, Larry Allred

							Comment Numbers
1. Voids?		X	yes		no		1
2. Gas Paths?			yes	X	no		
3. Soot?			yes	X	no		
4. Foreign Material?			yes	X	no		
5. Adhesive Porosity?			yes	X	no		
6. Aft Dome Edge Separations?			yes	X	no		
7. Baffle Torn?			yes	X	no		
8. Polysulfide in Vent Slots?		X	yes		no		2
9. Polysulfide Failure Mode	30 % Adhesive at NBR Interface					70 % Cohesive	
	0 % Adhesive at Phenolic Interface						

Notes/Comments:

1. Several small voids located forward of the insulation step. Two larger voids extended across the step as follows: Void at 27° located 0.10 in. down the step and 0.86 in. aft of the step with a max. circumferential width of 0.30 in. Void at 40° located 0.18 in. down the step and 1.02 in. aft of the step with a max. circumferential width of 0.40 in.

2.

Degree Location	% Slot Fill	Degree Location	% Slot Fill	Degree Location	% Slot Fill
0.0°	100	122.4°	100	244.8°	10
7.2°	100	129.6°	100	252.0°	10
14.4°	100	136.8°	100	259.2°	5
21.6°	60	144.0°	100	266.4°	10
28.8°	20	151.2°	30	273.6°	50
36.0°	50	158.4°	80	280.8°	80
43.2°	80	165.6°	70	288.0°	100
50.4°	0	172.8°	80	295.2°	100
57.6°	0	180.0°	50	302.4°	100
64.8°	100	187.2°	80	309.6°	100
72.0°	100	194.4°	80	316.8°	100
79.2°	100	202.6°	40	324.0°	100
86.4°	100	208.8°	40	331.2°	50
93.6°	100	216.0°	40	338.4°	90
100.8°	100	223.2°	20	345.6°	100
108.0°	100	230.4°	5	352.8°	100
115.2°	100	237.6°	10		

Average = 68%

2 of 50 slots had 0% fill
23 slots had 100% fill

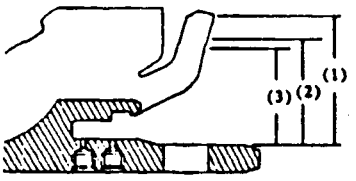
Table A-14
RSRM-4A Aft Field Joint Insulation Evaluation

Motor No.: RSRM-4A	Date: 11 May 1989	Time: 2300

Inspector(s): Jim Passman, Norm Eddy, Larry Allred

					Comment Numbers
1. Areas of Non-Contact?		yes	X	no	
2. Gas Paths?		yes	X	no	
3. Soot?	X	yes		no	1
4. Tang Heat Affected Material?	X	yes		no	See Below
5. Foreign Material?	X	yes		no	2
6. Clevis Edge Separations?		yes	X	no	

Tang End Measurements



	Degree Location	Depth (1)	Depth (2)	Depth (3)*	Bondline Contact **
	0°	2.93 in.	2.93 in.	2.60 in.	1.00 in.
	90°	2.82 in.	2.82 in.	2.55 in.	0.84 in.
	180°	2.86 in.	2.84 in.	2.40 in.	0.78 in.
	270°	2.89 in.	2.89 in.	2.28 in.	0.94 in.
Max					
Min					

Note:
The following measurements are taken from the inner diameter of the tang leg at the pinhole:
Depth (1) - to the tip of the remaining material
Depth (2) - to the outboard edge of the char layer
Depth (3) - to the outboard edge of the heat affected material*,
* Location based on the tan discoloration of the adhesive.
** Measurement taken from the outboard edge of the char layer to the outboard extent of contact.

Notes/Comments:

1. Sooting from splashdown on the tang and clevis insulation 0.30 in. outboard from remaining material intermittently. Larger area at 74° - 78°, 0.70 in. from remaining material.

2, White tape residue on tang insulation near capture feature O-ring intermittently.

3. Crazing/cracks in radius region on clevis from 300° - 316°. Max. 0.05 in. deep.

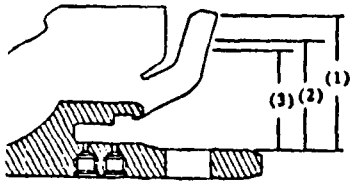
Table A-15
RSRM-4A Center Field Joint Insulation Evaluation

Motor No.: RSRM-4A	Date: 12 May 1989	Time: 0015

Inspector(s): Jim Passman, Norm Eddy, Larry Allred

						Comment Numbers
1.	Areas of Non-Contact?	____	yes	X	no	
2.	Gas Paths?	____	yes	X	no	
3.	Soot?	X	yes	____	no	1
4.	Tang Heat Affected Material?	X	yes	____	no	See Below
5.	Foreign Material?	X	yes	____	no	2
6.	Clevis Edge Separations?	____	yes	X	no	

Tang End Measurements



	Degree Location	Depth (1)	Depth (2)	Depth (3)*	Bondline Contact **
	0°	3.15 in.	3.10 in.	2.8 in.	1.46 in.
	90°	3.12 in.	3.12 in.	2.78 in.	1.04 in.
	180°	3.34 in.	3.18 in.	2.85 in.	1.33 in.
	270°	3.31 in.	3.09 in.	2.85 in.	1.15 in.
Max					
Min					

Note:
The following measurements are taken from the inner diameter of the tang leg at the pinhole:
Depth (1) - to the tip of the remaining material
Depth (2) - to the outboard edge of the char layer
Depth (3) - to the outboard edge of the heat affected material*,
* Location based on the tan discoloration of the adhesive.
** Measurement taken from the outboard edge of the char layer to the outboard extent of contact.

Notes/Comments:

1. Sooting from splashdown on tang and clevis 0.30 in. outboard from remaining material.

2. White tape residue intermittent on tang insulation near capture feature O-ring. Also on clevis insulation step.

3. Crazing/cracks intermittent on clevis in radius region.

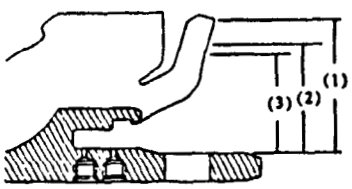
Table A-16
RSRM-4A Forward Field Joint Insulation Evaluation

Motor No.: RSRM-4A	Date: 12 May 1989	Time: 0100

Inspector(s): Jim Passman, Norm Eddy, Larry Allred

					Comment Numbers
1. Areas of Non-Contact?	____	yes	X	no	____
2. Gas Paths?	____	yes	X	no	____
3. Soot?	X	yes	____	no	1
4. Tang Heat Affected Material?	X	yes	____	no	1
5. Foreign Material?	X	yes	____	no	2
6. Clevis Edge Separations?	____	yes	X	no	____

Tang End Measurements



	Degree Location	Depth (1)	Depth (2)	Depth (3)*	Bondline Contact **
	0°	3.10 in.	3.10 in.	2.65 in.	1.15 in.
	90°	3.12 in.	3.12 in.	2.70 in.	1.20 in.
	180°	3.32 in.	3.15 in.	2.94 in.	1.27 in.
	270°	3.11 in.	3.11 in.	2.85 in.	1.10 in.
Max	____	____	____	____	____
Min	____	____	____	____	____

Note:
The following measurements are taken from the inner diameter of the tang leg at the pinhole:
Depth (1) - to the tip of the remaining material
Depth (2) - to the outboard edge of the char layer
Depth (3) - to the outboard edge of the heat affected material*,
* Location based on the tan discoloration of the adhesive.
** Measurement taken from the outboard edge of the char layer to the outboard extent of contact.

Notes/Comments:

1. Soot on both clevis and tang - depth approx. 0.30 in. from remaining material.

2. Slag and debris caught in flap near 40° location.

Table A-17
RSRM-4A Igniter Boss Insulation Evaluation

Motor No.: RSRM-4A	Date: 11 May 1989	Time: 1100

Inspector(s): Jim Passman

I.	Severe or Abnormal Insulation Erosion?	____ yes	X no	
II.	Blistering?	____ yes	X no	
III.	Edge Unbonds or Insulation Flashing?	____ yes	X no	

Condition (Observation Code)	Axial (Station) Location (in.)	Degree Start Location (deg.)	Degree Stop Location (deg.)	Circumferential Length (in.) If Applicable	Axial Length (in.) If Applicable	Radial Depth (in.) If Applicable

Notes/Comments:

1. Igniter boss insulation in normal condition, probing revealed no unbonds on the insulation to igniter boss metal bondline.

Table A-18
RSRM-4A Igniter Evaluation

Motor No.: RSRM-4A	Date: 11 May 1989	Time: 1100

Inspector(s): Jim Passman

Putty Condition

1. Color?		Variable	X	Constant			
2. Tack?	X	Good		Nominal			Poor

					Comment Numbers
A. Putty Gas Paths?	X	yes		no	1
B. Putty Adhesive Failure?		yes	X	no	
C. Putty Cohesive Failure?	X	yes		no	
D. Voids in Putty?		yes	X	no	
E. Foreign Material in Joint?		yes	X	no	
F. Soot?	X	yes		no	1

Clarify below:

Condition (Observation Code)	Degree Start Location (deg.)	Degree Stop Location (deg.)	Circumferential Length (in.) If Applicable	Axial Length (in.) If Applicable	Radial Depth (in.) If Applicable
Gas Paths	225°	225°	1.5 max.	N/A	N/A
Soot	190° - 270°	- 0°	N/A	N/A	N/A
Coh. Fail.	0°	360°	N/A	N/A	N/A

Igniter Chamber

I. Severe or Abnormal Insulation Erosion?		yes	X	no
II. Blistering?		yes	X	no
III. Gogues or Cuts?		yes	X	no

Condition (Observation Code)	Axial (Station) Location (in.)	Degree Start Location (deg.)	Degree Stop Location (deg.)	Circumferential Length (in.) If Applicable	Axial Length (in.) If Applicable	Radial Depth (in.) If Applicable

Notes/Comments:

1. Putty blow hole 225° to igniter gasket, no soot on gasket. Soot on putty 190°-270°-0° as a result of blow hole.

Table A-19
RSRM-4A Aft Segment Internal Insulation Evaluation

Motor No.: RSRM-4A	Date: 12 May 1989	Time: 1910

Inspector(s): Jim Passman, Norm Eddy

					Comment Numbers
Insulated Cylinder Region					
A. Blisters Visible?		yes	X	no	
B. Discolorations or Repairs Visible?	X	yes		no	1
C. Separations or Delaminations?		yes	X	no	
D. Excessive Erosion at Factory Joints?		yes	X	no	
E. Tears, Gouges, Cuts?	X	yes		no	2
F. Liner present?	X	yes		no	1
Aft Dome Region					
A. Abnormal CF/EPDM Erosion?		yes	X	no	
B. NBR Under CF/EPDM Exposed?		yes	X	no	

Notes/Comments:

1. One repair of aft face of inhibitor visible (liner repair) good condition.

2. One small gouge at 340° caused by splashdown debris, located near the stiffener to ET attach factory joint region.

Table A-20
RSRM-4A Aft Segment NBR Inhibitor Height Evaluation

Motor No.: RSRM-4A	Date: 11 May 1989	Time: 2300

Inspector(s): Jim Passman, Norm Eddy, Larry Allred

NBR Inhibitor Description

					Comment Numbers
A. Delaminations or Separations?		yes	X	no	
B. Unusual Erosion (Other than Tears)?	X	yes		no	1

NBR Inhibitor Measurements

Radial measurements from the I.D. of the inner clevis leg.

Degree Location	Radial Distance	Degree Location	Radial Distance
0°	7.9 in.	180°	7.2 in.
30°	7.8 in.	210°	5.0 in.
60°	8.0 in.	240°	6.5 in.
90°	7.8 in.	270°	5.5 in.
120°	6.3 in.	300°	8.0 in.
150°	5.5 in.	330°	8.8 in.

Max. inhibitor height = 8.8 in.
Min. inhibitor height = 5.0 in.

Notes/Comments:

1. NBR inhibitor exhibited some non-uniform (wavy) erosion from 140°-310°. This is typical of past RSRM aft segment NBR inhibitors.

Table A-21
RSRM-4A Aft Segment NBR Inhibitor Tear Evaluation

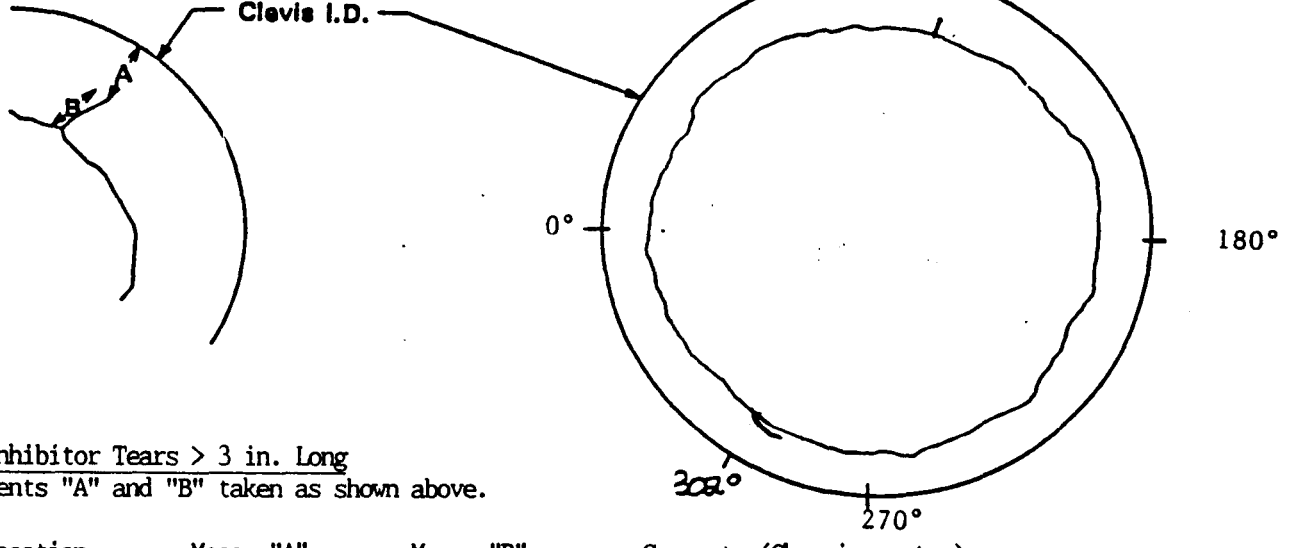
Motor No.: RSRM-4A	Date: 11 May 1989	Time: 2000

Inspector(s): Jim Passman, Norm Eddy, Larry Allred

NBR Inhibitor Description

					Comment Numbers
A. Number of radial tears greater than 3 in. long?	1				
B. Tears exhibiting charring or erosion?		yes	X	no	
C. Circumferential tears?	X	yes		no	1

Measurement Definitions



Radial Inhibitor Tears > 3 in. Long
Measurements "A" and "B" taken as shown above.

Degree Location	Meas. "A"	Meas. "B"	Comments (Charring, etc.)
110°	4.5 in.	3.1 in.	No Charring

Notes/Comments:

1. One circumferential tear at 302°, 3.2 in. long., no charring or erosion present.

Table A-22
RSRM-4A Aft Center Segment Internal Insulation Evaluation

Motor No.: RSRM-4A	Date: 12 May 1989	Time: 1920
Inspector(s): Jim Passman, Norm Eddy		

Insulated Cylinder Region					Comment Numbers
A. Blisters Visible?	____	yes	X	no	____
B. Discolorations or Repairs Visible?	____	yes	X	no	____
C. Separations or Delaminations?	____	yes	X	no	____
D. Excessive Erosion at Factory Joints?	____	yes	X	no	____
E. Tears, Gouges, Cuts?	X	yes	____	no	1
F. Liner present?	X	yes	____	no	2

Notes/Comments:

1. One 8 in. long cut at 80° location due to debris at splashdown was present adjacent to the factory joint.

2. Liner present from 3 ft. forward of the factory joint to inhibitor.

Table A-23
RSRM-4A Aft Center Segment NBR Inhibitor Height Evaluation

Motor No.: RSRM-4A	Date: 12 May 1989	Time: 0000

Inspector(s): Jim Passman, Norm Eddy, Larry Allred

NBR Inhibitor Description

					Comment Numbers
A. Delaminations or Separations?	____	yes	X	no	____
B. Unusual Erosion (Other than Tears)?	____	yes	X	no	____

NBR Inhibitor Measurements

Radial measurements from the I.D. of the inner clevis leg.

Degree Location	Radial Distance	Degree Location	Radial Distance
0°	15.0 in.	180°	13.8 in.
30°	12.5 in.	210°	13.5 in.
60°	12.3 in.	240°	14.8 in.
90°	13.0 in.	270°	13.5 in.
120°	14.2 in.	300°	14.5 in.
150°	15.2 in.	330°	14.3 in,

Max. inhibitor height = 15.2 in.
Min. inhibitor height = 12.3 in.

Notes/Comments:

1. At 6°, wire remains on the forward face of NBR inhibitor, sticking out radially.

Table A-24
RSRM-4A Aft Center Segment NBR Inhibitor Tear Evaluation

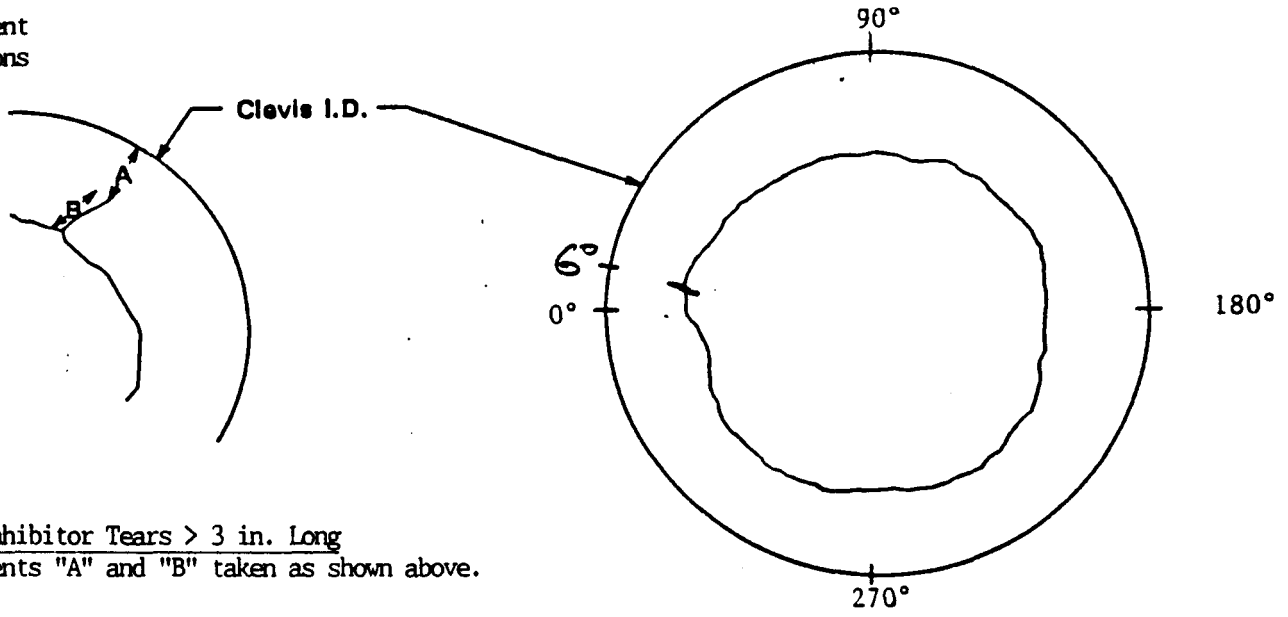
Motor No.: RSRM-4A	Date: 12 May 1989	Time: 1215

Inspector(s): Jim Passman, Norm Eddy, Larry Allred

NBR Inhibitor Description

					Comment Numbers
A. Number of radial tears greater than 3 in. long?	0				
B. Tears exhibiting charring or erosion?	____	yes	X	no	____
C. Circumferential tears?	____	yes	X	no	____

Measurement Definitions



Radial Inhibitor Tears > 3 in. Long
Measurements "A" and "B" taken as shown above.

Degree Location	Meas. "A"	Meas. "B"	Comments (Charring, etc.)

Notes/Comments:

1. At 6°, a thermocouple wire was sticking out of the end of the inhibitor.

Table A-25
RSRM-4A Aft Center Segment Stress Relief Flap Evaluation

Motor No.: RSRM-4A	Date: 11 May 1989	Time: 2300

Inspector(s): Jim Passman, Norm Eddy, Larry Allred

Flap Region					Comment Numbers
A. Gouges, Cuts, Tears?		yes	X	no	
B. Pocketing?		yes	X	no	
C. Missing Material?	X	yes		no	1
D. Heat Affected CF/EPDM or NBR?	X	yes		no	1
E. Eroded CF/EPDM or NBR?	X	yes		no	1
F. Bulb Separations, Voids, Delaminations?		yes	X	no	

Flap Measurements
Measurements from the tip of the tang to the aft edge of the flap.

Degree Location	Axial Distance
0°	14.9 in.
90°	15.2 in.
180°	15.0 in.
270°	14.8 in.

Tear Measurements
Measurement "A" taken from the J-leg tip to the aft edge of the flap.
Measurement "B" taken from the aft edge of the flap to the forward edge of the tear.

Degree Location	Measurement "A"	Measurement "B"	Comments (Charring, etc.)

Notes/Comments

1. Flap was eroded back to the flap bulb full circumference. CF/EPDM was eroded away to remaining flap. Both conditions are normal.

Table A-26
RSRM-4A Forward Center Segment Internal Insulation Evaluation

Motor No.: RSRM-4A	Date: 12 May 1989	Time: 1920
Inspector(s): Jim Passman, Norm Eddy		

Insulated Cylinder Region					Comment Numbers
A. Blisters Visible?	____	yes	X	no	____
B. Discolorations or Repairs Visible?	____	yes	X	no	____
C. Separations or Delaminations?	____	yes	X	no	____
D. Excessive Erosion at Factory Joints?	____	yes	X	no	____
E. Tears, Gouges, Cuts?	____	yes	X	no	____
F. Liner present?	X	yes	____	no	1

Notes/Comments:

1. Liner visible from 2 ft aft of factory joint to inhibitor.

Table A-27
RSRM-4A Forward Center Segment NBR Inhibitor Height Evaluation

Motor No.: RSRM-4A	Date: 12 May 1989	Time: 0100

Inspector(s): Jim Passman, Norm Eddy, Larry Allred

NBR Inhibitor Description

					Comment Numbers
A. Delaminations or Separations?	____	yes	X	no	
B. Unusual Erosion (Other than Tears)?	____	yes	X	no	

NBR Inhibitor Measurements

Radial measurements from the I.D. of the inner clevis leg.

Degree Location	Radial Distance	Degree Location	Radial Distance
0°	21.7 in.	180°	25.2 in.
30°	24.4 in.	210°	24.5 in.
60°	24.3 in.	240°	22.7 in.
90°	25.9 in.	270°	22.8 in.
120°	24.6 in.	300°	26.0 in.
150°	25.4 in.	330°	22.7 in.

Max. inhibitor height = 26.0 in.
Min. inhibitor height = 21.7 in.

Notes/Comments:

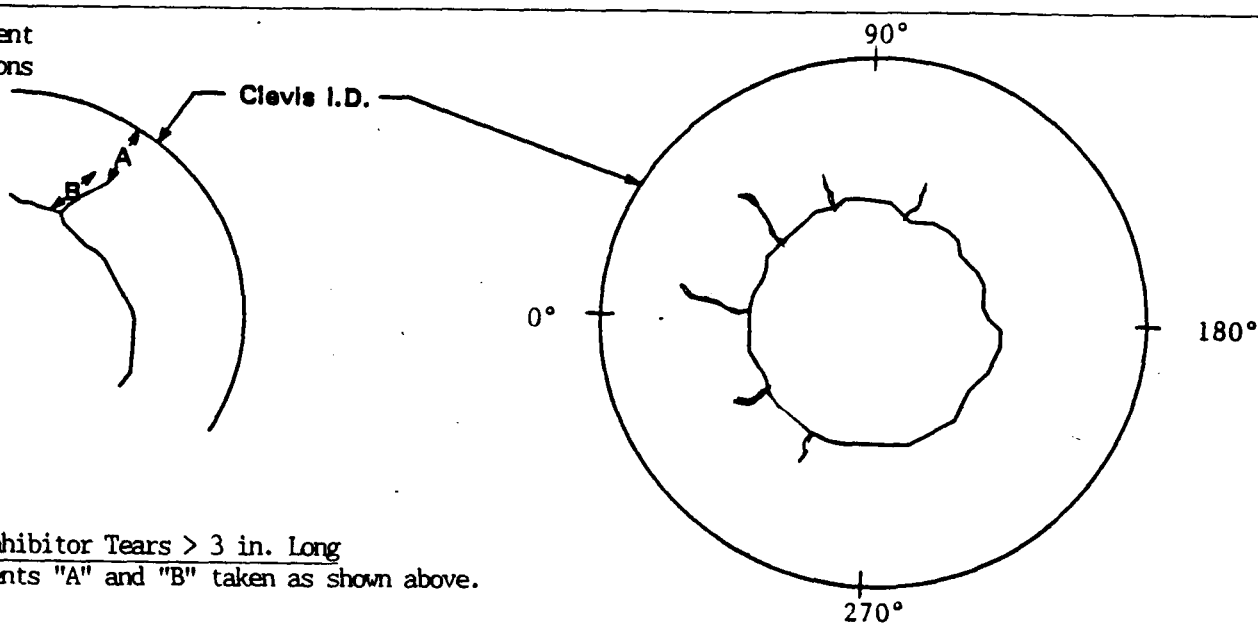
Table A-28
RSRM-4A Forward Center Segment NBR Inhibitor Tear Evaluation

Motor No.: RSRM-4A	Date: 12 May 1989	Time: 0100
Inspector(s): Jim Passman, Norm Eddy, Larry Allred		

NBR Inhibitor Description

					Comment Numbers
A. Number of radial tears greater than 3 in. long?	6				
B. Tears exhibiting charring or erosion?	____	yes	X	no	____
C. Circumferential tears?	____	yes	X	no	____

Measurement Definitions



Radial Inhibitor Tears > 3 in. Long
Measurements "A" and "B" taken as shown above.

Degree Location	Meas. "A"	Meas. "B"	Comments (Charring, etc.)
4	14.0 in.	8.6 in.	No Charring
50	17.7 in.	5.8 in.	" "
82	11.9 in.	11.7 in.	" "
108	10.2 in.	11.8 in.	" "
286	17.2 in.	7.5 in.	" "
324	20.5 in.	5.5 in.	" "

Notes/Comments:

Table A-29
RSRM-4A Forward Center Segment Stress Relief Flap Evaluation

Motor No.: RSRM-4A	Date: 12 May 1989	Time: 1215

Inspector(s): Jim Passman, Norm Eddy, Larry Allred

Flap Region						Comment Numbers
A. Gouges, Cuts, Tears?		yes	X	no		
B. Pocketing?		yes	X	no		
C. Missing Material?		yes	X	no		
D. Heat Affected CF/EPDM or NBR?	X	yes		no		1
E. Eroded CF/EPDM or NBR?	X	yes		no		1
F. Bulb Separations, Voids, Delaminations?		yes	X	no		

Flap Measurements
Measurements from the tip of the tang to the aft edge of the flap.

Degree Location	Axial Distance
0°	10.4 in.
90°	10.0 in.
180°	9.7 in.
270°	10.5 in.

Tear Measurements
Measurement "A" taken from the J-leg tip to the aft edge of the flap.
Measurement "B" taken from the aft edge of the flap to the forward edge of the tear.

Degree Location	Measurement "A"	Measurement "B"	Comments (Charring, etc.)

Notes/Comments:

1. Flap was eroded uniformly, CF/EPDM was present full circumference but eroded and heat affected.

Table A-30
RSRM-4A Forward Segment Internal Insulation Evaluation

Motor No.: RSRM-4A	Date: 12 May 1989	Time: 1920

Inspector(s): Jim Passman, Norm Eddy

						Comment Numbers
Insulated Cylinder Region						
A. Blisters Visible?		yes	X	no		
B. Discolorations or Repairs Visible?		yes	X	no		
C. Separations or Delaminations?		yes	X	no		
D. Excessive Erosion at Factory Joints?		yes	X	no		
E. Tears, Gouges, Cuts?		yes	X	no		
F. Liner present?	X	yes		no		1
Forward Dome Region						
A. Blisters Visible?		yes	X	no		
B. Discolorations or Repairs Visible?		yes	X	no		
C. Separtions or Delaminations?		yes	X	no		
D. Tears, Gouges, Cuts?	X	yes		no		2

Notes/Comments:

1. Liner present from aft face of factory joint going aft full segment, star pattern visible.
2. Several cuts in forward dome at 230° location, longest = 7 in.

Table A-31
RSRM-4A Forward Segment Stress Relief Flap Evaluation

Motor No.: RSRM-4A	Date: 12 May 1989	Time: 0100

Inspector(s): Jim Passman, Norm Eddy, Larry Allred

Flap Region					Comment Numbers
A. Gouges, Cuts, Tears?	X	yes		no	1
B. Pocketing?		yes	X	no	
C. Missing Material?	X	yes		no	1
D. Heat Affected NBR?	X	yes		no	2
E. Eroded NBR?		yes	X	no	
F. Bulb Separations, Voids, Delaminations?		yes	X	no	

Flap Measurements
Measurements from the tip of the tang to the aft edge of the flap.

Degree Location	Axial Distance
0°	6.5 in.
90°	3.5 in.
180°	3.5 in.
270°	4.1 in.

Tear Measurements
Measurement "A" taken from the J-leg tip to the aft edge of the flap.
Measurement "B" taken from the aft edge of the flap to the forward edge of the tear.

Degree Location	Measurement "A"	Measurement "B"	Comments (Charring, etc.)

Notes/Comments:

1. Intermittent tears typical of past flight motors.
2. Normal heat affected areas with material missing underneath flap.

Appendix B

Table B-1
RSRM-4B Aft Dome Factory Joint Weatherseal Evaluation

Motor No.: RSRM-4B	Date: 7 May 1989	Time: 1010
Inspector(s): Jim Passman		

Weatherseal Condition					Comment Numbers
A. Discolored?	X	yes		no	1
B. Charred Material?	X	yes		no	1
C. Moisture Under Seal?		yes	X	no	
D. Missing Material?		yes	X	no	
E. Edge Separation?		yes	X	no	
F. Impact Damage?		yes	X	no	

Notes/Comments:

1. Normal heat affected material was present from 200° - 350° on the aft and forward facing insulation surfaces.

Table B-2
RSRM-4B Aft Segment Stiffener to Stiffener Factory Joint Weatherseal Evaluation

Motor No.: RSRM-4B	Date: 7 May 1989	Time: 1020
Inspector(s): Jim Passman		

Weatherseal Condition					Comment Numbers
A. Discolored?	X	yes		no	1
B. Charred Material?	X	yes		no	1
C. Moisture Under Seal?		yes	X	no	
D. Missing Material?		yes	X	no	
E. Edge Separation?		yes	X	no	
F. Impact Damage?		yes	X	no	

Notes/Comments:

1. Normal heat affected material was present from 210° - 340° on the aft and forward facing insulation surfaces.

Table B-3
RSRM-4B Aft Segment ET Attach to Stiffener Factory Joint Weatherseal Evaluation

Motor No.: RSRM-4B	Date: 7 May 1989	Time: 1020
Inspector(s): Jim Passman		

Weatherseal Condition					Comment Numbers
A. Discolored?	X	yes		no	1
B. Charred Material?	X	yes		no	1
C. Moisture Under Seal?		yes	X	no	
D. Missing Material?		yes	X	no	
E. Edge Separation?		yes	X	no	
F. Impact Damage?		yes	X	no	

Notes/Comments:

1. Normal heat affected material was present from 210° - 340° on the aft and forward facing insulation surfaces.

Table B-4
RSRM-4B Aft Center Segment Factory Joint Weatherseal Evaluation

Motor No.: RSRM-4B	Date: 7 May 1989	Time: 1025
Inspector(s): Jim Passman		

Weatherseal Condition					Comment Numbers
A. Discolored?		yes	X	no	
B. Charred Material?		yes	X	no	
C. Moisture Under Seal?		yes	X	no	
D. Missing Material?		yes	X	no	
E. Edge Separation?		yes	X	no	
F. Impact Damage?		yes	X	no	

Notes/Comments:

Table B-5
RSRM-4B Forward Center Segment Factory Joint Weatherseal Evaluation

Motor No.: RSRM-4B	Date: 7 May 1989	Time: 1025
Inspector(s): Jim Passman		

Weatherseal Condition					Comment Numbers
A. Discolored?	____	yes	X	no	____
B. Charred Material?	____	yes	X	no	____
C. Moisture Under Seal?	____	yes	X	no	____
D. Missing Material?	____	yes	X	no	____
E. Edge Separation?	____	yes	X	no	____
F. Impact Damage?	____	yes	X	no	____

Notes/Comments:

1. At 272° on the aft edge, K5NA was present (appears to be a result of a repair) 3.75 in. circ., 0.65 in. axial. No damage, missing material, or heat effects were present.

   At 175° - 185° (approx.) weatherseal was covered (aft edge → forward edge) with K5NA as a result from a repair from a prefire DR. Postfire evaluation indicates that the repair functioned properly with no unbonds, gouges, or heat effects present.

Table B-6
RSRM-4B Forward Segment Cylinder to Cylinder Factory Joint Weatherseal Evaluation

Motor No.: RSRM-4B	Date: 7 May 1989	Time: 1035
Inspector(s): Jim Passman		

Weatherseal Condition					Comment Numbers
A. Discolored?	____	yes	X	no	____
B. Charred Material?	____	yes	X	no	____
C. Moisture Under Seal?	____	yes	X	no	____
D. Missing Material?	____	yes	X	no	____
E. Edge Separation?	____	yes	X	no	____
F. Impact Damage?	____	yes	X	no	____

Notes/Comments:

Table B-7
RSRM-4B Forward Dome Factory Joint Weatherseal Evaluation

Motor No.: RSRM-4B	Date: 7 May 1989	Time: 1035
Inspector(s): Jim Passman		

Weatherseal Condition					Comment Numbers
A. Discolored?	____	yes	X	no	____
B. Charred Material?	____	yes	X	no	____
C. Moisture Under Seal?	____	yes	X	no	____
D. Missing Material?	____	yes	X	no	____
E. Edge Separation?	____	yes	X	no	____
F. Impact Damage?	____	yes	X	no	____

Notes/Comments:

Table B-8
RSRM-4B Aft Stiffener Ring TPS Evaluation Before Ring Removal

Motor No.: RSRM-4B	Date: 7 May 1989	Time: 1315
Inspector(s): Jim Passman		

Stiffener Ring TPS Condition					Comment Numbers
A. Discolored?	X	yes	____	no	1
B. Blistered Paint?	____	yes	____	no	N/A
C. Heat Affected/Charred Material?	X	yes	____	no	1
D. Missing Material/Gouges?	____	yes	X	no	____
E. Insulation to Case Separations?	____	yes	X	no	2
F. Tears?	____	yes	X	no	____
G. Impact Damage?	____	yes	X	no	____

Notes/Comments:

1. The insulation was normally discolored and heat affected from 210° - 340°.

2. Tap testing revealed no unbonds.

Table B-9
RSRM-4B Center Stiffener Ring TPS Evaluation Before Ring Removal

Motor No.: RSRM-4B	Date: 7 May 1989	Time: 1325
Inspector(s): Jim Passman		

Stiffener Ring TPS Condition					Comment Numbers
A. Discolored?	X	yes		no	1
B. Blistered Paint?		yes		no	N/A
C. Heat Affected/Charred Material?	X	yes		no	1
D. Missing Material/Gouges?		yes	X	no	
E. Insulation to Case Separations?		yes	X	no	2
F. Tears?		yes	X	no	
G. Impact Damage?		yes	X	no	

Notes/Comments:

1. The insulation was normally discolored and heat affected from 220° - 320°.
2. Tap testing revealed no unbonds.

Table B-10
RSRM-4B Forward Stiffener Ring TPS Evaluation Before Ring Removal

Motor No.: RSRM-4B	Date: 7 May 1989	Time: 1330
Inspector(s): Jim Passman		

Stiffener Ring TPS Condition					Comment Numbers
A. Discolored?	X	yes		no	1
B. Blistered Paint?		yes		no	N/A
C. Heat Affected/Charred Material?	X	yes		no	1
D. Missing Material/Gouges?		yes	X	no	
E. Insulation to Case Separations?		yes	X	no	2
F. Tears?		yes	X	no	
G. Impact Damage?		yes	X	no	

Notes/Comments:

1. The insulation was normally discolored and heat affected from 220° - 320°.
2. Tap testing revealed no unbonds.

Table B-11
RSRM-4B Forward Stiffener Stub TPS Evaluation

Motor No.: RSRM-4B	Date: 7 May 1989	Time: 1335
Inspector(s): Jim Passman		

Stiffener Stub TPS Condition					Comment Numbers
A. Discolored?	X	yes		no	1
B. Blistered Paint?		yes		no	N/A
C. Heat Affected/Charred Material?	X	yes		no	1
D. Missing Material/Gouges?		yes	X	no	
E. Insulation to Case Separations?		yes	X	no	2
F. Tears?		yes	X	no	
G. Impact Damage?		yes	X	no	

Notes/Comments:

1. Normal heat affected and discolored insulation was present from 220° - 320°.

2. Tap testing revealed no unbonds.

Table B-12
RSRM-4B Stiffener Ring Segment TPS Evaluation After Ring Removal

Motor No.: RSRM-4B	Date: 11 May 1989	Time: 1115
Inspector(s): Jim Passman		

Stiffener Ring TPS Condition					Comment Numbers
A. Discolored?		yes		no	N/A
B. Blistered Paint?		yes		no	N/A
C. Heat Affected/Charred Material?		yes		no	N/A
D. Missing Material/Gouges?		yes		no	N/A
E. Insulation to Case Separations?		yes	X	no	1
F. Tears?		yes		no	N/A
G. Impact Damange?		yes		no	N/A

Notes/Comments:

1. Tap testing after ring removal (after hydrolaze) revealed no unbonds on all 36 inside corners and no unbonds on all 18 outside outside edges. Most of the ring segment end edges had KSNA remaining. This indicates that hydrolazing wasn't as severe as seen in the past.

Table B-13
RSRM-4B Nozzle to Case Joint Insulation Evaluation

Motor No.: RSRM-4B	Date: 12 May 1989	Time: 2200

Inspector(s): Jim Passman, Norm Eddy

						Comment Numbers
1. Voids?		X	yes		no	1
2. Gas Paths?			yes	X	no	
3. Soot?			yes	X	no	
4. Foreign Material?			yes	X	no	
5. Adhesive Porosity?			yes	X	no	
6. Aft Dome Edge Separations?			yes	X	no	
7. Baffle Torn?			yes	X	no	
8. Polysulfide in Vent Slots?		X	yes		no	2
9. Polysulfide Failure Mode	15 % Adhesive at NBR Interface				85 % Cohesive	
	0 % Adhesive at Phenolic Interface					

Notes/Comments:

1. Voids
   230° - aft of step 0.45 in. long. x 0.20 in. circ.
   272° - at wiper 0.30 in. long. x 0.10 in. circ.
   280° - at wiper 0.40 in. long. x 0.12 in. circ.
   Numerous small voids aft of step 0.15 in. long. x 0.10 in. circ.

2.

Degree Location	% Slot Fill	Degree Location	% Slot Fill	Degree Location	% Slot Fill
0.0°	50	122.4°	60	244.8°	95
7.2°	100	129.6°	100	252.0°	25
14.4°	100	136.8°	30	259.2°	40
21.6°	60	144.0°	0	266.4°	25
28.8°	70	151.2°	100	273.6°	10
36.0°	60	158.4°	50	280.8°	20
43.2°	40	165.6°	0	288.0°	30
50.4°	100	172.8°	50	295.2°	75
57.6°	100	180.0°	100	302.4°	75
64.8°	50	187.2°	100	309.6°	100
72.0°	50	194.4°	60	316.8°	100
79.2°	40	202.6°	40	324.0°	75
86.4°	50	208.8°	30	331.2°	100
93.6°	75	216.0°	90	338.4°	60
100.8°	80	223.2°	80	345.6°	50
108.0°	100	230.4°	80	352.8°	40
115.2°	90	237.6°	80		

Average = 64%

2 of 50 slots had 0% fill
12 slots had 100% fill

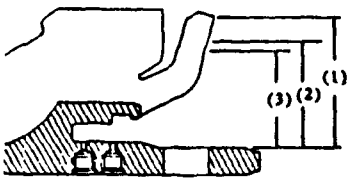
Table B-14
RSRM-4B Aft Field Joint Insulation Evaluation

Motor No.: RSRM-4B	Date: 12 May 1989	Time: 0930

Inspector(s): Jim Passman, Norm Eddy, Larry Allred

						Comment Numbers
1.	Areas of Non-Contact?	____	yes	X	no	
2.	Gas Paths?	____	yes	X	no	
3.	Soot?	X	yes	____	no	1
4.	Tang Heat Affected Material?	X	yes	____	no	See Below
5.	Foreign Material?	X	yes	____	no	2
6.	Clevis Edge Separations?	____	yes	X	no	

Tang End Measurements



	Degree Location	Depth (1)	Depth (2)	Depth (3)*	Bondline Contact **
	0°	2.80 in.	2.80 in.	2.35 in.	1.04 in.
	90°	2.89 in.	2.84 in.	2.3 in.	0.98 in.
	180°	2.92 in.	2.92 in.	2.34 in.	1.12 in.
	270°	2.85 in.	2.85 in.	2.46 in.	1.08 in.
Max	____	____	____	____	____
Min	____	____	____	____	____

Note:
The following measurements are taken from the inner diameter of the tang leg at the pinhole:
Depth (1) - to the tip of the remaining material
Depth (2) - to the outboard edge of the char layer
Depth (3) - to the outboard edge of the heat affected material*
* Location based on the tan discoloration of the adhesive.
** Measurement taken from the outboard edge of the char layer to the outboard extent of contact..

Notes/Comments:

1. Soot from splashdown on the tang and clevis insulation from 80° - 180°, 0.25 in - 0.30 in. outboard of remaining material

2. Tape residue on clevis insulation step and tang near capture feature O-ring.

3. Several tang edge unbonds were visible near capture feature O-ring (measurements will be taken at H-7).

4. Crazing/cracks in radius region of clevis.

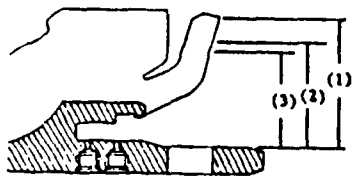
Table B-15
RSRM-4B Center Field Joint Insulation Evaluation

Motor No.: RSRM-4B	Date: 12 May 1989	Time: 1045

Inspector(s): Jim Passman, Norm Eddy, Larry Allred

						Comment Numbers
1.	Areas of Non-Contact?	____	yes	X	no	
2.	Gas Paths?	____	yes	X	no	
3.	Soot?	X	yes	____	no	1
4.	Tang Heat Affected Material?	X	yes	____	no	See Below
5.	Foreign Material?	____	yes	X	no	
6.	Clevis Edge Separations?	____	yes	X	no	

Tang End Measurements



	Degree Location	Depth (1)	Depth (2)	Depth (3)*	Bondline Contact **
	0°	3.40 in.	3.18 in.	2.80 in.	1.40 in.
	90°	3.14 in.	3.14 in.	2.80 in.	1.12 in.
	180°	3.20 in.	3.14 in.	2.74 in.	1.21 in.
	270°	3.15 in.	3.15 in.	2.73 in.	1.13 in.
Max	____	____	____	____	____
Min	____	____	____	____	____

Note:
The following measurements are taken from the inner diameter of the tang leg at the pinhole:
Depth (1) - to the tip of the remaining material
Depth (2) - to the outboard edge of the char layer
Depth (3) - to the outboard edge of the heat affected material*,
* Location based on the tan discoloration of the adhesive.
** Measurement taken from the outboard edge of the char layer to the outboard extent of contact.

Notes/Comments:

1. Soot from splashdown on tang and clevis full circumference 0.30 in. - 0.40 in. outboard from remaining material.

2. Several edge unbonds were present on tang insulation near capture feature O-ring (measurements will be taken at Clearfield).

3. Minor crazing/cracks intermittent in radius region of clevis.

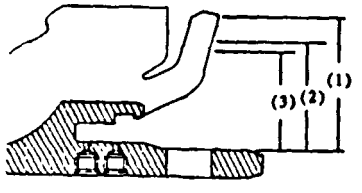
Table B-16
RSRM-4B Forward Field Joint Insulation Evaluation

Motor No.: RSRM-4B	Date: 12 May 1989	Time: 1130

Inspector(s): Jim Passman, Norm Eddy, Larry Allred

					Comment Numbers
1. Areas of Non-Contact?	____	yes	X	no	____
2. Gas Paths?	____	yes	X	no	____
3. Soot?	X	yes	____	no	1
4. Tang Heat Affected Material?	X	yes	____	no	See Below
5. Foreign Material?	X	yes	____	no	2
6. Clevis Edge Separations?	____	yes	X	no	____

Tang End Measurements



	Degree Location	Depth (1)	Depth (2)	Depth (3)*	Bondline Contact **
	0°	3.08 in.	3.08 in.	2.60 in.	1.00 in.
	90°	3.12 in.	3.12 in.	2.86 in.	1.10 in.
	180°	3.24 in.	3.13 in.	2.75 in.	1.26 in.
	270°	3.12 in.	3.12 in.	2.78 in.	0.98 in.
Max	____	____	____	____	____
Min	____	____	____	____	____

Note:
The following measurements are taken from the inner diameter of the tang leg at the pinhole:
Depth (1) - to the tip of the remaining material
Depth (2) - to the outboard edge of the char layer
Depth (3) - to the outboard edge of the heat affected material*,
* Location based on the tan discoloration of the adhesive.
** Measurement taken from the outboard edge of the char layer to the outboard extent of contact.

Notes/Comments:

1. Soot from splashdown on tang and clevis full circumference 0.40 in. outboard from remaining material.

2. Tape residue was present on tang and clevis insulation in ramp region intermittently.

3. Two small gouges on tang ramp region. Max. at 84° approx. 0.15 in. long, 0.10 in. wide, and 0.05 in deep.

Table B-17
RSRM-4B Igniter Boss Insulation Evaluation

Motor No.: RSRM-4B	Date: 11 May 1989	Time: 1730
Inspector(s): Jim Passman		

I.	Severe or Abnormal Insulation Erosion?		yes	X	no			
II.	Blistering?		yes	X	no			
III.	Edge Unbonds or Insulation Flashing?		yes	X	no			

Condition (Observation Code)	Axial (Station) Location (in.)	Degree Start Location (deg.)	Degree Stop Location (deg.)	Circumferential Length (in.) If Applicable	Axial Length (in.) If Applicable	Radial Depth (in.) If Applicable

Notes/Comments:

1. Igniter boss insulation in normal condition, probing revealed no unbonds on the insulation to igniter boss metal bondline.

Table B-18
RSRM-4B Igniter Evaluation

Motor No.: RSRM-4B	Date: 11 May 1989	Time: 1730

Inspector(s): Jim Passman

Putty Condition

1. Color?		Variable	X	Constant			
2. Tack?	X	Good		Nominal			Poor

					Comment Numbers
A. Putty Gas Paths?	X	yes		no	1
B. Putty Adhesive Failure?		yes	X	no	
C. Putty Cohesive Failure?	X	yes		no	
D. Voids in Putty?		yes	X	no	
E. Foreign Material in Joint?		yes	X	no	
F. Soot?	X	yes		no	1

Clarify below:

Condition (Observation Code)	Degree Start Location (deg.)	Degree Stop Location (deg.)	Circumferential Length (in.) If Applicable	Axial Length (in.) If Applicable	Radial Depth (in.) If Applicable
Gas Path	265°	265°	0.60 max.	N/A	N/A
Soot	225°	270°	N/A	N/A	N/A

Igniter Chamber

I. Severe or Abnormal Insulation Erosion?		yes	X	no
II. Blistering?		yes	X	no
III. Gouges or Cuts?		yes	X	no

Condition (Observation Code)	Axial (Station) Location (in.)	Degree Start Location (deg.)	Degree Stop Location (deg.)	Circumferential Length (in.) If Applicable	Axial Length (in.) If Applicable	Radial Depth (in.) If Applicable

Notes/Comments:

1. Blow hole through the putty at 265°, max. circ. width 0.60 in. extending to gasket. Resulting soot from 225°-265°-270°. Soot was on aft face of gasket but not to primary.

Table B-19
RSRM-4B Aft Segment Internal Insulation Evaluation

Motor No.: RSRM-4B	Date: 12 May 1989	Time: 2015

Inspector(s): Jim Passman, Norm Eddy, Larry Allred

						Comment Numbers
Insulated Cylinder Region						
A. Blisters Visible?	____	yes	X	no		____
B. Discolorations or Repairs Visible?	____	yes	X	no		____
C. Separations or Delaminations?	____	yes	X	no		____
D. Excessive Erosion at Factory Joints?	____	yes	X	no		____
E. Tears, Gouges, Cuts?	____	yes	X	no		____
F. Liner present?	X	yes	____	no		1
Aft Dome Region						
A. Abnormal CF/EPDM Erosion?	____	yes	X	no		____
B. NBR Under CF/EPDM Exposed?	____	yes	X	no		____

Notes/Comments:

1. Liner present at NBR inhibitor radius region.

Table B-20
RSRM-4B Aft Segment NBR Inhibitor Height Evaluation

Motor No.: RSRM-4B	Date: 12 May 1989	Time: 0930

Inspector(s): Jim Passman, Norm Eddy, Larry Allred

NBR Inhibitor Description

					Comment Numbers
A. Delaminations or Separations?	____	yes	X	no	
B. Unusual Erosion (Other than Tears)?	____	yes	X	no	1

NBR Inhibitor Measurements

Radial measurements from the I.D. of the inner clevis leg.

Degree Location	Radial Distance	Degree Location	Radial Distance
0°	4.3 in.	180°	8.3 in.
30°	4.3 in.	210°	7.6 in.
60°	5.1 in.	240°	7.0 in.
90°	6.6 in.	270°	7.2 in.
120°	4.8 in.	300°	4.3 in.
150°	7.4 in.	330°	4.4 in.

Max. inhibitor height = 8.3 in.
Min. inhibitor height = 4.3 in.

Notes/Comments:

1. Non-uniform erosion from 210°-320°. Typical of RSRM aft segment NBR inhibitors.

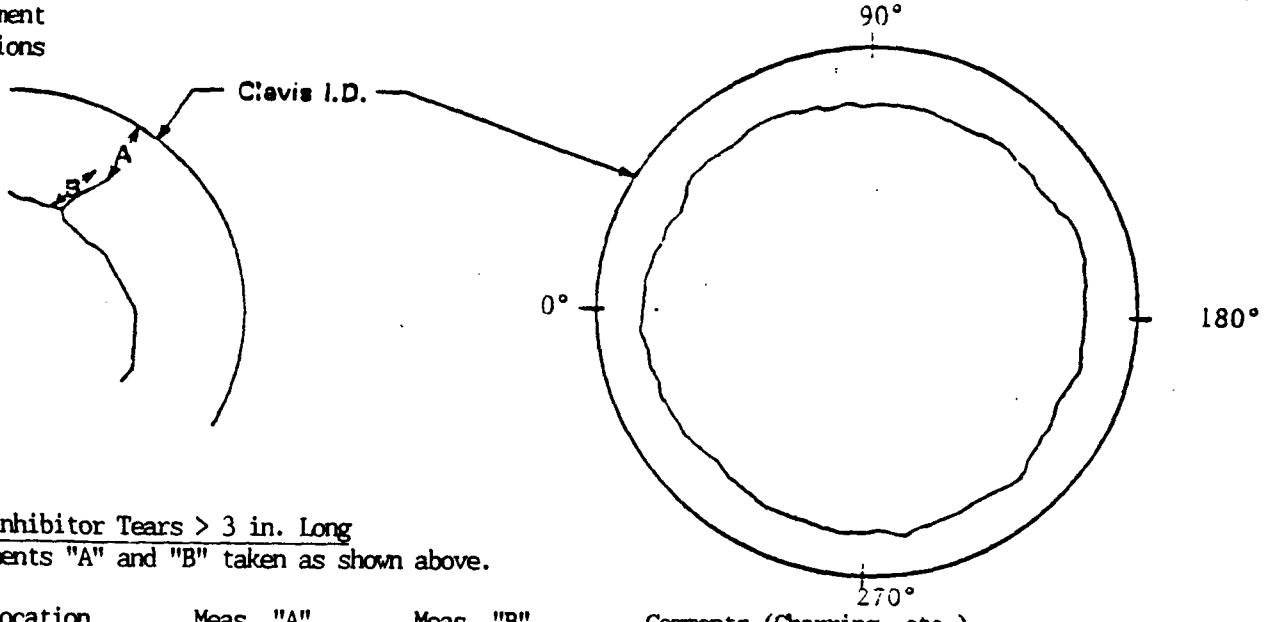
Table B-21
RSRM-4B Aft Segment NBR Inhibitor Tear Evaluation

Motor No.: RSRM-4B	Date: 12 May 1989	Time: 0930
Inspector(s): Jim Passman, Norm Eddy, Larry Allred		

NBR Inhibitor Description

					Comment Numbers
A. Number of radial tears greater than 3 in. long?	0				
B. Tears exhibiting charring or erosion?		yes	X	no	
C. Circumferential tears?		yes	X	no	

Measurement Definitions



Radial Inhibitor Tears > 3 in. Long
Measurements "A" and "B" taken as shown above.

Degree Location	Meas. "A"	Meas. "B"	Comments (Charring, etc.)

Notes/Comments:

Table B-22
RSRM-4B Aft Center Segment Internal Insulation Evaluation

Motor No.: RSRM-4B	Date: 12 May 1989	Time: 1945
Inspector(s): Jim Passman, Norm Eddy		

Insulated Cylinder Region					Comment Numbers
A. Blisters Visible?		yes	X	no	
B. Discolorations or Repairs Visible?		yes	X	no	
C. Separations or Delaminations?		yes	X	no	
D. Excessive Erosion at Factory Joints?		yes	X	no	
E. Tears, Gouges, Cuts?	X	yes		no	1,2
F. Liner present?	X	yes		no	3

Notes/Comments:

1. Scuffed areas at forward end of segment near inhibitor at 0° location.
2. One gouge on aft edge of factory joint at 185° was approx. 2 in. long.
3. Liner visible from 3 ft. forward of the factory joint to inhibitor.

Table B-23
RSRM-4B Aft Center Segment NBR Inhibitor Height Evaluation

Motor No.: RSRM-4B	Date: 12 May 1989	Time: 1045

Inspector(s): Jim Passman, Norm Eddy, Larry Allred

NBR Inhibitor Description

					Comment Numbers
A. Delaminations or Separations?	____	yes	X	no	
B. Unusual Erosion (Other than Tears)?	____	yes	X	no	

NBR Inhibitor Measurements

Radial measurements from the I.D. of the inner clevis leg.

Degree Location	Radial Distance	Degree Location	Radial Distance
0°	15.1 in.	180°	15.7 in.
30°	15.3 in.	210°	15.0 in.
60°	13.7 in.	240°	14.9 in.
90°	13.5 in.	270°	14.5 in.
120°	15.5 in.	300°	14.6 in.
150°	15.7 in.	330°	12.9 in,

Max. inhibitor height = 15.7 in.
Min. inhibitor height = 12.9 in.

Notes/Comments:

Table B-24
RSRM-4B Aft Center Segment NBR Inhibitor Tear Evaluation

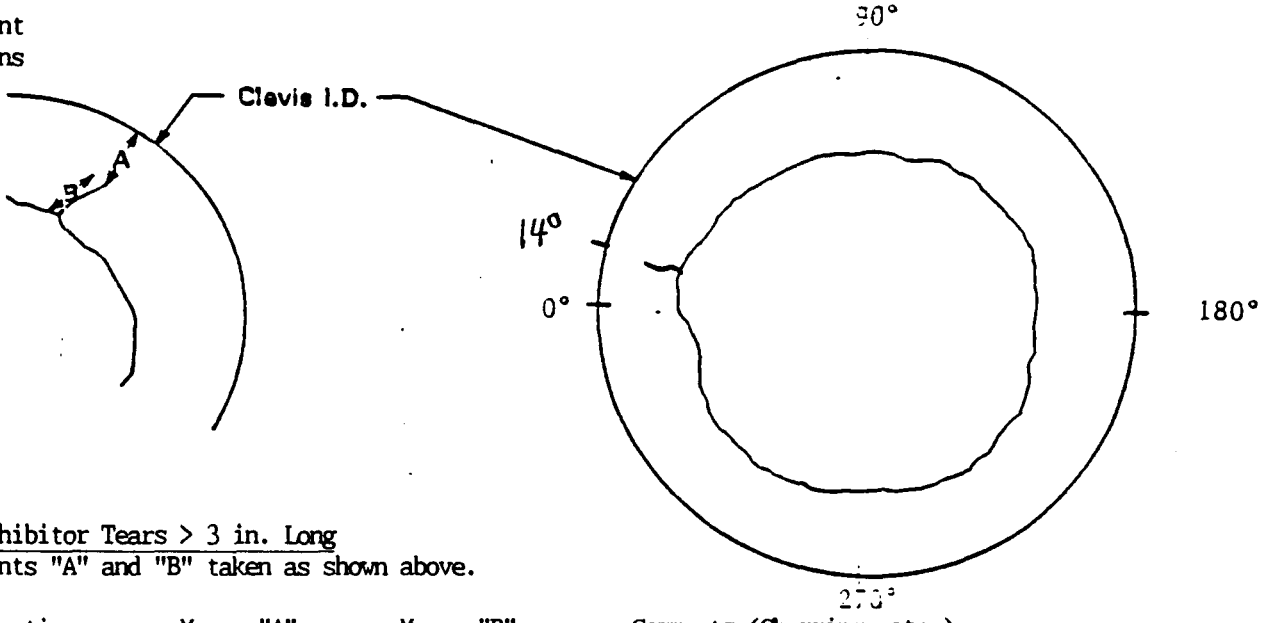
Motor No.: RSRM-4B	Date: 12 May 1989	Time: 1045

Inspector(s): Jim Passman, Norm Eddy, Larry Allred

NBR Inhibitor Description

					Comment Numbers
A. Number of radial tears greater than 3 in. long?	1				
B. Tears exhibiting charring or erosion?	____	yes	X	no	____
C. Circumferential tears?	____	yes	X	no	____

Measurement Definitions



Radial Inhibitor Tears > 3 in. Long
Measurements "A" and "B" taken as shown above.

Degree Location	Meas. "A"	Meas. "B"	Comments (Charring, etc.)
14°	7.2 in.	6.0 in.	No Charring

Notes/Comments:

Table B-25
RSRM-4B Aft Center Segment Stress Relief Flap Evaluation

Motor No.: RSRM-4B	Date: 12 May 1989	Time: 0930

Inspector(s): Jim Passman, Norm Eddy, Larry Allred

Flap Region					Comment Numbers
A. Gouges, Cuts, Tears?		yes	X	no	
B. Pocketing?		yes	X	no	
C. Missing Material?	X	yes		no	1
D. Heat Affected CF/EPDM or NBR?	X	yes		no	1
E. Eroded CF/EPDM or NBR?	X	yes		no	1
F. Bulb Separations, Voids, Delaminations?		yes	X	no	

Flap Measurements
Measurements from the tip of the tang to the aft edge of the flap.

Degree Location	Axial Distance
0°	15.5 in.
90°	15.1 in.
180°	15.1 in.
270°	15.3 in.

Tear Measurements
Measurement "A" taken from the J-leg tip to the aft edge of the flap.
Measurement "B" taken from the aft edge of the flap to the forward edge of the tear.

Degree Location	Measurement "A"	Measurement "B"	Comments (Charring, etc.)

Notes/Comments

1. Flap normally eroded back to the flap bulb. CF/EPDM was eroded away to remaining flap.

Table B-26
RSRM-4B Forward Center Segment Internal Insulation Evaluation

Motor No.: RSRM-4B	Date: 12 May 1989	Time: 1945
Inspector(s): Jim Passman, Norm Eddy		

Insulated Cylinder Region					Comment Numbers
A. Blisters Visible?	____	yes	X	no	____
B. Discolorations or Repairs Visible?	____	yes	X	no	____
C. Separations or Delaminations?	____	yes	X	no	____
D. Excessive Erosion at Factory Joints?	____	yes	X	no	____
E. Tears, Gouges, Cuts?	____	yes	X	no	____
F. Liner present?	X	yes	____	no	1

Notes/Comments:

1. Liner visible from aft of factory joint forward to inhibitor.

Table B-27
RSRM-4B Forward Center Segment NBR Inhibitor Height Evaluation

Motor No.: RSRM-4B	Date: 12 May 1989	Time: 1130

Inspector(s): Jim Passman, Norm Eddy, Larry Allred

NBR Inhibitor Description

					Comment Numbers
A. Delaminations or Separations?	____	yes	X	no	
B. Unusual Erosion (Other than Tears)?	____	yes	X	no	

NBR Inhibitor Measurements

Radial measurements from the I.D. of the inner clevis leg.

Degree Location	Radial Distance	Degree Location	Radial Distance
0°	25.0 in.	180°	24.8 in.
30°	23.8 in.	210°	26.1 in.
60°	25.7 in.	240°	26.0 in.
90°	25.5 in.	270°	25.8 in.
120°	25.0 in.	300°	26.0 in.
150°	25.0 in.	330°	25.9 in.

Max. inhibitor height = 26.1 in.
Min. inhibitor height = 23.8 in.

Notes/Comments:

Table B-28
RSRM-4B Forward Center Segment NBR Inhibitor Tear Evaluation

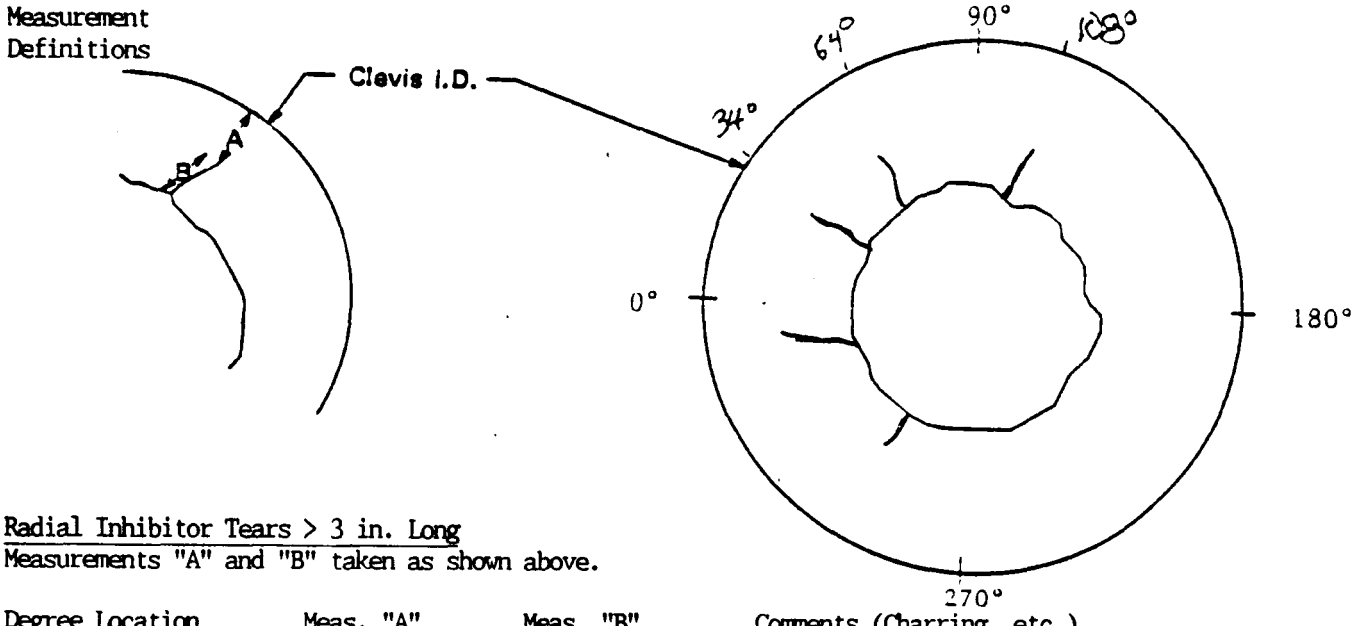
Motor No.: RSRM-4B	Date: 12 May 1989	Time: 1130

Inspector(s): Jim Passman, Norm Eddy, Larry Allred

NBR Inhibitor Description

					Comment Numbers
A. Number of radial tears greater than 3 in. long?	5				
B. Tears exhibiting charring or erosion?	____	yes	X	no	____
C. Circumferential tears?	____	yes	X	no	____

Measurement Definitions



Radial Inhibitor Tears > 3 in. Long
Measurements "A" and "B" taken as shown above.

Degree Location	Meas. "A"	Meas. "B"	Comments (Charring, etc.)
34	14.5 in.	11.0 in.	No Charring
64	12.7 in.	13.0 in.	" "
108	10.0 in.	14.4 in.	" "
330	15.5 in.	10.0 in.	" "
358	18.0 in.	7.9 in.	" "
			" "

Notes/Comments:

Table B-29
RSRM-4B Forward Center Segment Stress Relief Flap Evaluation

Motor No.: RSRM-4B	Date: 12 May 1989	Time: 1045

Inspector(s): Jim Passman, Norm Eddy, Larry Allred

Flap Region					Comment Numbers
A. Gouges, Cuts, Tears?		yes	X	no	
B. Pocketing?		yes	X	no	
C. Missing Material?	X	yes		no	1
D. Heat Affected CF/EPDM or NBR?	X	yes		no	1
E. Eroded CF/EPDM or NBR?	X	yes		no	1
F. Bulb Separations, Voids, Delaminations?		yes	X	no	

Flap Measurements
Measurements from the tip of the tang to the aft edge of the flap.

Degree Location	Axial Distance
0°	10.8 in.
90°	10.4 in.
180°	8.0 in.
270°	10.2 in.

Tear Measurements
Measurement "A" taken from the J-leg tip to the aft edge of the flap.
Measurement "B" taken from the aft edge of the flap to the forward edge of the tear.

Degree Location	Measurement "A"	Measurement "B"	Comments (Charring, etc.)

Notes/Comments:

1. Flap erosion was normal. CF/EPDM was present but heat affect and slightly eroded away.

Table B-30
RSRM-4B Forward Segment Internal Insulation Evaluation

Motor No.: RSRM-4B	Date: 12 May 1989	Time: 1945

Inspector(s): Jim Passman, Norm Eddy

						Comment Numbers
Insulated Cylinder Region						
A. Blisters Visible?	____	yes	X	no		____
B. Discolorations or Repairs Visible?	____	yes	X	no		____
C. Separations or Delaminations?	____	yes	X	no		____
D. Excessive Erosion at Factory Joints?	____	yes	X	no		____
E. Tears, Gouges, Cuts?	____	yes	X	no		____
F. Liner present?	X	yes	____	no		1
Forward Dome Region						
A. Blisters Visible?	____	yes	X	no		____
B. Discolorations or Repairs Visible?	____	yes	X	no		____
C. Separtions or Delaminations?	____	yes	X	no		____
D. Tears, Gouges, Cuts?	____	yes	X	no		____

Notes/Comments:

1. Liner visible from 1-2 ft aft of factory joint going aft full segment. Edge of liner very visible showing an irregular contour due to star pattern.

Table B-31
RSRM-4B Forward Segment Stress Relief Flap Evaluation

Motor No.: RSRM-4B	Date: 12 May 1989	Time: 1130

Inspector(s): Jim Passman, Norm Eddy, Larry Allred

Flap Region					Comment Numbers
A. Gouges, Cuts, Tears?	X	yes		no	1
B. Pocketing?		yes	X	no	
C. Missing Material?	X	yes		no	2
D. Heat Affected NBR?	X	yes		no	2
E. Eroded NBR?	X	yes		no	2
F. Bulb Separations, Voids, Delaminations?		yes	X	no	

Flap Measurements
Measurements from the tip of the tang to the aft edge of the flap.

Degree Location	Axial Distance
0°	11.0 in.
90°	5.6 in.
180°	7.0 in.
270°	4.5 in.

Tear Measurements
Measurement "A" taken from the J-leg tip to the aft edge of the flap.
Measurement "B" taken from the aft edge of the flap to the forward edge of the tear.

Degree Location	Measurement "A"	Measurement "B"	Comments (Charring, etc.)

Notes/Comments:

1. Several axial flap tears were present, none received heat effects indicating splashdown damage. The flap was scalloped full circumference.

2. The NBR under the flap was normally heat affected and slightly eroded.

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