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Volume V (Nozzle Component)

July 1989

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1.0 INTRODUCTION

A review of the performance and post-flight condition of the STS-26 Redesigned Solid Rocket Motor (RSRM) nozzles is presented in this document. Applicable Discrepancy Reports (DRs) and Process Departures (PDs) are presented in Section 5.0. The Nozzle Component Program Team (NCPT) performance evaluation and the Redesign Program Review Board (RPRB) assessment is included in Section 6.0.

The STS-26 nozzle assemblies were flown on the RSRM First Flight (Space Shuttle Discovery) on 29 September 1988. The nozzles were a partially submerged convergent/divergent movable design with an aft pivot point flexible bearing. The nozzle assembly (Figure 1) incorporated the following features:

- a. RSRM forward exit cone with snubbers
- b. RSRM fixed housing
- c. Structural backup Outer Boot Ring (OBR)
- d. RSRM cowl ring
- e. RSRM nose inlet assembly
- f. RSRM throat assembly
- g. RSRM forward nose and aft inlet ring
- h. RSRM aft exit cone assembly with Linear-Shaped Charge (LSC)
- i. RTV backfill in joints 1, 3, and 4
- j. Use of EA913 NA adhesive in place of EA913 adhesive

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k. Redesigned nozzle plug

1. Carbon Cloth Phenolic (CCP) with 750 ppm sodium content

Figures 2a and 2b show the CCP material usage for the STS-26 forward nozzle assemblies and aft exit cone assemblies.

2.0 OBJECTIVES

The RSRM First Flight test objectives, as outlined in TWR-17535 (MTI Engineering Requirements Document for RSRM First Flight), are as follows (CPW1-3600 paragraph numbers are in parentheses):

- K. Demonstrate flex bearing system reusability (3.2.1.9.c).
- Y. Post-flight inspection of flex bearing to determine sealing performance in the flight environment (3.2.1.2.3.b).
- Z. Post-flight inspection to verify no gas leaks occurred between the flex bearing internal components (3.2.1.2.3.d).
- AD. Post-flight inspection for flex bearing damage due to water impact (3.2.1.4.6.a).
- AE. Post-flight inspection to verify nozzle liner performance (3.2.1.4.13).
- AV. Post-flight inspection to verify remaining nozzle ablative thicknesses (3.3.6.1.2.7).

Post-flight inspection to verify nozzle safety factors (3.3.6.1.2.8).

3.0 SUMMARY/CONCLUSIONS

Compliance to the objectives is discussed below.

K. Evaluation indicates no condition which would adversely affect the reusability of the flex bearing system. Both flex bearings

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have met all of the refurbishment requirements and are acceptable for reuse.

- Y. Preliminary inspection shows the flex bearings remained sealed throughout all motor induced environments. Tensile leak tests done during the refurbishment cycle indicated no leakage.
- Z. Preliminary inspection shows the flex bearings maintained a positive seal within the internal components. Tensile leak tests done during the refurbishment cycle also indicated no leakage.
- AD. Both flex bearings have met all of the refurbishment requirements indicating there was no damage due to water impact.
- AE. Evaluation of both nozzle liners revealed erosion profiles similar to what has been observed on RSRM static test nozzles. Wedgeouts in the aft ends of the RH cowl (120 to 137 degrees) and nose cap (5 to 20 degrees) contained small amounts of slag. Sectioning of the liners showed that the wedgeouts occurred post-burn.
- AV. Measurements of the nozzle remaining ablative liner thicknesses show that the design safety factors have been met.

Sectioning and measurement of the liners show that the performance margins of safety are all positive.

4.0 RESULTS/DISCUSSION

All STS-26 post-flight nozzle observations are discussed in detail below. CCP liner Performance Margins of Safety (PMS) are presented using measured erosion, and corresponding measured char values adjusted to the end of action time.

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4.1 STS-26A (LH) Nozzle/Flex Bearing

Overall erosion of the STS-26A forward nozzle assembly CCP ablative liner was smooth and uniform. All CCP delaminations, wedgeouts, and pop-ups were determined to be post-burn occurrences resulting from cooldown of the liners. Blowpaths were observed in joints 1, 2, and 4, but there was no blowby, erosion, or heat effect to the primary O-rings. Small amounts of corrosion were found on the metal surfaces of joints 1, 3, 4, and 5, but no pitting was observed. Heavy corrosion and pitting was found on the nose inlet housing bonding surfaces when the phenolics were washed off.

Post-flight subassembly flow surface gaps are shown in Figure 3. Overall views of the nozzle are shown in Figures 4 through 9.

4.1.1 STS-26A Nozzle Components

STS-26A Aft Exit Cone Assembly

Overall views of the STS-26A aft exit cone fragment are shown in Figures 10 and 11.

The aft exit cone was severed aft of the compliance ring by the LSC. The nozzle severance system performance was nominal. The exit cone cut was clean, with no unusual tearing or breaking. The remaining aft exit cone

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fragment showed missing CCP liner 360 degrees circumferentially. This is a typical post-flight observation and occurs at LSC firing and at splashdown. Glass Cloth Phenolic (GCP) plies exposed by the missing liner showed no signs of heat effect.

The polysulfide groove fill on the forward end of the aft exit cone showed no separations. Post-flight measurements of the polysulfide groove radial width (Table 1) show that the GCP insulator did not pull away from the aluminum shell during cooldown. The polysulfide shrank axially aft up to 0.12 in.

There were no separations observed within the GCP insulator on the forward end.

STS-26A Forward Exit Cone Assembly

Overall views of the STS-26A forward exit cone are shown in Figures 8 and 9.

The forward exit cone showed missing CCP liner over the center portion of the cone 360 degrees circumferentially. This is a typical post-flight observation and occurs at splashdown and during Diver Operated Plug (DOP) insertion. The GCP insulator exposed by the missing liner showed no signs of heat effect. The CCP liner remained bonded on the forward 11 inches and

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on the aft 8 inches of the cone. These portions showed nominal erosion with no major washing or pocketing. The aft 8 inches of the liner showed the typical dimpled erosion pattern that has occurred on all flight and static test forward exit cones (see Figure 12). The maximum radial depth of the dimpled erosion was 0.15 inch.

The aft end of the forward exit cone showed bondline separations between the EA946 adhesive and the steel housing from 30 to 60 degrees and from 124 to 148 degrees. The maximum radial width of the separations was 0.025 inch. The forward end of the forward exit cone showed bondline separations between the GCP and CCP (0.04 inch maximum radial width), and cohesive separations within the GCP (0.04 inch maximum radial width) intermittently around the circumference. Figure 13 lists the location and radial width measurements of all separations on the forward exit cone. These separations are typical observations which have been seen on previous static test and flight nozzles, and have been shown to occur post-burn.

Photographs of the sectioned forward exit cone liner are presented in Figures 14 through 17. Char and erosion analysis of the sections is presented in Table 2. Figure 18 shows the location of the measurement stations. All margins of safety were positive, with a minimum of 0.01 occurring at station 28 (180 degrees).

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STS-26A Throat Assembly

Overall views of the STS-26A throat assembly (throat ring and throat inlet ring) are shown in Figures 8 and 9.

The post-fired mean diameter of the throat was 55.922 inches (erosion rate of 8.42 mils/second based on an action time of 122.4 seconds). Nozzle post-burn throat diameters have ranged from 55.787 to 56.38 inches. The flow surface bondline gap between the throat and throat inlet rings was 0.08 inch and is typical of past static test and flight nozzles.

Erosion of the throat and throat inlet rings was smooth and uniform with no wedgeouts observed. Popped-up charred CCP material was observed on the forward 1.5 inches of the throat ring at 10, 70, 210, 285, and 345 degrees. Sharp edges indicate the popped-up material occurred after motor operation. Impact marks were noted on the throat inlet ring and on the aft end of the throat ring intermittently around the circumference. The largest was located on the throat inlet ring at 130 degrees and measured 1 inch circumferentially by 0.5 inch axially by 0.25 inch radially (Figure 19). These marks most likely resulted from the loose aft and forward exit cone CCP material inside the motor at splashdown.

Bondline separations between the EA913 NA adhesive and the steel throat support housing were observed on the aft end circumferentially except from

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O to 25 degrees and at 335 degrees. The maximum radial width of these separations was 0.10 inch. Metal-to-adhesive bondline separations measuring 0.03 inch wide radially were observed on the forward end of the throat assembly circumferentially except at 180 degrees. Separations between the adhesive and GCP and within the adhesive were observed at 110, and 180 degrees, respectively. These also measured 0.03 inch wide radially. Figure 20 lists the location and radial width measurements of all separations on the throat assembly. These separations are typical observations which have been seen on previous static test and flight nozzles, and have been shown to occur post-burn.

Photographs of the sectioned throat assembly liner are presented in Figures 21 through 24. Char and erosion analysis of the sections is presented in Table 3. Figure 25 shows the location of the measurement stations. All margins of safety were positive, with a minimum of 0.06 occurring at station 8 (0 degrees).

STS-26A Nose Inlet Assembly

Overall views of the STS-26A nose inlet asssembly (forward nose ring, aft inlet ring, and nose cap) are shown in Figures 4 and 5.

The ply angle of the forward nose (-503) ring was checked and found to be of the RSRM design. The flow surface bondline gap between the -503 ring

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and the aft inlet (-504) ring was 0.15 inch. The flow surface bondline gap between the -503 ring and the nose cap was 0.05 inch. These post-fired measurements are typical of past static test and flight nozzles.

The -503 and -504 rings showed smooth erosion with no pockets, wash areas, or wedgeouts. Impact marks occurring after motor operation were observed on both rings intermittently around the circumference (Figures 26 and 27). These marks most likely resulted from the loose aft and forward exit cone CCP material inside the motor at splashdown.

The nose cap showed smooth erosion with no pockets or major washes observed. The aft 2 to 3 inches showed popped-up charred CCP material at 137, 280, 310, and 332 degrees. Typical post-burn wedgeouts on the aft 2 to 3 inches (Figure 28) were noted from 14 to 26, 40 to 93, 110 to 122, 156 to 172, and 248 to 265 degrees. The maximum radial depth was 0.5 inch at the cowl interface. Sharp edges indicate the popped-up material and the wedgeouts occurred after motor operation. No wedgeouts were observed on the forward end of the nose cap.

The aft end of the nose inlet assembly (-504 ring aft end) showed metal to adhesive bondline separations (0.01 inch maximum radial width) occurring intermittently around the circumference. Bondline separations between the EA946 adhesive and the GCP (0.01 inch maximum radial width) were also

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observed. Bondline separations were observed on the aft end of the nose cap between the metal and EA946 adhesive, and the adhesive and GCP intermittently around the circumference. The maximum radial width of these separations was 0.005 inch. One separation, 0.003 inch wide radially, was noted within the adhesive from 26 to 28 degrees. Figure 29 lists the location and radial width measurements of all separations on the nose inlet assembly. These separations are typical observations seen on previous static test and flight nozzles and have been shown to occur post-burn.

Photographs of the sectioned nose inlet assembly rings are presented in Figures 30 through 37. Char and erosion analysis of the sections is presented in Tables 4 and 5. Figure 38 shows the location of the measurement stations. All margins of safety were positive, with a minimum of 0.05 occurring at station 39.5 (180 degrees) for the -503/-504 rings, and 0.04 occurring at station 24 (90 degrees) for the nose cap.

Following the washout of the phenolics, it was found that the aluminum nose inlet housing had extensive corrosion and pitting on all bonding surfaces 360 degrees circumferentially (Figures 39 through 46). This was also found on the STS-26B (RH) nose inlet housing. The cause of this corrosion has been attributed to seawater which enters bondline separations during splashdown and retrieval (Ref. Memo L231-FY89-M130). The metal bonding surfaces were not accessible until phenolic washout at Clearfield Operations. Therefore, corrosion protection was not applied to these

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surfaces until approximately 4 months after flight. This hardware will be inspected during refurbishment for compliance to STW7-3434 (Refurbishment Of And Acceptance Criteria For Space Shuttle SRM Nozzle Metal Hardware).

STS-26A Cowl Ring

Overall views of the STS-26A cowl ring are shown in Figures 6 and 7. Close-up views are shown in Figures 47 through 50. All cowl vent holes appeared plugged with slag on the Outer Diameter (OD) of the ring (see Figure 48).

Typical ridged erosion was observed intermittently around the cowl circumference. The forward portion of the ring eroded a maximum of 0.15 inch greater than on the aft portion of the ring (Figure 47). This is a result of the low ply angle of the cowl ring and has been observed on the majority of flight and static test nozzles. There were no wedgeouts observed on the cowl ring.

There were no bondline separations on the forward end of the cowl ring.

Photographs of the sectioned cowl ring are presented in Figures 51 through 54. Typical subsurface ply lifting was observed intermittently around the circumference along the forward 2 inches of the cowl. The largest ply lift separation was 0.10 inch at 0 degrees (Figure 51). There was no evidence of flow or erosion within the delaminations.

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Char and erosion analysis of the sections is presented in Table 6 (Stations 0 through 7). Figure 55 shows the location of the measurement stations. All margins of safety were positive, with a minimum of 0.19 occurring at station 2 (90 degrees).

STS-26A Outer Boot Ring/Flex boot

Overall views of the STS-26A OBR and flex boot are shown in Figures 6 and 7. Close-up views of the OBR are shown in Figures 47 through 50. The bondline between the OBR and cowl ring remained intact with no indications of flow. The flow surface bondline gap was 0.18 inch and is typical of past static test and flight nozzles.

The structural backup OBR was intact. The flow surfaces showed smooth erosion with no pockets, major washes, or wedgeouts. Delaminations in the charred CCP of the aft tip were observed 360 degrees circumferentially (Figure 56). Charred CCP material on the aft tip adjacent to the flex boot fractured and popped up over a majority of the circumference (Figure 57). A large impact mark was located on the aft end of the OBR at 190 degrees and measured 6 inches circumferentially (Figure 49). This may have been due to the loose CCP material in the motor after splashdown. Sharp edges on the surfaces indicate this occurred after motor operation.

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Photographs of the sectioned OBR are presented in Figures 58 through 61. Char and erosion analysis of the sections is presented in Table 6 (Stations 8 through 12). Figure 55 shows the location of the measurement stations. All margins of safety were positive, with a minimum of 0.58 occurring at station 9 (90 degrees).

The flex boot remained attached to the outer boot ring 360 degrees circumferentially, and showed no bonline separations. The cavity side of the flex boot was evenly sooted and showed no evidence of flow or erosion (Figures 62 through 64). It appeared typical of previous flight and static test motor flex boots. A minimum of 3 NBR plies remained around the circumference after motor burn. Table 7 presents the flex boot material affected depths and performance margins of safety (PMS). The worst case PMS was 0.19 at 280 degrees.

STS-26A Fixed Housing

Overall views of the STS-26A fixed housing assembly are shown in Figures 6 and 7.

The fixed housing insulation erosion was smooth and uniform. Post-burn wedgeouts of charred CCP material were observed on the forward 2 inches intermittently around the circumference (Figure 65). The maximum radial depth of these wedgeouts was 0.5 inch. There was no heat effect to the GCP.

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There were no bondline separations observed on the forward or aft end.

Photographs of the sectioned fixed housing assembly liner are presented in Figures 66 through 69. Char and erosion analysis of the sections is presented in Table 8. Figure 70 shows the location of the measurement stations. All margins of safety were positive, with a minimum of 0.56 occurring at station 11 (0 degrees).

STS-26A Bearing Protector

The bearing protector was sooted along the entire length and circumference (Figures 71 through 73). Slightly heavier soot and erosion was observed in line with the cowl ring vent holes at the thickened portion, but there was no bearing protector burn-through. There was no evidence of heat effect on the Inner Diameter (ID) surface of the bearing protector.

STS-26A Flex Bearing

Examination of the flex bearing revealed no damage, soot, heat effect, or flow indications (see Figures 74 and 75). All rubber pads, metal shims, and end rings appeared to be in nominal condition. Subsequent refurbishment and testing has verified that the flex bearing is acceptable for reuse.

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4.1.2 STS-26A Nozzle Internal Joints

Descriptions of the STS-26A nozzle internal joints follows.

STS-26A Aft Exit Cone-to-Forward Exit Cone (Joint No. 1)

A cross-sectioned view of the STS-26A aft exit cone/forward exit cone field joint is presented in Figure 76. Photographs of the post-flight joint are shown in Figures 77 through 82.

The backfilled RTV extended below the joint char line circumferentially except at the 266.2-degree location. RTV filled the radial ID portion of the joint except at 236.2, 266.2, 292.8, and 296.6 degrees where unfilled void areas were located. The backfill also reached the high pressure side of the primary 0-ring from 38 to 185, and 314.4 to 356.2 degrees. One blowpath 0.10 inch wide circumferentially was observed at the 266.2 degrees unfilled void area. The primary 0-ring saw pressure, but showed no signs of blowby, erosion, or heat effect.

Examination of the joint showed a black residue and aluminum oxide corrosion appearing on both metal surfaces of the joint between the primary and secondary O-rings, and outboard of the secondary O-ring intermittently around the circumference. The black residue was heaviest from 131 to 270 to 0 degrees (Figure 83). The aluminum oxide corrosion was heaviest from 0

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to 90 to 131 degrees (Figure 84). There was no pitting observed. It has been determined that the black residue is the beginning stage of the aluminum oxide corrosion.

The aft flange of the forward exit cone was scratched at the 90-degree location by a guide pin during aft exit cone demate (Figure 85). The scratch was approximately 0.002 inch deep axially, 3.5 inches long circumferentially and 0.375 inch wide radially.

STS-26A Throat-to-Forward Exit Cone (Joint No. 4)

A cross-sectioned view of the STS-26A throat/forward exit cone joint is presented in Figure 86. Photographs of the post-flight joint are shown in Figures 87 through 92.

The RTV backfill extended below the joint char line and filled the axial portion of the joint 360 degrees circumferentially. RTV reached the high pressure side of the primary O-ring from 65 to 125, 195 to 210, and 312 to 350 degrees. One blow path measuring 1.0 inch circumferentially was found at 310 degrees on the radial OD portion of the joint (Figure 93). The GCP was sooted at this location, but not heat affected. The primary O-ring saw pressure, but there was no evidence of blowby, erosion, or heat effect. Soot was not evident on the radial ID or the axial portions of the joint.

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It is believed that the blow path extended cohesively through the RTV at this location. White deposits, possibly salt, were found on the phenolic radial ID portion of the joint intermittently around the circumference.

Corrosion was evident on both metal surfaces of the joint, extending from 25 to 125, and 190 to 330 degrees on the throat and 360 degrees circumferentially on the forward exit cone. There was no pitting observed on the metal surfaces.

STS-26A Nose Inlet-to-Throat (Joint No. 3)

A cross-sectioned view of the STS-26A nose inlet/throat joint is presented in Figure 94. Photographs of the post-flight joint are shown in Figures 95 through 100.

The RTV backfill extended below the joint char line 360 degrees circumferentially. RTV completely filled the radial ID portion of the joint circumferentially except from 309 to 313 degrees. RTV also extended onto the radial OD from 52 to 70, 146 to 149, 163 to 171, 174 to 190, 195 to 197, and 210 to 220 degrees, but did not reach the primary 0-ring. One blow path measuring 0.9 inch wide circumferentially and 1.2 inches deep radially was observed at 136 degrees (Figures 101 and 102). The blow path terminated within the RTV. The primary 0-ring did not see pressure.

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Aluminum oxide corrosion was observed on both metal surfaces of the joint inboard of the primary O-ring, but no pitting was observed. Rust was found within the metal/adhesive separations on the forward end of the throat support housing intermittently around the circumference.

Minor surface scratches were observed on the aft end of the nose inlet housing (-504 ring aft end) where jacking screws were used to disassemble the joint.

STS-26A Nose Inlet-to-Bearing Forward End Ring-to-Cowl (Joint No. 2)

A cross-sectioned view of the STS-26A nose inlet/forward end ring/cowl joint is presented in Figure 103. Photographs of the post-flight joint are shown in Figures 104 through 112.

The RTV extended below the joint char line and filled the axial portion of the joint 360 degrees circumferentially. The radial bondline between the nose cap and cowl showed RTV mixed with the EA913 NA adhesive 360 degrees circumferentially. The adhesive was typically sandwiched between two layers of RTV. There was no RTV extending to the primary O-ring. One blow path was observed at 216 degrees. On the aft end of the nose cap, the blow path measured 0.60 inch wide circumferentially and charred the GCP approximately 0.005 inch deep axially. On the forward end of the cowl ring, the blow path measured 0.40 inch wide circumferentially and charred

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the silica cloth phenolic (SCP) approximately 0.01 inch deep axially (Figure 113). The EA913 NA adhesive on the cowl eroded approximately 0.1 inch deep axially (maximum) by 0.7 inch wide circumferentially at the blow path location. Soot was observed on the nose cap/forward end ring interface surfaces, reaching the primary 0-ring from 156 to 162, and 180 to 240 degrees (Figure 112). There was no blowby, erosion, or heat effect to the primary 0-ring. Soot also extended to midway between the bolt holes around the remainder of the circumference.

Both the nose inlet housing and the cowl housing metal surfaces were heavily sooted at the blow path location. Electrical conductivity tests run on these parts showed that there was no heat damage. The bearing forward end ring was also sooted, and the paint was chipped off in various spots, but neither the end ring or the paint were heat affected.

Water was found on the nose housing aft face and in the bolt holes from 12 to 198 degrees. Aluminum oxide corrosion was observed on the forward face of the cowl housing from 214 to 224 degrees and extended approximately 0.5 inch radially inward. Corrosion and salt deposits were also found on the 360 degrees flange forward housing the cowl of surface ID This indicates water leaked between the cowl housing circumferentially. and bearing protector during splashdown.

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STS-26A Fixed Housing-to-Bearing Aft End Ring (Joint No. 5)

A cross-sectioned view of the STS-26A aft end ring/fixed housing joint is presented in Figure 114. Photographs of the post-flight joint are shown in Figures 115 through 121.

RTV filled approximately 80 percent of the axial portion of the joint and reached the high pressure side of the primary 0-ring at 25 to 30, 35 to 43, 55, 65 to 78, 240, and 308 to 313 degrees. Voids isolated within the RTV were observed on the radial portion of the joint intermittently around the circumference (Figure 121). The largest measured 0.9 inch deep radially by 1.7 inches wide circumferentially. None of the voids extended to the flex boot cavity. There were no blow paths observed in the joint.

Water was found on the aft face of the aft end ring and in the bolt holes intermittently around the circumference. Rust corrosion was observed on both metal surfaces of the joint between the O-rings at 15 degrees (Figure 122), but there was no pitting. Rust corrosion was found on the aft end ring inboard of the secondary O-ring intermittently around the circumference. Again, no pitting was observed. A white corrosion spot (0.10 inch in diameter) located at 260 degrees was also noted (Figure 123).

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4.2 STS-26B Nozzle/Flex Bearing

Overall erosion of the STS-26B forward nozzle assembly CCP ablative liner was smooth and uniform. All CCP delaminations, wedgeouts, and pop-ups were determined to be post-burn occurrences resulting from cooldown of the liners. Blowpaths were observed in joints 2 and 4, but there was no blowby, erosion, or heat effect to the primary O-rings. Small amounts of corrosion were found on the metal surfaces of joints 1, 2, 3, and 4, but no pitting was observed. Heavy corrosion and pitting was found on the nose inlet housing bonding surfaces when the phenolics were washed off. The forward exit cone also showed corrosion on the ID bonding surface.

Post-flight subassembly flow surface gaps are shown in Figure 124. Overall views of the nozzle are shown in Figures 125 through 130.

4.2.1 STS-26B Nozzle Components

STS-26B Aft Exit Cone Assembly

An overall view of the STS-26B aft exit cone fragment is shown in Figure 131.

The aft exit cone was severed aft of the compliance ring by the LSC. The nozzle severance system performance was nominal. The exit cone cut was clean, with no unusual tearing or breaking. The remaining aft exit cone

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fragment showed missing CCP liner 360 degrees circumferentially. This is a typical post-flight observation and occurs at LSC firing and during splashdown. GCP plies exposed by the missing liner showed no signs of heat effect.

The polysulfide groove fill on the forward end of the aft exit cone showed one separation between the polysulfide and the GCP insulator. The separation was located at 211 degrees and measured 0.02 inch wide radially, 0.04 inch deep axially and 1.3 inches long circumferentially. Post-flight measurements of the polysulfide groove radial width (Table 9) show that the GCP insulator did not pull away from the aluminum shell during cooldown. The polysulfide shrank axially aft up to 0.10 inch.

There were no separations observed within the GCP insulator on the forward end.

STS-26B Forward Exit Cone Assembly

Overall views of the STS-26B forward exit cone are shown in Figures 129 and 130.

The forward exit cone showed missing CCP liner over the center 14 inches of the cone 360 degrees circumferentially. This is a typical post-flight observation and occurs at splashdown and during Diver Operated Plug (DOP) insertion. The GCP insulator exposed by the missing liner showed no signs

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of heat effect. The CCP liner remained bonded on the forward 11 inches and on the aft 9 inches of the cone. These portions showed nominal erosion with no major washing or pocketing. The aft 9 inches of the liner showed the typical dimpled erosion pattern that has occurred on all flight and static test forward exit cones (Figure 132). The maximum radial depth of the dimpled erosion was 0.15 inch.

The aft end of the forward exit cone showed no bondline or cohesive separations. Bondline separations on the forward end of the forward exit cone were noted between the steel shell and the EA946 adhesive circumferentially except at 105 degrees. Separations were also found between the GCP and CCP, within the GCP, and within the adhesive. Figure 133 lists the location and radial width measurements of all separations on the forward exit cone. These separations are typical observations seen on previous static test and flight nozzles and have been shown to occur post-burn.

Photographs of the sectioned forward exit cone liner are presented in Figures 134 through 137. Char and erosion analysis of the sections is presented in Table 10. Figure 18 shows the location of the measurement stations. All margins of safety were positive, with a minimum of 0.05 occurring at station 1 (0 and 180 degrees), and station 8 (270 degrees).

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Following washout of the phenolics, large areas of corrosion were noted along the forward 5 to 12 inches of the ID bonding surface (Figures 138 and This "band" of corrosion appeared aft of the forward shear pins. 139). Light and dark colored areas of corrosion as well as rust spots and pitting were observed. Corroded areas were also found on the aft 7 inches of the ID bonding surface centered around the aft shear pin holes (Figures 140 through 144). The largest area was at 120 degrees (Figure 142). Visual inspections of these indicate that sea water may have leaked through the shear pin holes where the lightning cables were attached (every 30 Light and dark areas of corrosion, rust spots, and pitting were degrees). Small rust spots were also noted intermittently around the rest observed. of the ID surface (Figure 142). These were typically 0.050 to 0.10 inches in diameter. This hardware will be inspected during refurbishment for compliance to STW7-3434 (Refurbishment Of And Acceptance Criteria For Space Shuttle SRM Nozzle Metal Hardware).

STS-26B Throat Assembly

Overall views of the STS-26B throat assembly (throat ring and throat inlet ring) are shown in Figures 125 and 126.

The throat post-flight mean diameter was 55.876 inches (erosion rate of 8.18 mils/second based on an action time of 123.2 seconds). Nozzle post-burn throat diameters have ranged from 55.787 to 56.38 inches. The

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flow surface bondline gap between the throat and throat inlet rings was 0.10 inch and is typical of past static test and flight nozzles.

The throat and throat inlet rings eroded smoothly with no pockets or major washes observed. The forward end of the throat inlet ring showed post-burn wedgeouts of charred CCP material from 28 to 40, 95 to 105 and 355 to 0 to 5 degrees (Figure 145). The maximum axial width of the wedgeouts was 0.75 inch at the 28-to-40-degree location. Post-burn wedgeouts of the throat inlet ring forward end have been observed on previous post-flight nozzles. The forward 1.5 inches of the throat ring showed popped-up charred CCP material intermittently around the circumference. Sharp edges indicate the popped-up material occurred after motor operation. Marks resulting from DOP insertion were observed on the throat ring intermittently around the circumference.

Bondline separations on the aft end of the throat ring between the EA913 NA adhesive and the steel throat support housing were observed around the majority of the circumference. Separations were also found between the adhesive and GCP, within the GCP, and within the adhesive. There were no separations between the GCP and CCP on the aft end. The forward end of the throat inlet ring showed metal to adhesive bondline separations circumferentially except from 255 to 0 degrees. Separations were also observed between the GCP and CCP. Figure 146 lists the location and radial width measurements of all separations on the throat assembly. These

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separations are typical observations seen on previous static test and flight nozzles and have been shown to occur post-burn.

Photographs of the sectioned throat assembly liner are presented in Figures 147 through 149. Char and erosion analysis of the sections is presented in Table 11. Figure 25 shows the location of the measurement stations. All margins of safety were positive, with a minimum of 0.07 occurring at station 8 (180 degrees).

STS-26B Nose Inlet Assembly

Overall views of the STS-26B nose inlet assembly (forward nose ring, aft inlet ring, and nose cap) are shown in Figures 125 through 128.

The ply angle of the forward nose ring was checked and found to be of the RSRM design. The flow surface bondline gap between the forward nose (-503) ring and the aft inlet (-504) ring was 0.18 inch. The flow surface bondline gap between the -503 ring and nose cap was 0.05 inch. These post-fired measurements are typical of past static test and flight nozzles.

The -503 and -504 rings showed smooth erosion with no pockets or major washes observed. The -503 ring showed popped-up charred CCP material at the nose cap interface from 155 to 165 degrees. The popped-up material was 0.08 inch wide axially and occurred after motor operation. Impact marks

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occurring after motor operation were observed on both rings intermittently around the circumference (Figures 150 and 151). The marks most likely resulted from the loose aft and forward exit cone CCP material in the motor at splashdown.

The nose cap showed smooth erosion with no pockets or major washes observed. The aft 2.0 to 3.5 inches of the nose cap showed typical post-burn wedgeouts intermittently around the circumference (Figure 152). These measured approximately 0.5 in. deep radially at the cowl interface. One wedgeout location from 5 to 20 degrees showed slag covering exposed CCP material. Sectioning of the liner determined that this wedgeout occurred post-burn.

The aft end of the nose inlet assembly (-504 ring aft end) showed metal to adhesive bondline separations measuring 0.02 inch wide radially from 238 to 245 degrees, and at 250 degrees. There were no cohesive separations or separations at the adhesive/GCP and GCP/CCP interfaces. Bondline separations were observed on the aft end of the nose cap between the metal and EA946 adhesive at 105, 135 to 255, 285 to 315, and 345 degrees. These separations were typically 0.005 inch wide radially. There were no cohesive separations or separations at the adhesive/GCP and GCP/CCP interfaces. Figure 153 lists the location and radial width measurements of all separations on the nose inlet assembly. These separations are typical observations seen on previous static test and flight nozzles, and have been shown to occur post-burn.

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Photographs of the sectioned nose inlet assembly rings are presented in Figures 154 through 161. Char and erosion analysis of the sections is presented in Tables 12 and 13. Figure 38 shows the location of the measurement stations. All margins of safety were positive, with a minimum of 0.01 occurring at station 32 (180 degrees) for the -503/-504 rings, and 0.01 occurring at station 24 (225 degrees) for the nose cap.

Following the washout of the phenolics, it was found that the aluminum nose inlet housing had extensive corrosion and pitting on all bonding surfaces 360 degrees circumferentially (Figures 162 through 167). Most of the corrosion on the nose cap bonding surface was found on the aft 5 inches 360 degrees circumferentially. The forward edge of this corrosion was shaped in a "saw tooth" pattern (Figure 166). The leading edge of the nose inlet housing showed areas of pitting approximately 0.04 to 0.05 inch deep (Figure 168). The entire -503 ring bonding surface was heavily corroded and pitted 360 degrees circumferentially, and approximately 90 percent of the -504 ring bonding surface showed various stages of corrosion and This corrosion has been attributed to seawater which enters pitting. during splashdown and retrieval (Ref. Memo bondline separations L231-FY89-M130). The metal bonding surfaces were not accessible until phenolic washout at Clearfield Operations. Therefore, corrosion protection was not applied to these surfaces until approximately 4 months after This hardware will be inspected during refurbishment for flight. compliance to STW7-3434 (Refurbishment Of And Acceptance Criteria For Space Shuttle SRM Nozzle Metal Hardware).

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STS-26B Cowl Ring

Overall views of the STS-26B cowl ring are shown in Figures 127 and 128. Close-up views are shown in Figures 169 through 171. All cowl vent holes appeared plugged with slag on the OD of the ring (Figure 172).

The cowl ring showed typical ridged erosion intermittently around the part circumference. The forward portion of the ring eroded a maximum of 0.15 inch greater than the aft portion (Figure 169). This is a result of the low ply angle of the cowl ring and has been observed on the majority of flight and static test nozzles. One wedgeout was observed on the aft 3.5 inches of the cowl ring from 120 to 137 degrees (Figure 173). The maximum radial depth of the wedgeout was 0.6 inch at the outer boot ring interface. Slag coated the exposed CCP material at the wedgeout location. Sectioning of the liner determined that this wedgeout occurred post-burn.

There were no bondline separations on the forward end of the cowl ring.

Photographs of the sectioned cowl ring are presented in Figures 174 through 177. Typical subsurface ply lifting was observed intermittently around the circumference along the length of the cowl. The largest ply lift separation was 0.20 inch at 270 degrees (Figure 177). There was no evidence of flow or erosion within the delaminations. Char and erosion analysis of the sections is presented in Table 14 (Stations 0 through 7).

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Figure 55 shows the location of the measurement stations. All margins of safety were positive, with a minimum of 0.04 occurring at station 0 (45 degrees).

STS-26B Outer Boot Ring/Flex Boot

Overall views of the STS-26B outer boot ring are shown in Figures 127 and 128. Close-up views are shown in Figures 169 through 171. The bondline between the outer boot ring and cowl ring remained intact with no indications of flow. The flow surface bondline gap was 0.20 inch and is typical of past static test and flight nozzles.

The structural backup outer boot ring was intact. The flow surfaces showed smooth erosion with no pockets, wedgeouts, or major washes. Minor wash areas extended from the cowl to the forward 1.5 inches of the OBR from 120 to 150, and 151 to 158 degrees, and measured a maximum of 0.2 inch radially deep. These have occurred on the majority of flight and static test nozzles. Popped-up charred CCP material was observed on the forward 1.8 inches of the OBR intermittently around the circumference. The popped-up material is a common observation and occurs after motor operation. Delaminations in the charred CCP of the aft tip were observed 360 degrees circumferentially (Figure 178). Charred CCP material on the aft tip adjacent to the flex boot fractured and popped up over a majority of the circumference.

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Photographs of the sectioned outer boot ring are presented in Figures 179 through 182. Char and erosion analysis of the sections is presented in Table 14 (Stations 8 through 11.3). Figure 55 shows the location of the measurement stations. All margins of safety were positive, with a minimum of 0.59 occurring at station 10 (0 degrees).

The cavity side of the flex boot was evenly sooted and showed no evidence of flow or erosion (Figures 183 through 185). It appeared typical of previous flight and static test motor flex boots. A minimum of 3.0 NBR plies remained around the circumference after motor burn. Table 15 presents the flex boot material affected depths and Performance Margins of Safety. The worst case PMS was 0.19 at 280 degrees.

STS-26B Fixed Housing Assembly

Overall views of the STS-26B fixed housing assembly are shown in Figures 127 and 128.

The fixed housing insulation showed smooth erosion with no pockets or major washing observed. Post-burn wedgeouts of charred CCP material were observed on the forward 2.0 inches of the fixed housing insulation from 30 to 65, 135 to 145, and 165 to 180 degrees. The wedgeouts were a maximum of 0.5 inch deep radially. There was no heat effect to the GCP.

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There were no bondline separations observed on the forward or aft end.

Photographs of the sectioned fixed housing assembly liner are presented in Figures 186 through 189. Char and erosion analysis of the sections is presented in Table 16. Figure 70 shows the location of the measurement stations. All margins of safety were positive, with a minimum of 0.54 occurring at station 3 (270 degrees).

STS-26B Bearing Protector

The bearing protector was sooted along the entire length and circumference (Figures 190 through 192). Heavier soot and erosion were observed in line with the cowl ring vent holes at the thickened portion of the bearing protector. Erosion depths at the vent hole locations are presented in Table 17. There was no evidence of heat effect on the ID surface of the bearing protector.

STS-26B Flex Bearing

Examination of the flex bearing revealed no damage, soot, heat effect, or flow indications (Figure 193). All rubber pads, metal shims, and end rings appeared to be in nominal condition. Subsequent rerfurbishment and testing has verified that the flex bearing is acceptable for reuse.

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4.2.2 STS-26B Nozzle Internal Joints

Descriptions of the STS-26B nozzle internal joints follows.

STS-26B Aft Exit Cone-to-Forward Exit Cone (Joint No. 1)

A cross-sectioned view of the STS-26B aft exit cone-to-forward exit cone field joint is presented in Figure 194. Photographs of the post-flight joint are shown in Figures 195 through 200.

The backfilled RTV extended below the joint char line 360 degrees circumferentially. RTV filled the radial ID portion of the joint except at 103 degrees where an unfilled void area approximately 1.0 inch wide circumferentially was located. The backfill also extended to the high pressure side of the primary 0-ring from 0 to 81, 82 to 101, 103 to 123, 154 to 178, 182 to 237, 243 to 251, 258 to 265, and 268 to 0 degrees. There were no blowpaths observed in the joint and the primary 0-ring saw no pressure. Char was observed on the RTV in the axial portion of the joint at 237 degrees. The RTV was not eroded or heat affected at the charred location. It is believed that the char penetrated the joint at splashdown.

Examination of the joint showed a black residue and aluminum oxide corrosion appearing on both metal surfaces between the primary and secondary O-rings, and outboard of the secondary O-ring intermittently

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around the circumference (Figure 201). The aluminum oxide corrosion was heaviest from 112.6 to 143.2 degrees. There was no pitting observed. It was determined that the black residue is the beginning stage of the aluminum oxide corrosion.

One through hole on the forward exit cone housing aft flange was dinged by a guide pin during the aft exit cone demate. The ding was approximately 0.02 inch deep and was located at 95.6 degrees (Figure 202).

STS-26B Throat-to-Forward Exit Cone (Joint No. 4)

A cross-sectioned view of the STS-26B throat-to-forward exit cone joint is presented in Figure 203. Photographs of the post-flight joint are shown in Figures 204 through 209.

The RTV backfill extended below the joint char line and filled the radial ID portion of the joint circumferentially, except at 185 degrees. RTV filled the axial portion of the bondline from 40 to 165 degrees, and 240 to 345 degrees. RTV did not reach the high-pressure side of the primary 0-ring. One blow path measuring 0.25 inch circumferentially was found at 185 deg. Excess grease at this location inhibited the RTV backfill, resulting in an unfilled void area. The primary 0-ring saw pressure, but ther was no evidence of blowby, erosion, or heat effect. The GCP also showed no signs of heat effect.

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Rust corrosion was observed on both surfaces of the joint within the metal housing/adhesive bondline separations intermittently around the circumference. Black corrosion was observed near the primary sealing surface of the throat housing aft end from 80 to 85 degrees, and 345 to 0 to 4 degrees. There was no pitting on the metal surfaces.

STS-26B Nose Inlet-to-Throat (Joint No. 3)

A cross-sectioned view of the STS-26B nose inlet-to-throat joint is presented in Figure 210. Photographs of the post-flight joint are shown in Figures 211 through 216.

The RTV backfill extended below the joint char line 360 degrees circumferentially. RTV filled the radial ID portion of the joint circumferentially except at 50 degrees. RTV also extended onto the radial OD up to the GCP/CCP interface at 35, 275, and 325 degrees. An unfilled void area, 1.0 inch circumferentially, was located at 50 degrees. There was no blow path to the void area. The primary 0-ring did not see pressure. Grease was observed on both sides of the joint 360 degrees circumferentially extending 0.1 to 1.0 inch inboard of the primary 0-ring.

Minor surface corrosion was observed on the aft end of the nose inlet housing inboard of the primary O-ring, but no pitting was observed. This aluminum oxide corrosion extended approximately half way down the ID side

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of the primary O-ring groove at 325 degrees. There was no corrosion on the forward end of the throat housing.

STS-26B Nose Inlet-to-Bearing Forward End Ring-to-Cowl (Joint No. 2)

A cross-sectioned view of the STS-26B nose inlet-to-bearing forward end ring-to-cowl joint is presented in Figure 217. Photographs of the post-flight joint are shown in Figures 218 through 226.

The RTV extended below the joint char line and filled the axial portion of the joint 360 degrees circumferentially. The radial bondline between the nose cap and cowl showed RTV mixed with the EA913 NA adhesive intermittently around the circumference. The adhesive was typically sandwiched between two layers of RTV. RTV filled approximately 80 percent of the axial bondline between the nose cap and bearing forward end ring. No RTV extended to the primary O-ring. One blow path was observed at 266 degrees and measured 0.5 inch wide circumferentially (Figure 227). The cowl SCP and nose cap GCP insulators showed no heat effect. The primary O-ring saw pressure, but there was no evidence of blowby, erosion, or heat Soot was observed on the radial OD of the joint 360 degrees effect. circumferentially. Soot reached up to the axial bolt holes on the nose inlet housing intermittently around the circumference, but did not reach the primary O-ring. Salt deposits were also noted on the radial OD surfaces.

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Both the aft face of the forward end ring flange and the forward face of the cowl housing were sooted at 130 to 153, 165, 255, and 303 to 310 degrees, but were not heat effected. The paint on the forward end ring OD flange surface was chipped off in various spots, but was not heat affected. Minor rust spots were noted in areas where the paint was chipped off. Aluminum oxide corrosion was observed on the forward end ring/nose inlet housing interface surfaces, and on the cowl housing/forward end ring interface surfaces intermittently around the circumference. Aluminum oxide corrosion was also found intermittently on the forward flange ID surface of the cowl housing (Figure 228).

STS-26B Fixed Housing-to-Bearing Aft End Ring (Joint No. 5)

A cross-sectioned view of the STS-26B aft exit cone/forward exit cone field joint is presented in Figure 229. Photographs of the post-flight joint are shown in Figures 230 through 235.

RTV filled approximately 75 percent of the axial portion of the joint and reached the high pressure side of the primary 0-ring from 75 to 110, 123 to 128, 135 to 148, and 195 to 218 degrees. Voids isolated within the RTV were observed on the radial portion of the joint intermittently around the circumference. The largest measured 0.45 inch deep radially by 0.30 inch wide circumferentially. A void at 171 degrees extended onto the axial portion of the joint, but terminated within the RTV. There were no blow paths observed in the joint, and the primary 0-ring did not see pressure.

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Rust corrosion was found on the aft end ring inboard of the secondary O-ring intermittently around the circumference. No pitting was observed.

4.3 Instrumentation

There was no instrumentation installed on the STS-26 nozzles.

5.0 DISCREPANCY REPORTS AND PROCESS DEPARTURES

The STS-26 Nozzle DRs and PDs reviewed by the Morton Thiokol senior material review board are included in Appendix A. These were presented in the STS-26 RSRM Acceptance Review Level III (TWR-18117A). Brief descriptions of the DRs and PDs, and correlations to post-flight observations are discussed below.

5.1 STS-26A DRs and PDs

Aft Exit Cone

DR 123524-01 (Waiver No. RWW 404)

LDIs within the GCP were found at 240 degrees, 54 inches aft of the forward end. This portion of the aft exit cone was severed by the LSC during reentry and was not recovered. Post-flight inspection of this part was not possible.

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DR 162635-01, -02 (Waiver No. RWW 405)

LDIs within the GCP were found at 222 degrees (39.5 inches aft of the compliance ring), and 240 and 243 degrees (4 inches aft of the compliance ring). This portion of the aft exit cone was severed by the LSC during reentry and was not recovered. Post-flight inspection of this part was not possible.

Forward Exit Cone

DR 151717-01 (Waiver No. RWW 387)

Eight LDIs within the GCP were found running 360 degrees circumferentially along a full ply length. Post-flight inspection of the exposed GCP did not reveal any delaminations extending to the surface.

PD 150663-01

The white stripe (90-degree mark) on the phenolic liner was 1.75 inches from the 90-degree reference pin (0.75 inch over maximum). The liner was bonded at the same radial location as the dry fit. Orientation to correlate post-flight performance with any pre-flight anomalies was not affected.

Throat Assembly

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DR 128578-01

Intermittent pitting, a maximum of 0.002 inch deep, was found on the aft sealing surface. After being repaired, the joint was succesfully leak tested. Post-flight inspection did not reveal any indications of blow-by.

Nose Inlet Assembly

DR 152142-01

Phosphoric Acid Anodization (PAA) and EA9228 Primer applied to the bonding surfaces was not uniform (dark streaks and spots). The PAA and primer system was deleted from the engineering design change. This part was grit blasted and the phenolics bonded using 51-L surface preparation techniques. All of the phenolics were intact and remained bonded to the housing.

PD 150024-01

The EA946 adhesive for the nose cap bond was not applied within 6 hours from the grit blast requirement. This was reworked to blueprint requirements. No post-flight anomamlies were noted.

PD 150024-02

The EA946 adhesive for the nose cap bond was not applied within 1 hour from methylchloroform wipe. This was reworked to blueprint requirements. No post-flight anomamlies were noted.

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Cowl Assembly

DR 126842-01

Intermittent pitting was found on the cowl housing (worst-case condition was 0.180 inch in diameter by 0.039 inch deep on the ID flange. The pits were honed out to remove sharp edges. No post-flight anomalies were noted.

Flex Bearing

DR 123208-01

One threaded hole (0.190-32 UNF) on the aft end ring accepted the no-go threaded plug gage for 6.5 turns. Proper bolt torque was verified and showed no damage. Post-flight inspection showed damage to the bolt hole.

DR 123439-01

The unbond area on pad 11 exceeded the maximum allowable of 9 in². The flex bearing passed all of the acceptance tests and post-flight refurbishment requirements.

5.2 STS-26B DRs and PDs

Nozzle/Aft Segment Assembly

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DR 153960-01

A broken girth gage wire was found between the aft dome boss and nozzle assembly. This did not affect O-ring gap openings. The joint successfully passed leak check. Post-flight inspection showed no anomalies as a result of this condition.

Aft Exit Cone

DR 123533-01, (Waiver No. RWW 406)

An LDI measuring 2.35 inches circumferentially, 1.2 inches axially, and 0.031 inch radially was found in the GCP 0.393 inch from the forward end at 45 degrees. Post-flight inspection of the GCP after sectioning (Figure 236) did not reveal any delaminations.

Throat/Nose Inlet Joint Assembly

DR 150682-01, -02

The primary to secondary seal cavity was pressurized to 1040 psig during high pressure leak check (the requirement is 740 ± 15 psig), and 40 psig during low pressure leak check (the requirement is 30 ± 3 psig). The joint passed leak check, and no anomalies were observed during post-flight inspection.

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Nose Inlet Assembly

PD 149145-01

This involved the forward first wrap of the nose ring during the carbon hydroclave cure. While decreasing pressure, the pressure dropped to 168 psig for 4 minutes, then remained in tolerance during the remainder of the cure. The CCP liner met all acceptance criteria. There were no anomalies observed during post-flight inspection.

Cowl Assembly

DR 128474-01

Pitting was observed on the OD and ID surfaces of the cowl housing. Maximum depths were 0.049 inch on the ID side, and 0.041 inch on the OD side. These were blended out to remove sharp edges. Post-flight inspection has not revealed any anomalies.

Flex Bearing

DR 123437-01

One threaded hole (0.750-16 UNF) on the aft end ring accepted the no-go threaded plug gage for eight turns. A helical coil insert was used as a standard repair. There was no damage noted during post-flight inspection. The repair did not affect the flex bearing performance.

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Bearing Protector

PD 127767-01

This involved the GCP autoclave cure for the bearing protector inner ring. The autoclave vacuum dropped below the minimum of 15 in. Hg for a total of 177 minutes. The inner ring met all acceptance tests, and the bearing protector assembly using this ring passed strength tests. There were no anomalies observed during post-flight inspection.

6.0 NOZZLE COMPONENT PROGRAM TEAM (NCPT) RECOMMENDATIONS AND REDESIGN PROGRAM REVIEW BOARD (RPRB) ASSESSMENT

The NCPT reviewed all observations documented in this report. The team classified five Problem Reports (written at KSC) as minor anomalies. After internal nozzle joint inspections at Clearfield, the team initially classified five observations as potential anomalies. Three of these were further classified as minor anomalies, and the other two remained observations. These were presented to the RPRB on 9 and 11 November, 1988. The RPRB agreed with all the classifications. These minor anomalies were recorded on Post-Fire Anomaly Record (PFAR) forms and are included in Appendix B. The PFARs contain detailed descriptions and corrective actions as accepted and/or modified by the RPRB. A listing of the PFARs is listed below.

6.1 STS-26A Nozzle

PFAR NUMBER	DESCRIPTION
	Corrosion on aft exit cone metal between primary and secondary O-rings.

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360L001A-12	Corrosion on forward exit cone metal between primary and secondary aft exit cone O-rings.
360L001A-43	RTV and EA913 NA adhesive mixing in joint 2.
6.2 STS-26B Nozzle	
PFAR NUMBER	DESCRIPTION
360L001B-10	Corrosion on aft exit cone metal between primary and secondary O-rings.
360L001B-38	Ding on forward exit cone aft flange.
360L001B-42	Corrosion on forward exit cone metal between primary and secondary aft exit cone O-rings.
360L001B-44	RTV backfill in joint 4 inhibited by excessive grease.
360L001B-45	RTV and EA913 NA adhesive mixing in joint 2.

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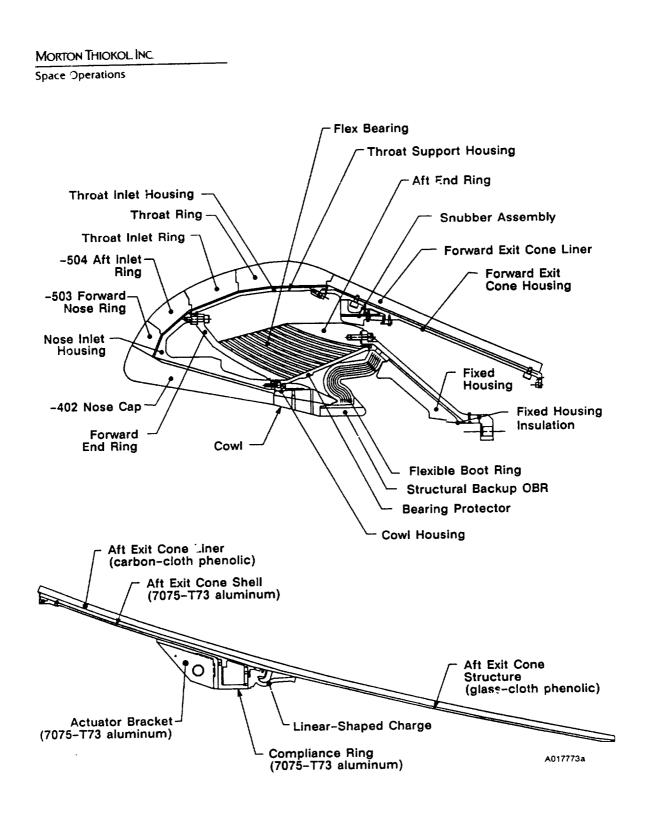
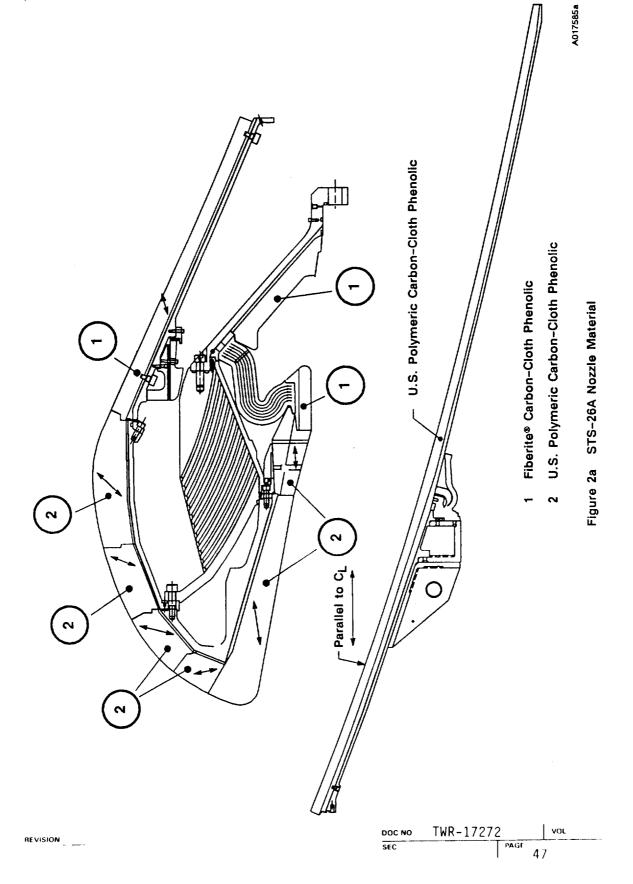


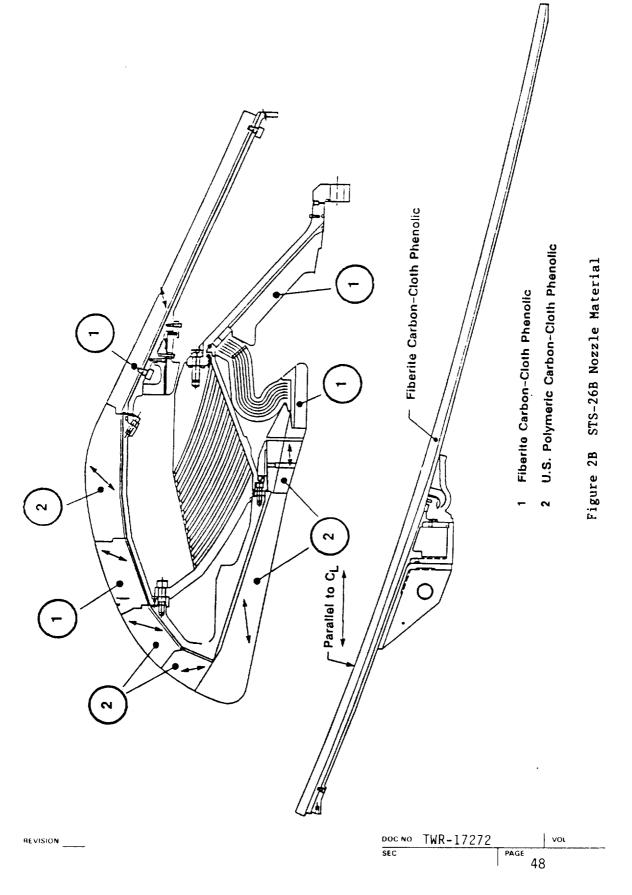
Figure 1 STS-26 Nozzle Components

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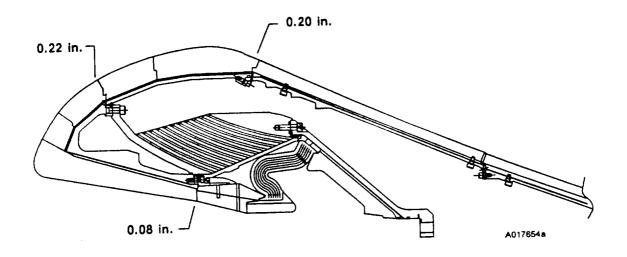


Figure 3 STS-26A Joint Flow Surface Gap Openings

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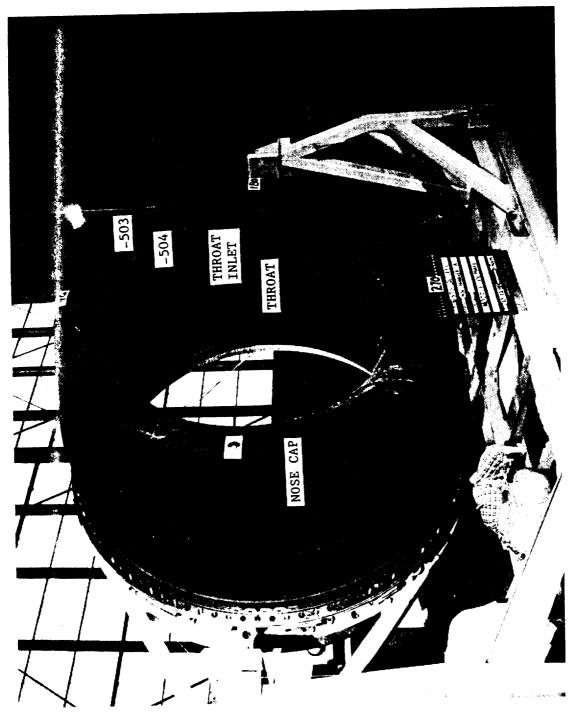
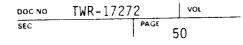


Figure 4 STS-26A Forward Nozzle Assembly

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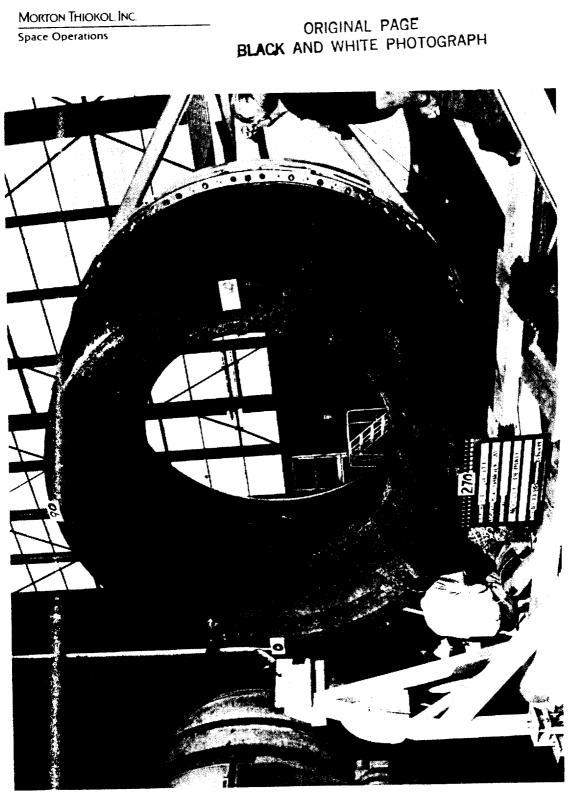
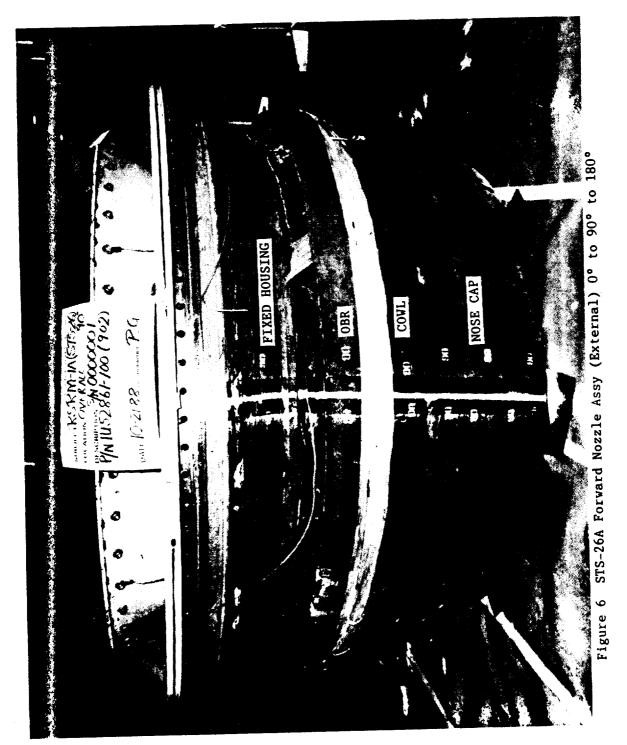


Figure 5 STS-26A Forward Nozzle Assembly

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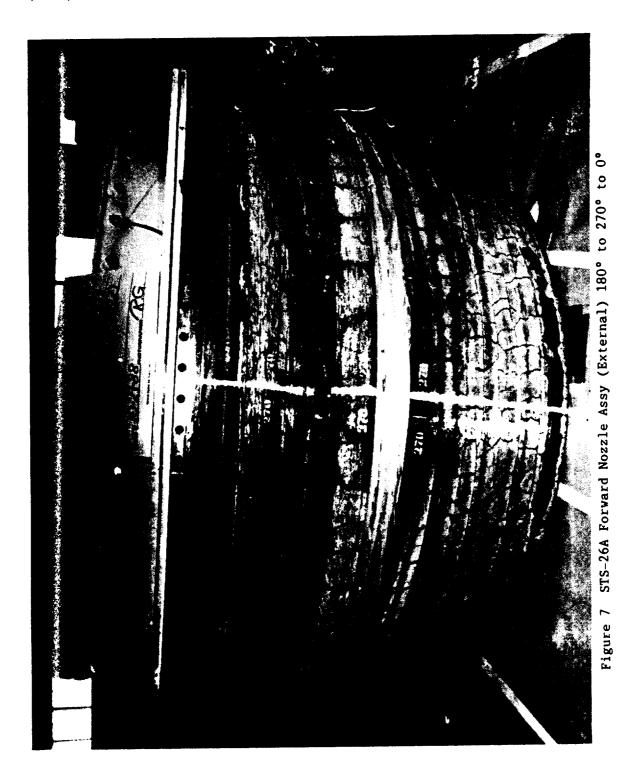


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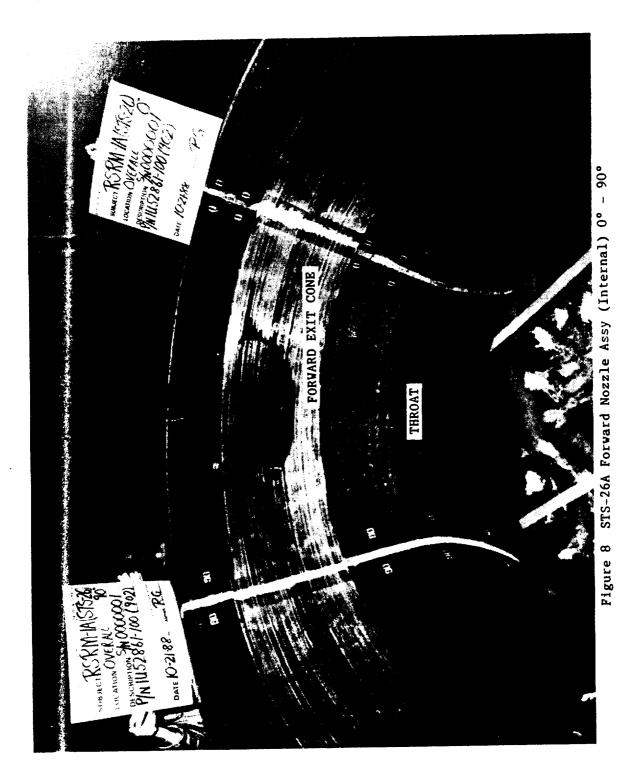
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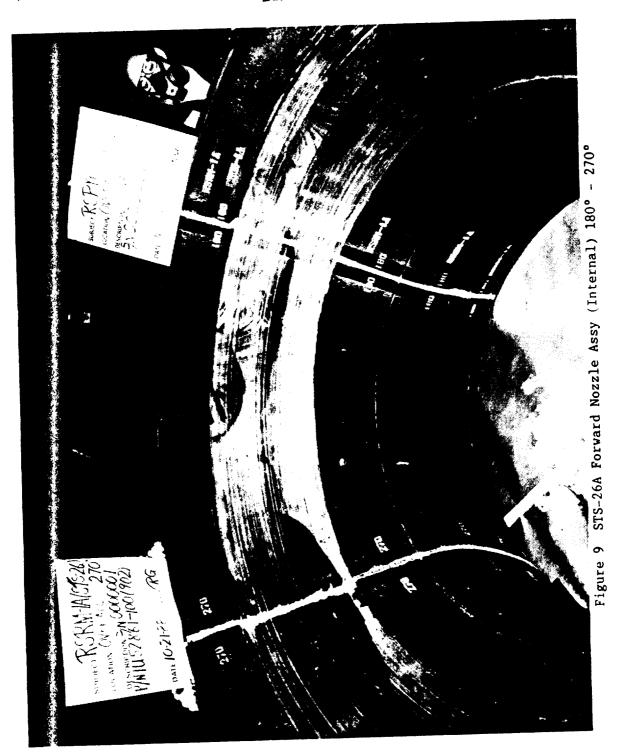
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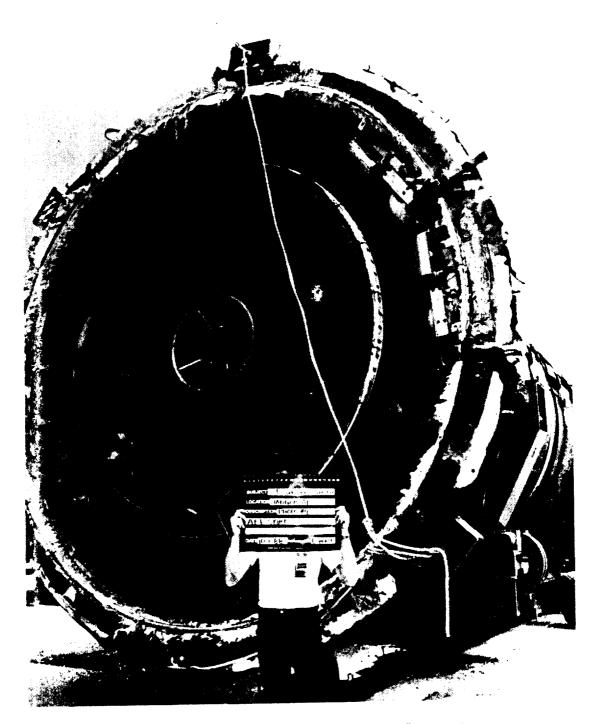


Figure 10 STS-26A Aft Exit Cone Fragment

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	Nominal Preflight Radial Groove Width	Carbon-Cloth Phenolic (completely missing) Aft Exit Cone Assembly 0.20 in. Polysulfide Groove Fill EA 946
Angular		
Location	Width	Glass-
_(de ç)	<u>(in.)</u>	Cloth
	0.40	Phenolic
С	0.18	Aluminum/
15	0.19	/
30	0.19	\sim
45	0.18	A017588a
60	0.19	
75	0.18	
90	0.18	
105	0.19	
120	0.18	
13 5	0.18	
150	0.17	
165	0.17	
180	0.17	
195	0.16	
210	0.16	
225	0.17	
240	0.16	
255	0.17	
270	0.14	
285	0.18	
300	0.17	
315	0.19	
330	0.16	
345	0.17	

Table 1 STS-26A Aft Exit Cone Post-Flight Polysulfide Groove Radial Widths

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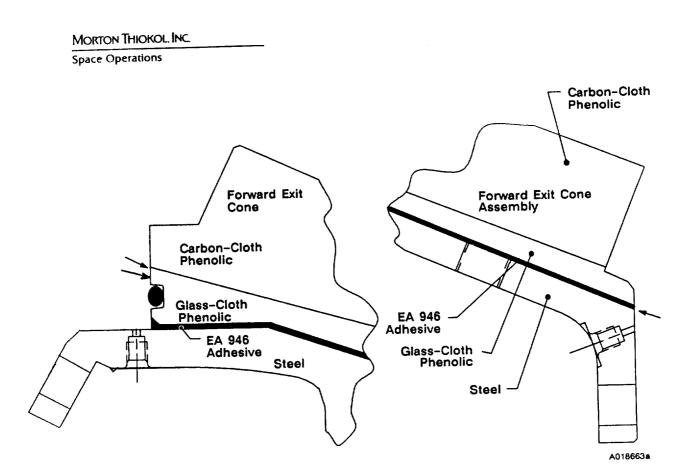
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Figure 12 STS-26A Forward Exit Cone Dimpled Erosion (270 Degrees)

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Forward End			Aft End			
Location (deg)	Radial Separation (in.)	Separation Type	Location (deg)	Radial Separation (in.)	Separation Type	
310 325 332	0.005 0.040 0.040	GCP/CCP GCP/CCP GCP/CCP	30 45 60 124	0.015 0.015 0.002 0.025	Metal/Adhesive Metal/Adhesive Metal/Adhesive Metal/Adhesive	
182-192 230-252 285-307 318-325 362-0	0.015 0.030 0.030 0.030 0.030 0.040	Within GCP Within GCP Within GCP Within GCP Within GCP	135 148	0.025 0.025	Metal/Adhesive Metal/Adhesive	

Figure 13 STS-26A Forward Exit Cone Bondline Separations

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Figure 14 STS-26A Forward Exit Cone Liner Section (0 Degrees)

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Figure 15 STS-26A Forward Exit Cone Liner Section (90 Degrees)

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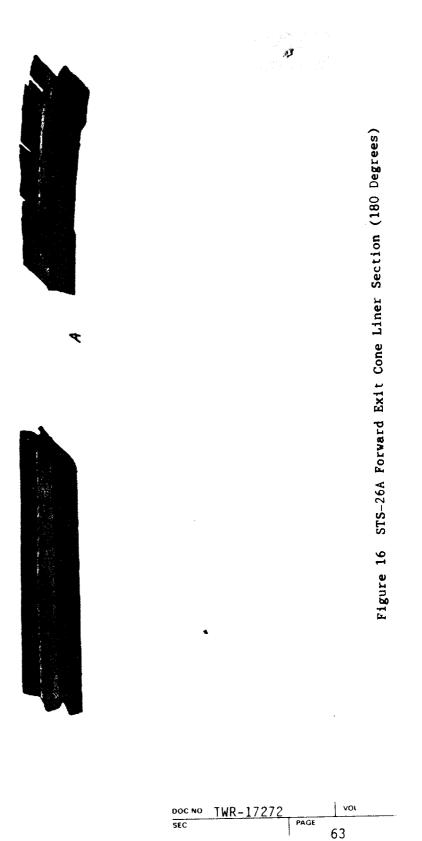
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Figure 17 STS-26A Forward Exit Cone Liner Section (270 Degrees)

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•										
	ľ	¥	8	12	16	2 0	24	28	32	34
0 degrees										
	N N	•	m	A M	N.N.	КЛ	N N	 N 	2	
Measured Char	N N	9	ŗ.	X X	N N	N N	N N	ø	ŗ.	~
Adjusted Char*	A P	ŝ		V R I	4 H H	44	44	ŝ	ņ	ه ه
2E + 1.25AC	A P	5.		4 H 4		< - -	4 H V H	-		•
RSRM Min Liner Thickness Margin of Safety	1.769 MA	1.714 0.24	1.614 0.14	1.510 HA	1.414 MA	1.345 MA	1.314 MA	1.321 0.11	1.3660.10	4.0
90 degrees										
Measured Trosion	0.45	•	•	A N	N N	A N	MA	0.24	~	•
Measured Char	0.84	•	0.71	A M	N N	N N	МЛ	0.71	٢.	•
	0.67	•	5	A M	MA	A N	МA	0.57	9.	•
2E + 1.25AC	1.74	1.46	m	N N	N N	N N	RA	1.19	1.22	1.12
RSRM Min Liner Thickness	1.789	•	e.	1.510	1.414	1.345	1.314	1.321	٣.	
Margin of Safety	0.03	•	•	A R	ИЛ	N N	N N	0.11	7	•
180 degrees										
Measured Erosion	٠.	•	۳.	A N	N A	ИЛ	МА	0.29		-
Measured Char	•	•	٢.	A N	N N	N N	A N	0.73	٢.	٢.
Adjusted Char [*]	0.66	0.61	0.58	A N	N N	N A	N N	0.58	0.62	0.58
2E + 1.25AC	9.	•	•	N N	NA	NA	MA	1.31	-	۴.
RSRM Min Liner Thickness	٢.	•	9	1.510	1.414	1.345	1.314	1.321	۳.	٦.
Margin of Safety	٩.	•	- .	۲ N	N N	V E	V N	0.01	7.	₹.
270 degrees										
Measured Fresion	0.44	0.37	0.41	N N	Ш	N A	N N	N N	МA	A N
Messured Char				A R	N A	A N	N N	N N	N N	N N
	9.	. 6		A R	N N	N N	MA	A M	N A	N A
2E + 1.25AC	•	ŝ		N N	N N	A N	R A	N N	A N	N N
RSRM Min Liner Thickness	1.789	1.714	1.614	1.510	1.414	1.345	1.314	1.321	1.366	1.404
Margin of Safety	۰.	-		47	K N	K N	4 Y	V H	V N	4 H
•	Messure	d Char	Adjusted	to end o	of action	i time				
			m 1	imum li	ner thic)	thickness				
Ž.	Margin of	Sacaty								

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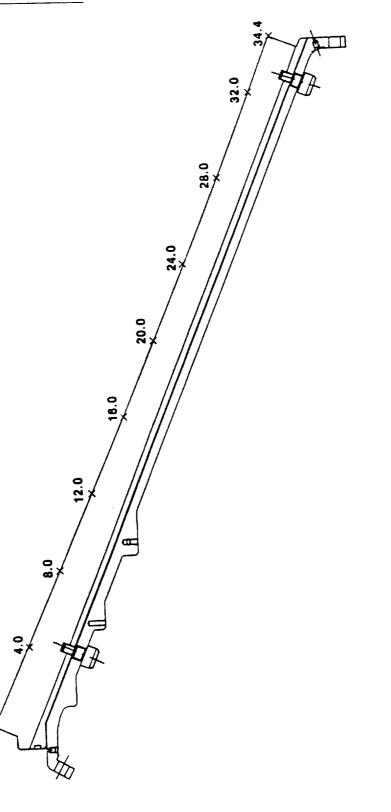
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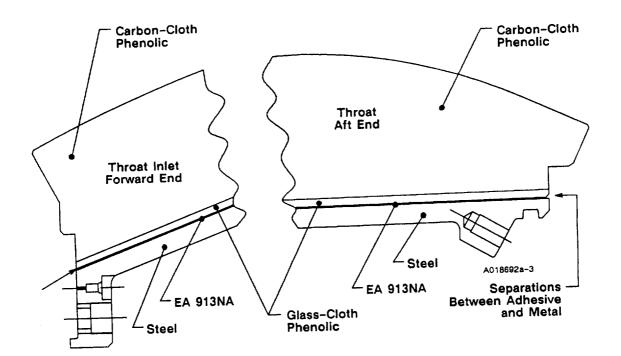


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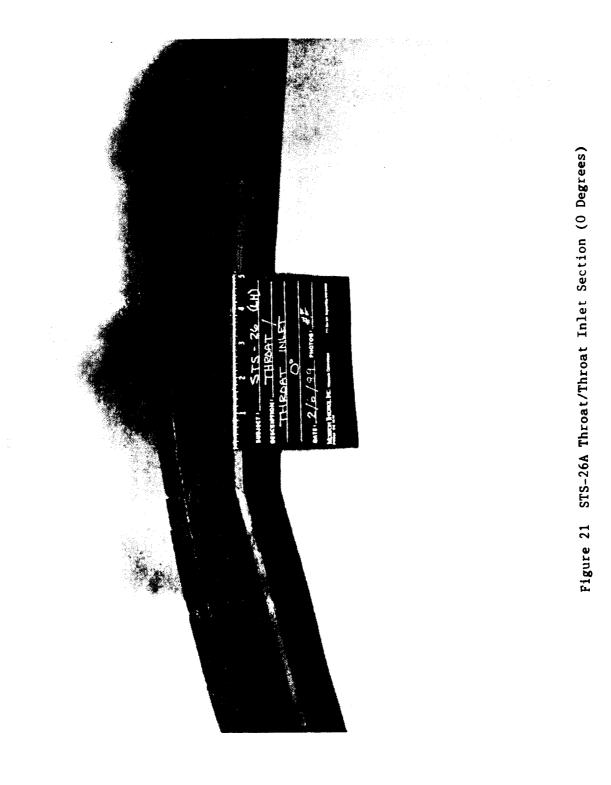


B	Fwd End	ations	Aft End Metal-to-Adhesiv <u>Bondline Separatic</u> Radia						
Location (deg)	Badial Separation (in.)	Separation Type	Location	Separation (in.)					
0 15 30 45 60 75 90 105 110 120 135 150 165 180 185 210 225 270 285 300 315 330 345	0.030 0.030	Metal/Adhesive Metal/Adhesive	30 45 60 75 90 105 120 135 150 165 180 195 210 225 270 285 300 315 330 345	0.100 0.005 0.100 0.100 0.100 0.100 0.005 0.005 0.005 0.005 0.005 0.005 0.005 0.005 0.005 0.005 0.003 0.100 0.100 0.100 0.100 0.100 0.100					

Figure 20 STS-26A Throat Assembly Bondline Separations

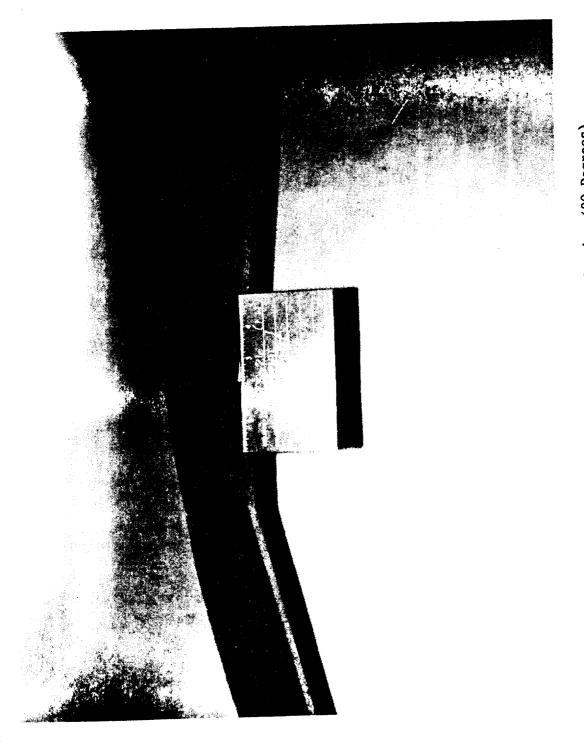
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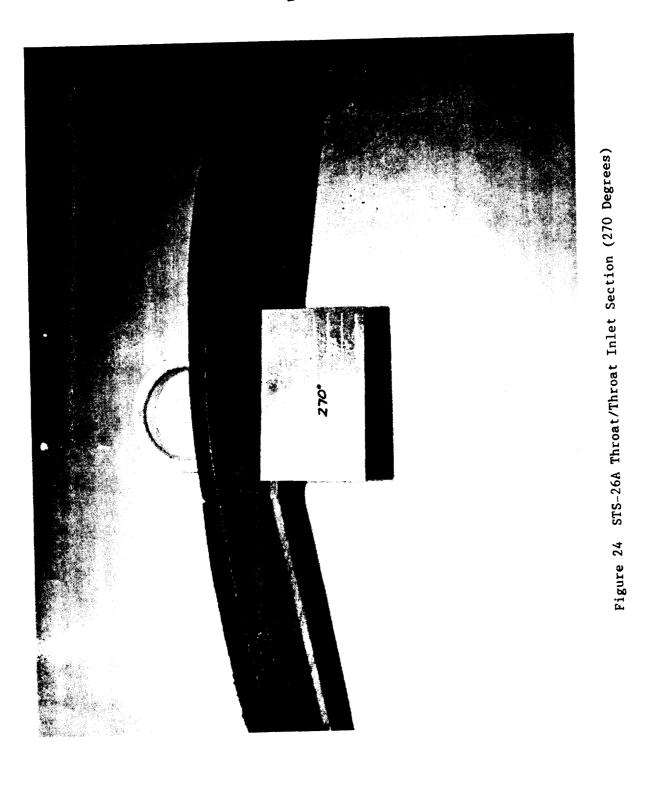


Figure 23 STS-26A Throat/Throat Inlet Section (180 Degrees)

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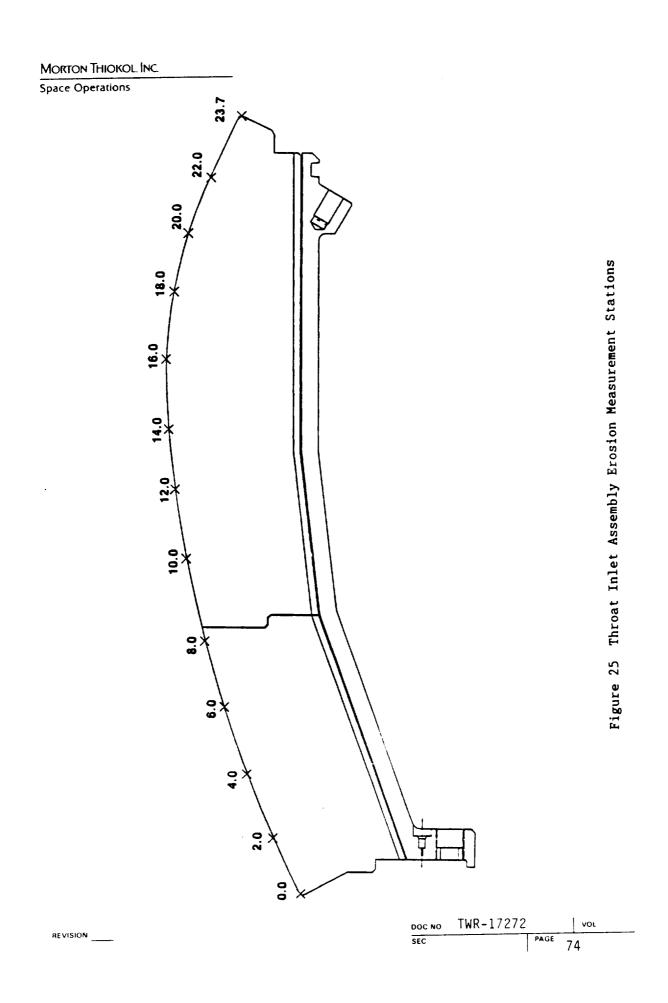
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	Loc	'n			djusted cnat E + 1.25AC	Li f S	4				2E + 1.25AC	ΞŢ	0 degrees		ພີ ບາ	טנ הינ	25A	ן ני ני		- 10	رد. ا	J C	9 P C		٥ţ	degrees				. 25	1 n o f		
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Refer to Figure 25 for Station Locations

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Figure 26 STS-26A -503 Ring Impact Marks (3 Degrees)

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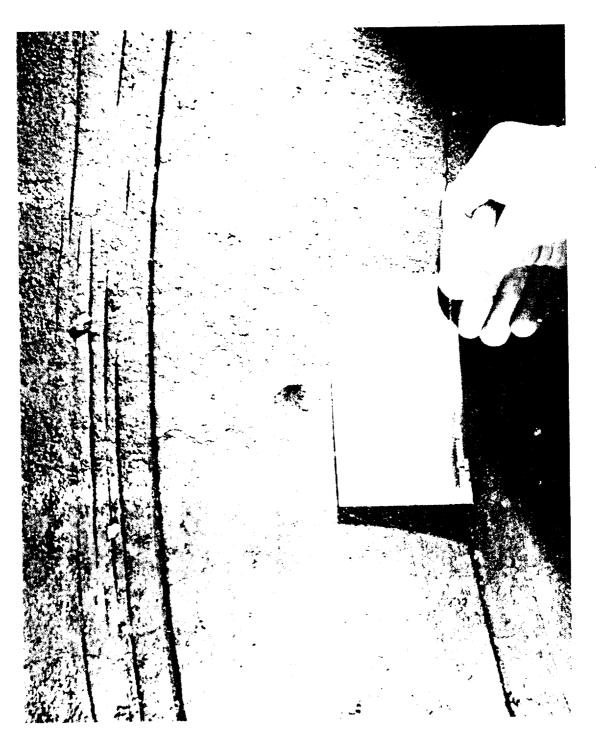


Figure 27 STS-26A -504 Ring Impact Mark (85 Degrees)

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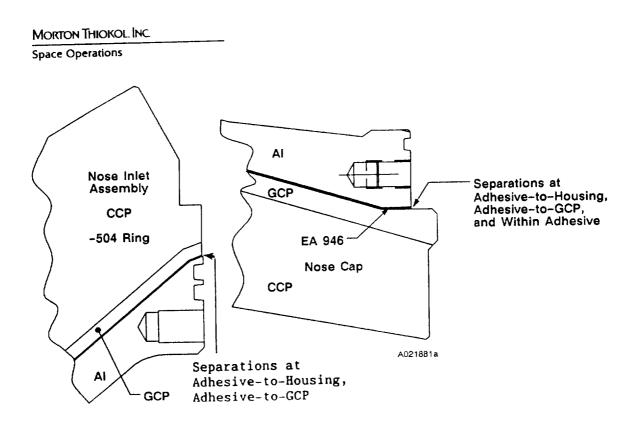
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Figure 28 STS-26A Nose Cap Wedgeout (20 Degrees)

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Location (deg)	Radial Separation (in.)	Separation Type*	Location (deg)	Radial Separation (in.)	Separation Type*
0	0.005	1	0	0.005	1
15	0.005	1	0-6	0.005 0.005	2
30	0.005	1	15	0.005	1
45	0.005	1	24	0.003	3
75	0.005	1	26-28 28-36	0.003	3 2 2
165	0.005	1	28-30 75	0.003	2
180	0.010	1	114	0.003	1
195	0.010	2	150	0.003	1
210	0.005	1	165	0.003	2
240	0.005 0.005	1	180	0.003	2
255	0.005	1	228	0.003	1
270	0.005	2	240	0.003	2
330 345	0.005	2	250-256	0.005	2
340	0.000	-	258-267	0.003	2
			277–282	0.005	1
			282-285	0.003	2
			300	0.003	1, 2
			309-319	0.003	2 2
			330	0.003	2
			336-342	0.003	2
			345	0.003	2

*Type 1 = Metal/Adhesive
Type 2 = Adhesive/GCP

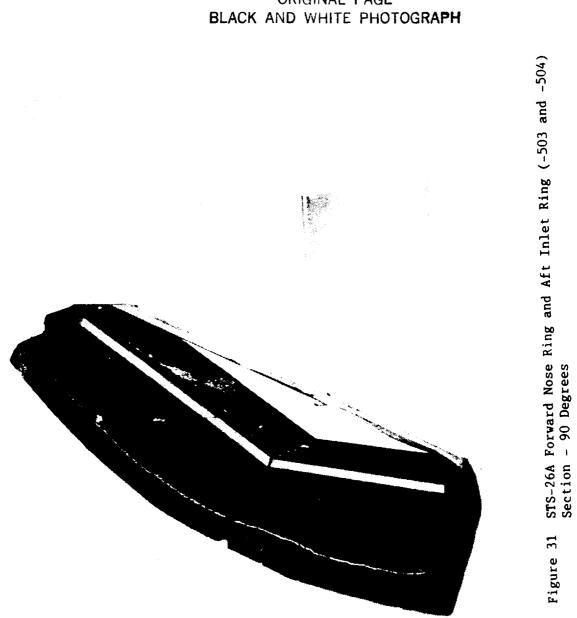
Figure 29 STS-26A Nose Inlet Assembly Bondline Separations

	Figure 25		TWR-17272	,	Lun
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Figure 31

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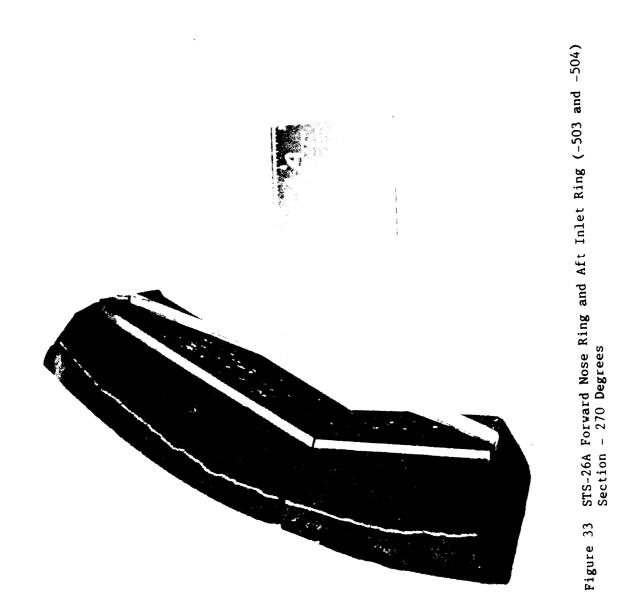
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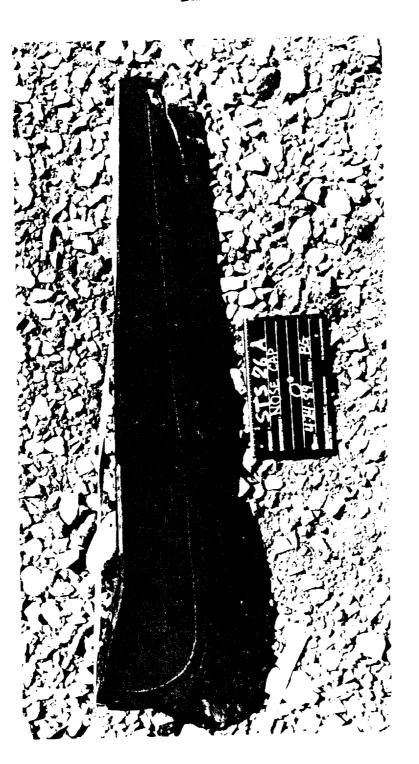


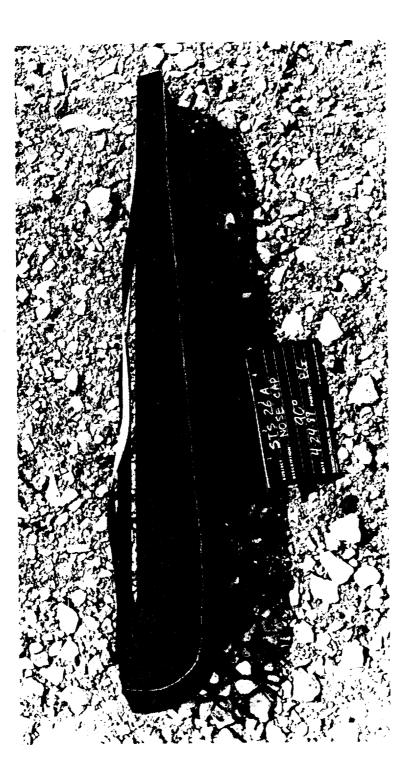
Figure 34 STS-26A Nose Cap Section (0 Degrees)

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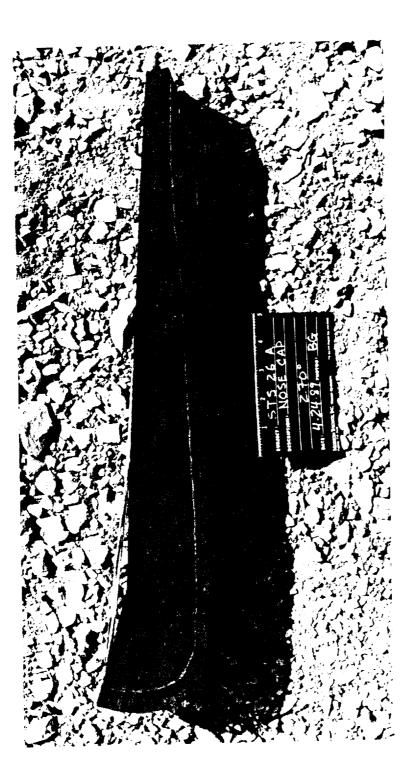
Figure 36 STS-26A Nose Cap Section (180 Degrees)

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Table 4 STS-26A Nose Inlet Rings (-503, -504) Erosion and Char Data

Angular Location			S	tations			
Angular Docution	28	30	32	34	36	38	39.5
0 degrees					0.90	0.96	1.20
Measured Erosion	1.19 0.70	0.94 0.71	0.91 0.66	0.87 0.55	0.90	0.60	0.45
Measured Char	0.53	0.53	0.50	0.41	0.45	0.45	0.34
Adjusted Char*	3.04	2.55	2.44	2.26	2.36	2.48	2.82
2E + 1.25AC	3.508	3.252	2.950	3.182	3.200	3.026	2.981
RSRM Min Liner Thkns	0.16	0.28	0.21	0.41	0.35	0.22	0.06
Margin of Safety	••••						
90 degrees							
Manual Provid	1.09	0.83	0.86	0.83	0.85	0.94	1.15
Measured Erosion Measured Char	0.70	0.70	0.64	0.63	0.61	0.62	0.44
Measured Char Adjusted Char*	0.53	0.53	0.48	0.47	0.46	0.47 2.46	2.71
2E + 1.25AC	2.84	2.32	2.32	2.25	2.27 3.200	2.40	2.981
RSRM Min Liner Thkns	3.508	3.252	2.950	3.182	0.41	0.23	0.10
Margin of Safety	0.24	0.40	0.27	0.41	0.41	0.25	•••
180 degrees				0.82	0.83	0.90	1.20
Measured Erosion	0.96	0.75	0.86 0.76	0.69	0.67	0.70	0.48
Measured Char	0.85	0.75	0.57	0.52	0.50	0.53	0.36
Adjusted Char*	0.64	0.56	2.43	2.29	2.29	2.46	2.85
2E + 1.25AC	2.72	2.20	2.950	3,182	3.200	3.026	2.981
RSRM Min Liner Thkns	3.508	3.252	0.21	0.39	0.40	0.23	0.05
Margin of Safety	0.29	0.40	0.11				
270 degrees							
	1.08	0.87	0.94	0.87	0.86	0.94	NA
Measured Erosion	0.88	0.72	0.67	0.58	0.69	0.62	NA
Measured Char	0.66	0.54	0.50	0.44	0.52	0.47	NA
Adjusted Char* 2E + 1.25AC	2.99	2.42	2.51	2.28	2.37	2.46	NA 2.981
2E + 1.25AC RSRM Min Liner Thkns	3.508	3.252	2.950	3.182	3.200	3.026 0.23	2.901 NA
Margin of Safety	0.18	0.35	0.18	0.39	0.35	0.23	86
120 degrees							
-		0.87	0.89	0.82	0.86	0.91	0.97
Measured Erosion	1.15	0.87	0.78	0.62	0.60	0.67	0.65
Measured Char	0.59	0.82	0.59	0.47	0.45	0.50	0.49
Adjusted Char*	3.03	2.32	2.51	2.22	2.28	2.45	2.55
2E + 1.25AC	3.508	3.252	2.950	3.182	3.200	3.026	2.981
RSRM Min Liner Thkns	0.16	0.40	0.17	0.43	0.40	0.24	0.17
Margin of Safety							
	* Measu	red Char	Adjuste	d to end	of acti	on time	

minimum liner thickness Margin of Safety = ______ - 1 2 X erosion + 1.25 X adj char*

Refer to Figure 38 for Station Locations

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Data
Char
and
Erosion
Assembly
Cap
Nose
STS-26A
Table 5

Angular Location		2 				ŝ	Stations						
	1.5	4	ę	ø	10	12	14	16	18	20	22	24	26
0 degrees													
Maasurad Erosion	NA	0.26	0.34		٠.	4		9.	Ś	0.92	1.42	1.59	1.13
Char	NA.	0.60	0.54	ŝ	ŝ	ŝ	4	٠	₹.	1	ŝ	9.	Γ.
	NA	0.48	0.43	4	٠.	4.	٣.	٣,	۳.	۳.	₹.	ŝ	ŝ
2E + 1.25AC	N N	1.12	1.22	1.23	1.36	1.45	m	1.66	.81	. 24	. 4 2	. 8 6	. 9 2
RSRM Min Liner Thickness	1.776	2.038	2.248	۳.	9.	۰.	٩.	?	ŝ	•	٢.	•	°.
Margin of Safety	NA	0.82	0.84	٩.	°.	σ.	°.	б.	ື	~	<u>.</u>		.
45 degrees													
			76 0		4	u"	ŝ	9		0	9	80	۳.
Measured Erosion	44	# 0 •		е и	ŗ	1	1		4		5	٢.	٢.
	A N			, 4	۲	. "			. "	1	ി	9	s.
Adjusted Chat "		 		. 4	4		9	1 10	2.1	2.63	5 C C C	4.39	3.32
26 t 1.20AC Dodk min Tinar Thirkness	1 776	2.038	2.248		9	80	°.	?	3.5	٩.	٢.	٠6	•
Margin of Safety	NA	0.60	0.76	0.71	0.79	0.89	0.85	.80	. 67	. 54	. 20	٩.	7
90 degrees													
Measured Erosion	NA	0.40	0.42	4.	s.	'n	0.66	0.75	0.80	1.05	1.63	1.84	1.23
Measured Char	NA	0.62	0.66	9.	۰	9.	9.	ŝ	ŝ	•	Ŀ.		<u>،</u> ه
	NA	0.50	0.53	. 52	ŝ	ŝ	4	4	4	Ω.	ŝ		
2E + 1.25AC	NA	1.42	0	ŝ	. 6 8	. 67	. 9 2	8.			5.		
	1.776	2.038	2.248	2.458	2.668	2.878	<u>،</u>	Ņ	٩, v			• •	0 0 1
Margin of Safety	NA	0.44	0.50	Ϋ́.	ŝ		•	•	•	4	•		!
ı				•									
135 degrees													
Measured Erosion	NA	NA	NA	NA	NA	NA	N A	NA	NA	NA	NA	NA	NA
Char	NA	NA	NA	NA	NA	NA	NA	N N	NA	NA	٧N	NA	V N
	NA	N N	NA	NA	NA	NA	N A	N N	A N	NA	N N	N N	N N
2E + 1.25AC	NA	NA		N N	ΝA	N A	N N	N N N	A N	N N N		A N	A N N
RSRM Min Liner Thickness	1.776	2.038	2.248	2.458	2.668	2.878	3.055	3.298	106.5	4.000	4./13 41	4.07T	100.0
Margin of Safety	NA	NA	VN	NA	AN	~	4		6	6		G	ç
	' measured char		adjusted	to end o	f action	time							
TW			in	i mumi	er thi	10 K							
	margin of safety	safety											
	I.		9	051	.25 X	dj char*							

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Refer to Figure 38 for Station Locations

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STS-26A Nose Cap Assembly Erosion and Char Data (continued) Tahle 5

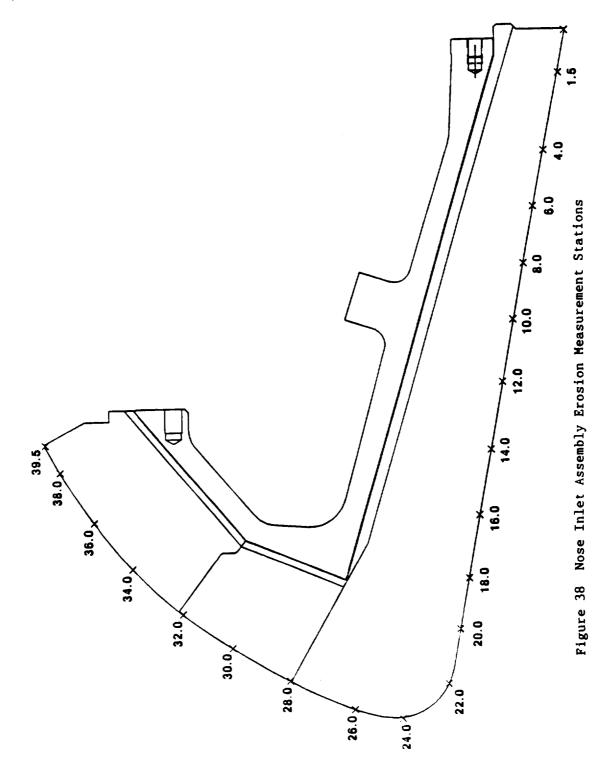
		Table	5 STS-	-26A Nose	Cap	ASSEMULY	1010111				•		
						st	tations						
Angulat botation	1.5	4	ę	83	10	12	14	16	16	20	22	24	26
180 degrees										•	4		
	N N	0.38	0.38	٠.	ŝ	<u>د</u>	ŝ	•	0.75	1.04	0.73	0.00	0.75
Mensured Froston Konstrad Char	NA	0.62	0.61	9.	ŝ	n, '	<u>^</u> -	٠	. 4		ി	۰.	°.
noticeted Char *	NA	0.50	0.49	•	4		- r	•	: -:	9	σ.	4	.38
7E + 1.25AC	N N	60	1.37	4 S .	5 . 5	•	29	• •	ູ່ທີ	°.	٢.	÷.	°.
RSRM Min Liner Thickness Margin of Safety	1.776 NA	2.038 0.48	2.248 0.64	0.60	0.68	0.78	0.82	0.67	. 65	- 54	r.	°.	-
225 degrees											-	Y	c
		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	0 8 0	~	2	4	ŝ	9	Γ.	5		• •	, r
	0.28	17.0	0.57	. თ	ി	s.	۰.	٠.	<u>س</u>	• •	ų.	0 ¥	
Measured Char	10.0	1010	0.46	4	4.	۳.	ς.	<u>,</u> ,	., e	<u>,</u> r		1 CC -	1
Adjusted Char "	1 07	1.05	1.17	.24	.28	.38	.49		א יע	<u>,</u> c	5	4.691	3.863
2E + 1.23AC RSRM Min Liner Thickness Margin of Safety	1.776 0.66	2.038 0.94	2.248 0.92	2.458 0.98	2.668 1.08	2.878 1.09	3.088	0.67.0		0.72	0.38	0.22	.40
270 degrees								,	f	d	•	1.65	-7
	NA	0.26	0.31	۳.	4	0.48	ົ່	29.0	• •	94.0	0.72	0.85	0.81
Here is the second s	A N	0.74	0.52	9	ف	90.0	ņ.	. "	1	. ~	ŝ	0.68	٩.
Adjusted Char *	NA	0.59	0.42	ŝ	۰.	0.40			6.	.36	.56		.10
2E + 1.25AC	NA	1.26	1.14	2.4	. 4	878 C		2	ŝ	٩.	٢.	4.691	
RSRM Min Liner Thickness Margin of Safety	1.776 NA	2.038 0.62	0.97	0.81	60	0.87	6.0	6.	0.84	. 72	m.	0.13	
315 degrees										•	•	F	-
		08 0	1 35		4	<u>د</u>	۰	0.66	0.78	5,1	٩, I		• •
Measured Erosion	A N	0.00	0.60	<u>،</u>	0.58	0.53	0.48	0.45	0.41	0.36			0.53
Measured Char	(A 2	74.0	0.48	1	٩.	4.	۳.	0.36			י י י	41.6	
4	A N	1.19	1.30	۳.	.38	. 57	. 76	E .	1.9.1			4.691	
ZE + 1.23AC		2.038	2.248	4	φ.	æ	਼	3.298		ים היים היים	• •	0.13	.34
RSRM MIN LINE INTERNESS Margin of Safety	AN	0.71		0.85	<u>.</u>	÷.	·.	0.80					
	AUSA88 *	measured char	adjusted	to end	of actio	on time							
	- - 	1											

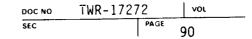
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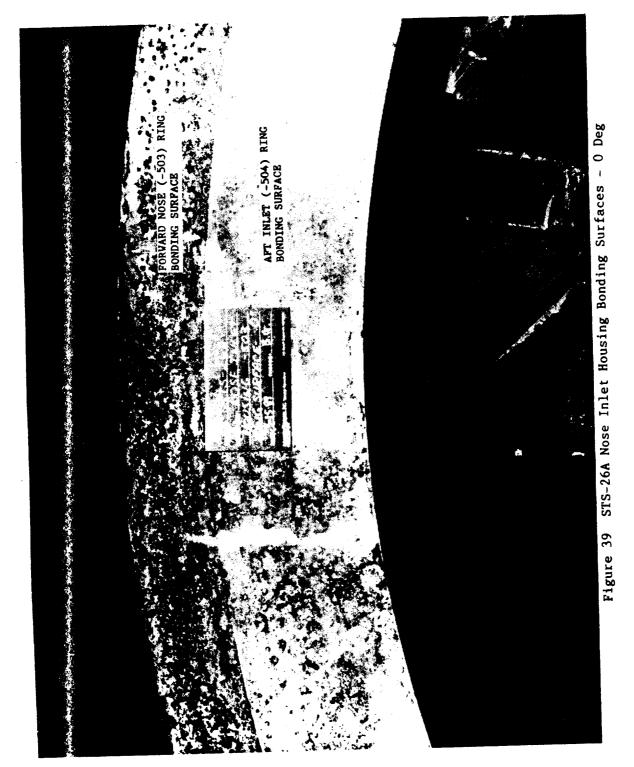
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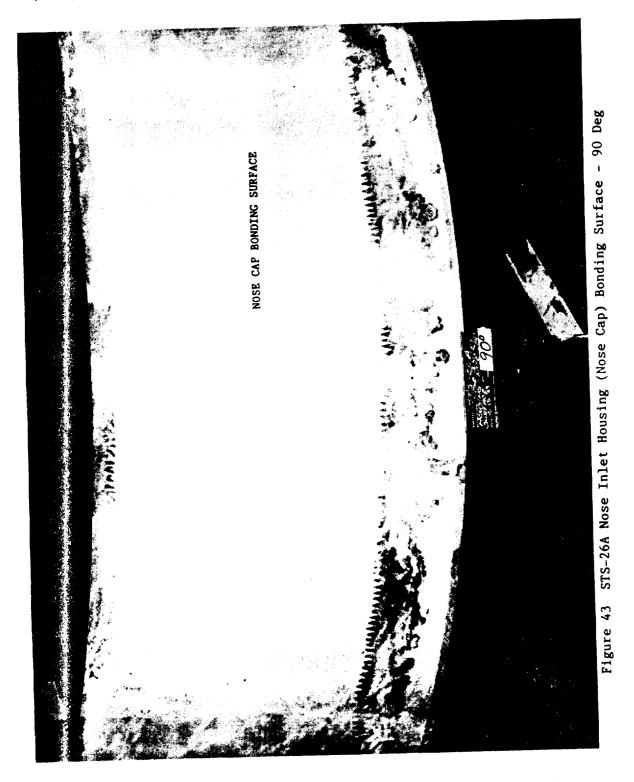
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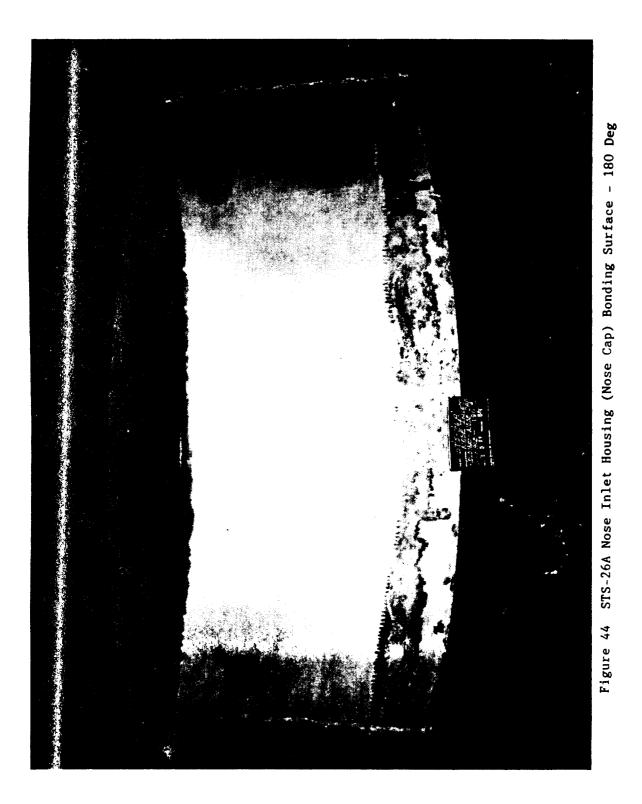
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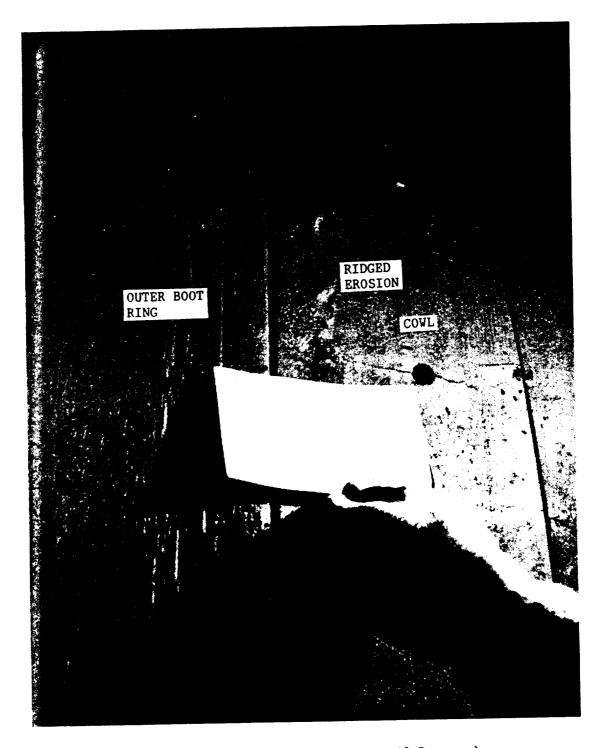


Figure 47 STS-26A Cowl/OBR Closeup (O Degrees)

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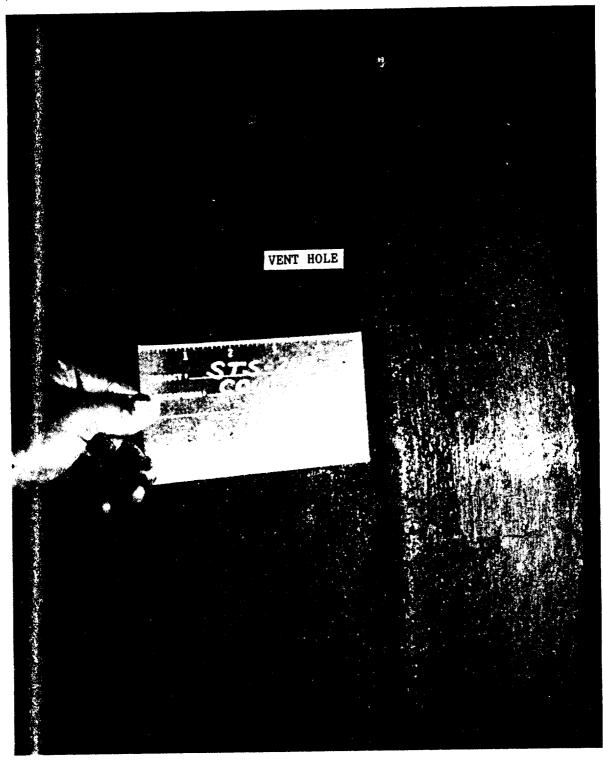


Figure 48 STS-26A Cowl/OBR Closeup (160 Degrees)

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Figure 49 STS-26A Cowl/OBR Closeup (180 Degrees)

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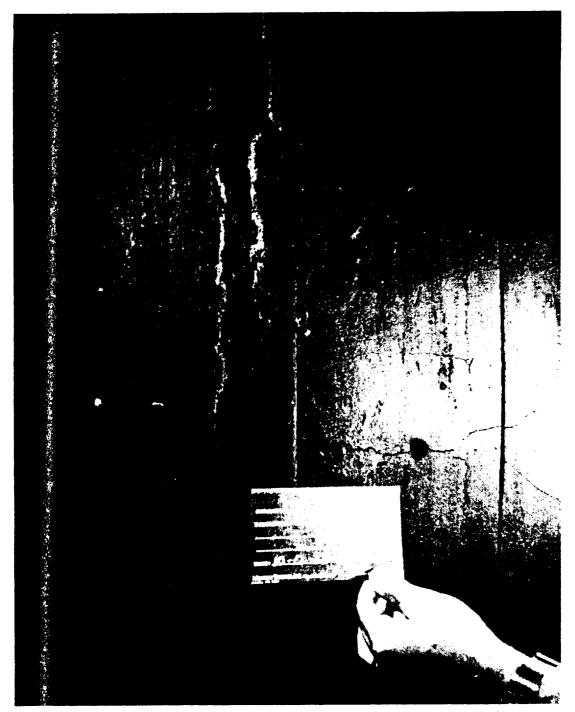
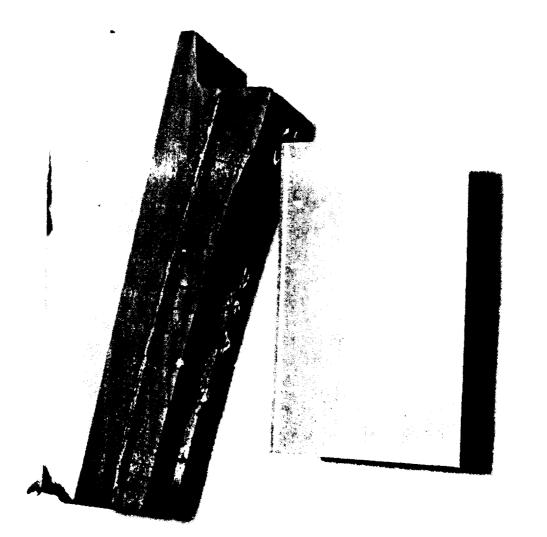


Figure 50 STS-26A Cowl/OBR Closeup (320 Degrees)

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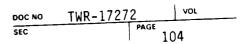


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Figure 52 STS-26A Cowl (90 Degrees) ÷

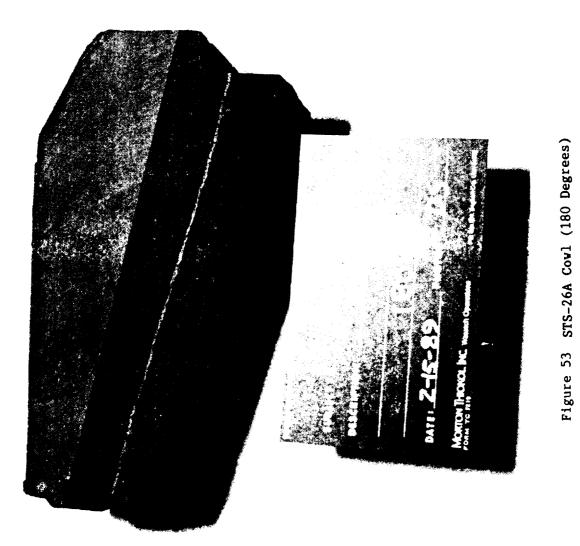
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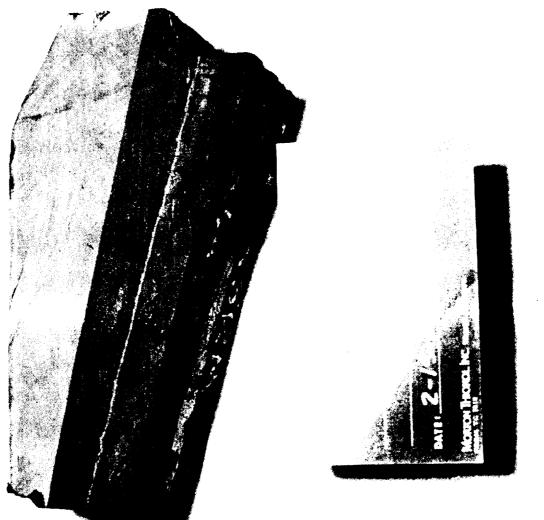


Figure 54 STS-26A Cowl (270 Degrees)

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SEC		PAGE	106	

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destens 0 1 0 1 0 1 0 1 0 </th <th>0 1 Char 0.18 0.26 Char 0.57 0.62 Char 0.57 0.50 Char 0.93 1.49 Liner 1.417 1.49 Liner 0.52 0.31 E 546 0.52 0.31 E 546 0.52 0.31 Char 0.52 0.52 0.31 Char NA NA NA</th> <th>. 29</th> <th>r</th> <th>•</th> <th></th> <th>,</th> <th></th> <th></th> <th></th> <th></th> <th></th>	0 1 Char 0.18 0.26 Char 0.57 0.62 Char 0.57 0.50 Char 0.93 1.49 Liner 1.417 1.49 Liner 0.52 0.31 E 546 0.52 0.31 E 546 0.52 0.31 Char 0.52 0.52 0.31 Char NA NA NA	. 29	r	•		,					
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			to end	f actio	n ti						
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			ıniau	lner		1 1					

Table 6 STS-26A Cowl/OBR Erosion and Char Data

Refer to sigure 55 for Station Locations

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	char	946.0		<u>,</u> "	: ^	1	1.21	.01	. 30		0 ř 5 v	84.	1.704
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ar Thickness 1.417 1.499 1.277 4.00 MA NA NA NA NA NA NA 1.04 0.90 A A fety NA NA NA NA 1.04 0.90 A A fety na NA NA NA 1.04 0.90 A A A A A A A A A A A A A A A A A A A	Adjusted cimi 26 + 1.25AC	NA	<u>.</u>	NA LLa	NA 1 A 5	1.733	1.811	1.38	.96	. 59	1.6	9 9 9 9	
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Measured char adjusted to end of action minimum liner this	Margin of Safety	NA	NN	NA									
inimum liner thi		Measu	ed cha	djuste	to	ofa							

(continued)
Data
and Char Data
Erosion
Cowl/OBR
STS-26A
Table 6

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totation							Stations					
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25 + 1.25AC	1 417	1.499	о и 	9	5	•	8	6.	1.597	9	9	<u> </u>
RSRM MID LINET INLERNESS Margin of Safety	0.27	0.56	. 5 2	. 52	. 55	φ.	• •	. 0	V N	°.	?	?
200 degrees												
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Adrusted Char *	NA	NA	NA	N N	X N	N N	N N	< 2 1	4 H H	0.0	, d	•
2F + 1.25AC	NA	NA	N N		٨N	Z N	N N	V V		5 F N 4		, r
RSRM Min Liner Thickness Margin of Safety	1.417 NA	1.499 NA	1.577 NA	1.655 Ma	1.733 Ka	1.811 NA	1.889 Na	1.905 NA		0.86	0.76	1.10
210 degrees												
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RSRM Min Liner Thickness	1.417	1.499	1.577	1.655	1.733	1.811	1.889	1.903	/ 6C · T		1 0 0 1 T	
Margin of Safety	0.52	16.0		4	*	<u>.</u>	•	n .	5	5		
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te titane Thickness	1.417	1.499	1.577	1.655	1.733	1.811	1.889	1.963	1.96.1	<u>م</u> , •	• •	7
Margin of Safety	VN	NA	NA	V N	ИЛ	NA	N N	A N	N N	7.		
240 degrees												•
Measured Erosion	NA	NA	NA	NA	NA	A N	N N	A N	NA V	0.06	9 0 0 0 0	0.02
Measured Char	NA	N N	NA	N N	N N	A N	A N	44		e 4	9 M	
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2E + 1.25AC	NN		NA '	NA	NA 1 733	LIS I	1.889	1.963	1.597		9	5
RSRM Min Liner Thickness Margin of Safety	1.417 NA	1.499 MA	V C - T	VN VN	NA	N.	N A	N N	N.N.	. 78	•	•0
	* Measured cha	•d char	adjusted	to end	of actio	on time						

		-		107-010	A COWL/U	BK Eros	10n and	313-20A COWL/UBK Erosion and Char Data (continued)	ita (con	tinued)		
Angular Location							Stations					
270 degrees	0	ы	2	£	Ŧ	ŝ	Q	٢	Ð	6	10	11.3
Measured Erosion	0.19	0.22	0.23	0.27	0.32	0.20	0.16	0.19	R.A.	0.03	0.03	0.03
Measured Char	0.62	0.57	0.63	0.63	0.60	0.70	0.80	0.80	NA	94.0	0.96	0.95
Adjusted char *	0.50	0.46	0.50	0.50	0.48	0.56	0.64	0.64	MA	0.75	0.77	0.76
2E + 1.25AC	1.00	1.01	1.09	1.17	1.24	1.10	1.12	1.18	NA	1.00	1.02	1.01
RSRM Min Liner Thickness	1.417	1.499	1.577	1.655	1.733	1.811	1.889	1.963	1.597	1.675	1.687	1.704
Margin of Safety	0.42	0.48	0.45	0.41	0.40	0.65	0.69	0.66	NA	0.68	0.65	0.69
280 degrees												
Measured Eroston	NA	NA	N N	NA	NA	NA	NA	N.A.	V N	00.0	0.00	0 0 0
Measured Char	NA	NA	NA	NA	NN	NA	NA	N N	N N	0.89	0.83	0.85
Adjusted char *	A N	NA	N N	N N	N.N.	NA	NA	NA	N N	0.71	0.66	0.68
2E + 1.25AC	٩N	N N	N N	N N	NA	NA	NA	NA	NA	0.89	0.83	0.85
RSRM Min Liner Thickness	1.417	1.499	1.577	1.655	1.733	1.811	1.889	1.963	1.597	1.675	1.687	1.704
Margin of Safety	NA	NA	N N	N N	N N	NN	N A	NA	N A	0.88	1.03	1.00
300 degrees												
Measured Eroston	0.16	0.22	0.24	0.30	0.31	0.19	0.15	0.17	КА	0.01	0.02	0.01
Measured Char	0.60	0.64	0.66	0.63	0.66	0.76	0.78	0.82	NA	0.80	0.81	0.81
Adjusted char *	0.48	0.51	0.53	0.50	0.53	0.61	0.62	0.66	N N	0.64	0.65	0.65
2E + 1.25AC	0.92	1.08	1.14	1.23	1.28	1.14	1.08	1.16	NA	0.82	0.85	0.83
RSRM Min Liner Thickness	1.417	1.499	1.577	1.655	1.733	1.811	1.889	1.963	1.597	1.675	1.687	1.704
Margin of Safety	0.54	0.39	0.38	0.35	0.35	0.59	0.75	0.69	VN	1.04	86.0	1.05

Table 6 STS-26A Cowl/OBR Erosion and Char Data (continued)

TWR-17272

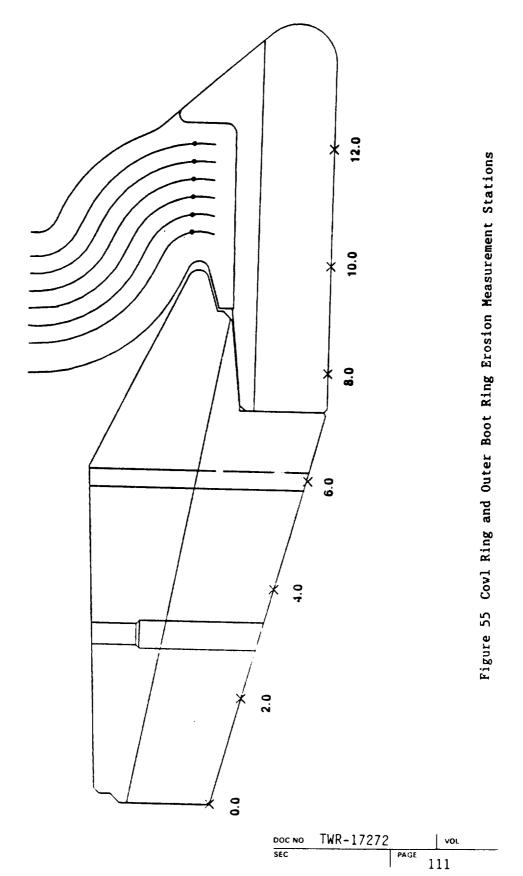
-1 -

ainiaum liner thickness

* Measured char adjusted to end of action time

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Figure 56 STS-26A OBR Aft End Delaminations (260 Degrees)

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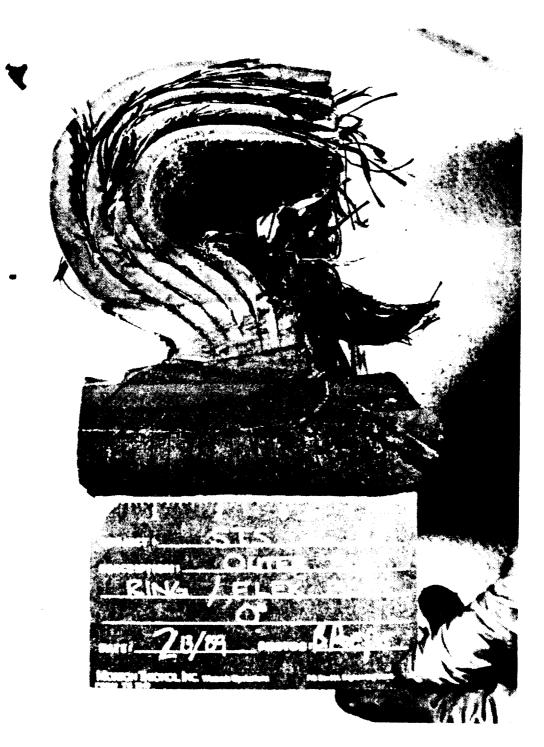


Figure 58 STS-26A Outer Boot Ring Section (0 Degrees)

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Figure 59 STS-26A Outer Boot Ring/Flex Boot (90 Degrees)

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Figure 60 STS-26A Outer Boot Ring/Flex Boot (180 Degrees)

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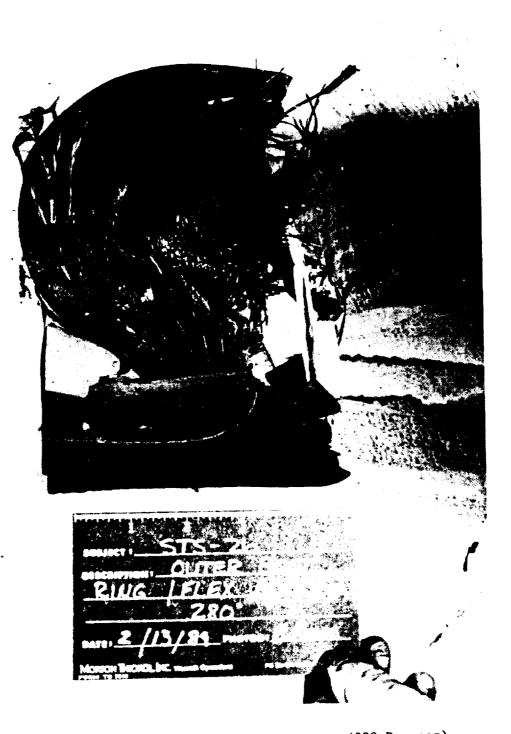


Figure 61 STS-26A Outer Boot Ring/Flex Boot (280 Degrees)

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Figure 62 STS-26A Flex Boot (Cavity Side - 0 Degrees)

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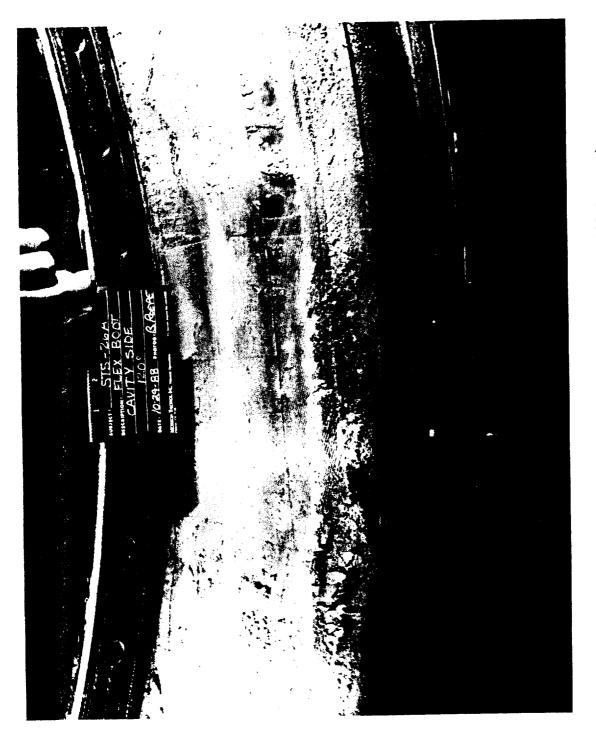


Figure 63 STS-26A Flex Boot (Cavity Side - 120 Degrees)

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STS-26A Flex Boot (Cavity Side - 240 Degrees) Figure 64

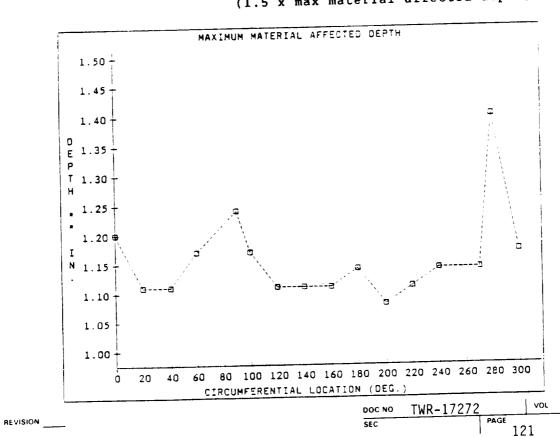
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Degree Location	Remaining Plies	Max Material Affected Depth (in.)	Margin Of Safety*
0 20 40 60 90 100 120 140 160 180 200 220 240 270 280	3.6 3.9 3.9 3.7 3.5 3.7 3.9 3.9 3.9 3.9 3.8 4.0 3.9 3.8 4.0 3.9 3.8 4.0 3.9 3.8 3.8 3.8 3.8	$1.20 \\ 1.11 \\ 1.11 \\ 1.17 \\ 1.24 \\ 1.17 \\ 1.11 \\ 1.11 \\ 1.11 \\ 1.14 \\ 1.08 \\ 1.11 \\ 1.14 \\ 1.14 \\ 1.14 \\ 1.14 \\ 1.14 \\ 1.14 \\ 1.17 $	0.39 0.50 0.42 0.34 0.42 0.50 0.50 0.50 0.50 0.50 0.46 0.54 0.54 0.50 0.46 0.46 0.46 0.19 0.42
300	3.7	1.1/	

Table 7 STS-26A Flex Boot Data Performance Margins of Safety



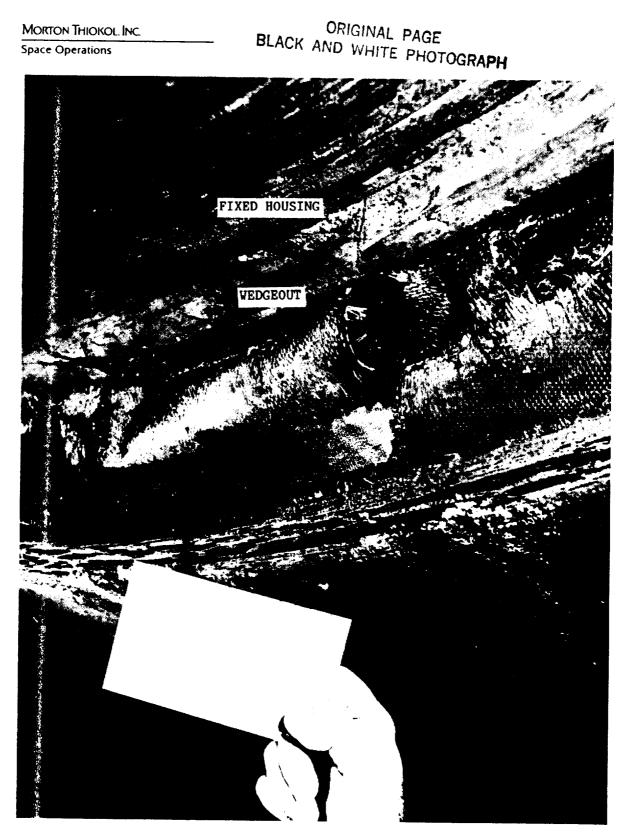


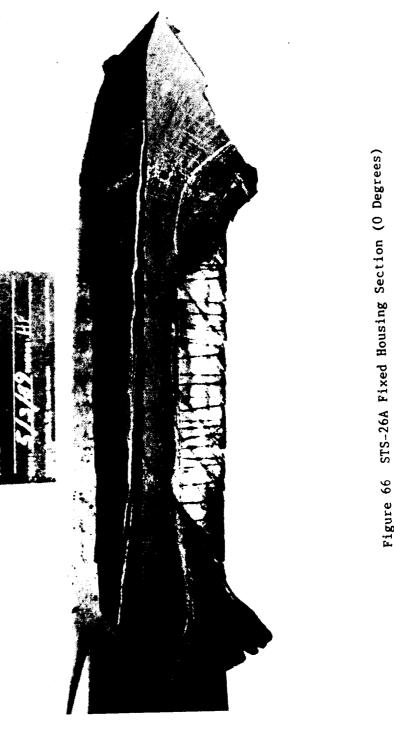
Figure 65 STS-26A Fixed Housing Wedgeout (280 Degrees)

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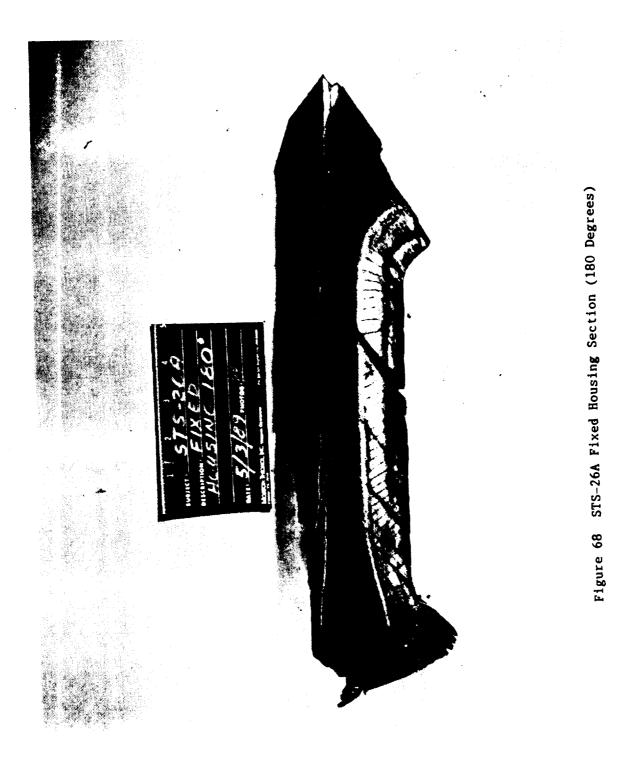


Figure 67 STS-26A Fixed Housing Section (90 Degrees)

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01 0.04 0.03 0.00 <												
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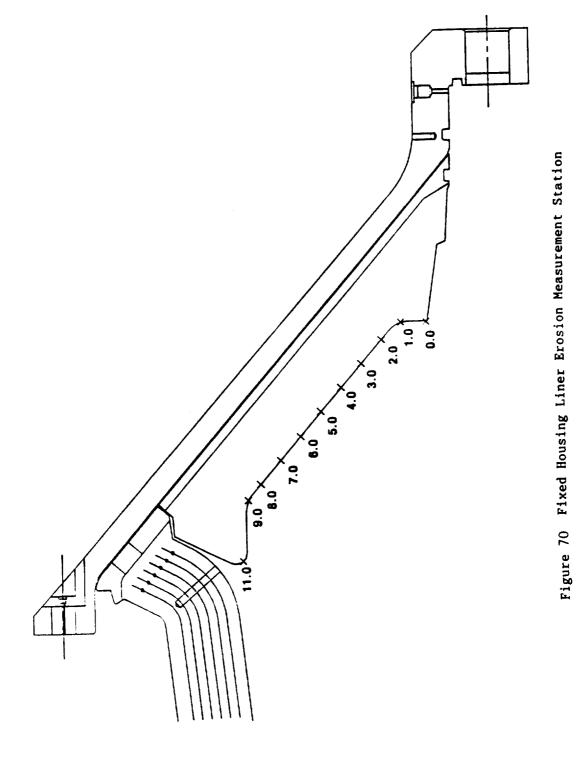
Table 8 STS-26A Fixed Housing Insulation Erosion and Char Data

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 $\mathsf{Pe}^{\texttt{fer}}$ to Figure 70 for Station Locations

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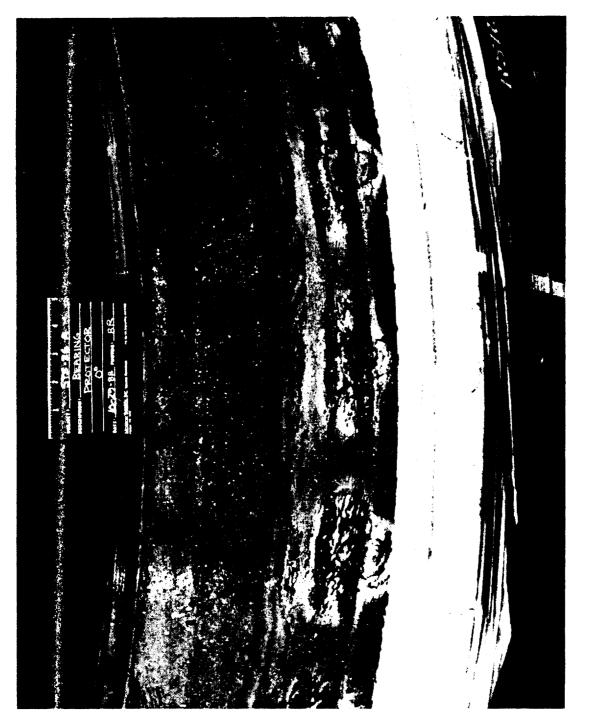


Figure 71 STS-26A Bearing Protector (0 Degrees)

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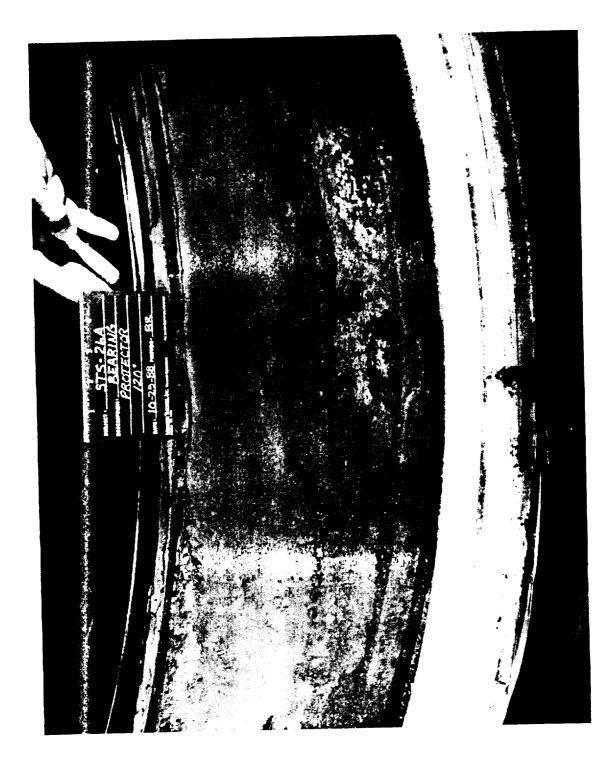


Figure 72 STS-26A Bearing Protector (120 Degrees)

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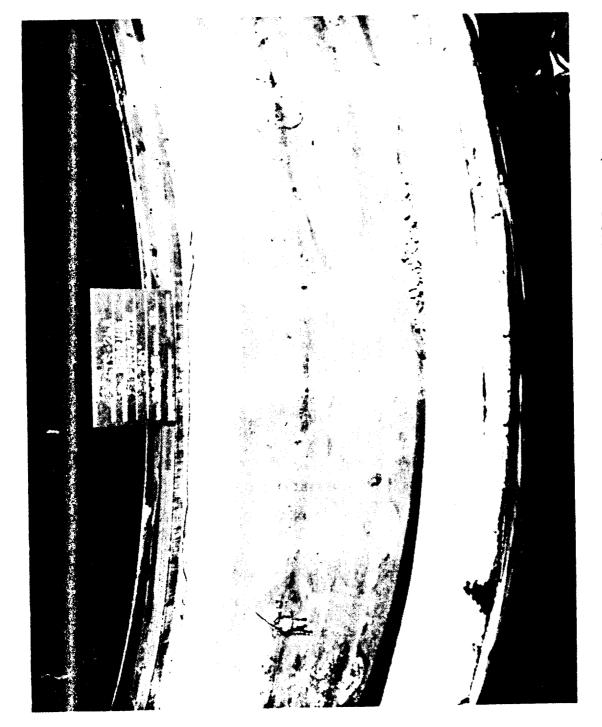


Figure 73 STS-26A Bearing Protector (240 Degrees)

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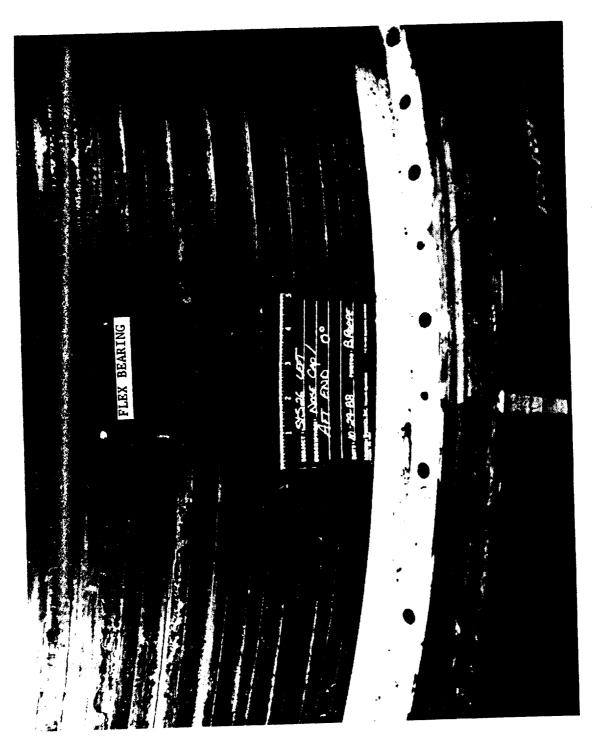


Figure 74 STS-26A Flex Bearing (0 Degrees)

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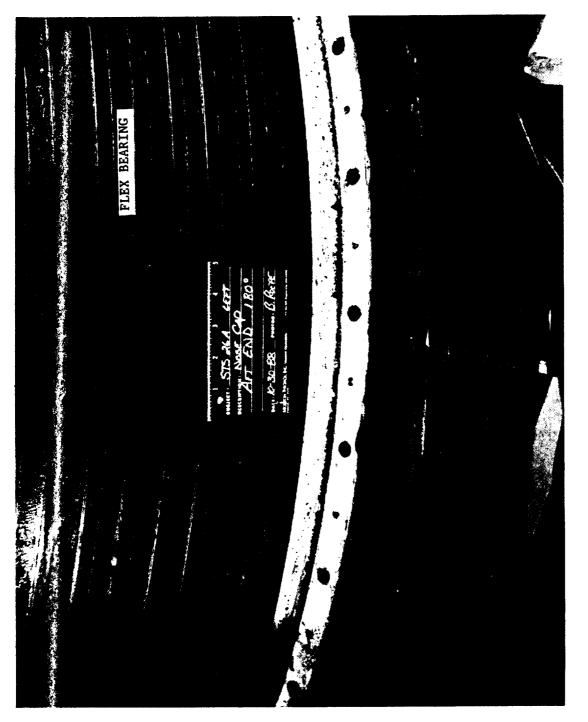


Figure 75 STS-26A Flex Bearing (180 Degrees)

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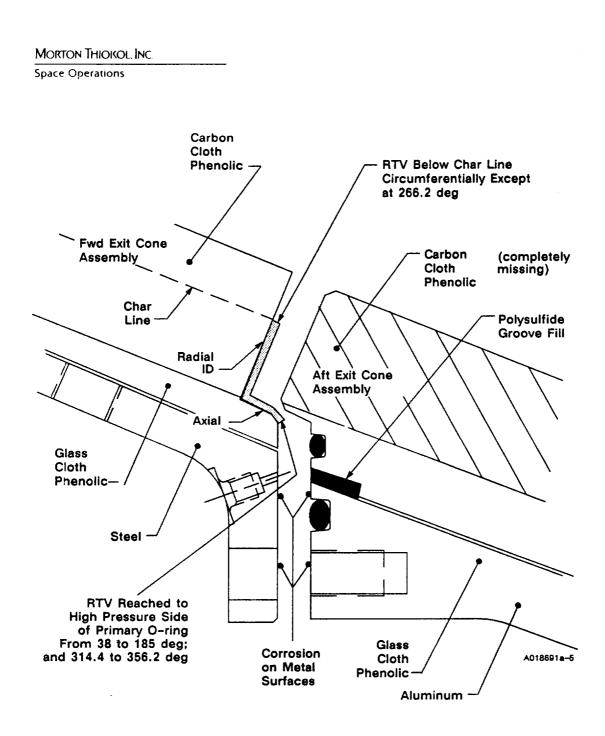


Figure 76 STS-26A-Forward Exit Cone-to-Aft Exit Cone Joint Interface

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Figure 77 STS-26A Aft Exit Cone Forward End (O Degrees)

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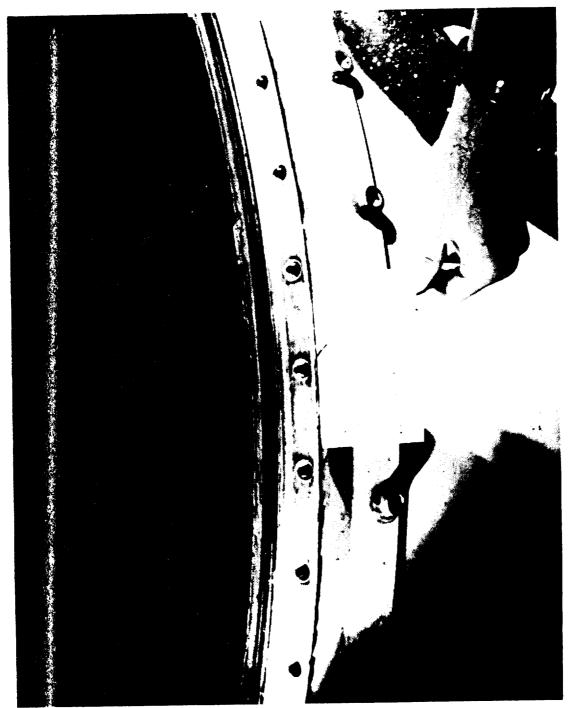


Figure 78 STS-26A Aft Exit Cone Forward End (120 Degrees)

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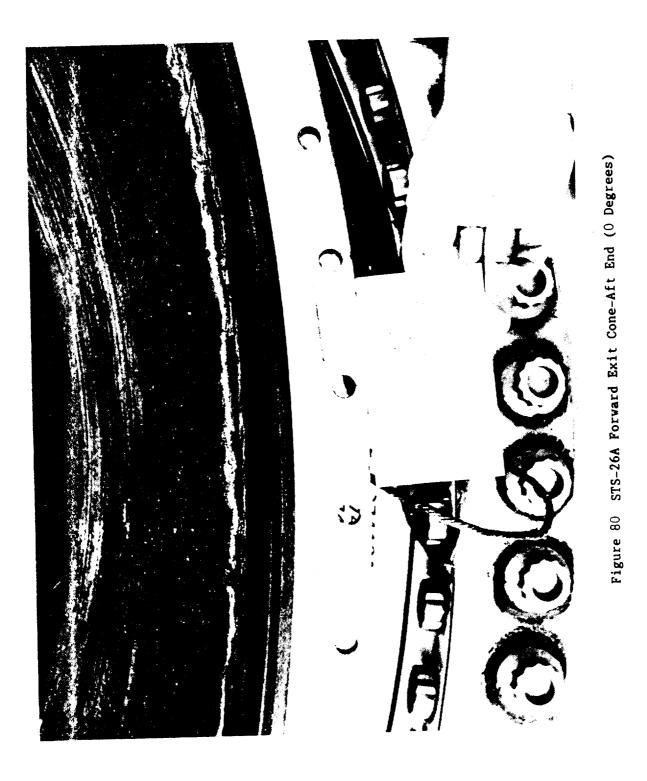


Figure 79 STS-26A Aft Exit Cone-Forward End (240 Degrees)

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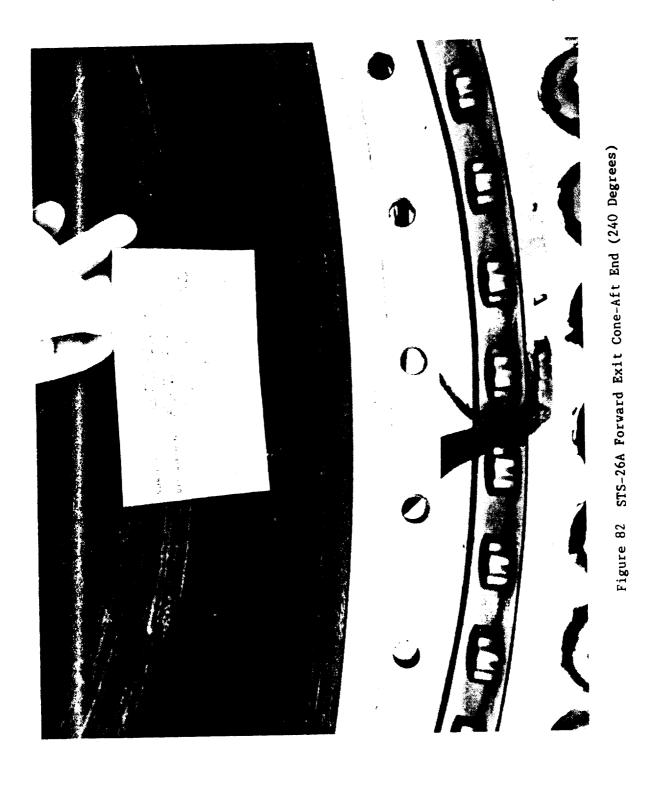


Figure 81 STS-26A Forward Exit Cone-Aft End (120 Degrees)

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STS-26A Forward Exit Cone-Aft End White Corrosion (45 Degrees) Figure 84

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STS-26A Forward Exit Cone-Aft End Scratch Mark (90 Degrees) Figure 85

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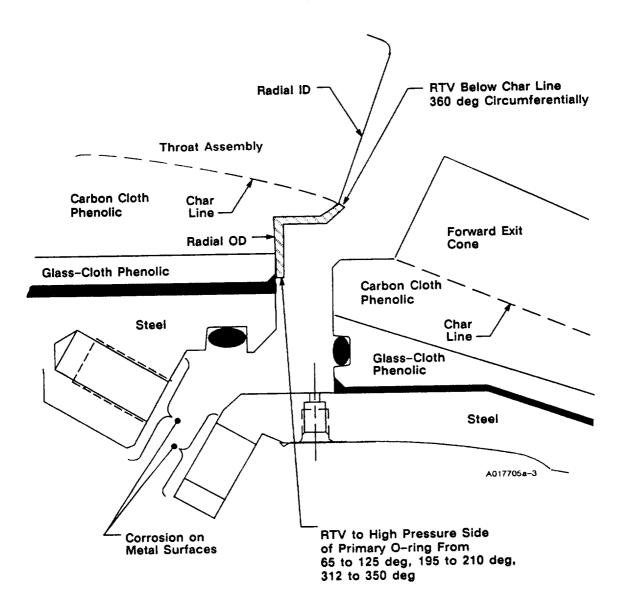


Figure 86 STS-26A Throat/Forward Exit Cone Joint

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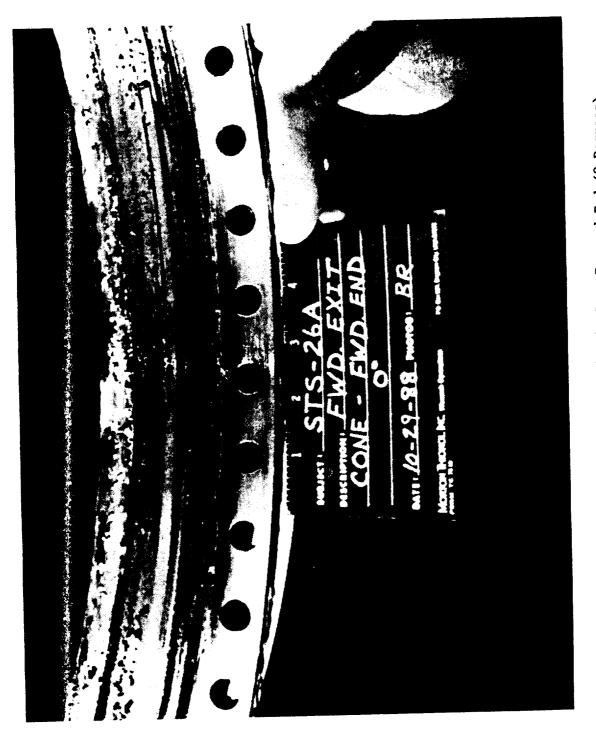


Figure 87 STS-26A Forward Exit Cone-Forward End (O Degrees)

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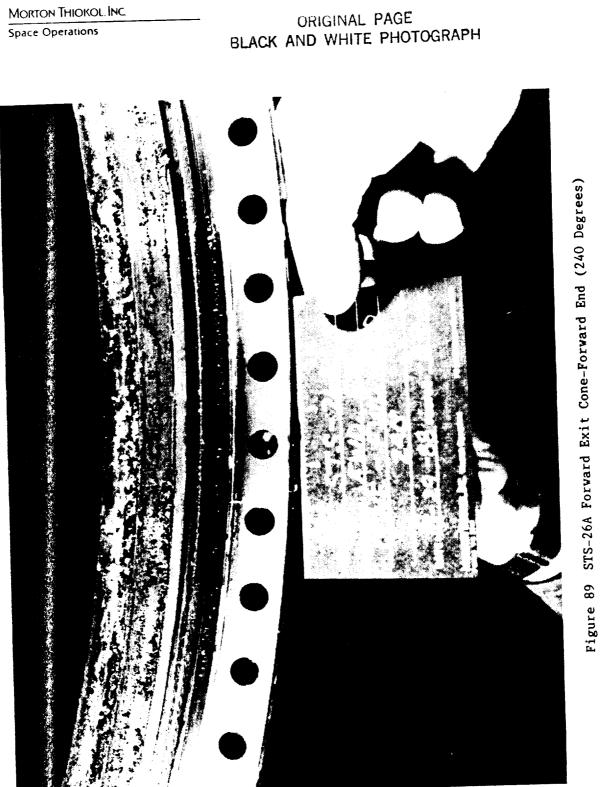
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Figure 88 STS-26A Forward Exit Cone-Forward End (120 Degrees)

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Figure 90 STS-26A Throat Aft End (0 Degrees)

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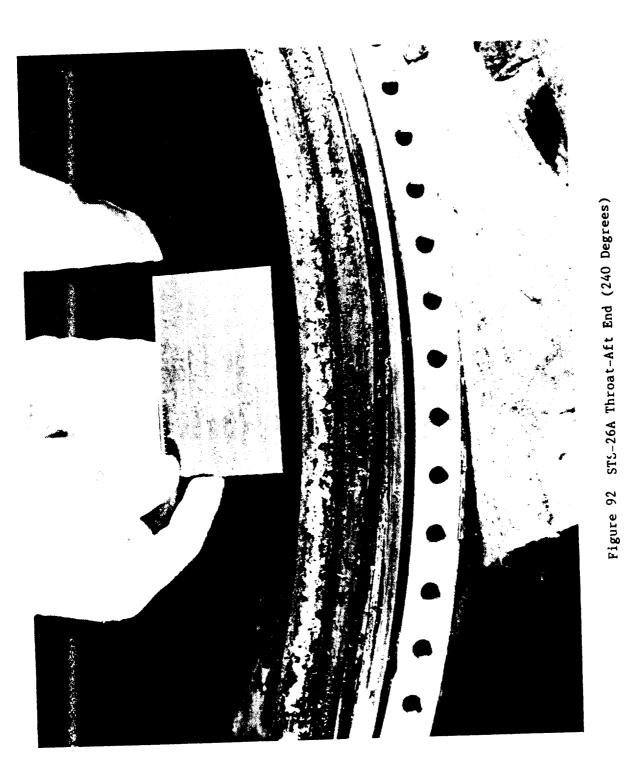
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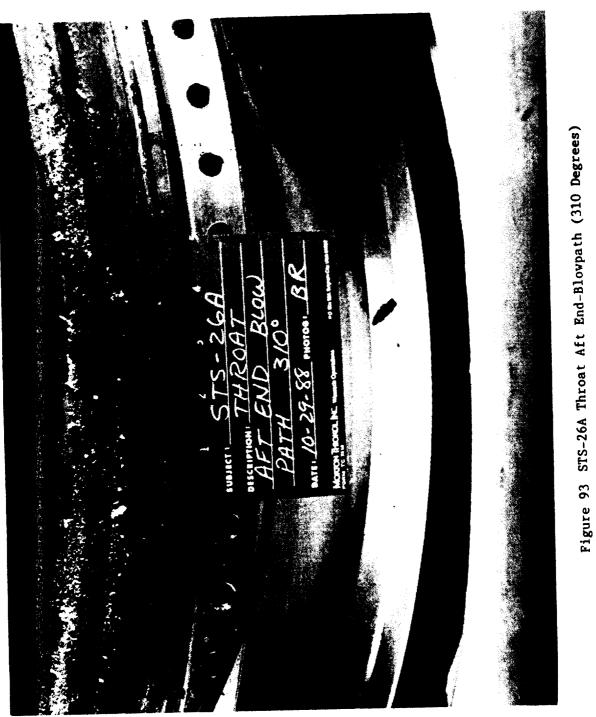
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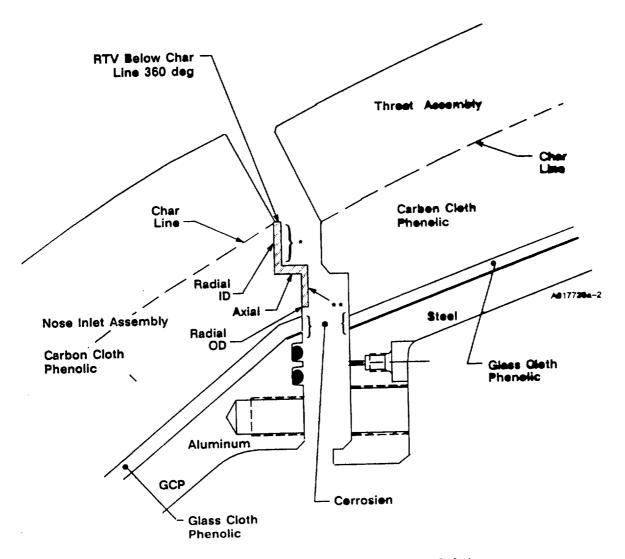


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*RTV filled radial ID circumferentially except from 309 deg to 313 deg **RTV extended onto radial OD intermittently around circumference

Figure 94 STS-26A-Nese Inlet/Throat Heusing Jeint

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Figure 95 STS-26A Throat-Forward End (0 Degrees)

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Figure 96 STS-26A Throat-Forward End (120 Degrees)

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Figure 97 STS-26A Throat-Forward End (240 Degrees)

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Figure 98 STS-26A Aft Inlet (-504) Ring-Aft End (0 Degrees)

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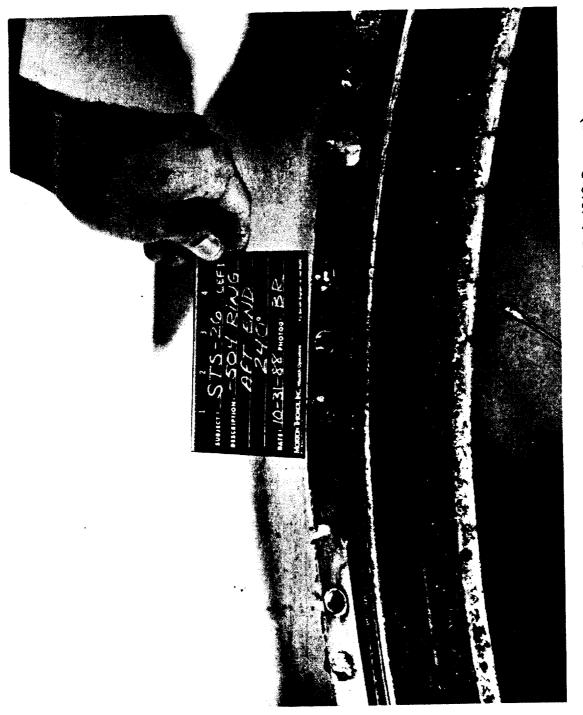
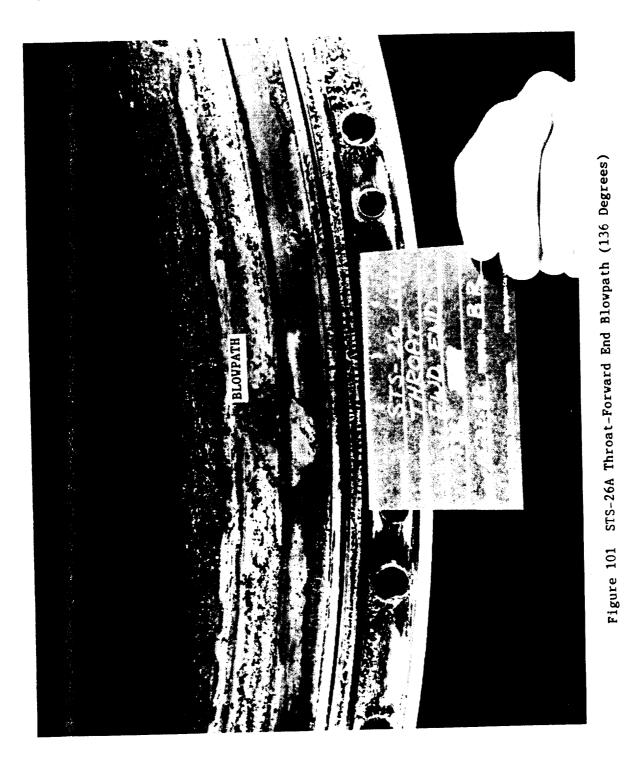


Figure 100 STS-26A Aft Inlet (-504) Ring-Aft End (240 Degrees)

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Figure 102 STS-26A Aft Inlet (-504) Ring-Aft End Blowpath (136 Degrees) BLOUPATH 0

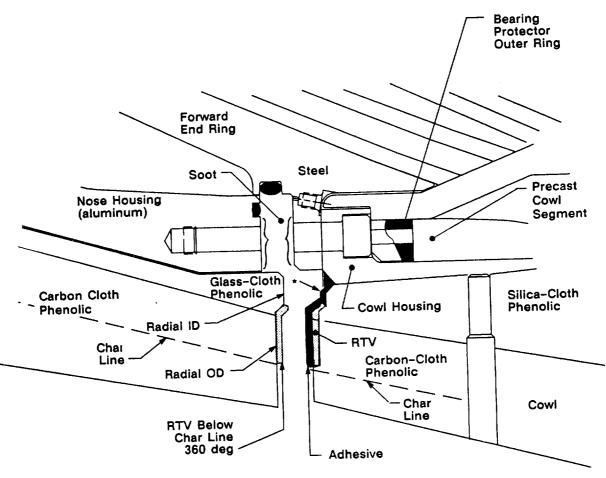
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*Blowpath at 216 deg Eroded the Adhesive and Charred the SCP

Figure 103 STS-26A Nose Inlet Housing/Flex Bearing Joint

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Figure 104 STS-26A Cowl-Forward End (O Degrees)

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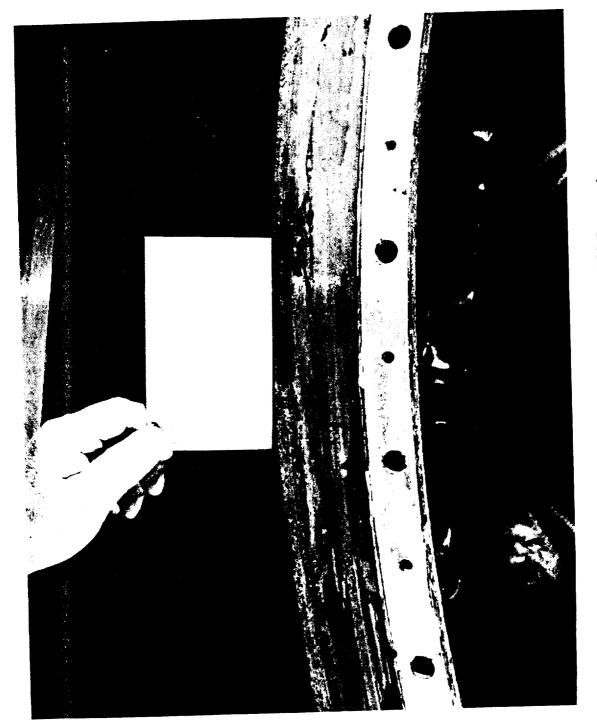


Figure 105 STS-26A Cowl-Forward End (120 Degrees)

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Figure 106 STS-26A Cowl-Forward End (240 Degrees)

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Figure 107 STS-26A Nose Cap-Aft End (0 Degrees)

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Figure 108 STS-26A Nose Cap-Aft End (120 Degrees)

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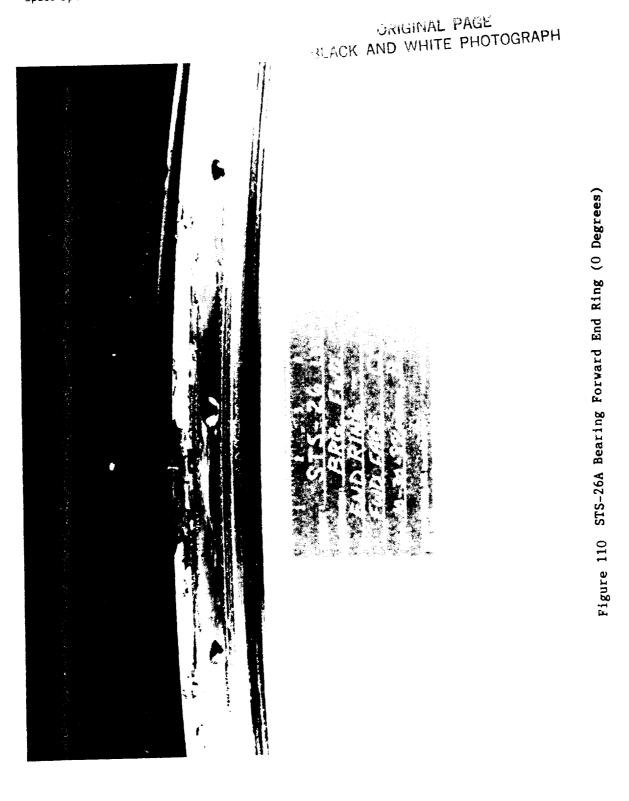


Figure 109 STS-26A Nose Cap-Aft End (240 Degrees)

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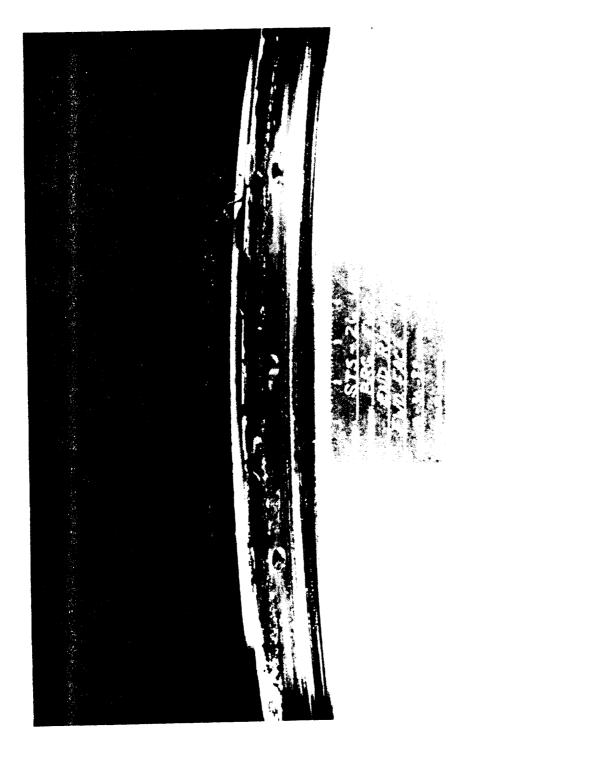
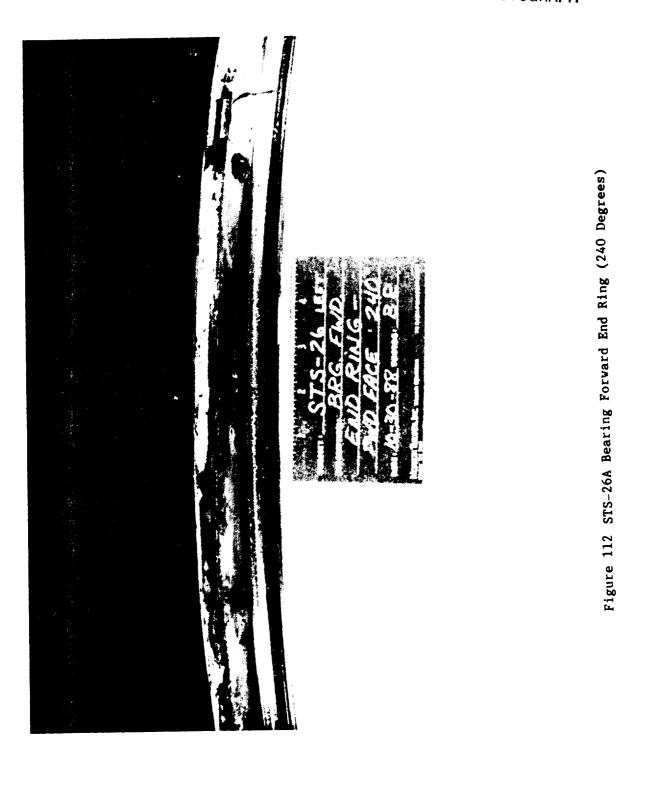


Figure 111 STS-26A Bearing Forward End Ring (120 Degrees)

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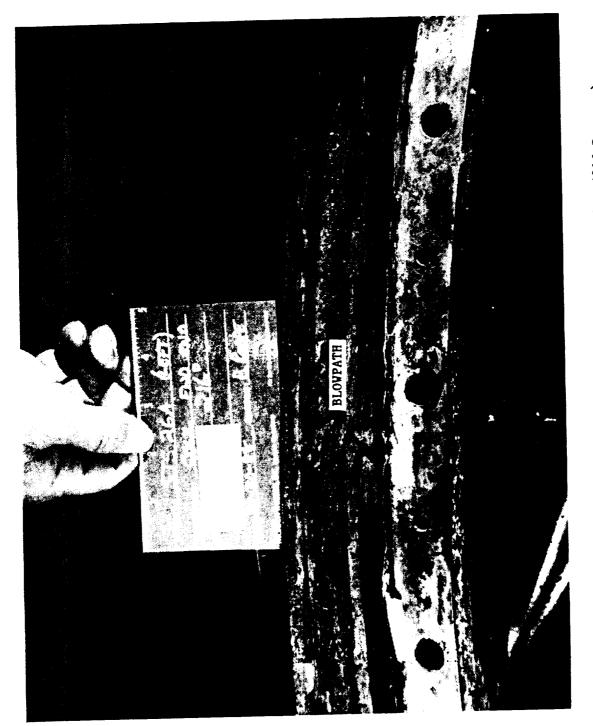


Figure 113 STS-26A Cowl Forward End-Blowpath Location (216 Degrees)

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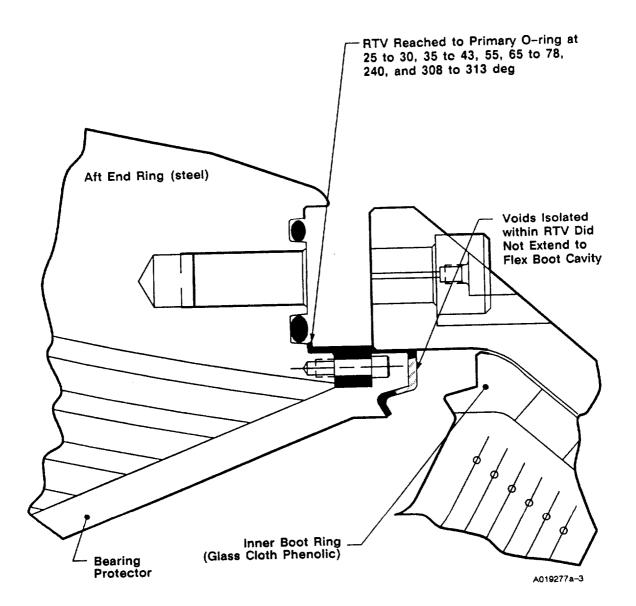


Figure 114 STS-26A—Flex Bearing/Fixed Housing Joint

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Figure 115 STS-26A Fixed Housing Forward End (0 Degrees)

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Figure 116 STS-26A Fixed Housing Forward End (120 Degrees)

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Figure 117 STS-26A Fixed Housing Forward End (240 Degrees)

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Figure 119

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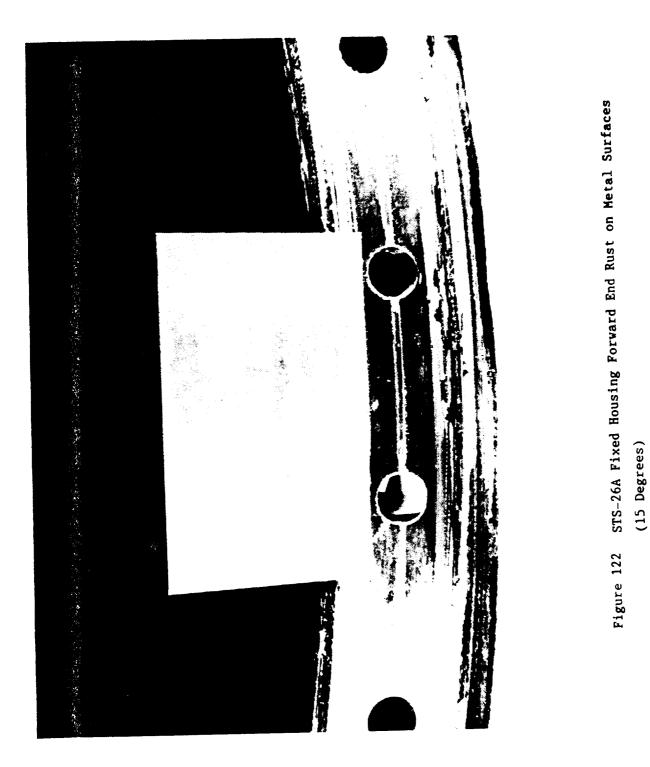
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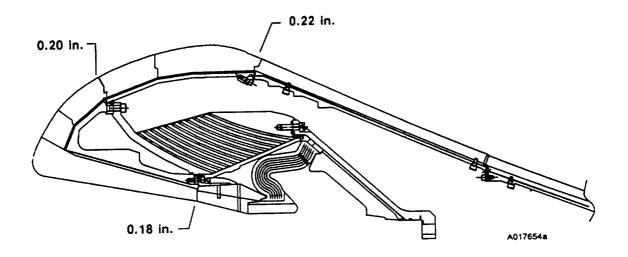


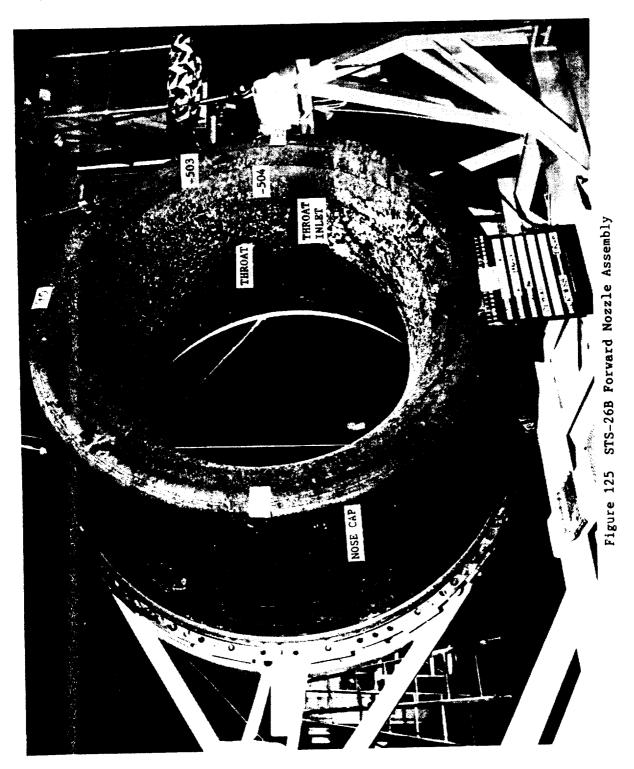
Figure 124 STS-26B Joint Flow Surface Gap Openings

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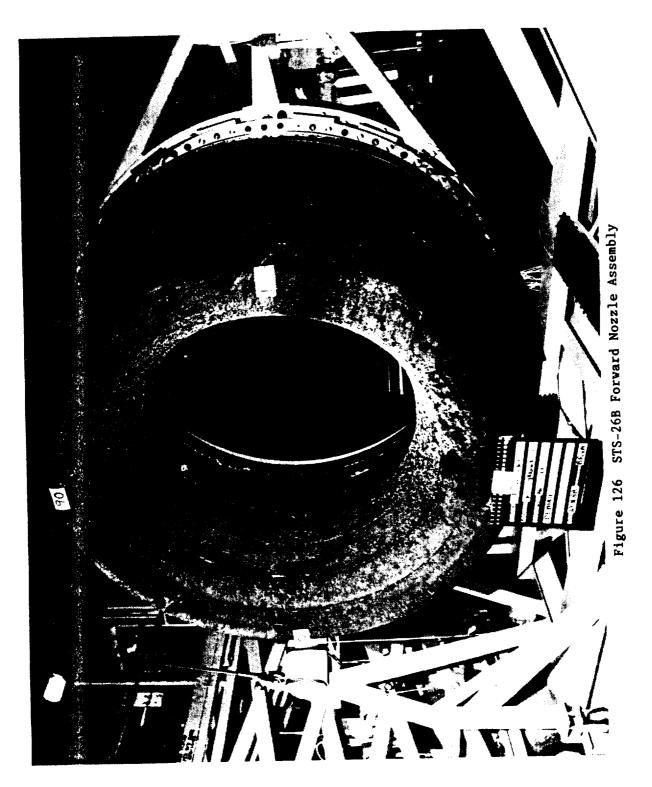
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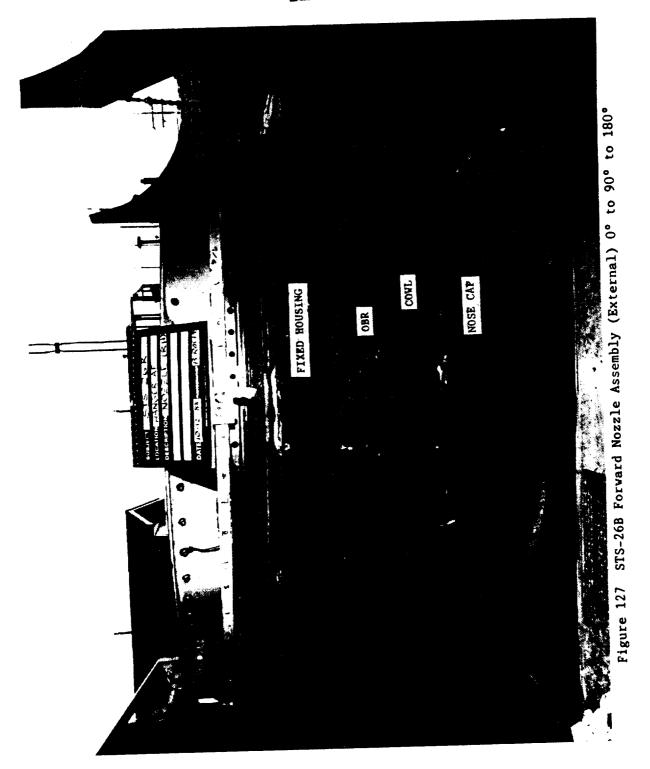


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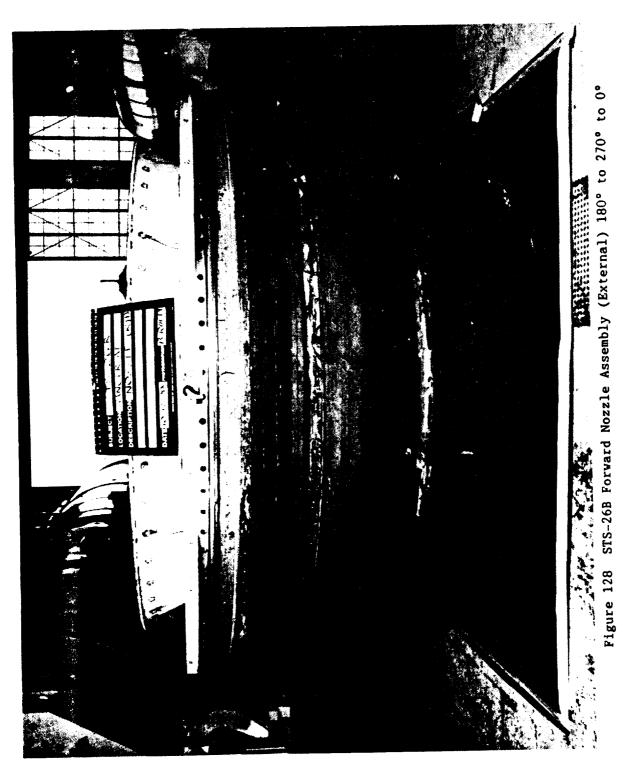
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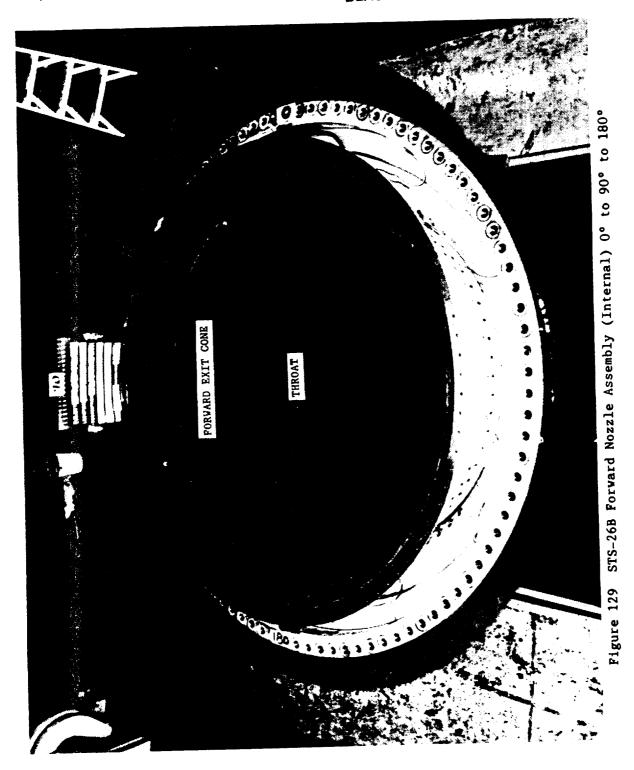
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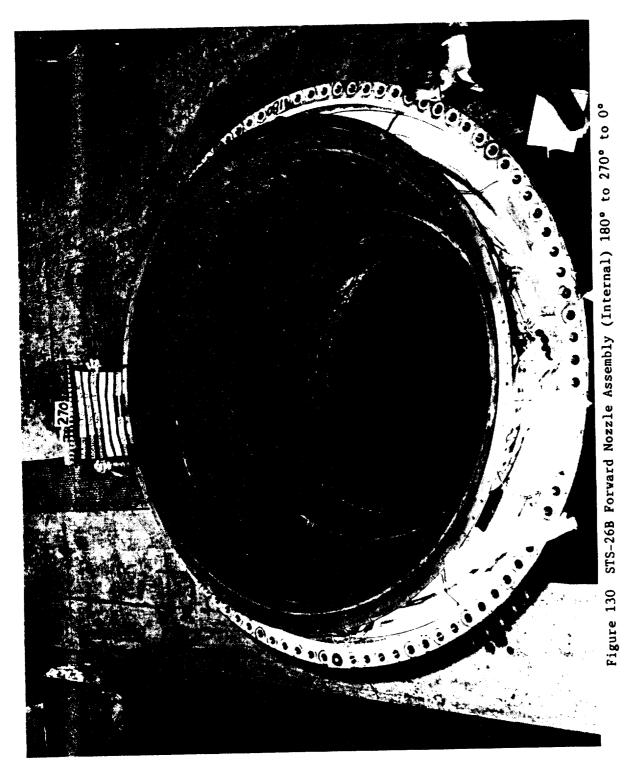
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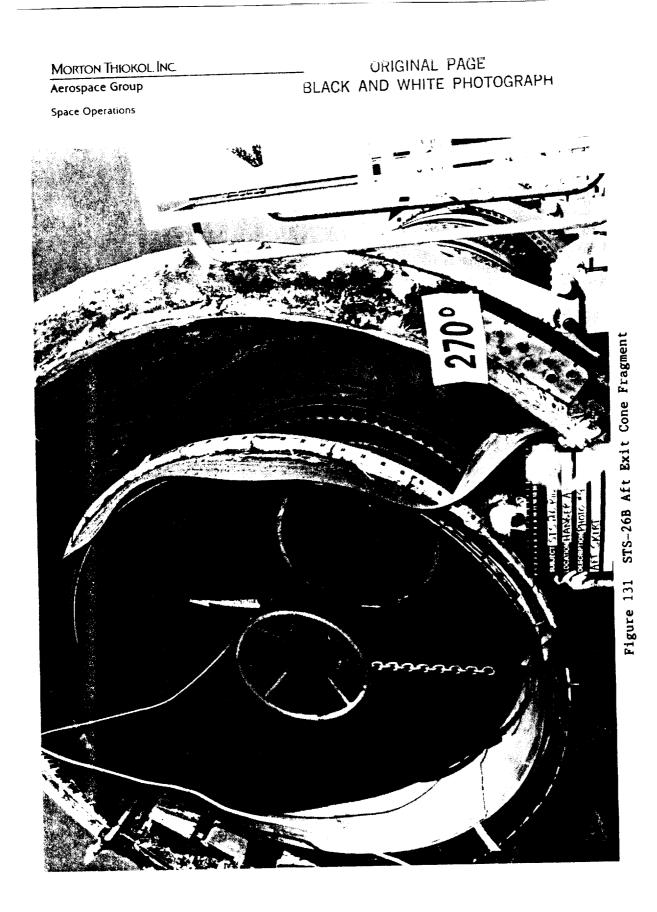
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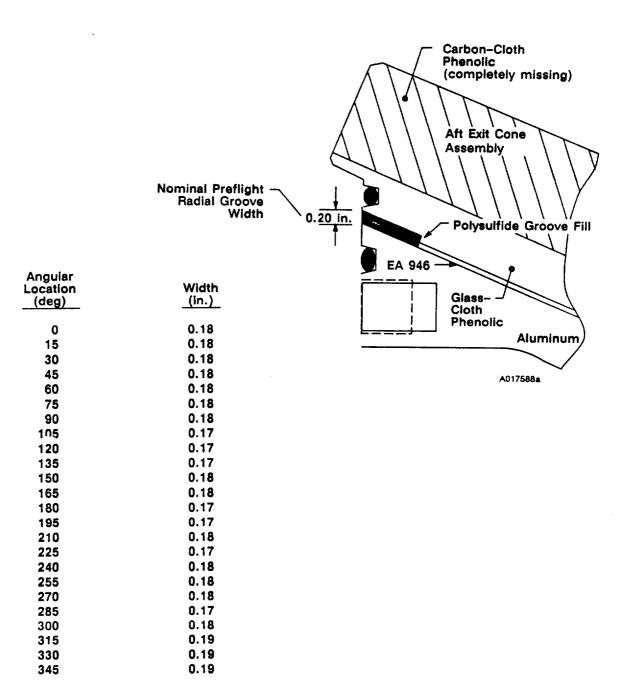


Table 9 STS-26B Aft Exit Cone Post-Flight Polysulfide Groove Radial Widths

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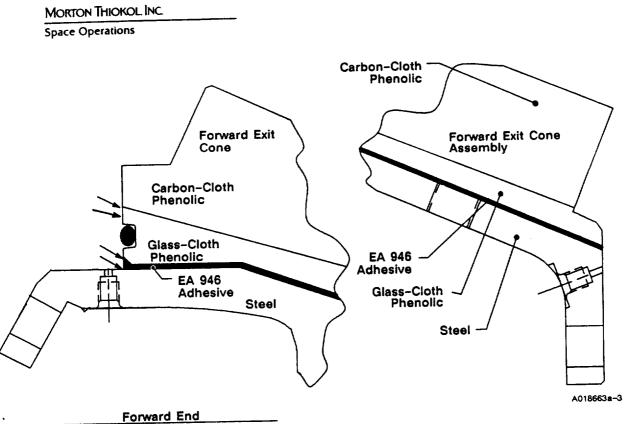
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Forward End				
Location (deg)	Radial Separation (in.)	Separation Type		
0 15	0.05 0.03	Metal/Adhesive Metal/Adhesive		
30	0.005	Metal/Adhesi√e Metal/Adhesive		
45 60	0.005 0.005	Metal/Adhesive		
60	0.03	GCP Metal/Adhesive		
75 75	0.02 0.03	GCP		
90	0.005	Metal/Adhesive Cohesive		
90 105	0.04 0.01	Metal/Adhesive		
105	0.02 0.005	GCP/CCP GCP		
120 135	0.005	Metal/Adhesive		
150	0.03 0.005	Metal/Adhesive Metal/Adhesive		
165 180	0.005	Metal/Adhesive		
195	0.005 0.005	Metal/Adhesive Metal/Adhesive		
210 225	0.005	Metal/Adhesive		
240	0.005 0.005	Metal/Adhesive Metal/Adhesive		
255 270	0.01	Metal/Adhesive		
285 300	0.005 0.005	Metal/Adhesive Metal/Adhesive		
315	0.005	Metal/Adhesive		
330 345	0.01 0.02	Metal/Adhesive Metal/Adhesive		

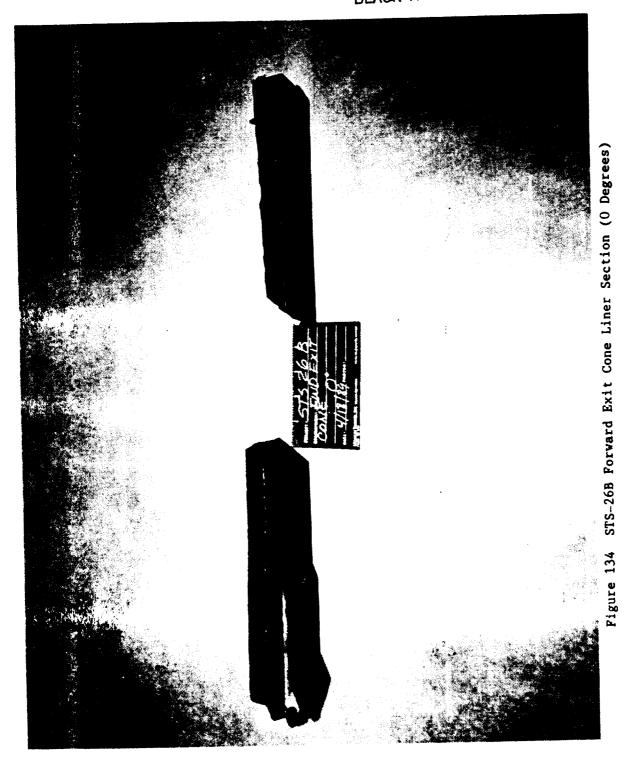
Figure 133 STS-26B Forward Exit Cone Bondline Separations

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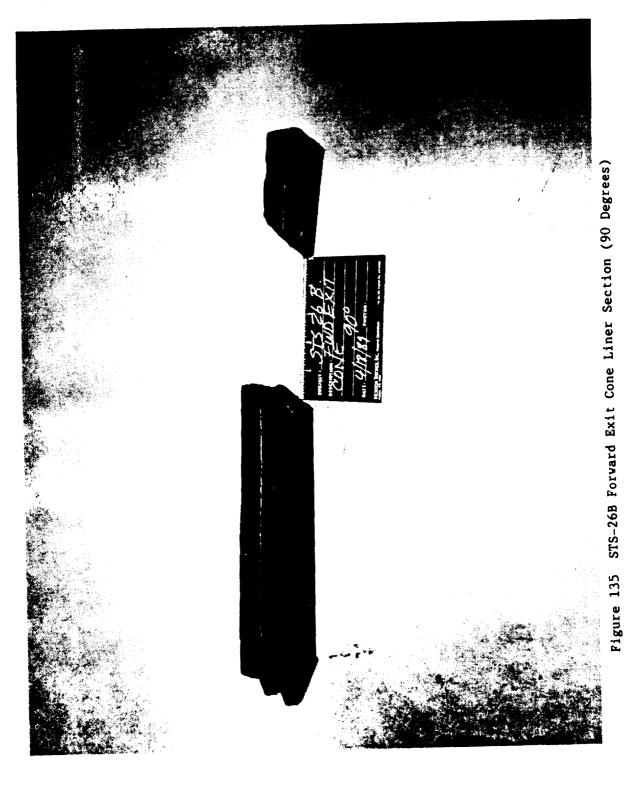


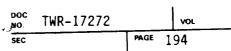
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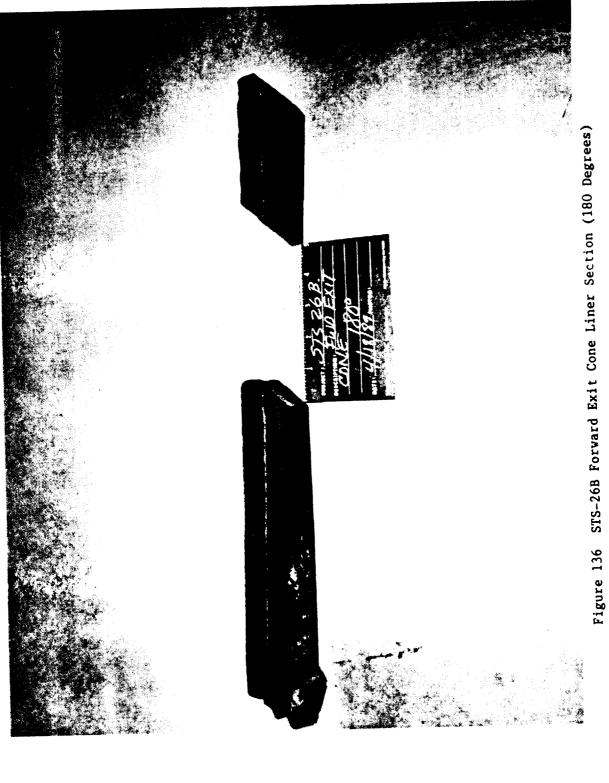


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STS-26B Forward Exit Cone Liner Section (270 Degrees) Figure 137

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Tite 0.66 0.66 0.29 NA NA <td>Kessing Cher</td> <td>- 0</td> <td>+</td> <td>•</td> <td>N A</td> <td>N N</td> <td>NA</td> <td>N N</td> <td>N N</td> <td>۳.</td> <td>0.72</td>	Kessing Cher	- 0	+	•	N A	N N	NA	N N	N N	۳.	0.72
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<pre>Ther* 0.64 0.62 0.62 NA NA NA NA NA NA 0.62 0.62 Ther Thickness 1.70 1.47 1.41 NA NA NA 1.19 1.27 C 1.710 1.714 1.510 1.414 1.345 1.314 1.321 1.366 1.40 Safety 0.05 0.17 0.14 NA NA NA NA 1.321 1.366 1.40 Erosion 0.47 0.36 0.35 NA NA NA NA NA 0.20 0.17 0.16 Erosion 0.47 0.36 0.35 NA NA NA NA 0.20 0.17 0.72 Char* 0.75 0.81 0.83 NA NA NA NA 0.60 0.77 0.73 Char* 0.75 0.81 0.83 NA NA NA NA 1.20 1.11 1.10 C 1.65 Char* 0.60 0.65 NA NA NA NA 0.20 0.17 0.16 C 2.65 Char* 0.76 0.12 0.05 NA NA NA NA 0.20 0.17 0.16 Safety 0.60 0.65 NA NA NA NA 0.20 0.17 0.16 C 2.75 Char* 0.76 0.12 0.63 NA NA NA NA 0.20 0.17 0.16 C 2.65 Char* 0.76 0.12 0.05 NA NA NA NA NA 0.20 0.17 0.16 C 2.65 C 2.</pre>	Measured Char	0.80	0.77	٢.	NA	V N	NA	N A	N N	ŗ.'	11.0
<pre>1.10 1.47 1.41 MA NA NA NA NA NA NA 1.19 1.10 1.1366 1.40 2.1614 1.510 1.414 1.345 1.314 1.321 1.366 1.40 2.1614 1.510 1.414 1.345 1.314 1.321 1.366 1.40 2.161 5.20101 0.47 0.36 0.35 NA NA NA NA NA 0.20 0.17 0.78 5.161 0.53 NA NA NA NA 0.64 0.67 0.62 Char 0.75 0.81 0.83 NA NA NA NA 1.20 1.11 1.10 Char 0.75 0.61 0.65 NA NA NA NA 1.314 1.321 1.366 1.40 Char 0.60 0.65 NA NA NA NA NA 0.64 0.62 0.62 Char 0.75 0.61 1.53 NA NA NA NA 1.30 1.316 1.40 Char 0.06 0.12 0.05 NA NA NA NA 0.010 0.23 0.23 Char 1.69 1.53 1.53 NA NA NA NA 0.010 0.23 0.23 Char 0.06 0.12 0.05 NA NA NA NA NA 0.010 0.23 0.23 Char 1.69 1.51 1.510 1.414 1.345 1.314 1.326 1.40 Char 1.69 1.53 1.53 NA NA NA NA NA 0.10 0.23 0.23 Char 1.69 1.51 1.510 1.414 1.345 1.314 1.326 1.40 Char 1.69 1.51 1.53 NA NA NA NA NA NA 0.10 0.23 0.23 Char 1.69 1.51 1.510 1.414 1.345 1.314 1.326 1.40 Char 1.69 1.53 1.53 NA NA NA NA NA 0.10 0.23 0.23 A magin of Safety =</pre>	Adjusted Char*	0.64	0.62	9	N A	YN	NA	N N	N.N	۰.	29.0
<pre>iner Thickness 1.789 1.714 1.614 1.510 1.414 1.345 1.314 1.321 1.300 1.70 Safety 0.05 0.17 0.14 NA NA NA NA NA NA 0.15 0.11 Erosion 0.47 0.36 0.35 NA NA NA NA 0.20 0.17 0.16 Erosion 0.47 0.36 0.35 NA NA NA NA 0.64 0.62 0.62 Char 0.75 0.81 0.83 NA NA NA NA 0.64 0.67 0.73 Char 0.75 0.65 0.66 NA NA NA NA 1.20 1.11 1.10 Char 1.69 1.53 1.53 NA NA NA NA 1.20 1.11 1.10 Char 1.69 1.53 1.53 NA NA NA NA 0.10 0.23 0.23 Char 0.06 0.12 0.05 NA NA NA NA 0.10 0.23 0.23 Char 1.789 1.714 1.614 1.510 1.414 1.345 1.314 1.321 1.366 1.40 Char 1.789 1.714 1.614 1.510 1.414 1.345 1.314 1.321 1.366 1.40 Char 1.789 1.714 1.614 1.510 1.414 1.345 1.314 1.321 1.366 1.40 Char 1.69 1.53 1.53 NA NA NA NA 0.10 0.23 0.23 Char 1.789 1.714 1.614 1.510 1.414 1.345 1.314 1.321 1.306 1.40 Char 1.780 0.06 0.12 0.05 NA NA NA NA NA 0.10 0.23 0.23 Char 1.780 1.714 1.614 1.510 1.414 1.345 1.314 1.321 1.366 1.40 Char 1.780 1.714 1.614 1.510 1.414 1.345 1.314 1.321 1.306 1.40 Char 1.780 0.06 0.12 0.05 NA /pre>	2E + 1.25AC	. 70	1.47	.41	A N		A N	VN	Ň		3
Safety 0.05 0.17 0.14 MA MA MA MA MA WA 0.13 0.14 Sefety 0.47 0.36 0.35 MA NA MA MA 0.20 0.17 0.1 Erosion 0.47 0.36 0.35 MA NA MA MA 0.20 0.17 0.1 Char 0.75 0.81 0.83 NA NA MA MA 0.60 0.67 0.7 Char 1.69 1.53 1.53 NA NA MA MA 0.64 0.62 0.6 Char 1.69 1.53 1.53 NA NA MA MA 1.20 1.11 1.1 Liner Thickness 1.789 1.714 1.614 1.510 1.414 1.345 1.314 1.320 1.1366 1.4 Liner Thickness 1.789 1.714 1.614 1.510 1.414 1.345 1.314 1.321 1.326 1.4 Liner Thickness 1.789 1.714 1.614 1.510 1.414 1.345 1.314 1.321 1.326 1.4 Liner Thickness 1.789 1.714 1.614 1.510 1.414 1.345 1.314 1.321 1.316 1.4 Liner Thickness 1.789 1.714 1.614 1.510 1.414 1.345 1.314 1.321 1.316 1.4 Liner Thickness 1.789 1.714 1.614 1.510 1.414 1.345 1.314 1.321 1.316 1.4 Liner Thickness 1.789 1.714 1.614 1.510 1.414 1.345 1.314 1.321 1.316 1.4 Liner Thickness 1.789 1.714 1.614 1.510 1.414 1.345 1.314 1.321 1.316 1.4 Liner Thickness 1.789 1.714 1.614 1.510 1.414 1.345 1.314 1.321 1.316 1.4 Liner Thickness 1.789 1.714 1.614 1.510 1.414 1.345 1.314 1.321 1.316 1.4 Liner Thickness 1.789 1.714 1.510 1.414 1.345 1.314 1.231 1.316 1.4 Margin of Safety =	knes	. 78	1.714	.61	. 51		7 7		. 3 4	2.	2.
<pre>ss Froston 0.47 0.36 0.35 MA NA NA NA 0.20 0.17 0.1 Char 0.75 0.81 0.83 NA NA NA NA 0.80 0.77 0.7 Char 0.60 0.65 0.66 NA NA NA NA 0.80 0.77 0.7 Char 1.69 1.53 1.53 NA NA NA NA 1.20 1.11 Liner Thickness 1.789 1.714 1.614 1.510 1.414 1.345 1.314 1.321 1.366 1.4 Ciner Thickness 1.789 1.714 1.614 1.510 1.414 1.345 1.314 1.321 1.366 1.4 Ciner Thickness 1.789 1.714 1.614 1.510 1.414 1.345 1.314 1.321 1.366 1.4 Ciner Thickness 1.789 1.714 1.614 1.510 1.414 1.345 1.314 1.321 1.366 1.4 Ciner Thickness 1.789 1.714 1.614 1.510 1.414 1.345 1.314 1.321 1.366 1.4 Ciner Thickness 1.789 1.714 1.614 1.510 1.414 1.345 1.314 1.321 1.366 1.4 Ciner Thickness 1.789 1.714 1.614 1.510 1.414 1.345 1.314 1.321 1.366 1.4 Ciner Thickness 1.789 1.714 1.614 1.510 1.414 1.345 1.314 1.321 1.366 1.4 Ciner Thickness 1.789 1.714 1.614 1.510 1.414 1.345 1.314 1.321 1.366 1.4 Ciner Thickness 1.789 1.714 1.614 1.510 1.414 1.345 1.314 1.321 1.366 1.4 Ciner Thickness 1.789 1.714 1.614 1.510 1.414 1.345 1.314 1.321 1.366 1.4 Ciner Thickness 1.789 1.714 1.614 1.510 1.414 1.345 1.314 1.321 1.366 1.4 Ciner Thickness 1.789 1.714 1.614 1.510 1.414 1.345 1.314 1.321 1.366 1.4 Ciner Thickness 1.789 1.714 1.614 1.510 1.414 1.345 1.314 1.356 1.4 Ciner Thickness 1.789 1.714 1.614 1.55 X adj char* 1.4 Ciner Thickness 1.755 X adj char* 1.55 X</pre>	οĘ	0.05	0.17	-	N N	N	A A	NA	4	-	-
Erosion 0.47 0.36 0.35 NA NA NA NA 0.20 0.17 0.1 Char Char Char Char Char Char Char Char Char Char Char Char Char Char Char Co Co Co Co Co Co Co Co Co Co	270 degrees										
<pre>Char 0.75 0.81 0.83 NA NA NA NA NA 0.80 0.77 0.7 Char 0.60 0.65 0.66 NA NA NA NA 0.64 0.62 0.6 Liner Thickness 1.69 1.53 1.53 NA NA NA 1.20 1.11 1.1 Liner Thickness 1.789 1.714 1.614 1.510 1.414 1.345 1.314 1.321 1.366 1.4 Safety 0.06 0.12 0.05 NA NA NA NA 0.10 0.23 0.2 Margin of Safety =</pre>	Measurad Erosion		0.36	Ξ.	NA	N A	NA	NA	0.20	1	7
Char 0.60 0.65 0.66 NA NA NA NA 0.64 0.62 0.6 C. 1.69 1.53 1.53 NA NA NA NA 1.20 1.11 1.1 Liner Thickness 1.789 1.714 1.614 1.510 1.414 1.345 1.314 1.321 1.366 1.4 Safety 0.06 0.12 0.05 NA NA NA NA 0.10 0.23 0.2 Margin of Safety = minimum liner thickness - 1 Margin of Safety =	Measured Char	•	0.81	۰.	NA	NA	N A	NA	0.80	٢.	٢.
NG 1.69 1.53 1.53 NA NA NA 1.20 1.11 1.1 Liner Thickness 1.789 1.714 1.614 1.510 1.414 1.345 1.314 1.366 1.4 Liner Thickness 1.789 1.714 1.614 1.510 1.414 1.345 1.321 1.366 1.4 Safety 0.06 0.12 0.05 NA NA NA 0.10 0.23	Char	•	0.65	9.	NA	NA	NA	NA	9.64	Ŷ.	9.
Liner Thickness 1.789 1.714 1.614 1.510 1.414 1.345 1.314 1.321 1.366 1.4 Safety 0.06 0.12 0.05 NA NA NA 0.10 0.23 0.2 * Measured Char Adjusted to end of action time Margin of Safety =	7E + 1 25AC	•	1.53	ŝ	N N	NA	NA	NA	1.20	.11	7
0.06 0.12 0.05 NA KA NA NA 0.10 0.23 0.2 • Measured Char Adjusted to end of action time miner thickness Margin of Safety =	Liner Thicknes	. 78	11.	9.	1.510		.34	1.314	1.321	.36	۳.
Measured Cher Adjusted to end of action time minimum liner thickness rgin of Safety =		. 06	0.12	۰.	V N	NA	NA	NA	0.10	?	?
minimum liner thickness rgin of Safety =		9 7.	ъ	Adjusted	to en d						
rgin of Safety =					ļ	er thi	kness				
		rgin		*	rosion	1.25	di char	; 			
				•			;,				

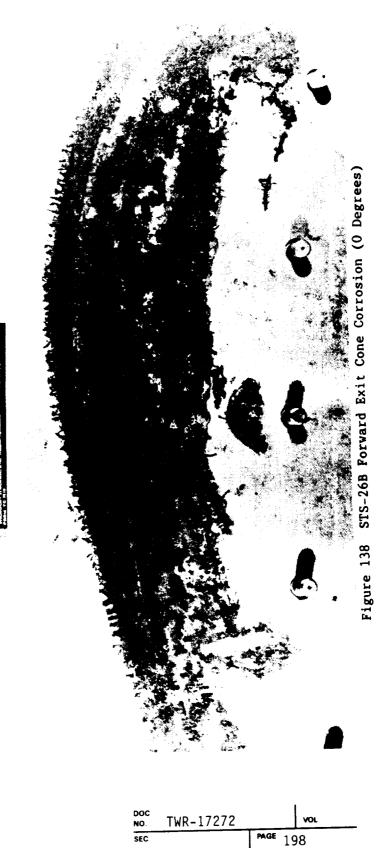
Refer to Figure 18 for Station Locations

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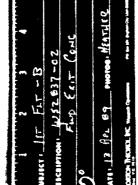
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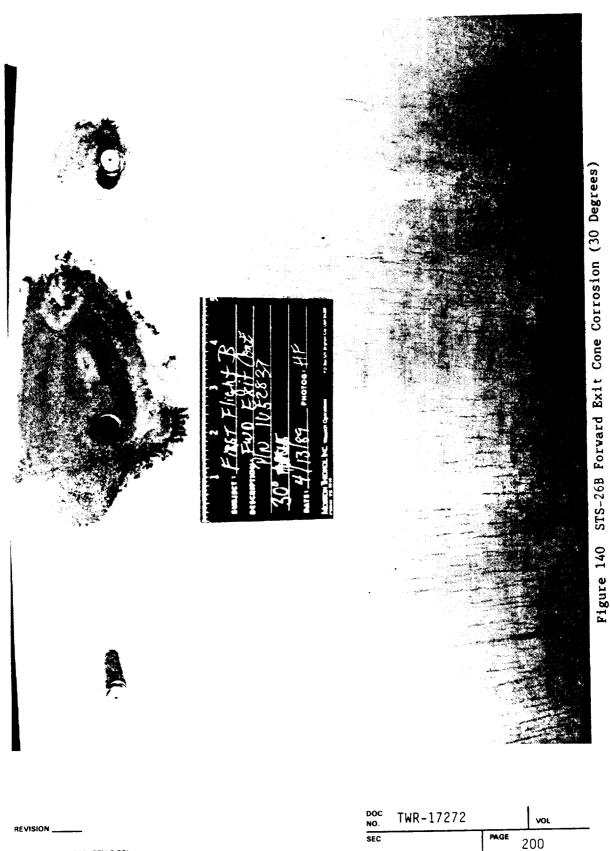
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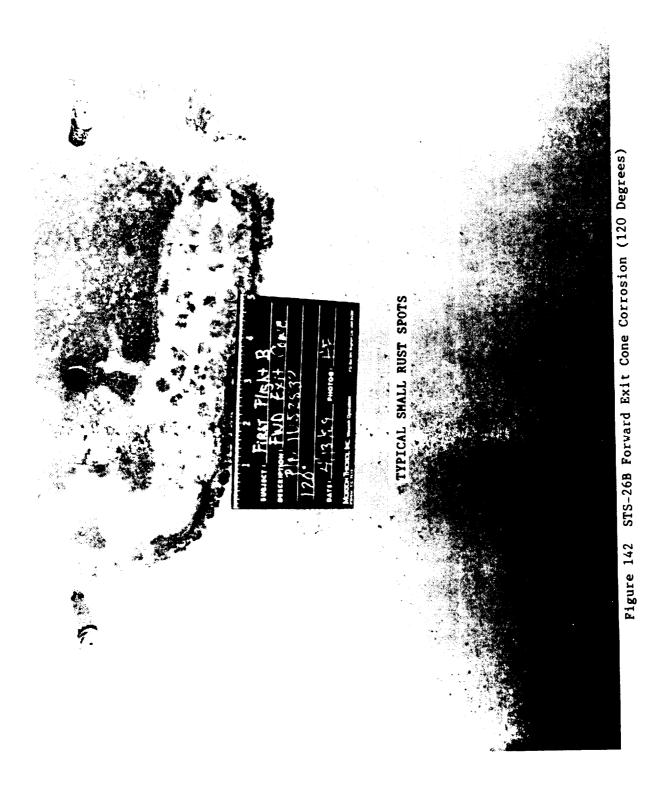
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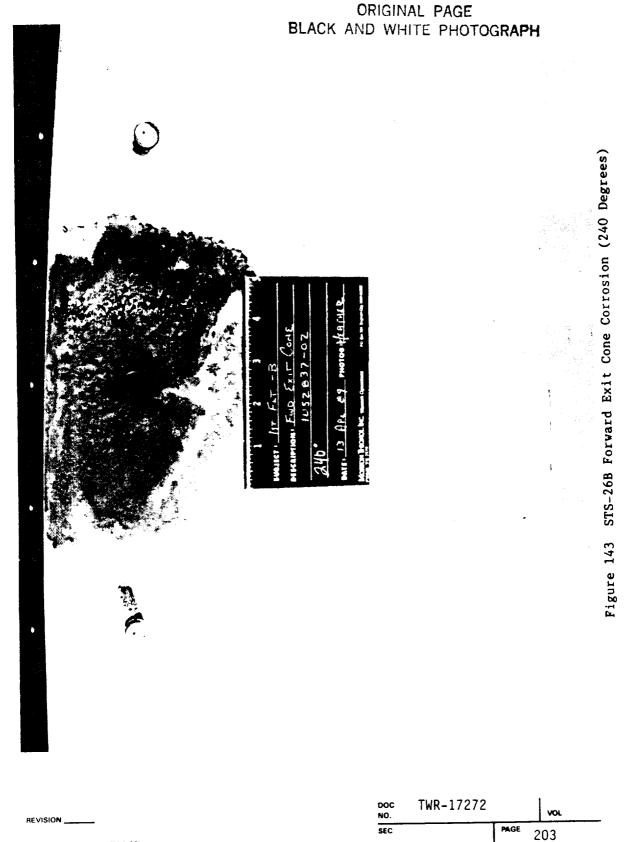
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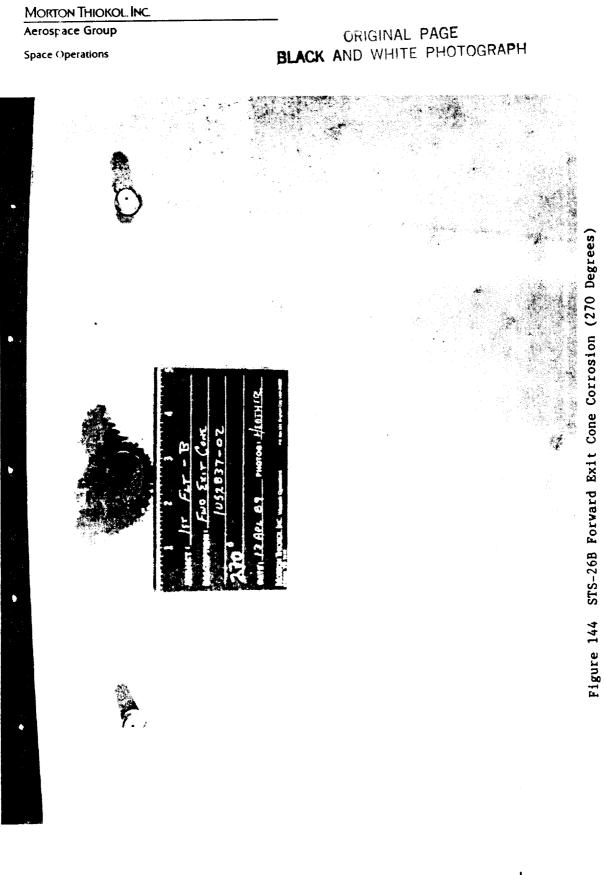
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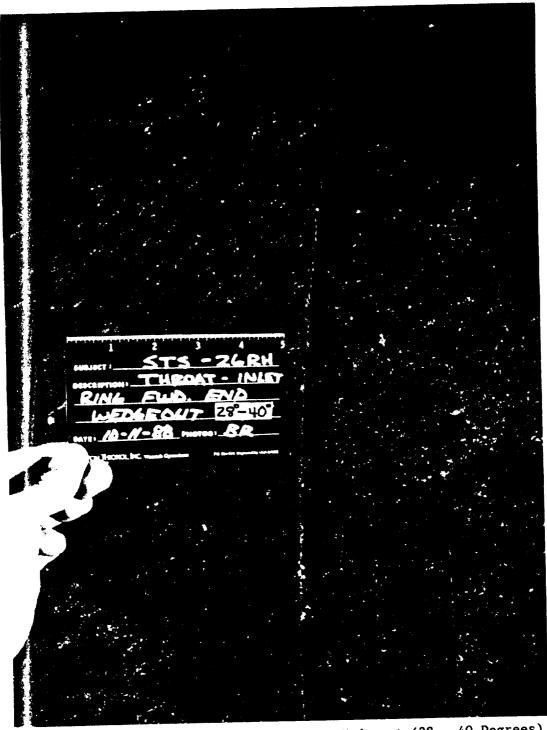
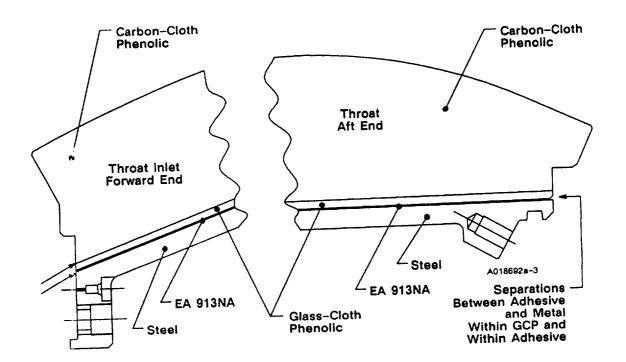


Figure 145 STS-26B Throat Inlet Ring Wedgeout (28 - 40 Degrees)

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Fwd End Bondline Separations				Aft End Bondline Separations			
Location (deg)	Radial Separation (in.)	Separation	Location (deg)	Radial Separation (in.)	Separation		
0 15 20 45 45 5 9 10 5 10 5 10 5 10 5 10 5 10 5 10 5	0.030 0.030 0.030 0.030 0.020 0.030 0.030 0.030 0.020	Metal/Adhesive Metal/Adhesive Metal/Adhesive Metal/Adhesive Metal/Adhesive Metal/Adhesive Metal/Adhesive Metal/Adhesive Metal/Adhesive Metal/Adhesive Metal/Adhesive Metal/Adhesive Metal/Adhesive Metal/Adhesive Metal/Adhesive GCP/CCP Metal/Adhesive GCP/CCP	0 15 30 45 60 75 90 105 120 135 150 165 180 195 210 225 240 255 270 285 300 315 330 345 345	0.030 0.030 0.020 0.040 0.040 0.040 0.040 0.040 0.050 0.050 0.050 0.050 0.050 0.020 0.020 0.010 0.030 0.010 0.030 0.030 0.030 0.030 0.030 0.030 0.030 0.030	Metal/Adhesive GCP Metal/Adhesive Within Adhesive Metal/Adhesive Metal/Adhesive Within Adhesive Wetal/Adhesive Metal/Adhesive		

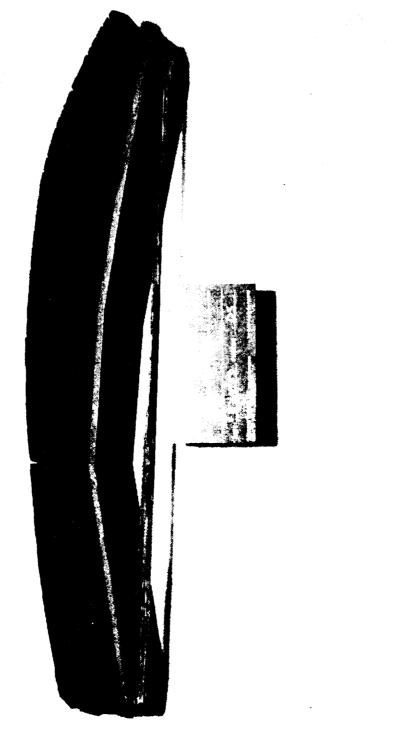
Figure 146 STS-26B Throat Assembly Bondline Separations

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STS-26B Throat/Throat
Figure 147

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Inlet Section (0 Degrees)

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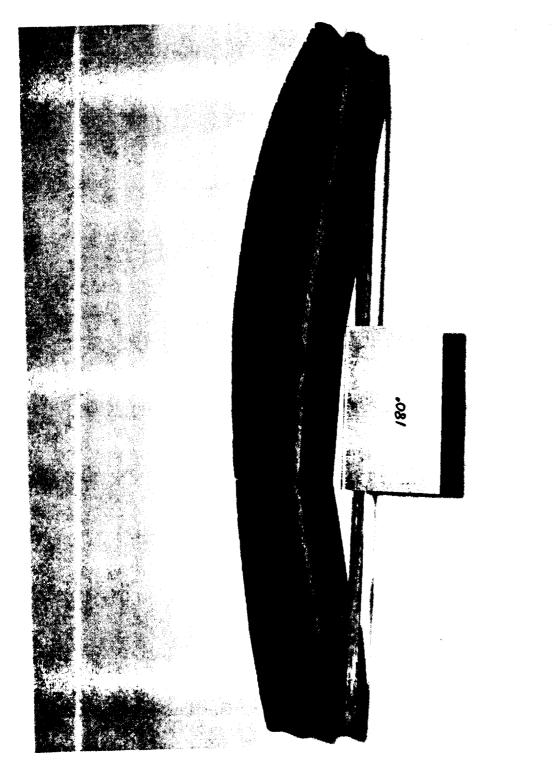


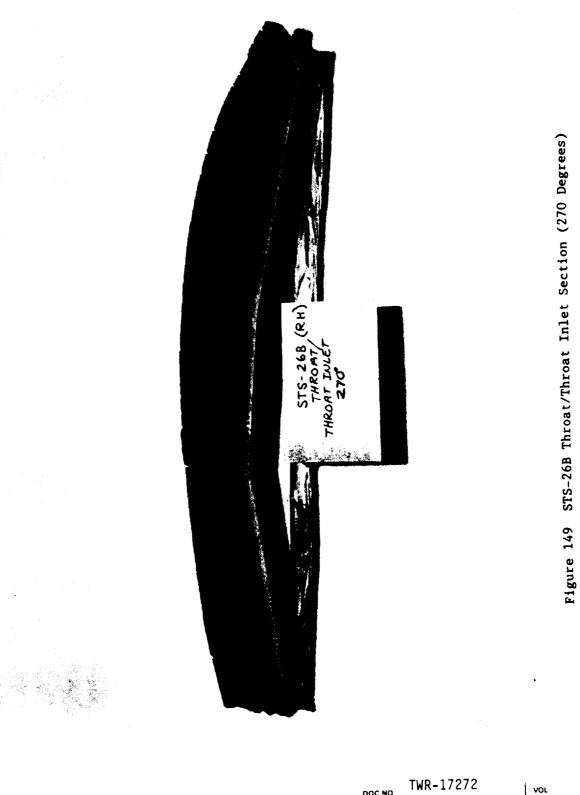
Figure 148 STS-26B Throat/Throat Inl&t Section (180 Degrees)

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			Table	11 STS	5-26B Throat		Assembly Erosion	Irosion	and Char	c Data			
and for foretton						5	stations				;		
	7	7	-	'9	-	10	12	14	16	18	20	2	6 7
0 degrees							20.	~	1.05	88.0	0.71	0.49	0.43
Measurad Erosion	86.0	1.03	1.03	1.15	1.18	1.10	1.00	0.66	0.66	0.70	0.67	0'.79	0.86
	0.61	0.62	0.64	* * * • •	0.45	0.41	94.0	1	0.50	0.5 u	0.0	1.72	1.67
Adjusted Char *	0.46	2.64	2.66	2.90	92	2.71	2.72	~ ~	3.710	3.586	3.232	2.583	2.110
2E + 1.25AC RSRM Min Liner Thickness Margin of Safety	3.174	3.247	3.314 0.25	3.280 0.13	3.189 0.09	3.397 0.26	62.0	1 0 1	0.36	4	0.58	0.50	0.27
Searcet Co													.,
			,			1 09	1.09	1.02	1.02		0.64		
Measured Erosion	1.06	1.10	1.13	1.20	0.62	0.59	0.57	0.60	0.59	0.67	9/ · 0		0.61
Measured Char	0.56	- 0 - 0 - 0			0.47	0.44	0.43	0.45	0.44 		66.1	1.60	5.0
Adjusted Char *	1 4 7 7 4 7	2.71		•	2.86	. 73	2.71	2.60	012.1	3.586	3.232	2.583	2.110
2E + 1.25AC	1.174	3.247	3.314	•	3.189	3.397	110.5			0.57	. 62	0.61	0.34
RSRM Min Liner inicaness Margin of Safety	0.20	0.20	0.15	•	0.11	0.24	2						
180 degraes											07	0.53	0.45
	1.08	1.11	1.18	1.19	1.21	1.14	1.10	1.10	0.50	0.61	0.75	0.74	0.79
Measured Fronton Londinal Char	0.58	0.55	0.56	0.58	0.60		0.42	0.38	0.38	0.46	- 56	0.56	65.0
Adducted (1995 Adjusted (Dat *	0.44	0.41	0.42	44.0	 	2.82	2.73	2.67	2.59	· •	.10		1.01
2E + 1.25AC	2.70	2.74	2.89	26.7 080 c	1.189	3.397	3.517	3.626	3.710	3.586	. 232		• •
rsam Min Liner Thickness Margin of Safety	3.174 0.17	3.2470.19	17.0	0.12	0.07	0.20	0.29	0.36	0.43	0.40	• n		
270 degrees								5			0.68	0.50	0.44
	1 06	1.10	-	1.17	1.14	1.12	1.0.1		0.59	. •	0.67	0.76	0.78
Measured Erosion Measured Fher	0.50	0.53	ŝ	0.59	0.60	50.D		. 4 3		٠.	0.50	0.57	65.0
resured Char	0.38	0.40	-			2.74	2.66	2.67	2.61	2.45	1.99	1./1	1011 C
2E + 1.25AC	2.59	<u> </u>	<u>،</u> م	2 0 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	1.189	3.397	3.517	3.626	3.710	. .	3.232		
RSRM Min Liner Thickness Marrin of Safety	0.23	3.24/0.20	0.17	0.13	0.12	0.24	0.32	0.36	0.42				
	* Measur	Measured char	adjusted	d to end	of action	n time							
TWR			1.1 m	inimum l:	iner thic	ckness		-					
-17	Margin o	of Safety	~ ~	erosion	•rosion + 1.25 X	∎dj ch	•						
272 21	Refer 1	Refer to Figure	25	r Statio	for Station Locations	ions							

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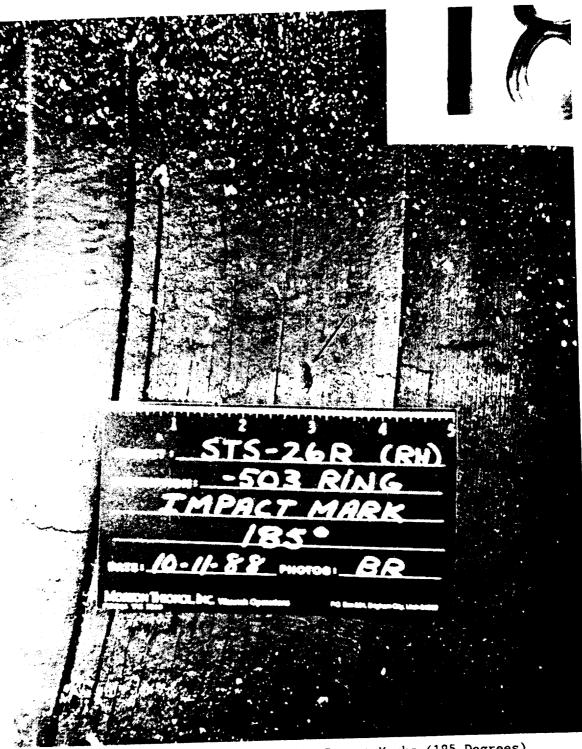


Figure 151 STS-26B (-503) Ring Impact Marks (185 Degrees)

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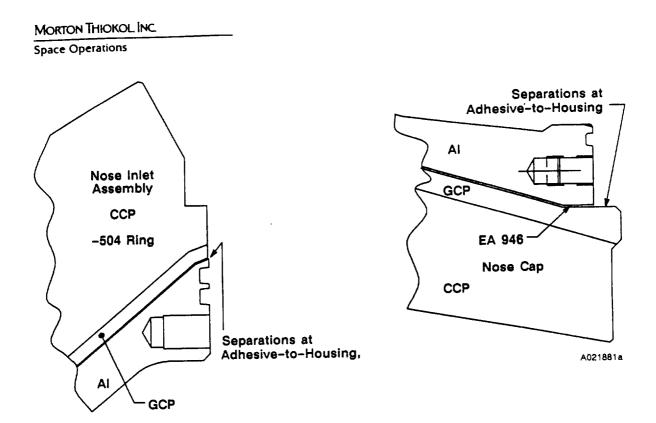
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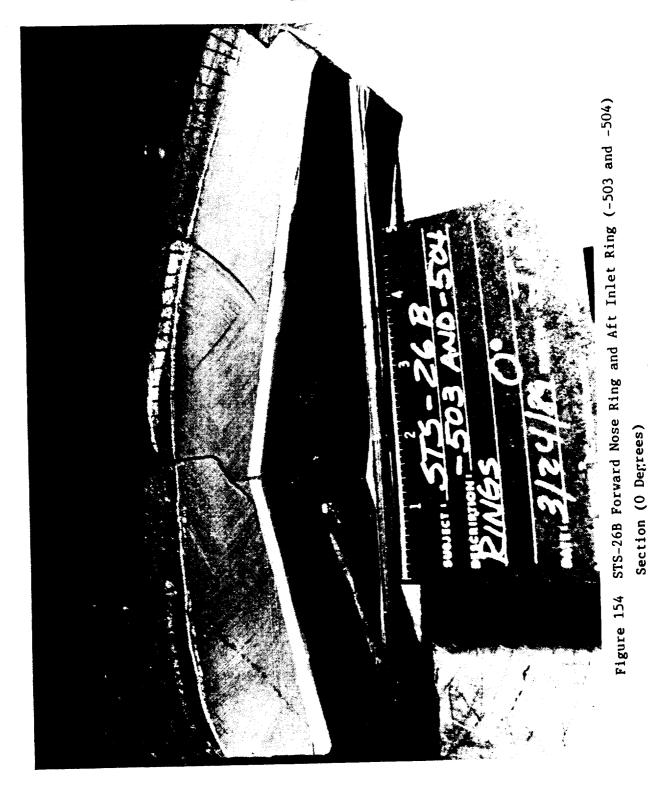
Location (deg)	Radial Separation (in.)	Separation Type*	Location (deg)	Radial Separation (in.)	Separation Type*
		Metal/Adhesive	105	0.005	Metal/Adhesive
238-245	0.020		135	0.005	Metal/Adhesive
250	0.020	Metal/Adhesive	150	J.005	Metal/Adhesive
			165	0.005	Metal/Adhesive
			180	0.005	Metal/Adhesive
			195	0.005	Metal/Adhesive
			210	0.005	Metal/Adhesive
			225	0.005	Metal/Adhesive
			240	0.005	Metal/Adhesive
			255	0.005	Metal/Adhesive
			285	0.005	Metal/Adhesive
			300	0.005	Metal/Adhesive
			315	0.005	Metal/Adhesive
			345	0.005	Metal/Adhesive

Figure 153 STS-26B Nose Inlet Assembly Bondline Separations

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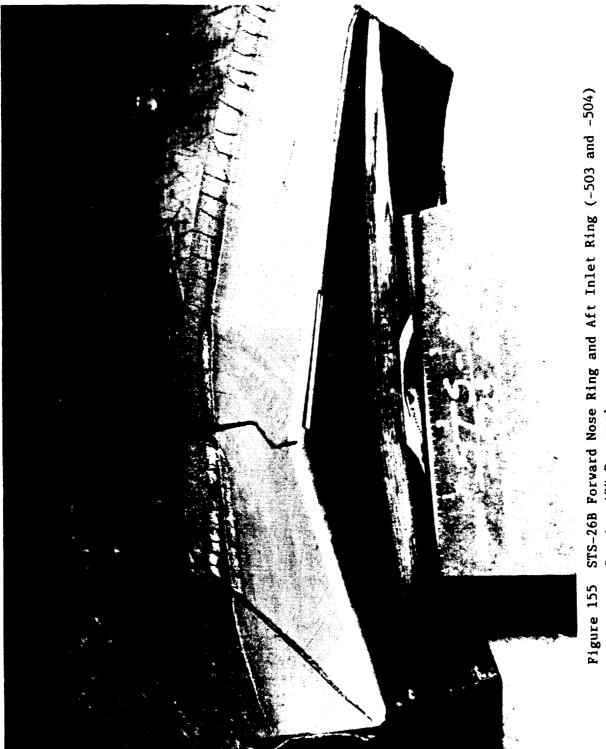
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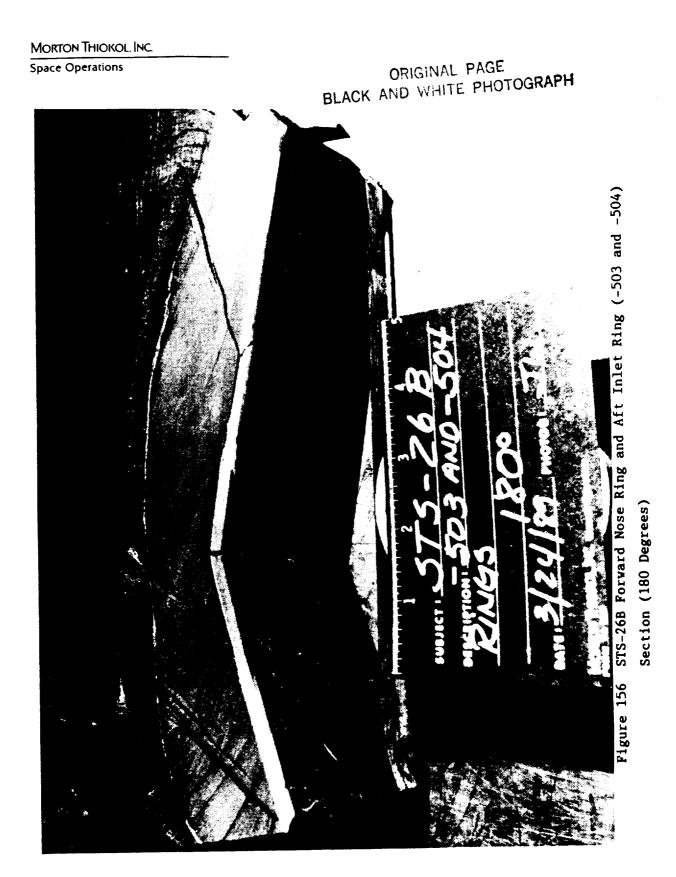
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STS-26B Forward Nose Ring and Aft Inlet Ring (-503 and -504) Section (90 Degrees)

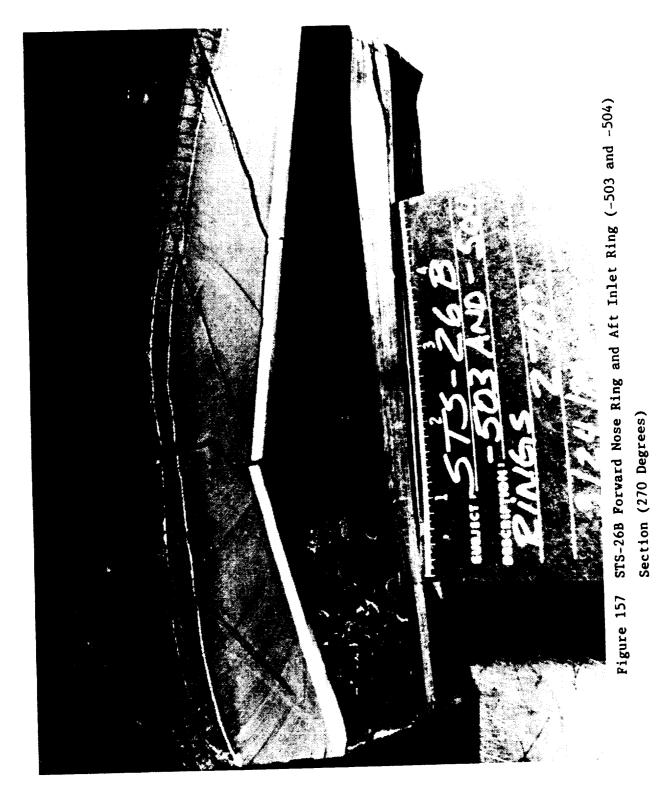
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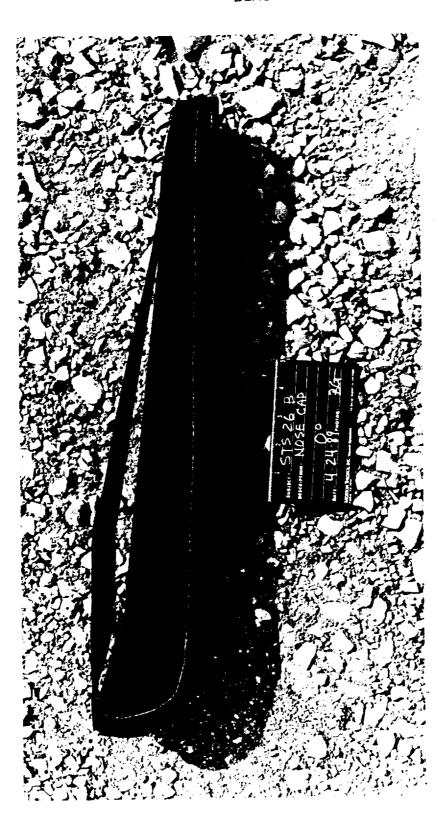
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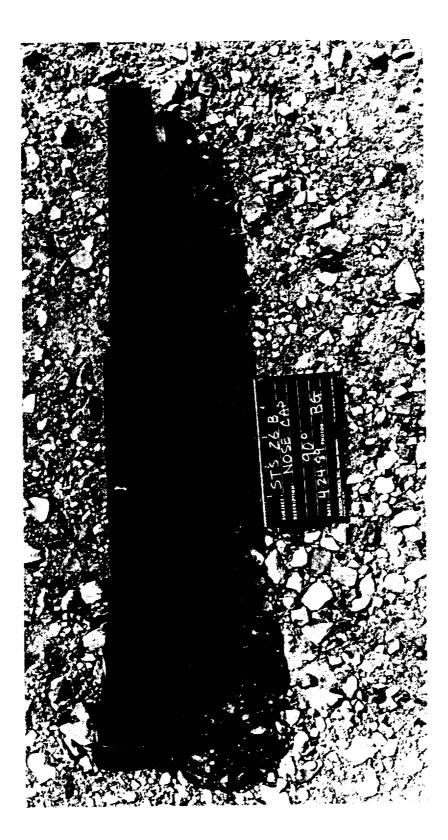
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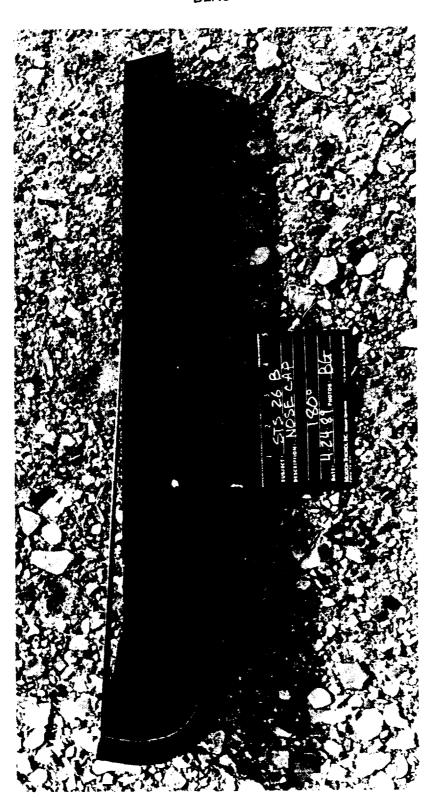
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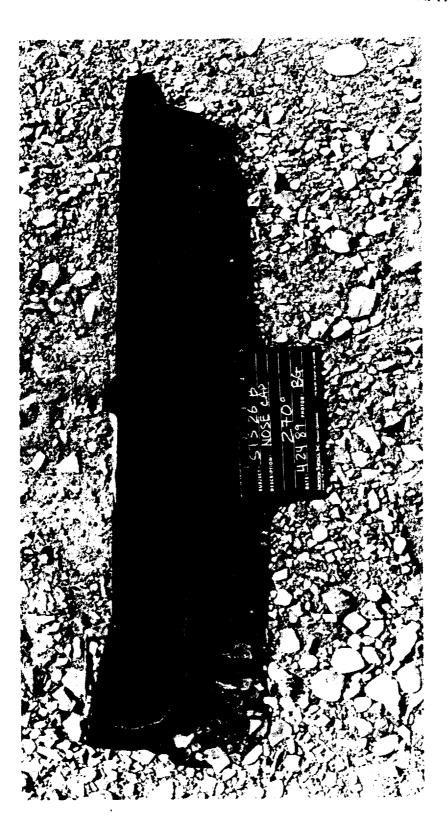
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Table 12 STS-26B Nose Inlet Rings (-503,-504) Erosion and Char Data

Angular Location			s	tations			
	28	30	32	34	36	38	39.5
0 degrees							
Measured Erosion	0.97	0.81	0.88	0.80	0.88	0.92	0.95
Neasured Char	0.95	0.77	0.73	0.64	0.62	0.72	0.68
Adjusted Char*	0.71	0.58	0.55	0.48	0.47	0.54	0.51
2E + 1.25AC	2.83	2.34	2.44	2.20	2.34	2.52	2.54 2.981
RSRM Min Liner Thickness	3.508	3.252	2.950	3.182	3.200	3.026	0.17
Margin of Safety	0.24	0.39	0.21	0.45	0.37	0.20	0.17
90 degrees							
Measured Erosion	1.12	0.84	0.87	0.86	0.90	0.97	NA
Measured Char	0.72	0.76	0.76	0.68	0.70	0.65	NA
Adjusted Char*	0.54	0.57	0.57	0.51	0.53	0.49	NA
2E + 1.25AC	2.92	2.39	2.45	2.36	2.46	2.55	NA
RSRM Min Liner Thickness	3.508	3.252	2.950	3.182	3.200	3.026	2.981
Margin of Safety	0.20	0.36	0.20	0.35	0.30	0.19	NA
180 degrees							
Measured Erosion	1.38	0.85	1.28	0.86	0.87	0.92	1.02
Measured Char	0.53	0.76	0.37	0.66	0.58	0.63	0.49
Adjusted Char*	0.40	0.57	0.28	0.50	0.44	0.47	0.37
2E + 1.25AC	3.26	2.41	2.91	2.34	2.28	2.43	2.50 2.981
RSRM Min Liner Thickness		3.252	2.950	3.182	3.200	0.24	0.19
Margin of Safety	0.08	0.35	0.01	0.36	0.40	0.24	0.19
270 degrees							
Measured Erosion	1.07	0.83	0.95	0.82	0.84	0.95	1.19
Measured Char	0.77	0.78	0.67	0.60	0.63	0.60	0.54
Adjusted Char*	0.58	0.59	0.50	0.45	0.47	0.45	0.41
2E + 1.25AC	2.86	2.39	2.53	2.20	2.27	2.46	2.89
RSRM Min Liner Thickness		3.252	2.950	3.182	3.200	3.026	2.981
Margin of Safety	0.23	0.36	0.17	0.44	0.41	0.23	0.03
	* Heasure	d Char A	djusted	to end	of action	time	
				nimum li:	ner thick	n e s s	1
	Margin of	Safety	2 X •1	rosion +	1.25 X A	dj char'	

Refer to Figure 38 for Station Locations

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Table 13 STS-26B Nose Cap Assembly Erosion and Char Data

						s	tations						
Angulat Potetton	1.5	4	ę	æ	10	12	14	16	18	20	22	24	26
0 degrees											I	1	
	0.31	0.35	۳.	4	₹.	n.	9.		<u>م</u> ،		1.73	1.70	1.32
		0.67	0.61	9.	ŝ	ŝ	ŝ	γ,	<u></u>	ņ,	•	. «	5
	ŝ	0.54	0.49	ŝ	4	4	4	•	er (* 0			. "
	1.30	1.37	1.39	. 53	. 54	. 70	80 G 80 G	7 0 7	<u>י</u> י	2 V 0 C		• •	8
RSRM Min Liner Thickness Margin of Safety	1.776 0.37	2.038 0.49	2.248 0.62	2.458 0.61	2.668 0.73	2.8/8	3. U 6 9 0. 6 4	0.63	0.52	9.44.0	.16	0.13	.17
45 degrees												1	(
	4 10	0.25	0.32	۳.	4.	ŝ	4	0.63	0.66	0.86	1.43	1.63	1.22
Reastred Froston Restrict Char	NA	0.63	0.53	\$	ŝ	₹.	ŝ	4	4.1		<u>،</u> ۱	• •	- K
	NA.	0.50	0.42	٩.	4	<u>س</u> ،	4° 4	י י	ŗr	ļ		20	
2E + 1.25AC	NA	1.13	1.17			1.50 1.50		• •		: ?	Γ.	9	8
RSRM Min Liner Thickness	1.776	2.038	2.248	-	•	°, с		1 U 1 U 1	8	8.4	ς.	.16	. 23
Margin of Safety	NA	0.80	0.92	•	•	·.	an - T	n •)			
90 degrees											•	٩	ſ
Konstrod Rrocion	NA	0.36	0.37	4	4	₹.	ŝ		°, '		e v	1 C C	•
Measured Char	NA	0.58	0.59	ŝ	ŝ	ŝ	Ŷ	e . r	5 M	р (* •	з и ^с		ŝ
	NA	0.46	0.47	4	4	4	. .	າ ª			5		۳.
2E + 1.25AC	NA	1.30	1.33	.46	.44		. c	. ^	• •		ς.	9.	8
RM Mİ	1.776	2.038	2.248	2.458	2.008	0/0.7 0 0V		0.80	0.61	0.51	0.18	Р.	0.14
Margin of Safety	N A	16.0	£0.0	•		2							
135 degrees													
	A IN	05 0	0.40	4	ŝ	്	0.64		0.86	1.10	1.70	1.95	1.40
	A N	0.71	0.61	9.	. و	<u>۹</u>	0.49	4	ŝ	Ŷ	. `	<u> </u>	. v
	NA	0.57	0.49	ŝ	4.	₹.	0.39	ς.	م ا		°	ņч	י א י
Adjusted Luat Jr + 1 25ar	NA	1.31	1.41	m	.60	1.69	1.77	ao (~		• •	9.4	
26 T L.C.D.C Depk Min Tiner Thickness	٦	2.038	2.248	. 4	9	°,	3.088		2	? `		? -	1
Margin of Safety		0.56	0.59	. 61	0.67	5	0.74		ſ.		-		•
	* measure	ed char	adjusted	to end	of actio	n time							
WR-				nimum li	ner thi	2 2 2 2	-						
-172	margin o	of safety	2 X e	rosion +	1.25 X	char	4 1 [*						

Refer to Figure 38 for Station Locations

IR-17272 -240 Table 13 STS-26B Nose Cap Assembly Erosion and Char Data (continued)

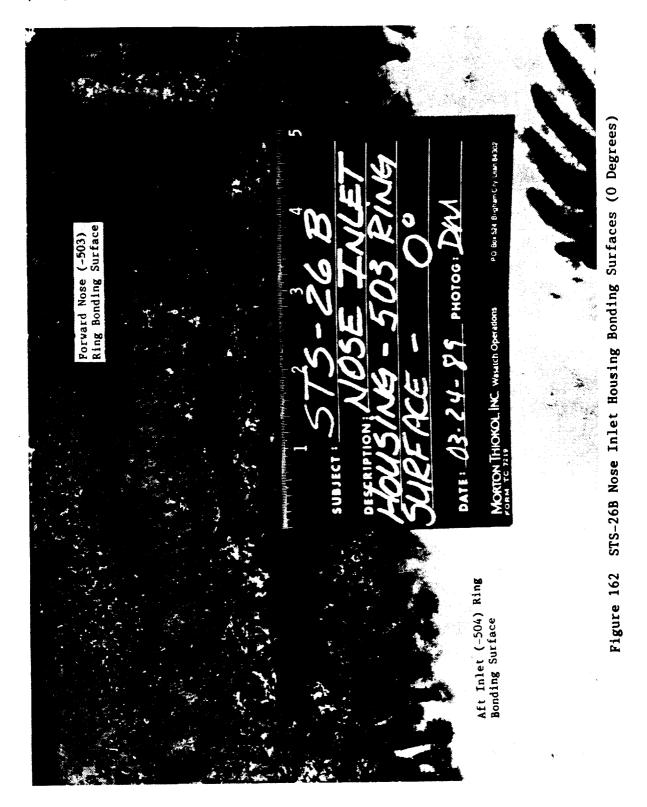
1 180 degrees													
180 degrees	1.5	4	9	60	10	12	14	16	18	20	22	24	26
Measured Erosion 0.	. 23		0.30	<u>م</u>	0.33	0.49	0.52	0.56	0.66	0.93	1.37	1.50	1.02
Char			0.59	ŝ	<u>•</u> •		ан (т •	1."		, m		9	9
• •				• •	-	. "	. 4			. "	. 39	۲.	•0
	1 50.1 1 376 1		1.13	• •	• •			2	\$	°,	٢.	9.	3.86
RSKM MIN LINE INICANERS 1. Margin of Safety 0.		0.82	69.0	1.05	. 24	Τ.	-	. 18	6 .	. 73	Ű,	<u>م</u>	m.
225 degrees													
Maasurad Erosion N		.15	0.22	m.	۳.	64.0	0.48	0.50	0.67	0.90	1.65	1.99	1.43
Char	NA 0		0.63	ŝ	ŝ	0.51	• •	. .	n 1	о ч •	• •	s vr	
Char *			0.50	4	•	1 4 1		? *	* *		2	9.10	
			1.07		N 4	878 6	29	"	. vi	: ?	Γ.	9	•0
RSRM Min Liner Thickness I. Margin of Safety ^b	NA 1	1.04	1.10	1.16	1.08	1.10	. 22	•	88.	. 68		°.	-
270 degrees													•
Maasurad Erosion	NA C	1.33	0.37	4.	•	\$	0.62	0.71	0.81	1.06	1.50	1.68	
		1.69	0.60	.و	9.	ŝ	ŝ		0.48	4	•		- u
Char *		0.55	0.48	4	₹.	٠.	4		0.35		•	<u>-</u>	<u> </u>
		1.35	1.34		1.54	1.57	. 81	6.		- v		- 4	• •
ner Thickness	76	2.038	2.248	٩.	9	30 ·	<u> </u>	•	100.0		•	? -	
		0.51	0.68	0.63	<u>г</u> .	•0	17.0	6 · / 4		ņ	•	•	•
315 degrees													
	A N	0 24	0.30		۳,	۳.	4.	0.54	9	۳.	?		ົ່
Reasured Eroston		65.0	0.53	ŝ	٩.	ŝ	ŝ	0.51	ŝ	ŝ	9	~ '	٠
		0.47	0.42	4.	4.	4.	4.	0.41	-	4 (n, ·	eч	Ωŗ
5AC		1.07	1.13	1.16	1.17	1.25	1.42	1.59	1.63	2.21	3.18 • 713	107 0	
RM Min Liner Thickness	1.776	2.038	2.248	4	9	•		5.246				. "	
		06.0	66.0		?		-	1.0/	7	•	0 T	n i	
<u>i</u> 15 degrees											(- -
doisol permaen	NA	0.30	0.39	۳.	۳.	•	0.42	0.53	0.67	68.0	1.31	1.57	0 4 - 0
Measured Char		0.50	0.44	s,	ŝ	ŝ	ŝ	ŝ	•		. '	. "	
Adjusted Char *		0.40	0.35	4	4	4	4.	4			• •	∩ ≪	• • •
2E + 1.25AC		1.10	1.22	1.21	1.30		.41	2.5.	. "	8 T .	е г	• •	
RSRM Min Liner Thickness	76	2.038	2.248	4	9.	8 . '	•••	7	n c	» «	100		0.41
Margin of Safety	AN	0.85	0.84	°.	2	⊃	:	•					

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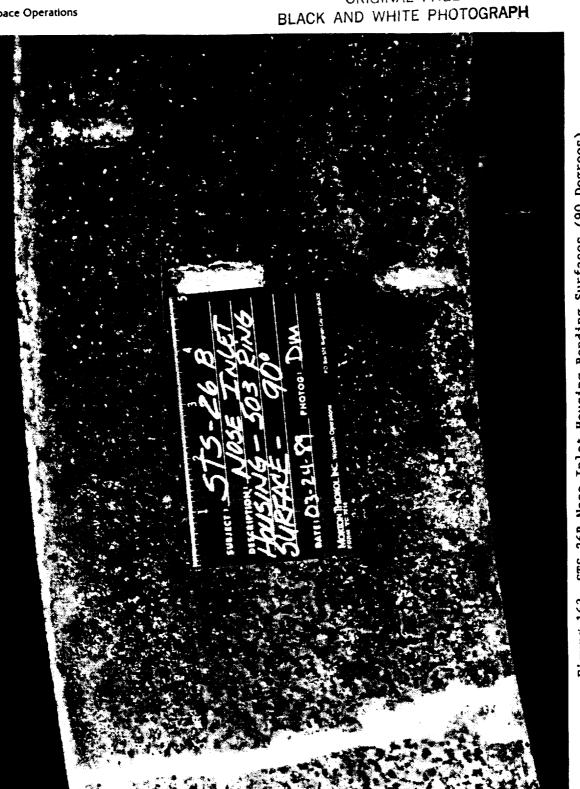
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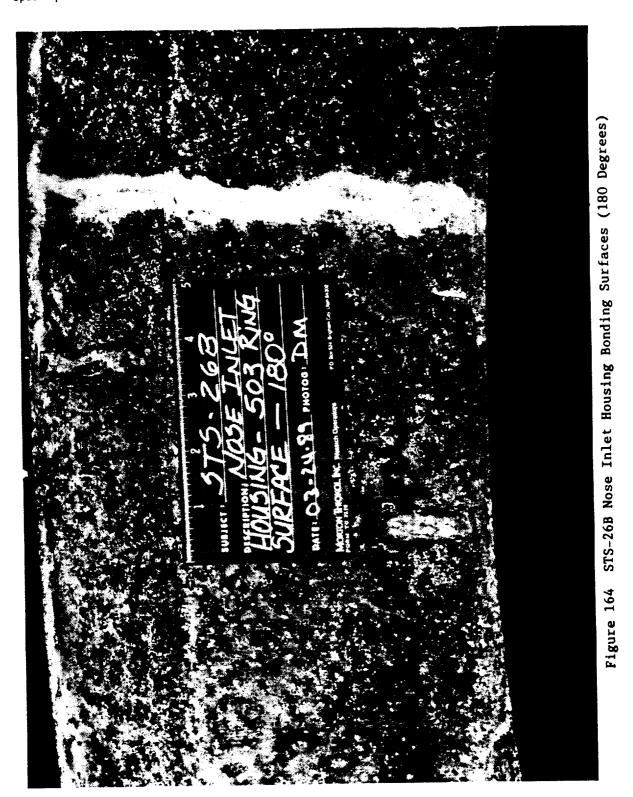
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STS-26B Nose Inlet Housing Bonding Surfaces (90 Degrees) Figure 163

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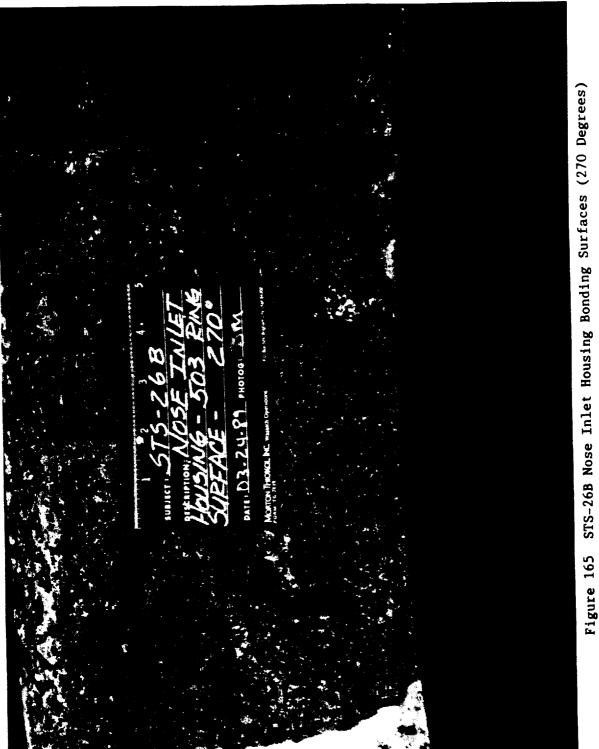


Figure 165

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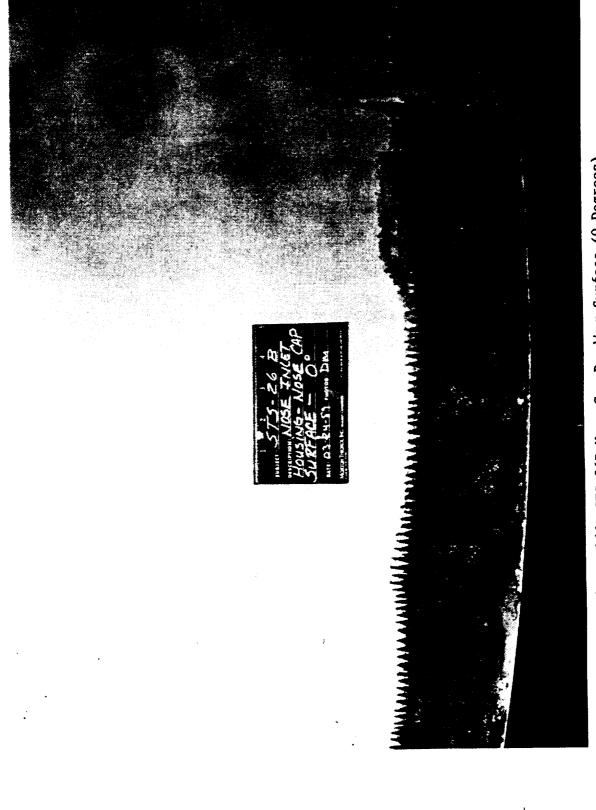


Figure 166 STS-26B Nose Cap Bonding Surface (0 Degrees)

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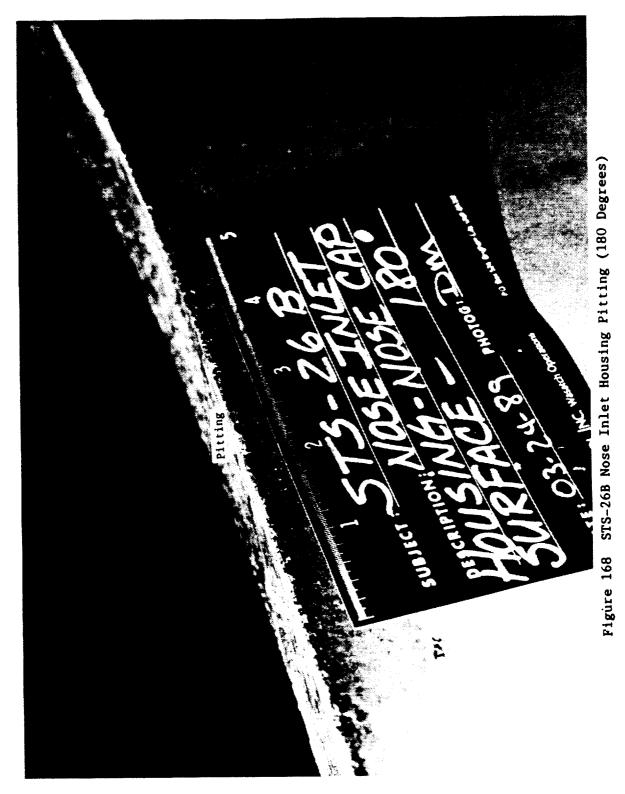


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Figure 169 STS-26B Cowl/OBR Closeup (O Degrees)

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Figure 170 STS-26B Cowl/OBR Closeup (180 Degrees)

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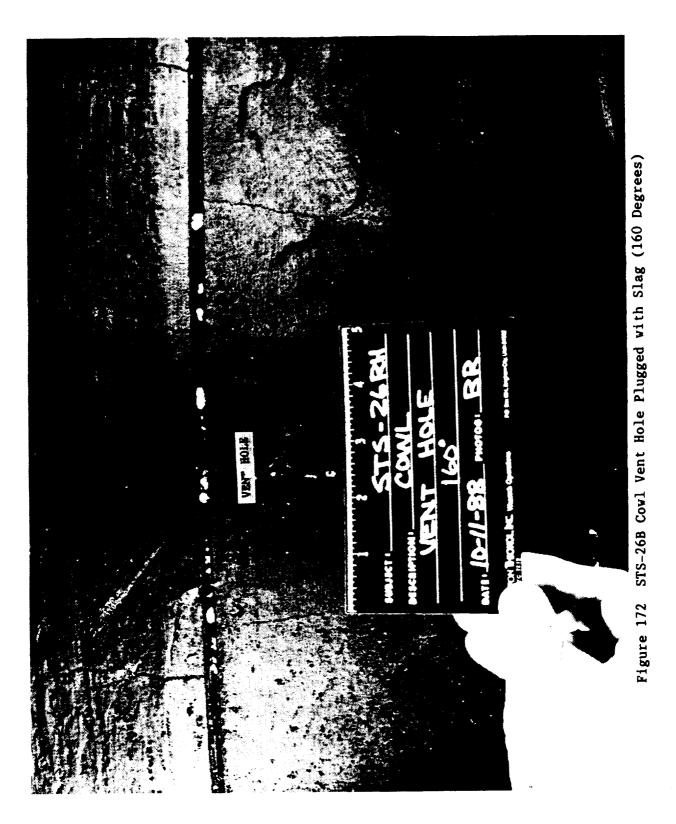
Figure 171 STS-26B Cowl/OBR Closeup (320 Degrees)

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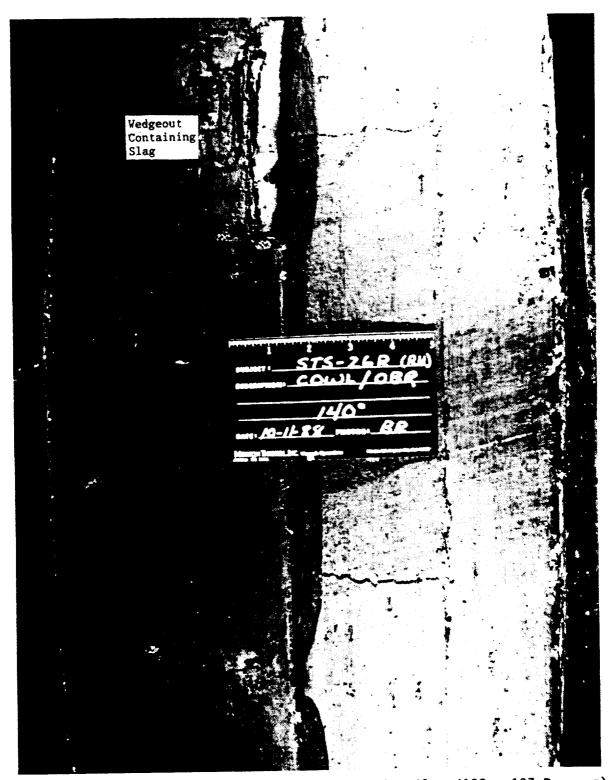


Figure 173 STS-26B Cowl Ring Wedgeout Containing Slag (120 - 137 Degrees)

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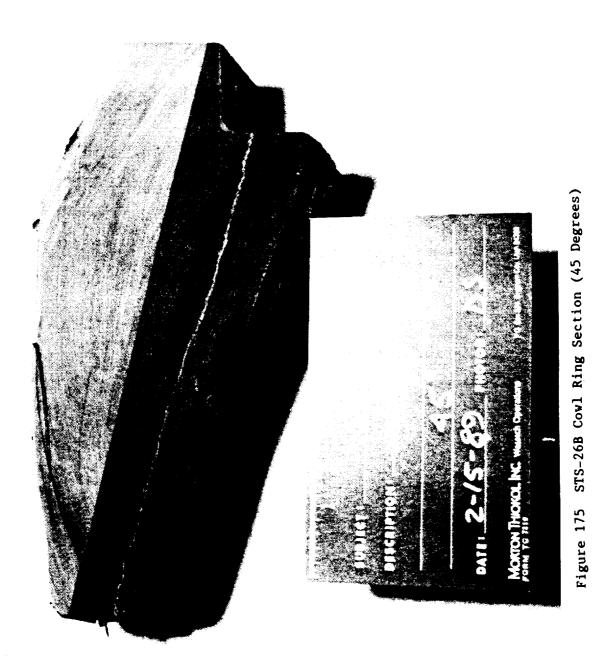
STS-26B Cowl Ring Section (0 Degrees) Figure 174

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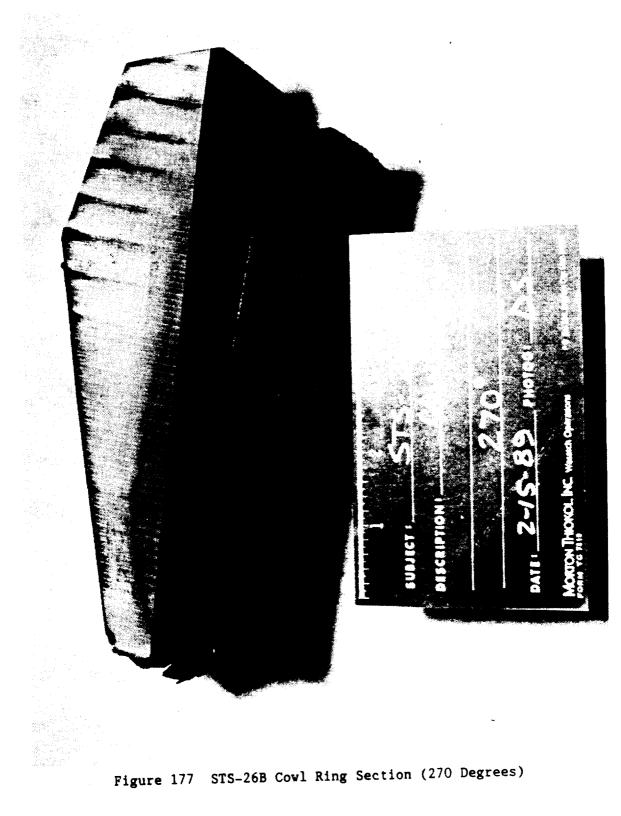
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AC NA NA NA NA NA NA NA NA NA NA NA NA NA	Char	NA	NA	NA	NA	N N	NA	NA	NA	NA	NA 	<u> </u>	. •
th Min Liner Thickness 1.417 1.499 1.577 1.655 1.733 1.911 4.003 4.577 4.07 4.07 4.07 4.07 4.07 4.07 4.07 4.	E + 1.25AC	NA .	NA	NA 	NA NA	NA NA	NA.	NA •	A A A	4 4 6 4 4 6	A A A		•
gin of Safety NA NA NA NA NA NA NA NA NA NA NA NA NA	SRM Min Liner Thickness	1.417	1.499	.5	2		10.	•				, d	. ve
Measured char adjusted to end of action time 	argin of Safety	NA	NA	AN	NA	AN	A N	4			6		
······································		* Measure		djuste	to end	f acti	n tim						
DINUM TIME LUTCENS					iniaua		ickne						

Table 14 STS-26B Cowl/OBR Erosion and Char Data

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Refer to Figure 55 for Station Locations

់ ២.ស.ស.ស. 🧿	•										
Erosion Char Char a 5AC Liner Thickness f Safety	-	2	m	4	ß	9	٢	60	6	10	11.3
char Char SAC Liner Thickness f Safety	NN	NA	NA	NA	NA	NA	NA	NA	0.00	00.00	0.00
Char * 5AC Liner Thickness f Safety	NA	NA	NA	N N	NA	NA	NA	N N	n 1	יי	<u>م</u> .
	VN	N N	V N	N N	4 z 3	44			. •	. "	
	NA NA	NA 1 677	NA 1 655	657 1	AN 1	1.889	1.963	1.597			<u>۲</u>
	C C L - T			V N	V N	N N	VN	V N	. 8 2	. 8.7	°.
90 degrees											
NA Stration	0.27	~			-	۳.	1.	N N	NA	0	0
	NA	٢.	۲.	٢.	٢.	٢.	۴.	NA	٨N	•••	8
Char *	NA	ŝ	9.	۰2	ŝ	9.	<u> </u>	VN	N N	•••	••
AC .		.18	. 13	.14	.08	60.	. 21	A N A	AN Ara	юч •	• •
RSRM Min Liner Thickness 1.417 Margin of Safety NA	1.499 NA	1.577 0.34	1.655 0.46	1./33 0.52	1.811 0.68	1.00.73	0.63	VN VN	A N	1.03	1.05
120 degrees											
NA Street on	NA	NA	NA	NA	NA	NA	NA	NA	NA	•	۰.
	NA	NA	NA	NA	NA	NA	NA	NA	NA	eo •	م ۱
Char *	NA	N N	NA	N N	NA	NA	N A	NA	N N	0.70	0
, AC			NA	NA	NA	N A	NA V V	Ň	N N N		זר
RSRM Min Liner Thickness 1.417	٦	1.577	1.655	1.733	1.811	1.889	1.903	2	c/ g · T		•
Margin of Safety NA	V N	AN	V N	NA	VN	AN	C Z	4	4	'n.	•
125 degrees											
Maasurad Frosion 0.16		.2	. 2	4	.6	٢.	NA	NA	NA	N N	N N
Char Char		٢.	9.	s.	۳.	٦.	NA	N A	NA	AN	AN
Char *	0.64	°.	ŝ	4	. 2	-	NA	NA	V N	V N	A N
2E + 1.25AC 1.02	1.	1.24	1.24	1.35	1.60	1.77	AN	d u Z	NA A	NA 1 687	4 N 1 0 C 1
ner Thickness	1.4	ŝ	•			» ه	606.T	n i			. 4
			m.	~	7.	? .	4		6	6	6
140 degrees											•
Wassurad Erosion NA	NA	NA	NA	NA	NA	NA	NA	N N	٩,	<u>.</u>	• •
	NA	NA	NA	NA	NA	NA	NA	NA	5	<u>۲</u>	د ه ۱
Char t	NA	NA	NA	NA	NA	NA	NA	NA	ņ	<u>،</u> ه	7
		NA		NA	NA	NA 20	NA NA	A N A	0.74 , 575	0.80	
ner Thickness 1	-	1.577	1.655 	1.733	1.811	1.889	1.905	7 7	•	°	•
Margin of Safety NA	NA	NN	A N	G E		t n					
* Measured	ured char	adjusted	to end	of action	n time						
					-						

Table 14 STS-26B Cowl/OBR Erosion and Char Data (continued)

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ī

160 degrees							Stations	vi				
	o	1	7	e	4	2	9	7	•	6	10	11.3
Measured Erosion Measured Char Addinated Char	4 4 4 7 7 7 7 7	V V V	4 4 4 7 4 7	V N V N N	V N V N V N	V N V N	4 N V N V N	4 N 1 N 1 N	V N V N V N	9.7.9	0.7.9	
AC Liner Safe	NA 1.417 NA	NA 1.499 NA	ИА 1.577 NA	NA 1.655 NA	NA 1.733 NA	NA 1.811 NA	NA 1.889 NA	NA 1.963 NA	NA 1.597 NA	0.85 1.675 0.97	0.83 1.687 1.03	0.88 1.704 0.93
180 degrees												
Measured Erosion	0.28	0.18	. 7		. 2	. 2		. 2	NA	N N	N N	NA
Char	0.58	0.70	<u>۲</u> , י	<u>م</u> ا	<u>،</u> ،	ŗ.,	۲.	8 4	N N	N N	VN VN	V N N
Adjusted Char " 26 + 1.25AC	0.40 1.14	0 C . D 6	<u>, 1</u>		<u>י י</u>	<u>, -</u>	:	. ግ	4 N	A N	4 N N N	<
	1.4170.25	1.499 0.41	1.577 0.40	1.655 0.18	1.733 0.43	1.811 0.53	1.889 0.69	1.963 0.51	1.597 NA	1.675 NA	1.687 MA	1.704 NA
220 degrees												
	NA	NA	NA	NA	NA	NA	NA	NN	NA	•	0.1	0.1
Char	NA	N N	A N	A z	N N	N N	N N	A N	VN N		. '	10 V
Adjusted Char * 25 ± 1 35ac	V 2	V N V N	A N A N	A N N	4 4 7	A N A N	4 N N	VN N	VN VN	•	e «	° .
	1.417	1.499	1.577	1.655	1.733	1.811	1.889	1.963	1.597	1.675	1.687	1.704
Margin of Safety	NA	N N	VN	NA	NA		Y N	NA	NA	•	°.	°.
225 degrees												
	0.18	0.28		<u>۳</u>	4	4	~ `	~	NA	NA	NA	NA
Measured Char	0.68	0.68	•		о ч	<u> </u>	, r	ю.чо •	A N A N	4 N N	A N A N	4 A 2
	1.04	1.24	. Se	• • •		<u>.</u>	.32	. 28	NN	VN	NA	NA
M Min L	1.417	1.499	1.577	1.655	1.733	1.811	1.889	1.963	1.597 WA	1.675 WA	1.687	1.704
Margin of Sarety		17.0	•		-		•		e e			5
240 degrees												
	NA	NA	NA	NA	NA	NA	NA	NA	NA	°. '	°. '	
	NA	N A	N N	N N	A N	N N	A N	V 2	A N	юч •	юч •	ю Г ,
Adjusted Char * 25 ± 1 25ac	A N N	N A N A	V N N N	A N N	V N V N	A N	A N	A N	A N	• • •	°.	<u>ີ</u> ີ.
RSRM Min Liner Thickness	1.417	1.499	1.577	1.655	1.733	1.811	1.889	1.963	1.597	1.675	1.687	
Margin of Safety	NA	NA	NA	NA	NA	NA	VN	NA	NA	6.	8 .	₿.
	* Measured	char	adjusted	to end	of actio	n time						
			-	anaini	liner th							
	Margin of	f Safety				1	1					

Table 14 STS-26B Cowl/OBR Erosion and Char Data (continued)

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Angular Location							Stations					
	o	1	2	£	4	ŝ	9	L	•0	6	10	11.3
	N N	NA	NA	N N	NA	NA.	NA	NA	N.N.	0.00	0.00	00.0
Measured Erosion Measured Erosion	N.N.	NA	N N	NA	NA	NA	NA	N N	V 8 7	ъ. г	יי	
198011911111111111111111111111111111111	N N	NA	N N	NA	NA	NA	V N	4 H		. •	. •	
	NA	NA		NA	NA	NA.	۲°	70	1 597		9	
RSRM Min Liner Thickness	1.417	1.499	1.577	1.655 Wb	1.733 NA	1.811 NA	L. 007	NA.	N N	.82	79	٢.
Margin of Safety	VN	4		4								
270 degrees												
		0 7 0	<u> </u>	<u>م</u>	. 2	~	. 2	۲.	NA	٩.	0.04	00.00
Measured Erosion	090	0.73	9	٢.	٩.	80	•0	•	V N	ຸ່	1 0	•
easured Char	0.48	0.58	<u>م</u>	ŝ	9.	e.		9.	V N	. '	. •	•
	0.86	1.11	. 25	.32	. 30	. 26	?'	20		<u>ч</u>		• •
۰ X	1.417	1.499	1.577	1.655	1.733	1.811	1.603	1.303 0.64	N.N.	0.71	.74	•
Margin of Safety	0.65	0.35	~	7	•	r	י י	•				
280 degrees												
	N N	NA	NA	NA	NA	NA	NA	NA	NA N	NA	0.00	0.0
Measured Eroston	NA	NA	NA	NA	AN	NA	NA	NA	A N		9 Y	•
	NA	NA	NA	NA	NA	NA	N N	V N		C 4	° «	
AC	NA	NA	NA	NA	A N	NA.		1 963	1.597	1.675	9	•
RSRM Min Liner Thickness	1.417	1.499	1.577	1.605		770-7) (M	N.N.	NA	٧N	۴.	•
Margin of Safety	NA	AN	4	4	6							
300 degrees												Ċ
	0.16	0.22		۲.	۳.	0.18	0.15	0.16	N N	0.07	0.04	
	0.60	0.65	0.67	0.63	0.64	0.77	<u>،</u>	<u>ہ</u>	< 2 × 2	o 4		
Jepsuret (1921) Advincted (Ther *	0.48	0.52	ŝ	ŝ	ŝ	•••	<u>،</u> م	9-			. n	
лијизста сила Эк + 1.25АС	0.92	1.09	. 17	. 21	. 26	. °	. °	• •	1.597		9	н. Т
RSRM Min Liner Thickness	1.417	1.499	ŝ	<u>،</u>	. '	о ч •			NA	. 69	٢.	0
Margin of Safety	0.54	0.38	<u>,</u>		n	•						
315 degrees												1
Konstad Frasion	0.20	0.18	. 2	•	3	0.22	0.18	0.20	N N	NA	A N N	5 25
Measured Char	0.66	0.67	. 6	9.	9	. "	. '	• •	Y N	NN	NA	Z
	0.53	0.54	ŝ	ŝ	n, i	Û.	• -		NA	NA	NA	Z
2E + 1.25AC	1.06	1.03	1.11	1.09	- f	. •	• •	۰ ۰	1.597	1.675	1.687	1.7
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	1.417	1.499	Ŷ,	0.4		о и	69	9	NA	<b>N</b> A	NA	Z
Margin of Safety	0.34	0.46	4	•	r •	2						
	30540W *	Measured char	adjusted	to end	of actio	n time						
					liner thi	a i r k n e s s						
				1								

Table 14 STS-26B Ccwl/OBR Erosion and Char Data (continued)

(continued)
Data
Char
and
Erosion
Cov1/0BR
STS-26B
Table 14

Angular Location							Stations					
320 degrees	o	1	2	3	-	ŝ	ę	٢	80	6	10	11.3
Measured Erosion Measured Char Adjusted Char * 2E + 1.25AC RSRM Min Liner Thickness Margin of Safety	87 87 87 87 87 1.417 1.417	NN NN NN NN 1.499 NN	NA NA NA NA 1.577 NA	NA NA NA NA 1.655 NA	мл Мл Мл Nл 1.733 Nл	NA NA NA NA 1.811 NA	NA NA NA NA NA 1.889 NA	NA NA NA NA NA 1.963 NA	NA NA NA NA NA 1.597 NA	0.03 0.83 0.66 0.89 1.675 0.88	0.03 0.83 0.66 0.89 1.687 0.90	0.04 0.83 0.66 0.91 1.704 0.87
340 degrees Measured Erosion Measured Char Adjusted Char * 2E + 1.25AC RSRM Min Liner Thickness Margin of Safety	NA NA NA NA NA NA NA NA NA NA 1.417 1.499 NA NA Surad Chaf		NA NA NA NA 1.577 NA Adjusted	NA NA NA NA NA 1.655 1 NA to end of	NA NA NA NA NA 1.733 NA Action	NA NA NA NA NA 1.811 NA 1.811 NA	КИ КИ КИ КИ 1.889 КИ	ИА ИА ИА ИА 1.963 ИА	МА ИА ИА ИА 1.597 ИА	NA NA NA NA 1.675 NA	0.07 0.84 0.67 0.98 1.687 0.72	0.02 0.90 0.72 0.94 1.704

Margin of Safety = ----- minimum liner thickness 2 X erosion + 1.25 X adj char*

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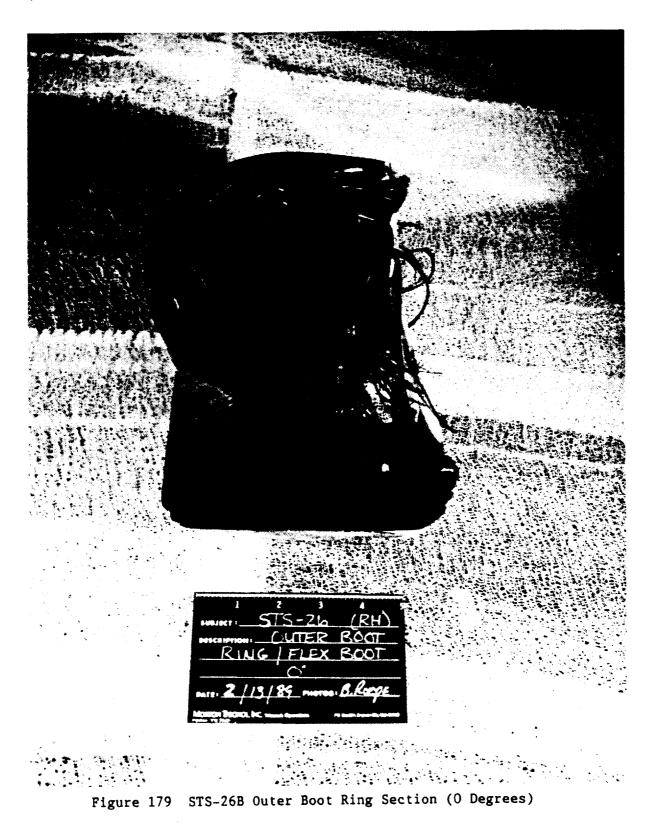


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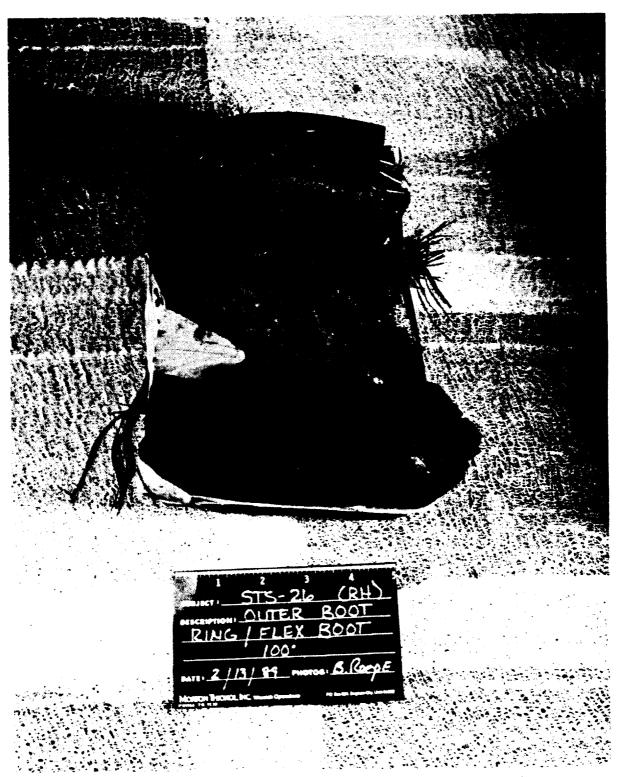


Figure 180 STS-26B Outer Boot Ring Section (100 Degrees)

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Figure 181 STS-26B Outer Boot Ring Section (160 Degrees)

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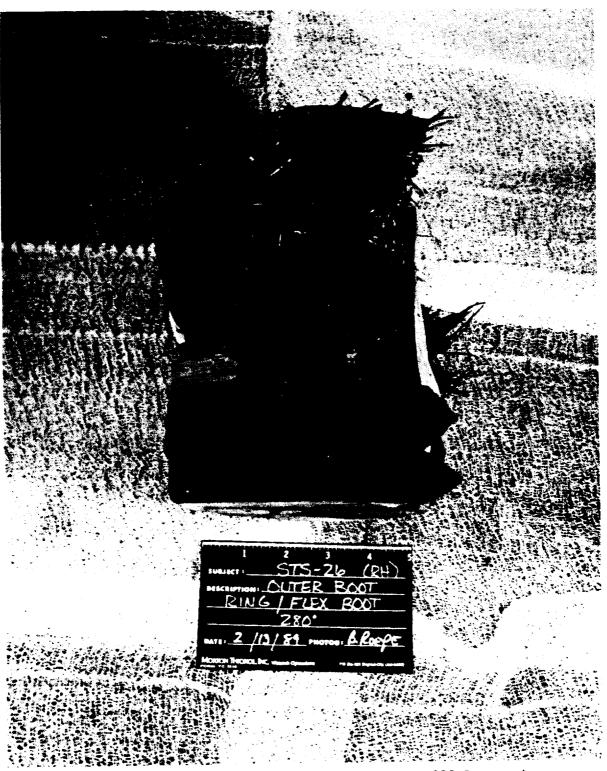


Figure 182 STS-26B Outer Boot Ring Section (280 Degrees)

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Figure 184 STS-26B Flex Boot (Cavity Side - 120 Degrees)

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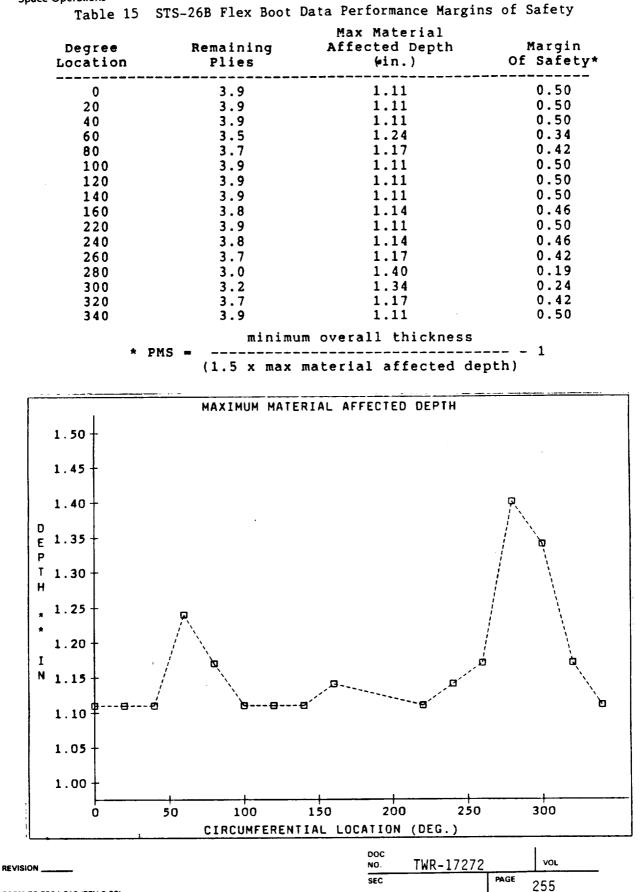




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Figure 187 STS-26B Fixed Housing Section (90 Degrees)

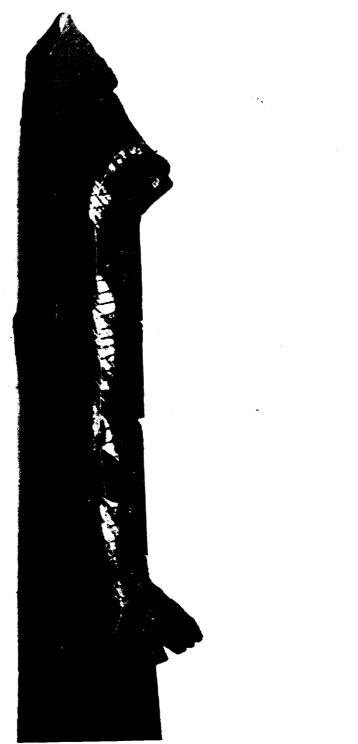
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STS-26B Fixed Housing Section (180 Degrees)

Pigure 188

1 575-268 EXED HOUSING 180

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Figure 189 STS-26B Fixed Housing Section (270 Degrees)

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0       1       2       3       5       5       7       8         0       4097001       0.01       0.01       0.01       0.00       0.00       0.00       0.00         Xenured Exer       0.01       0.01       0.01       0.01       0.01       0.00       0.00       0.00         Xenured Exer       0.01       0.01       0.01       0.01       0.01       0.01       0.01       0.01         Xenured Exer       0.01       1.03       1.11       1.11       1.11       1.11       0.11       0.11       0.01       0.01         Xenured Exer       0.11       1.12       1.12       1.12       1.12       1.12       1.12       1.12       1.12       1.13       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11	Stations	Stations	
<pre>Froston 0.04 0.04 0.01 0.00 0.00 0.00 0.00 0.00</pre>	•	Q	9 11
Ereston         0.04         0.01         0.01         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00			
Control       1:01       1:10       1:10       1:01       1:01       0.01       0.04         Control       1:11       1:10       1:12       1:12       1:12       1:10       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11       0.11	.00 0.00 0	00 0.00 0.00 0.	0.0 0.0
Chart         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01         0.01 <th0.01< th="">         0.01         0.01         <th< td=""><td>.14 1.07 1</td><td>07 1.07 1.05 1.</td><td>.84 0.88 1.6</td></th<></th0.01<>	.14 1.07 1	07 1.07 1.05 1.	.84 0.88 1.6
ACC       1.11       1.13       1.12       1.14       1.07       1.05       1.01       0.044         Lisser Phickness       3.107       2.03       0.53       0.60       0.71       0.71       0.73       0.03       1.01         Safety       2.03       0.73       0.63       0.60       0.71       0.71       0.74       0.02         Safety       2.03       0.73       0.63       0.60       0.01       0.02       0.02       0.02       0.02       0.02       0.02       0.02       0.02       0.03       0.02       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0	.91 0.86 0	86 0.86 0.84 0.	.67 0.70 1.3
<pre>Main Timer Thickness 3.007 2.001 1.025 1.027 1.020 0.71 0.71 0.73 0.02 1.103 degrees degrees degrees aured Erosion 1.22 1.29 1.16 1.11 1.12 1.12 1.12 1.10 0.09 aured Char 1.12 1.29 1.10 1.10 1.12 1.12 1.12 1.12 1.10 0.09 aured Char 1.12 1.20 1.10 0.01 0.00 0.00 0.00 0.00 0.00 0.0</pre>	.14 1.07 1	07 1.07 1.05 1.	.84 0.88 1.6
gin of safety       2.43       0.75       0.63       0.60       0.71       0.71       0.74       0.82       1         degrees       sured Erosion       0.055       0.00       0.00       0.01       0.03       0.02       0.03       0.02       0.03       0.02       0.02       0.03       0.02       0.03       0.02       0.03       0.02       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       <	1.827 1.829 1	<b>829 1.831 1.832 1.</b>	.836 2.426 3.0
degrees       degrees       0.05       0.00       0.03       0.03       0.02       0.03       0.02       0.03       0.02       0.03       0.02       0.03       0.02       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03       0.03	.60 0.71 0	71 0.71 0.74 0.	.19 1.76 0.8
0.05       0.00       0.00       0.02       0.02       0.03       0.03         1:22       1:29       1:16       1:17       1:12       1:12       1:04       0         1:21       1:29       1:65       1:17       1:12       1:12       1:13       0.03         1:21       1:29       1:65       1:17       1:16       1:12       1:23       0.03         1:21       1:29       1:61       0.57       0.56       0.53       0.63       0.70       0         1:26       1:15       1:01       0.56       0.56       0.53       0.69       0.70       0         1:26       1:15       1:01       0.94       0.99       0.99       0.79       0.77         1:26       1:15       1:01       0.96       0.99       0.99       0.79       0.77         1:26       1:15       1.01       0.96       0.79       0.79       0.79       0.79         1:26       1:15       1.01       0.96       0.99       0.99       0.99       0.79         1:26       1:15       1.01       0.96       0.96       0.99       0.79       0.79         1:21       1.01			
hickness       1:22       1:29       1:16       1:13       1:12       1:12       1:16       1:04       0         hickness       1:20       1:25       1:25       1:16       1:12       1:12       1:16       1:04       0         hickness       1:03       0.57       0.56       0.59       0.50       0.53       0.63       0.63         1:00       0.61       1.257       1:26       1:16       1:22       1:04       0         1:01       0.57       0.56       0.59       0.59       0.50       0.50       0.70       0         1:01       0.10       0.04       0.00       0.00       0.00       0.00       0.00       0.00         1:01       0.92       0.91       0.79       0.79       0.79       0.77         1:01       0.92       0.81       0.78       0.79       0.77       0.70       0.70         1:01       0.92       0.91       0.79       0.79       0.79       0.72       0.70         1:01       0.92       0.91       0.79       0.79       0.79       0.72       0.70         1:01       1.01       0.78       0.79       0.79       0.79	.02 0.02 0.0	.02 0.00 0.03 0.0	.00 0.03 0.0
hickness       1.03       0.93       0.93       0.93       0.93       0.83       0.83         hickness       1.32       1.16       1.17       1.16       1.12       1.22       1.03         1.18       0.61       0.57       0.55       0.53       0.63       0.50       0.70         1.18       0.61       0.57       0.55       0.53       0.63       0.50       0.70         1.18       0.10       0.00       0.00       0.00       0.00       0.00       0.70         0.10       0.10       0.01       0.00       0.00       0.00       0.00       0.70         1.126       1.15       1.01       0.79       0.79       0.79       0.79         1.01       0.79       0.79       0.79       0.79       0.79       0.70         1.01       0.95       0.96       0.99       0.99       0.79       0.79         1.05       1.01       0.79       0.79       0.79       0.79       0.79         1.06       1.23       1.01       0.79       0.79       0.79       0.79         1.06       1.23       1.01       0.96       0.96       0.99       0.99       <	.13 1.12 1.1	.12 1.12 1.16 1.0	.93 0.97 1.
hickness       1.32       1.29       1.16       1.17       1.16       1.12       1.22       1.03       0         hickness       3.807       2.081       1.825       1.827       1.829       1.831       1.832       1.833       1.833       1.834       1         1.18       0.61       0.57       0.56       0.53       0.50       0.70       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0	.0 06.0 06.0	.90 0.90 0.93 0.8	.74 0.78 1.5
hickness       3.007       2.001       1.825       1.827       1.629       1.631       1.632       1.634       1         1.88       0.61       0.57       0.56       0.58       0.63       0.50       0.70       0         0.10       0.010       0.00       0.00       0.00       0.00       0.00       0.70       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0<	.17 1.16 1.1	.16 1.12 1.22 1.0	.93 1.03 1.9
1.88       0.61       0.57       0.56       0.58       0.63       0.50       0.70       0         0.10       0.004       0.00       0.00       0.00       0.00       0.00       0       0         1.26       1.15       1.01       0.98       0.99       0.99       0.99       0.99       0.90         1.101       0.91       0.91       0.91       0.99       0.99       0.99       0.90         1.146       1.23       1.01       0.98       0.94       0.99       0.99       0.90         1.466       1.23       1.01       0.98       0.94       0.99       0.99       0.90         1.461       1.23       1.01       0.98       0.94       0.99       0.99       0.90         1.461       1.23       1.01       0.98       0.99       0.99       0.99       0.99         1.461       1.23       1.827       1.829       1.831       1.833       1.834       1         1.61       0.69       0.99       0.99       0.99       0.99       0.99       0.99         1.61       1.107       1.182       1.182       1.183       1.03       1.03         1.	1.827 1.829 1.63	.629 1.631 1.632 1.83	1.836 2.426 3.0
0.10       0.04       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.01       0.01       0.01       0.01       0.01       0.01       0.01       0.01       0.01       0.01       0.01       0.01       0.01       0.00       0.00       0.00       0.00       0.00       0.00       0.00       0.01       0.01       0.01       0.01       0.01       0.01       0.01       0.01       0.01       0.01       0.01       0.01       0.01       0.01       0.01       0.01	.56 0.58 0.6	.58 0.63 0.50 0.7	.97 1.36 0.5
0.10 0.04 0.00 0.00 0.00 0.00 0.00 0.00			
1.26       1.15       1.01       0.98       0.94       0.99       0.99       0.99       0.90       0         1.01       0.92       0.81       0.75       0.79       0.72       0       0         1.46       1.23       1.01       0.98       0.99       0.99       0.99       0.72       0         1.46       1.23       1.01       0.98       0.99       0.99       0.90       0       0         1.46       1.23       1.825       1.827       1.831       1.831       1.833       1         1.61       0.69       0.81       0.86       0.995       0.85       0.85       1.04       1         1.61       0.69       0.81       0.86       0.99       0.99       0.90       0         0.00       0.00       0.81       0.86       0.95       0.85       0.85       1.03       0         1.07       1.19       1.12       1.19       1.16       1.17       1.08       1.03       0         1.07       1.09       1.12       1.19       1.16       1.17       1.08       1.03       0       0       0       0       0       0       0.103       0	0.0 0.00 0.0	0.00 0.00 0.0	0.0 60.0 00.
Chart 1.01 0.92 0.81 0.75 0.79 0.79 0.72 AC 1.23 1.01 0.98 0.99 0.99 0.99 0.90 Liner Thickness 3.807 2.081 1.825 1.827 1.829 1.831 1.832 1.834 1 Safety 1.61 0.69 0.81 0.86 0.95 0.85 0.85 1.04 1 E Safety 0.00 0.00 0.00 0.00 0.00 0.00 0.02 0 Erosion 0.00 0.00 0.00 0.00 0.00 0.00 0.02 0 Erosion 0.00 0.00 0.00 0.00 0.00 0.00 0.02 0 Erosion 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.	98 0.94 0.9	<b>6.0 66.0 66.0</b>	.62 0.69 1.9
Thickness 1.46 1.23 1.01 0.98 0.94 0.99 0.99 0.99 0.90 0.90 0.90 0.90	78 0.75 0.7	0.79 0.79 0.7	
Thickness 3.807 2.081 1.825 1.827 1.829 1.831 1.832 1.04 1 Y 1.61 0.69 0.81 0.86 0.95 0.85 0.85 1.04 1 n 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.	0.98 0.94 0.99		
Safety 1.01 0.00 0.00 0.00 0.00 0.00 0.00 0.0	1.827 1.529 1.83 2.25 0.05 0.65		
<pre> ************************************</pre>			
Erosion 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.			
Char Char Char Char Char Char Char Char 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.07 1.08 1.07 1.08 1.07 1.08 1.07 1.08 1.07 1.08 1.07 1.08 1.07 1.08 1.07 1.08 1.07 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08 1.08	0.00 0.00	0.00 0.00	0.00 0.03 0.00
Char* 0.86 0.95 0.90 0.95 0.93 0.94 0.86 0.82 0 AC 1.07 1.19 1.12 1.19 1.16 1.17 1.08 1.07 0 Liner Thickness 3.807 2.081 1.825 1.827 1.829 1.831 1.832 1.834 1 Safety 2.56 0.75 0.63 0.54 0.58 0.56 0.70 0.71 1 * Measured char adjusted to end of action time	1.19 1.16	1.17 1.08	.91 0.91
.AC 1.17 1.08 1.07 1.19 1.12 1.19 1.16 1.17 1.08 1.07 0 Liner Thickness 3.807 2.081 1.825 1.827 1.829 1.831 1.832 1.834 1 : Safety 2.56 0.75 0.63 0.54 0.58 0.56 0.70 0.71 1 * Measured char adjusted to end of action time	0.95 0.93	0.94 0.86	. 73 0. 73
M min Liner Thickness 3.807 2.081 1.825 1.827 1.829 1.831 1.832 1.834 1 gin of Safety 2.56 0.75 0.63 0.54 0.56 0.70 0.71 1 * Measured char adjusted to end of action time	1.19 1.16	1.17 1.08	.91 0.97
2.56 0.75 0.63 0.54 0.58 0.56 0.70 0.71 1 * Measured char adjusted to end of action time	1.827 1.829	9 1.831 1.832	.836 2.426
Measured char adjusted to end of action tim	0.54 0.58	0.56 0.70	.02 1.50
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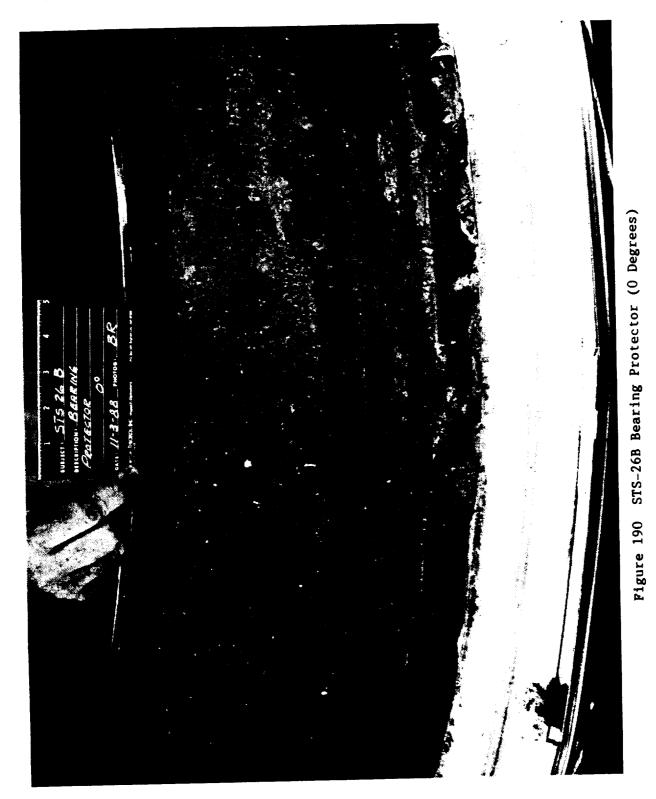
DOC NO. TWR-17272 VOL SEC PAGE 260 Refer to Figure 70 for Station Locations

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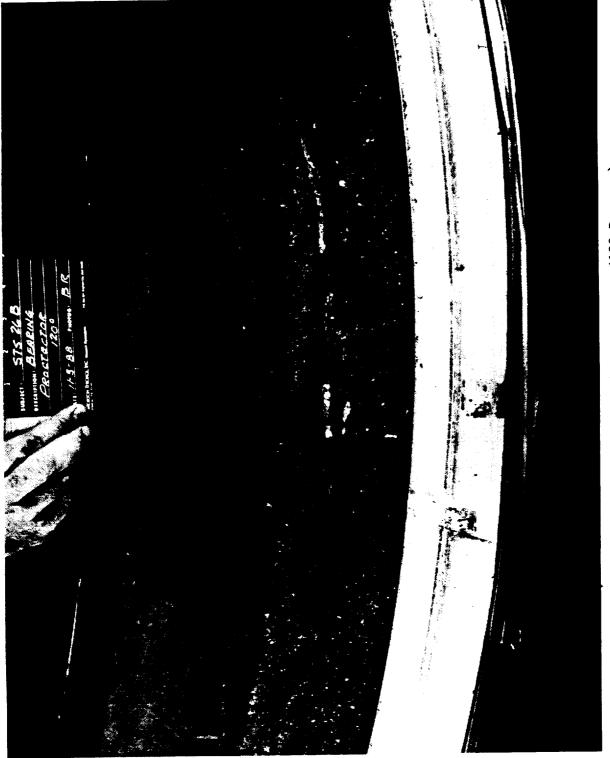


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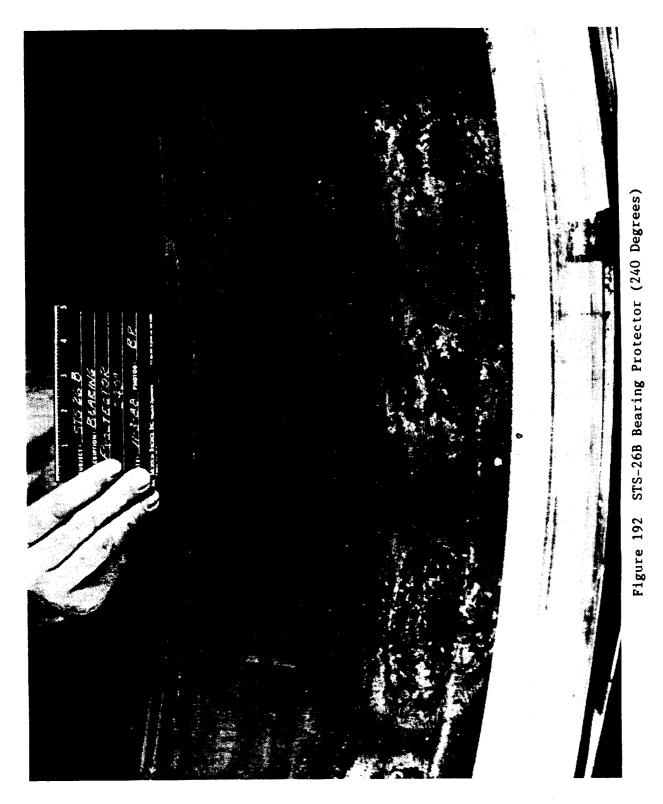


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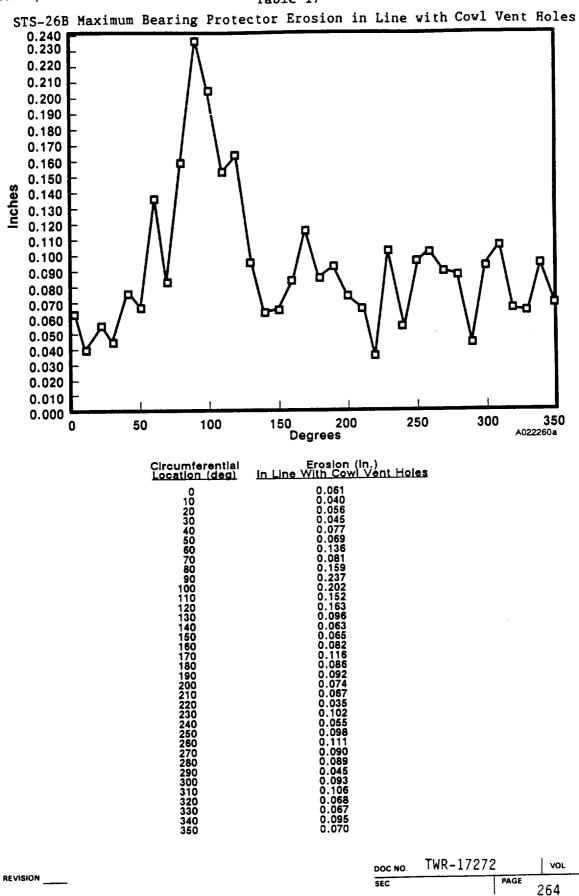
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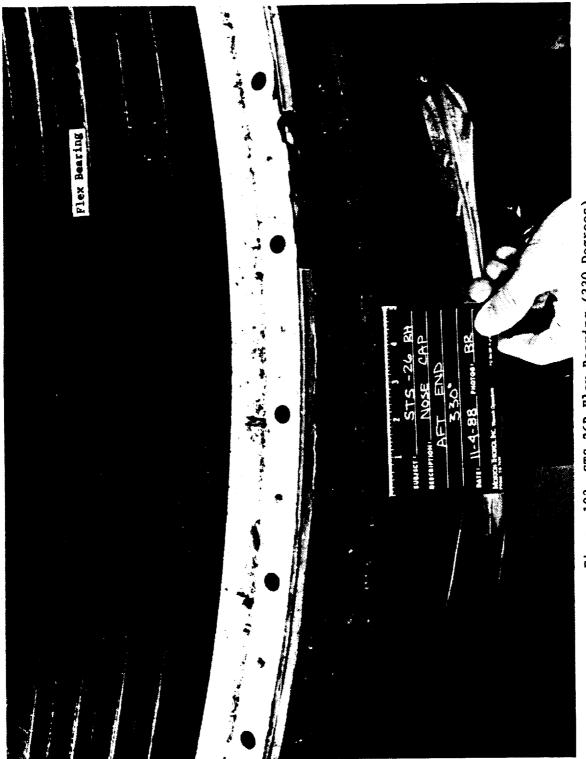
Table 17

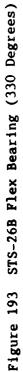


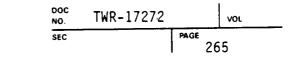
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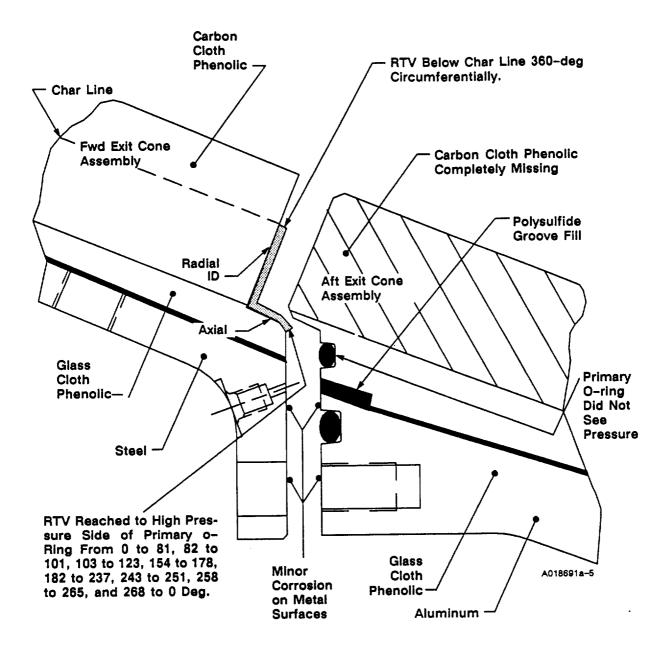


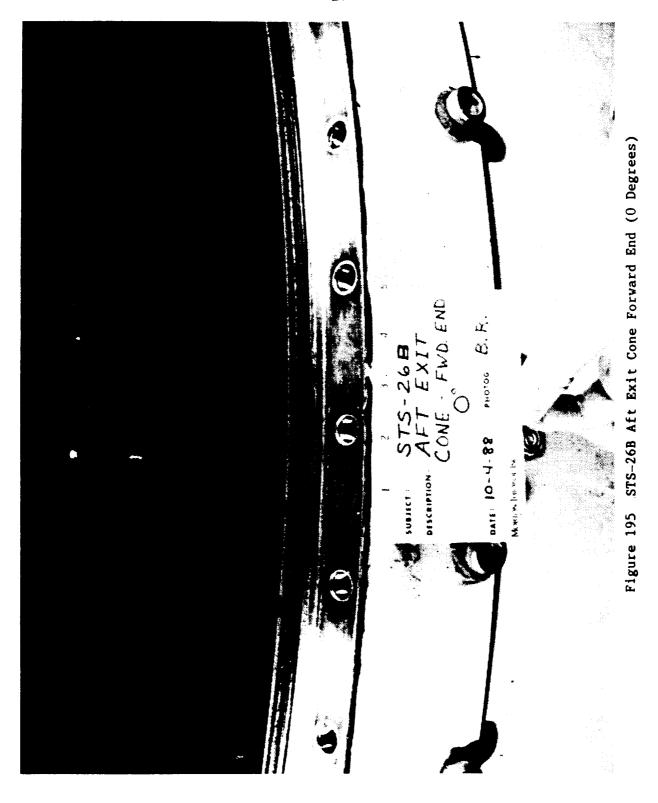
Figure 194 STS-26B-Aft Exit Cone-to-Forward Exit Cone Joint Interface

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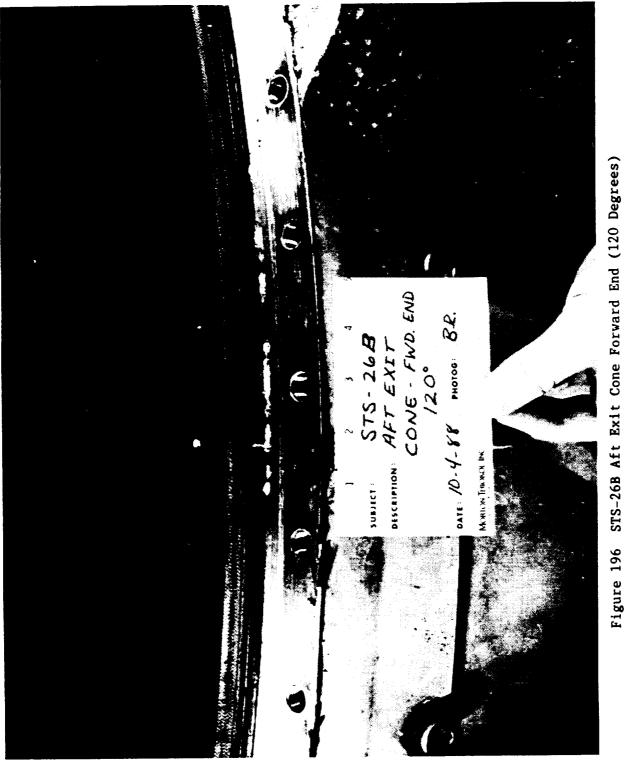
DOC TWR-17272 VOL SEC PAGE 267

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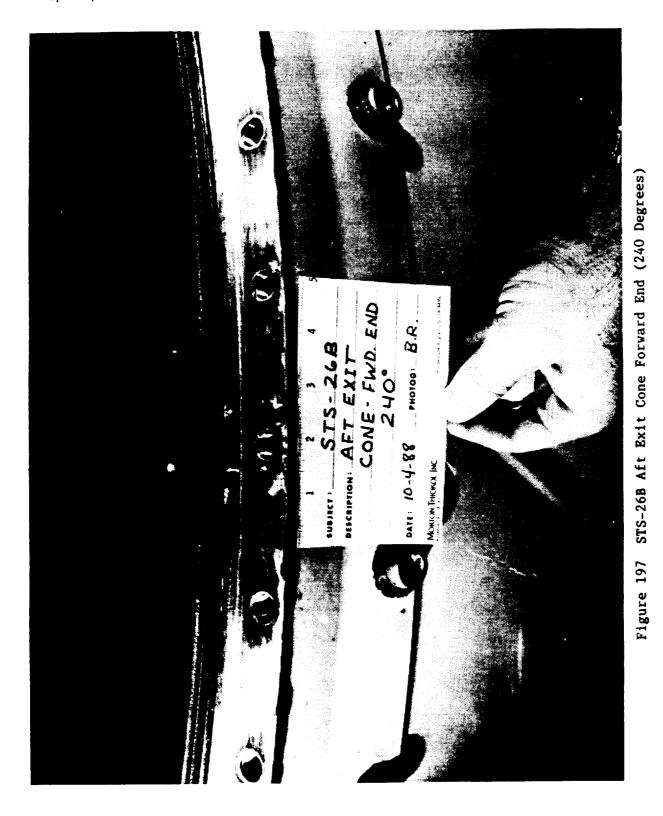
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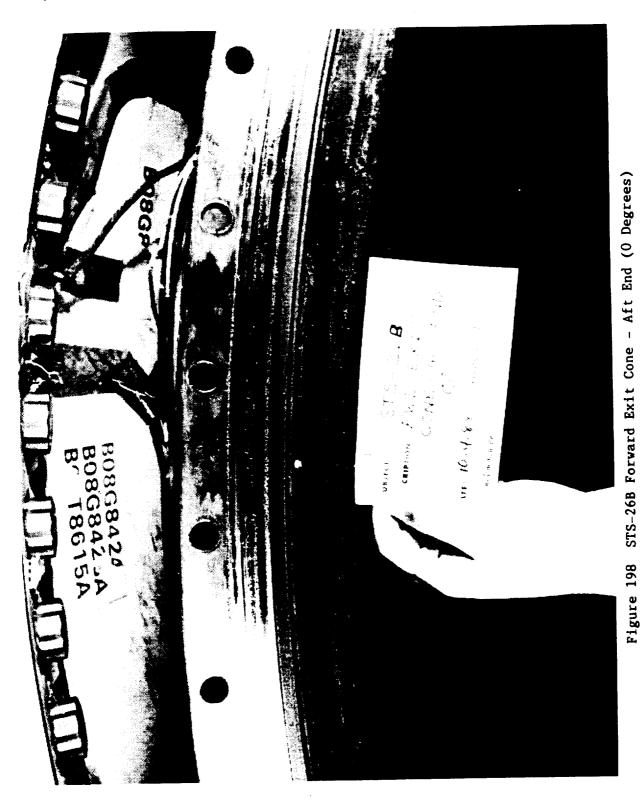
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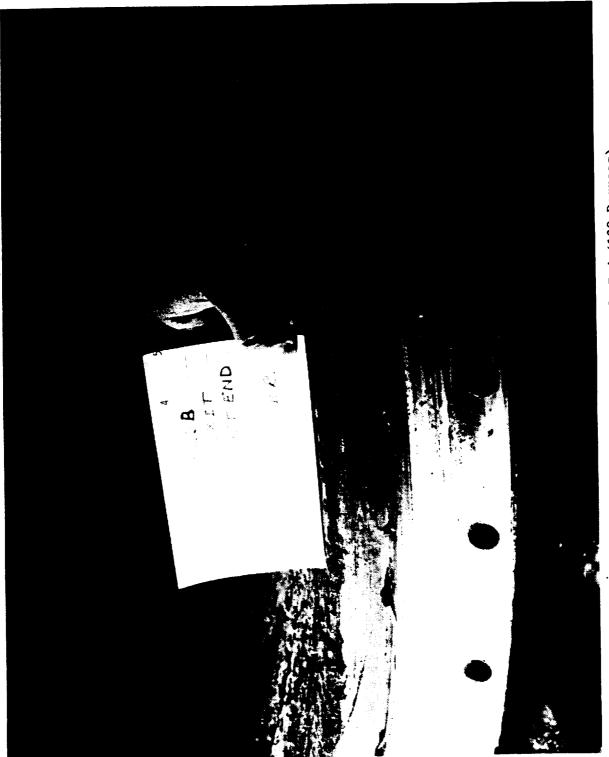


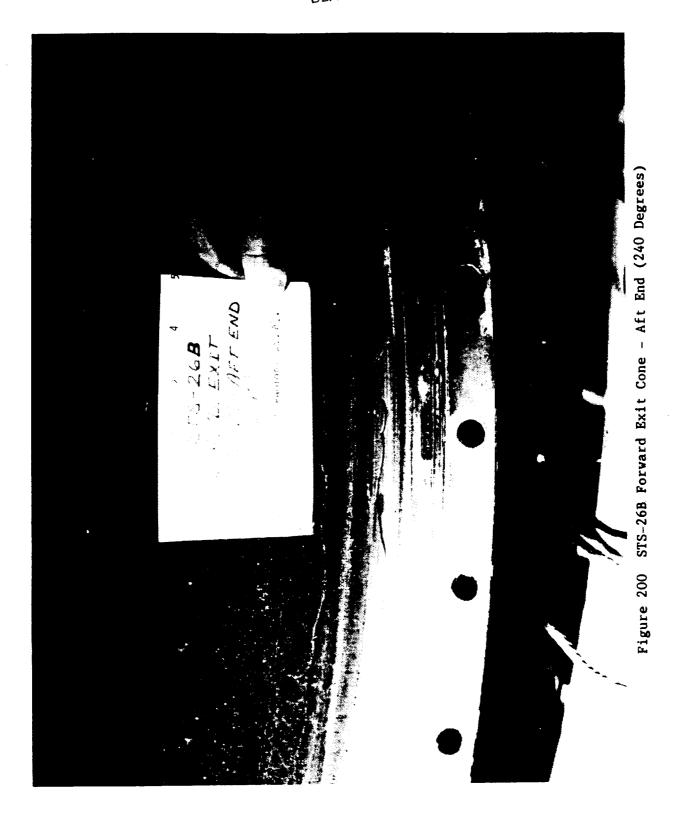
Figure 199 STS-26B Forward Exit Cone - Aft End (120 Degrees)

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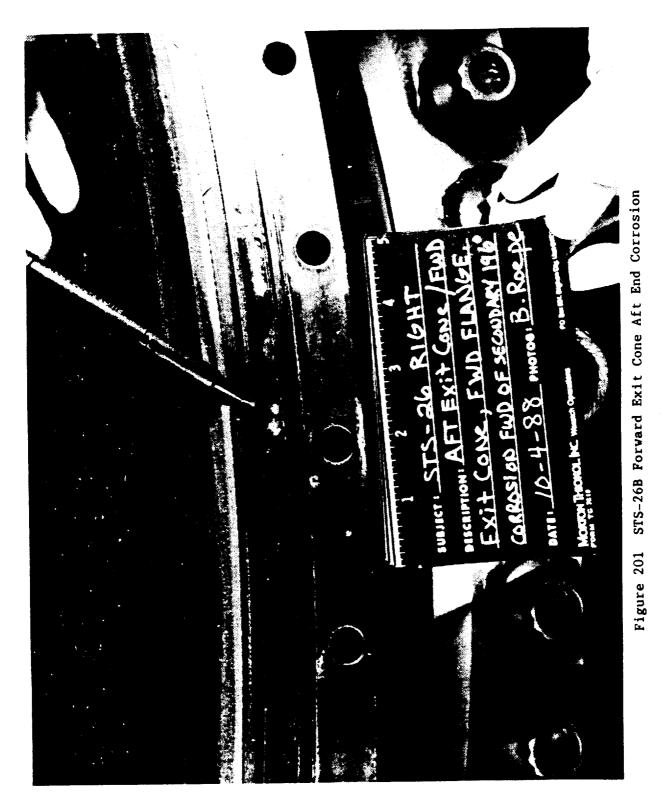
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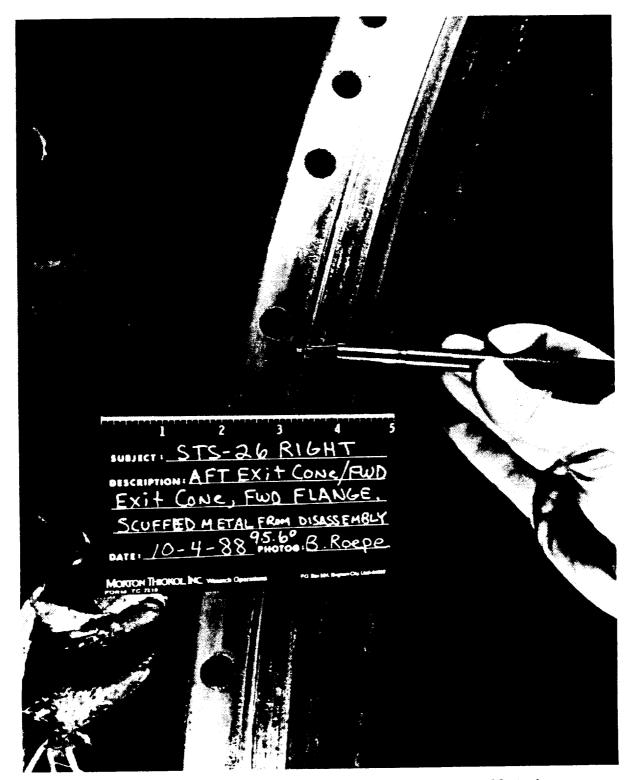


Figure 202 STS-26B Forward Exit Cone Aft End Scuff Mark

 
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Thickol CORPORATION SPACE OPERATIONS

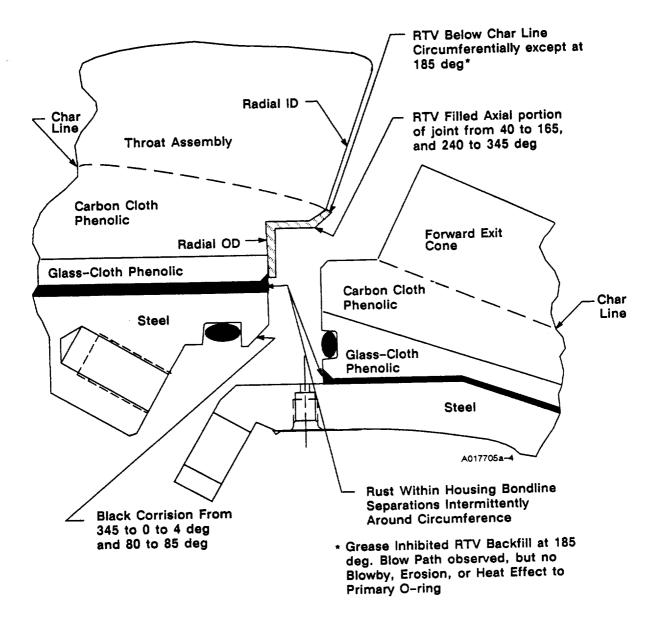


Figure 203 STS-26B Throat/Forward Exit Cone Joint

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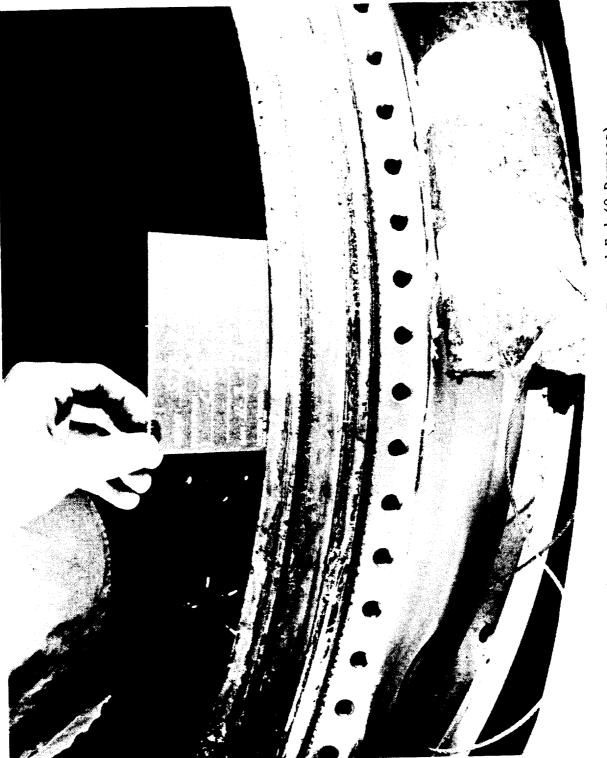


Figure 204 STS-26B Forward Exit Cone - Forward End (0 Degrees)

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MORTON THIOKOL. INC. Aerospace Group

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Figure 205

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Figure 208 STS-26B Throat Aft End (120 Degrees)

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FORM TC 7994-310 (REV 2-88)

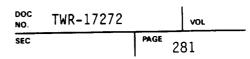
MORTON THIOKOL, INC.

Aerospace Group

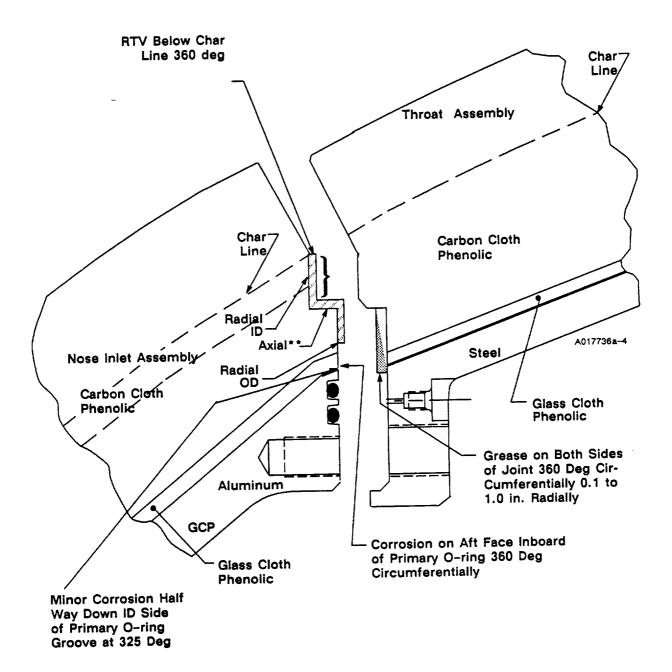
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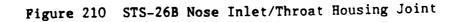
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Thickol CORPORATION SPACE OPERATIONS





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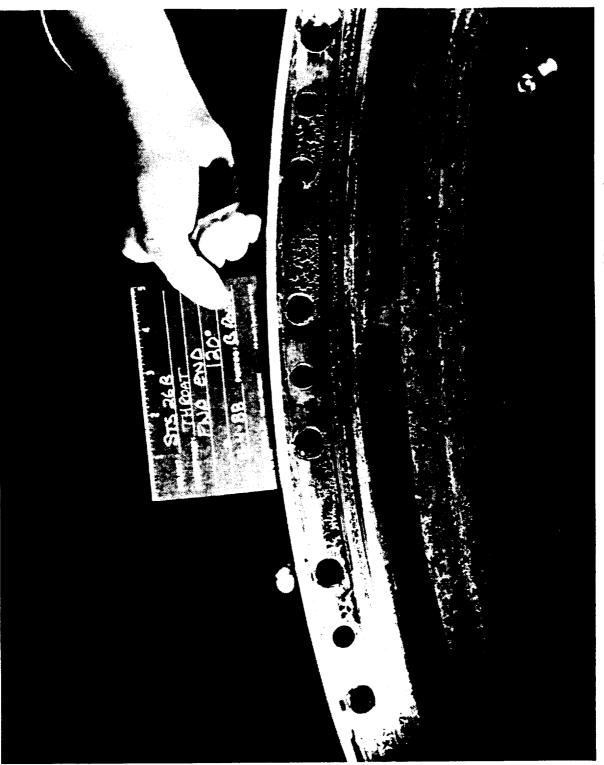


Figure 212 STS-26B Throat-Forward End (120 Degrees)

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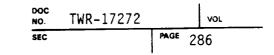
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Figure 214 STS-26B Aft Inlet (-504) Ring-Aft End (0 Degrees)



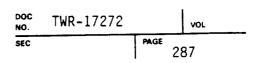
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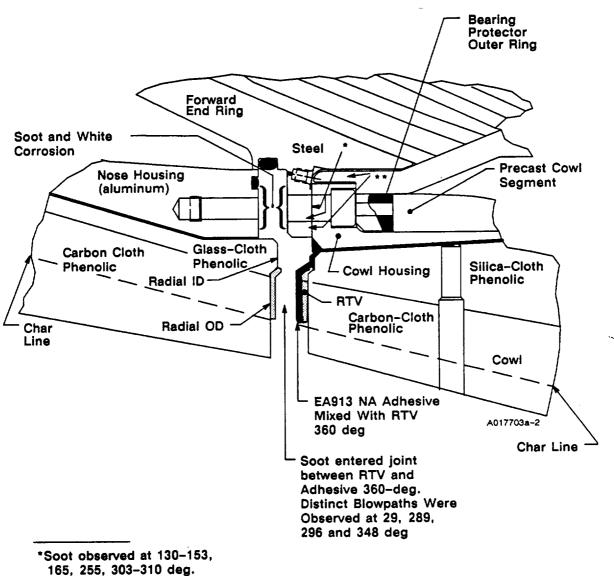
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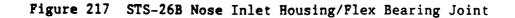
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Thickol CORPORATION SPACE OPERATIONS



**Intermittent White Corrosion



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Figure 218 STS-26B Cowl-Porward End (0 Degrees)

 
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Figure 219 STS-26B Cowl-Forward End (120 Degrees)

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STS-26B Cowl-Forward End (240 Degrees)

Figure 220

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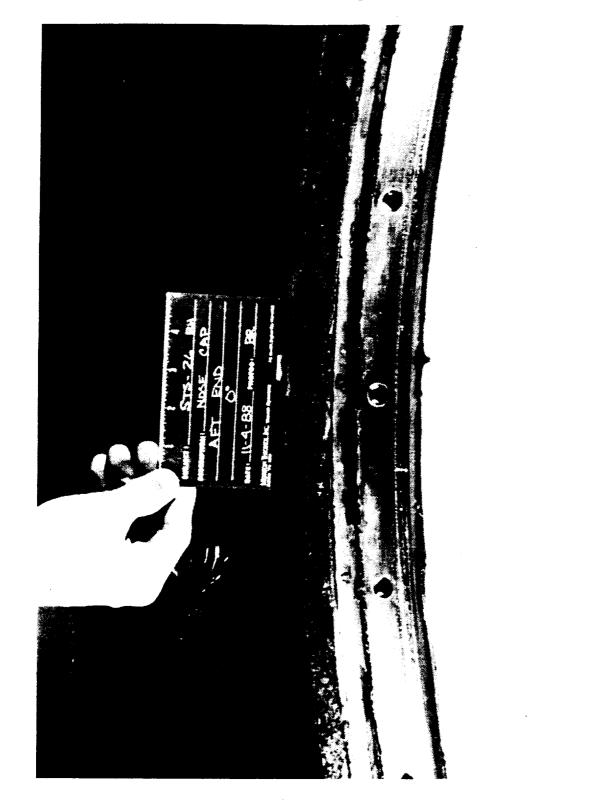


Figure 221 STS-26B Nose Cap-Aft End (0 Degrees)

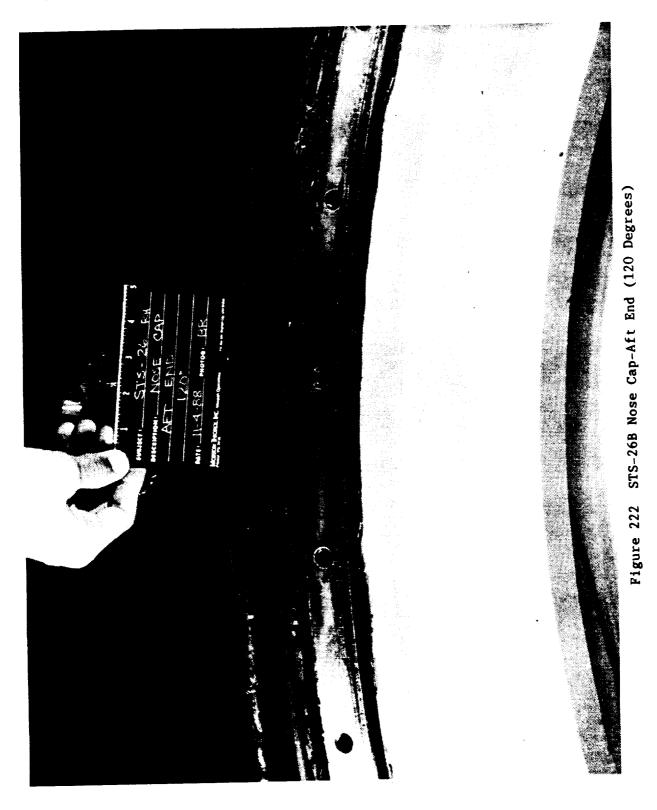
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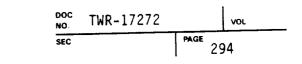
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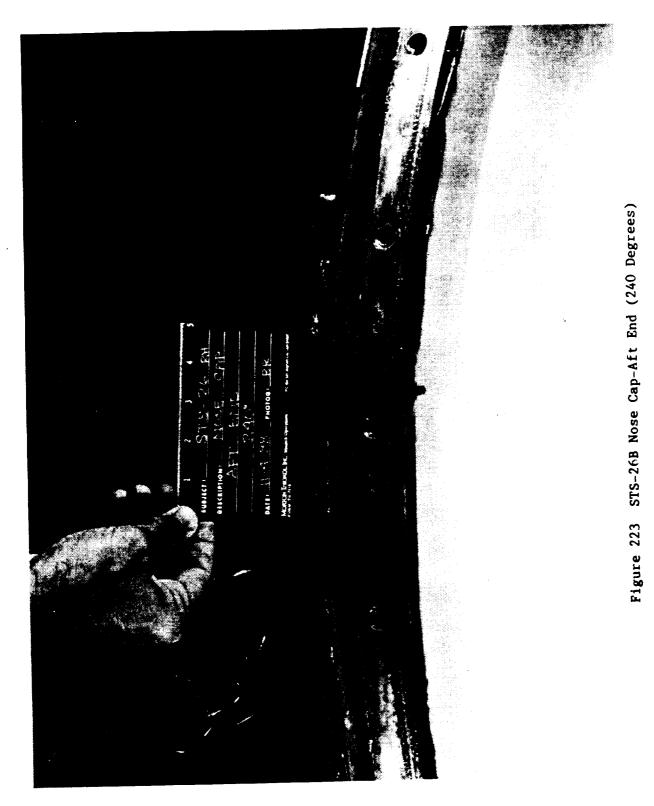


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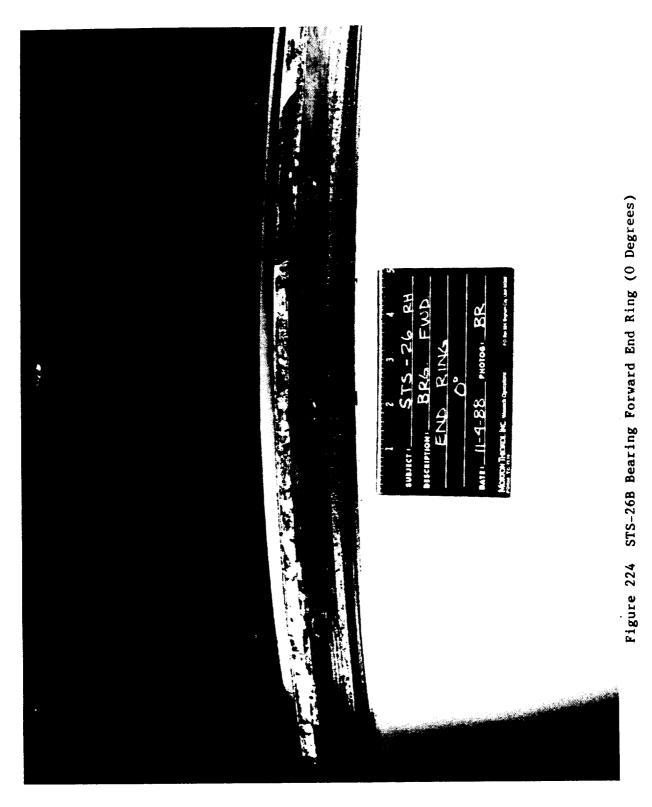




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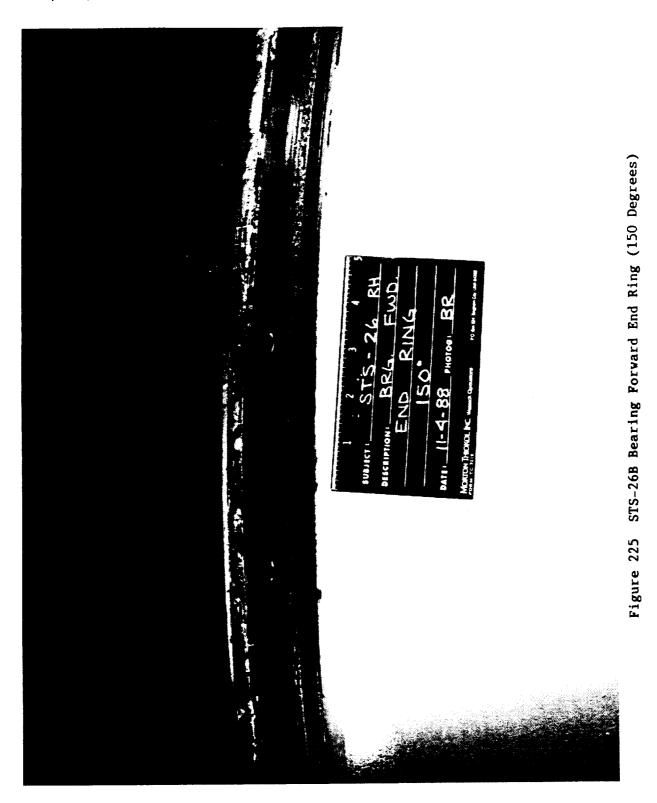


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STS-26B Bearing Forward End Ring (240 Degrees) 26 RH BR TUNT TUNT RING PHOTOG: BRG. 240. STS A DATE: 11-4-85 MORTON THIOKOL INC. DESCRIPTION: SUBJECT : ... Figure 226 a states Q

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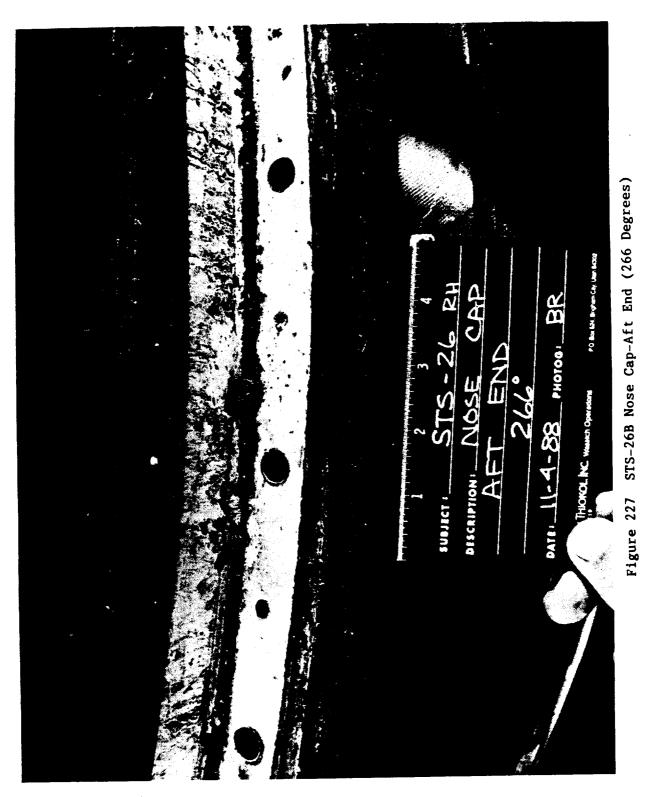
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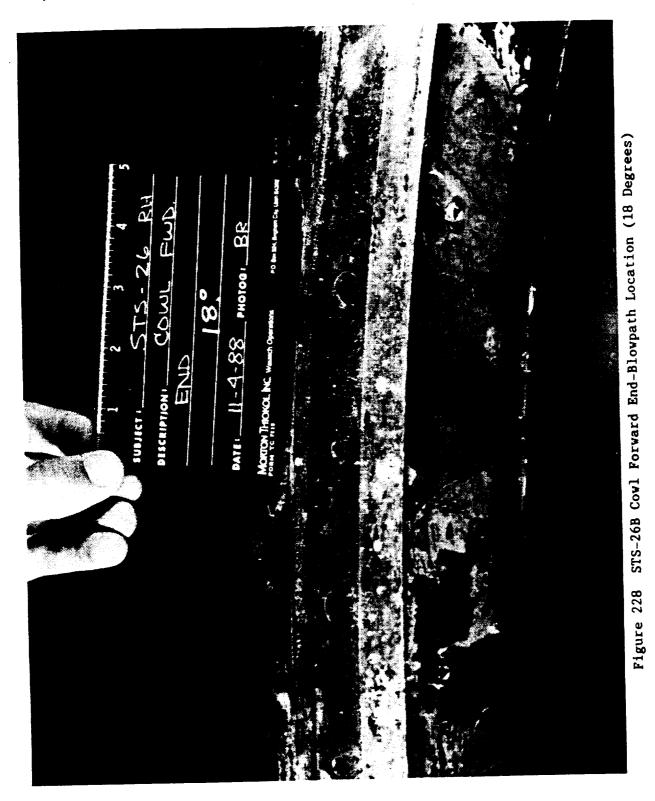


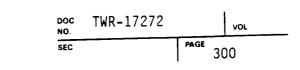
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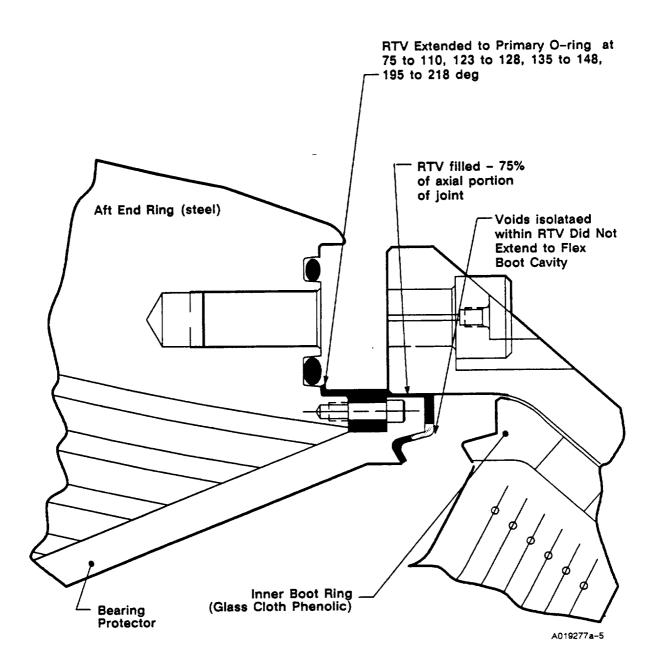
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Thickol CORPORATION SPACE OPERATIONS



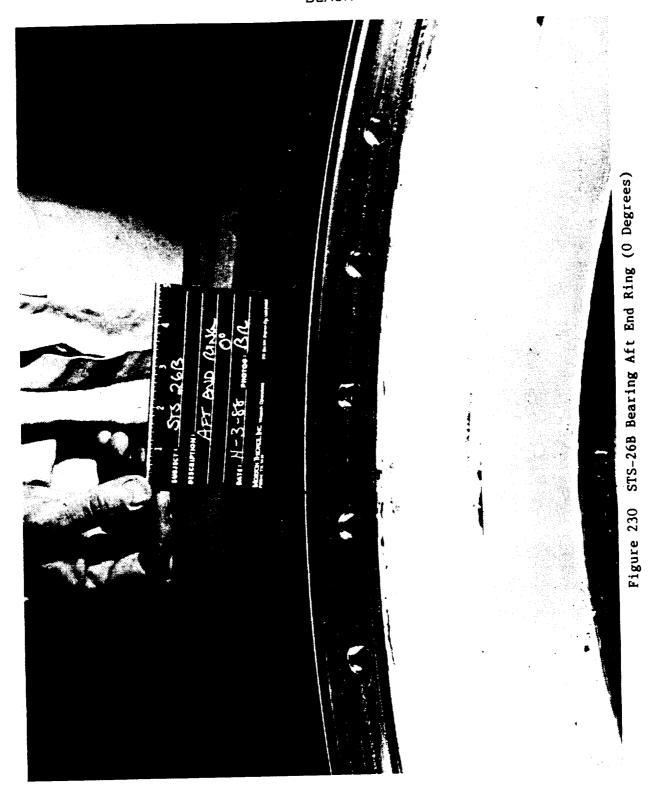
#### Figure 229 STS-26B Flex Bearing/Fixed Housing Joint

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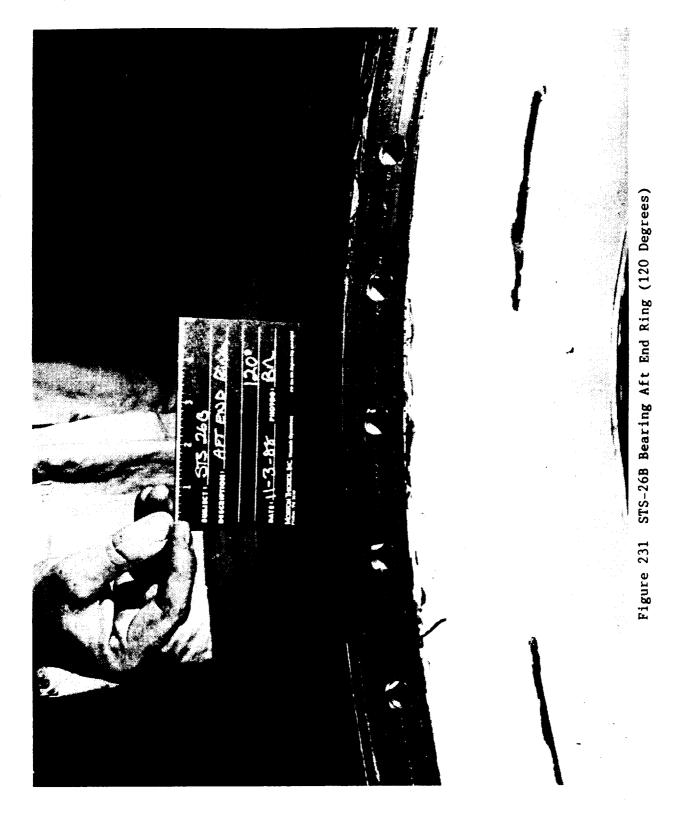




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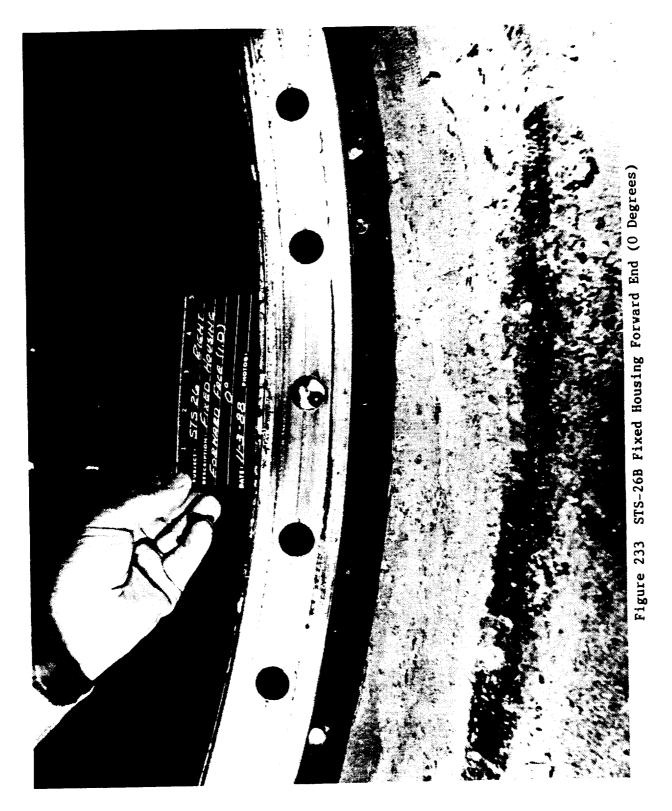


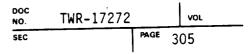
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STS-26B Fixed Housing Forward End (120 Degrees) Figure 234

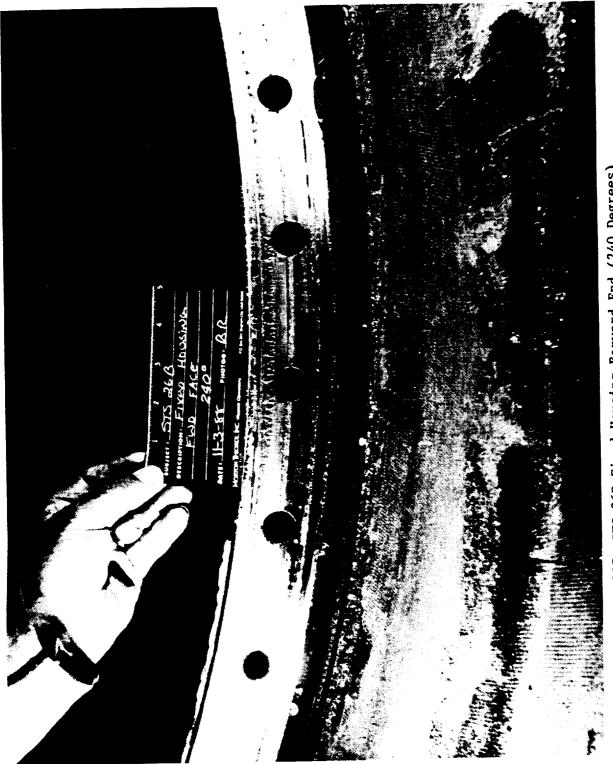
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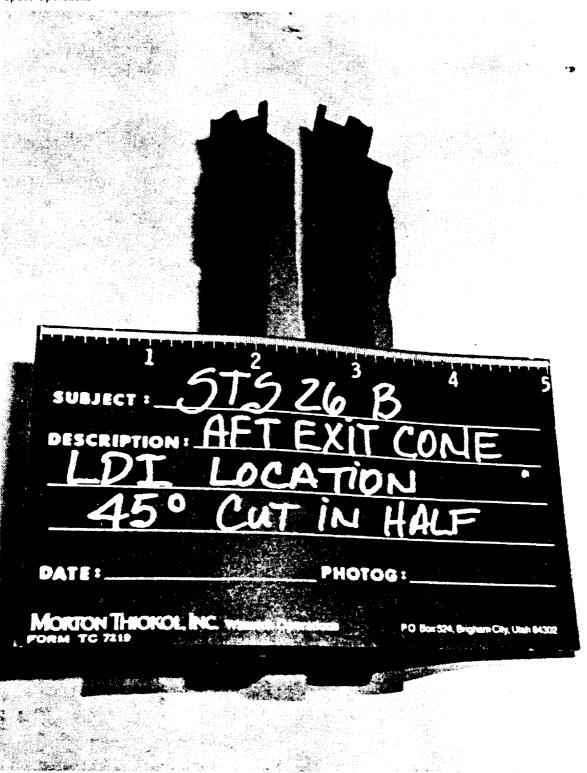


Figure 236 STS-26B Aft Exit Cone LDI Location (45 Degrees)

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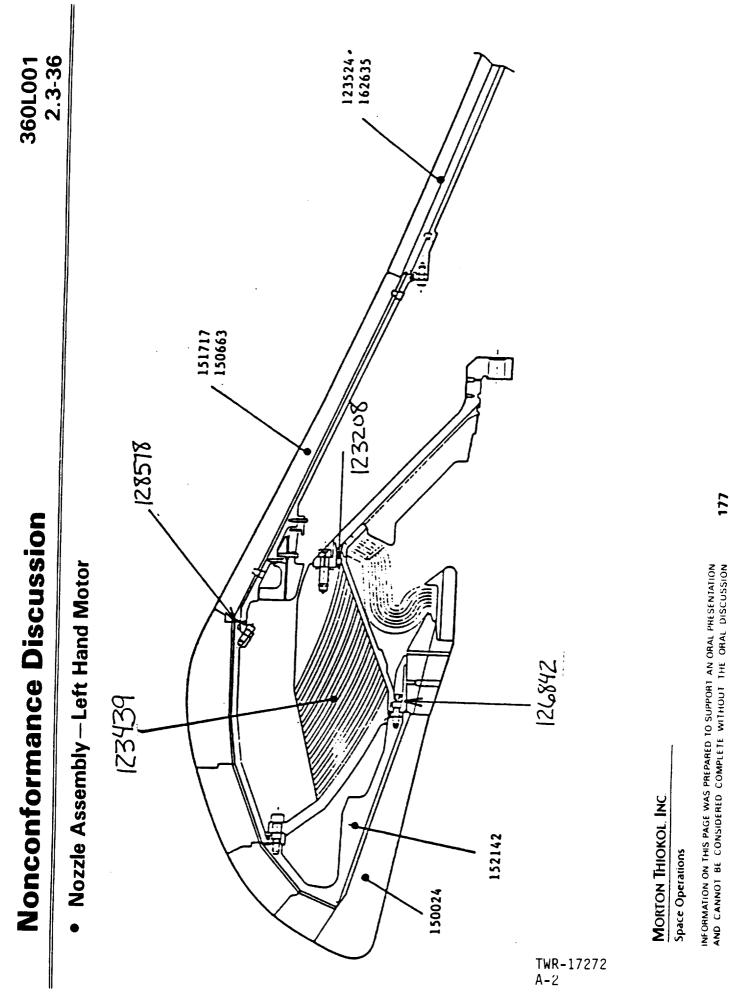
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DR 123524-01 Aft Exit Cone Second Machine

LEFT HAND MOTOR

SENIOR MRB CRITERIA: 9 WAIVER #: RWW 404

Discrepancy

- None SB: Low density indications within the glass cloth phenolic. None greater than 2.5 in. width, 1.9 in. long. length and 0.020 in. radial depth of ply.
- IS: At 240 degrees, 54 in. aft of fwd end and 0.29 in. from 0.D. of glass checks 4.00 in. long. length and 0.040 in. radial depth.

Disposition

**USE-AS-IS** 

Justification

Thermal-structural analysis shows:

Area of defect is in across ply compression during motor operation.

delamination propagation and 10.9 for fiber breakage (including The minimum margin of safety for the area of defect is 15.4 for a 1.4 factor of safety). Across ply and interlaminar shear state for the defect area are 59 psi respectively including actuator stall. 81 and

The The nominal fiber stress in area of defect is 2730 psi. fiber strength of glass is 45600 psi.

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DR 123524-01 Aft Exit Cone Second Machine

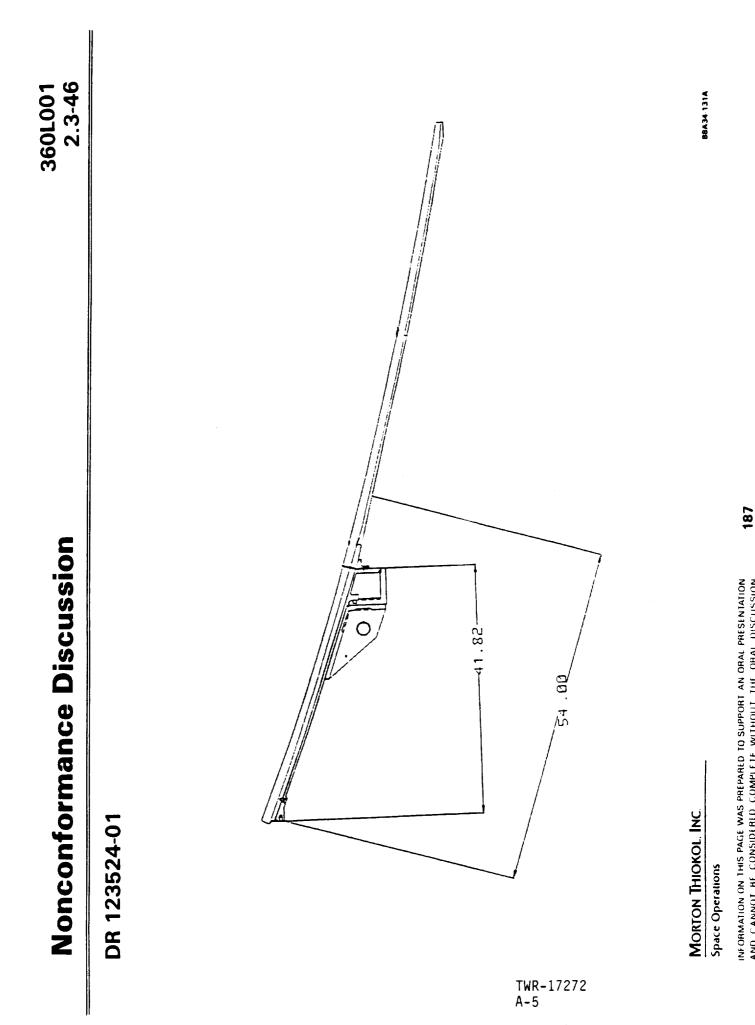
LEFT HAND MOTOR

SENIOR MRB CRITERIA: 9 WAIVER #: RWW 404

Waiver Status

Submitted to MSFC: 22 Dec 1987

Closed: 10 Mar 1988



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NON-CONFORMANCE DISCUSSION 360L001 2.3-47	0L001 2.3-47
DR 162635-01 Exit Cone Sub-Assembly - LEFT HAND MOTOR Nozzle, Aft	OTOR
SENIOR MRB CRITERIA: 9 WAIVER #: RWW-405	
Discrepancy	
SB: Low density indications within the glass cloth phenolic. None greater than 2.5 in. width, 1.9 in. long. length and 0.020 in. radial depth of ply.	
IS: At 240 and 243 degrees, 4 in. aft of Compliance Ring and 0.224 in from part 0.D., checks 0.745 in. long. length by 0.224 radial depth.	in.
Note: Glass thickness at this location = .706 in.	
Disposition	
USE-AS-IS	
Justification	
Thermal-structural analysis shows:	
The area of defect is in across ply compression during motor operation (approximately 50 psi).	
Minimum margin of safety for the area of defect is 19.43 (fiber breakage). Includes a 1.4 factor of safety.	er
The maximum interlaminar shear stress is approximately 60 psi. Interlaminar shear capability of glass cloth phenolic is 4000 psi.	

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LEFT HAND MOTOR Exit Cone Sub-Assembly -Nozzle, Aft 162635-01 DR

SENIOR MRB CRITERIA: 9 WAIVER #: RWW-405

Justification (cont.)

The Maximum fiber stress in areas of defect are 2620 psi. fiber strength of glass cloth phenolic is 45600 psi.

Waiver Status

Date to MSFC: 30 Dec 1987

Closed: 10 Mar 1988

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Exit Cone Sub-Assembly -	Nozzle, Aft
EX	No
162635-02	
DR	

LEFT HAND MOTOR

SENIOR MRB CRITERIA: 9 WAIVER #: RWW-405

Discrepancy

- None greater than 2.5 in. width, 1.9 in. long. length and 0.020 in. SB: Low density indications within the glass cloth phenolic. radial depth of ply.
- IS: At 222 degrees, 39.5 in. aft of Compliance Ring and 0.133 in. from part 0.D., checks 0.979 in. long. length by 0.031 radial depth.

Disposition

USE-AS-IS

Justification

Thermal-structural analysis shows:

The area of defect is in across ply compression during motor operation (approximately 50 psi). Minimum margin of safety for the area of defect is 11.43 (fiber breakage). Includes a 1.4 factor of safety.

The maximum interlaminar shear stress is approximately 60 psi. Interlaminar shear capability of glass cloth phenolic is 4000 psi. Maximum fiber stress in areas of defect is 1610 psi. The fiber strength of glass cloth phenolic is 45600 psi.

DR 162635-02 Exit Cone Sub-Assembly -Nozzle, Aft

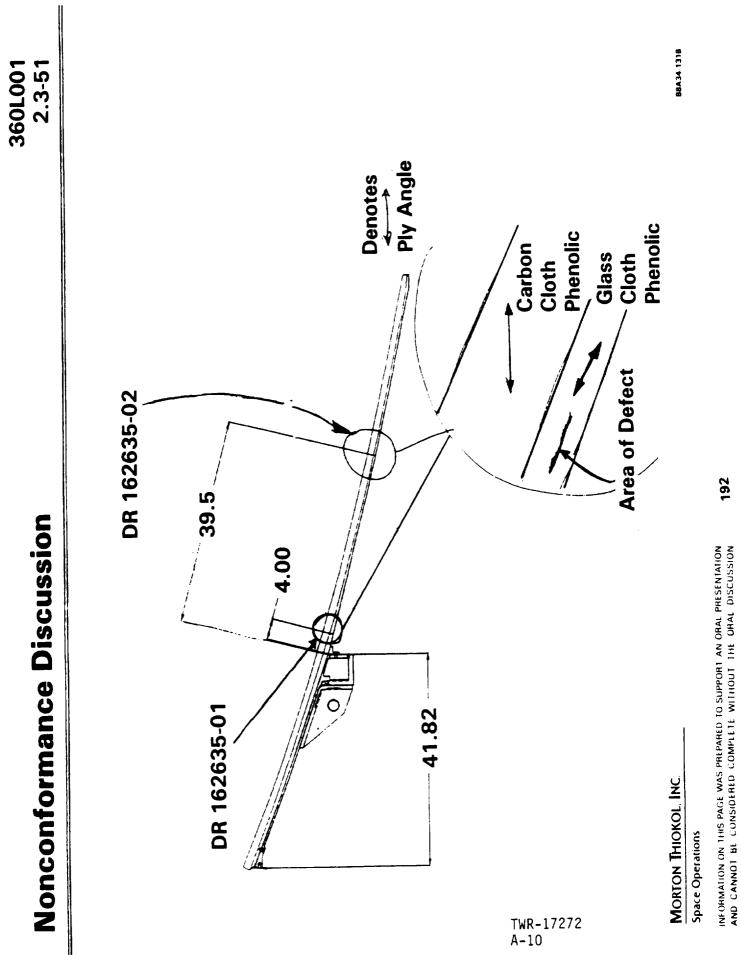
LEFT HAND MOTOR

SENIOR MRB CRITERIA: 9 WAIVER #: RWW-405

Waiver Status

Date to MSFC: 30 Dec 1987

Closed: 10 Mar 1988



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DR 151717-01 Fwd Exit Cone 2nd Machine

LEFT HAND MOTOR

SENIOR MRB CRITERIA: 9 WAIVER #: RWW 387R1

Discrepancy

- SB: Low density indications in glass cloth phenolic, none greater than 5.00 in. circum width, 0.025 in. radial depth and full longitudinal length of a ply.
- 8 Eight low density indications exist in glass cloth phenolic. :SI

Run 360 degree circumference

Full ply length

Disposition

**USE-AS-IS** 

Justification

Minimum margin of safety for area of defect is 7.72 at T = 20 S. Normal and shear stresses at the minimum M.S. are + 50 psi and 300 psi respectively (includes a 1.4 factor of safety).

Normal Minimum M.S. for interface failure is 75.0 at T = 120 S. Not and shear stresses at minimum M.S. location are - 80 psi and 60 psi respectively (includes a 1.4 factor of safety).

Carbon-to-glass interface is in normal compression thru motor operation.

DR 151717-01 Fwd Exit Cone 2nd Machine

LEFT HAND MOTOR

SENIOR MRB CRITERIA: 9 WAIVER #: RWW 387R1

Justification (cont.)

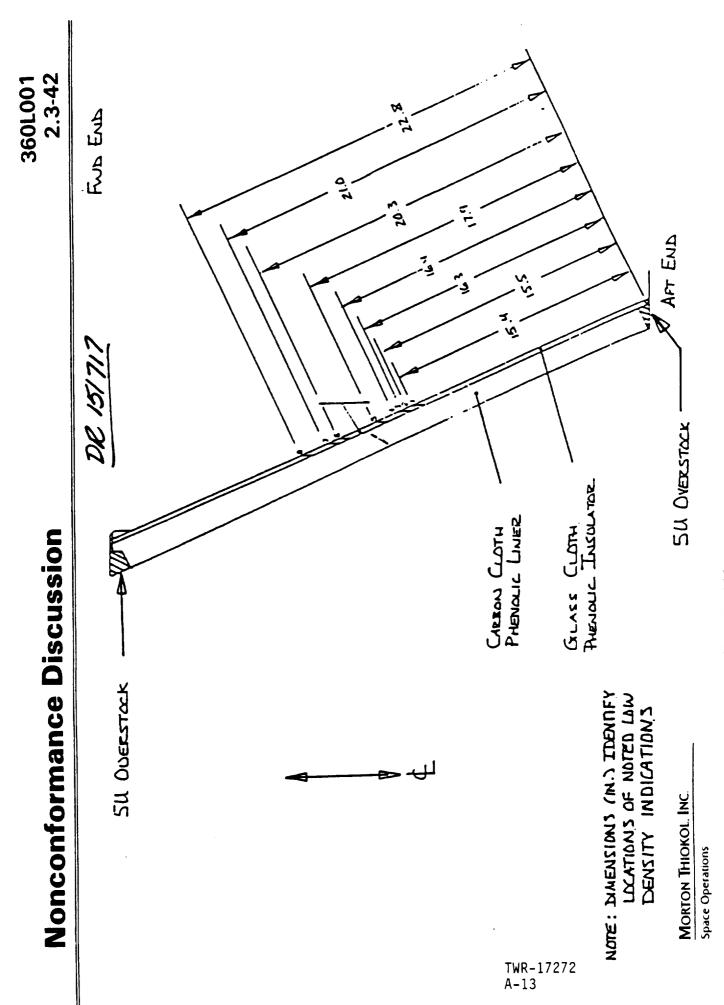
Due to low stress states, any delaminations present will not propagate during motor operation.

Visual and alcohol wipe inspection of OD surface shows no wetlines or porous areas

Waiver Status

Date to MSFC: 24 Feb 1988

Waiting approval, MSFC



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PD 150663-01 Exit Cone Assembly, Fwd Section

LEFT HAND MOTOR

SENIOR MRB CRITERIA: 9 WAIVER #: NONE

Discrepancy

- White stripe on phenolic liner to be in alignment with 90 degree reference on Housing within +/- 1 in. SB:
- Max condition IS: Alignment between Housing and Liner was incorrect. is 1.75 in. from 90 degree reference.

Disposition

Acceptable Departure

Justification

Liner was bonded at the same radial location as dry fit, no effect on bondgaps.

Common orientation is to correlate post-test performance with any pre-test anomalies. The 0.75 in. oversize misalignment will not interfere with this process.

during radiographic inspection. Location is used to identify X-ray The white stripe is identified randomly as 90 degrees on phenolic film.

DR 128578-01 Throat Support Housing

LEFT HAND MOTOR

#### CRITICALITY 1/1R

Discrepancy

SB: No pitting allowed on aft sealing surface.

IS: Pits intermittently around entire circumference, max condition checks 0.002 in. depth.

Disposition

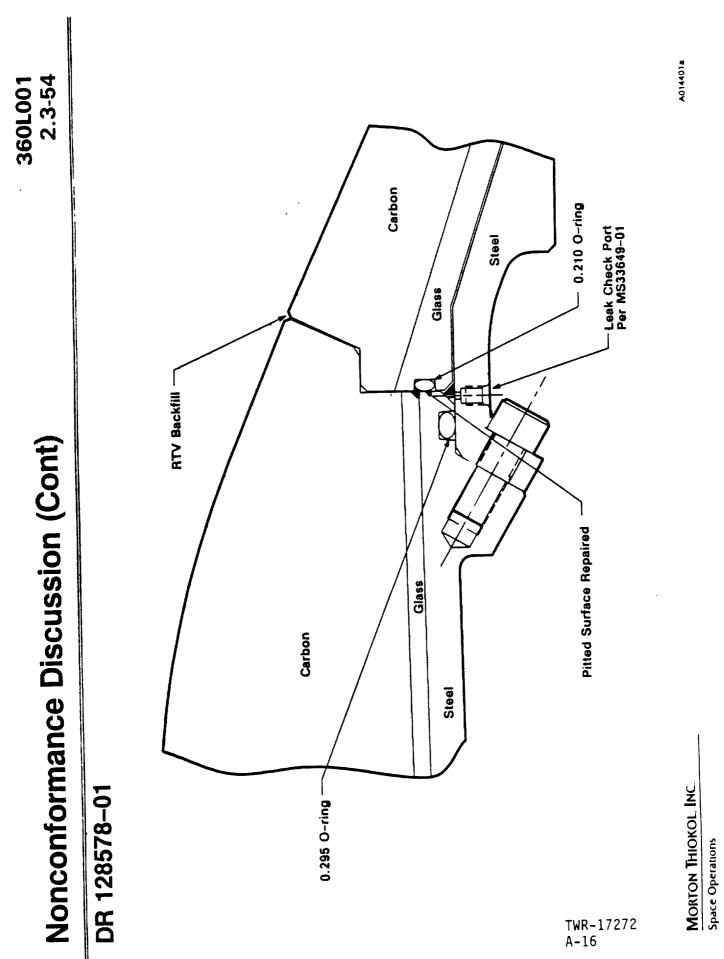
REPAIR

Justification

Raised metal and sharp edges have been removed.

Noted condition results in an 0-ring squeeze of 11.43% using 15.7 compressive set and maximum tolerances. Worst case squeeze based on Minimum design goal for % squeeze = 10 %. max - min part tolerances = 12.28%.

Joint passed leak test requirements.



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DISCUSSION
NON-CONFORMANCE

DR 152142-01 Housing Assy- Nose/Inlet, Nozzle

LEFT HAND MOTOR

SENIOR MRB CRITERIA: 8 WAIVER #: NONE

Discrepancy

EA-9228 Primer surface applied to Nose Inlet Housing bond surfaces. Variation in uniformity of phosphoric acid anodization (PAA) and (Dark streaks and spots)

Disposition

Repair - Grit blast housing to remove PAA and Primer.

Justification

PAA and Primer system has been deleted from the Engineering (Design change). Phenolics were bonded using 51-L surface prep techniques (grit blast - methyl chloroform wipe - blacklight inspection).

2.3-38 360L001

> Nose-Inlet Assembly, Nozzle 150024-01 ΡD

LEFT HAND MOTOR

WAIVER #: NONE σ CRITERIA: SENIOR MRB

Discrepancy

- SB: Completion of EA-946 Adhesive application to housing shall occur within 6 hrs. of end of grit blast.
- IS: Adhesive was not applied within the 6 hour from grit blast requirement for nose cap bond.

Disposition

Part reworked to blue print requirements.

Justification

Housing was regrit blasted and methyl chloroform wiped.

Nose Cap was bonded using standard bonding procedures.

PD 150024-02 Nose-Inlet Assembly, Nozzle

LEFT HAND MOTOR

SENIOR MRB CRITERIA: 9 WAIVER #: NONE

Discrepancy

SB: Application of adhesive to begin within 1 hr of "dry time in" of methyl chloroform wipe.

IS: 1 hr requirement was not met.

Disposition

Part reworked to blue print requirements.

Justification

Housing was methyl chloroform wiped and reinspected for cleanliness.

Nose cap was bonded using standard bonding procedures.

DR 126842-01 Cowl Housing

LEFT HAND MOTOR

#### CRITICALITY 1/1R

Discrepancy

- SB: Pits less than 0.100 inch dia. and less the 0.020 inch depth are acceptable
- IS: Intermittent pits on entire part, worst case condition is .180 dia. x .039 depth on I.D. flange

Disposition

REPAIR

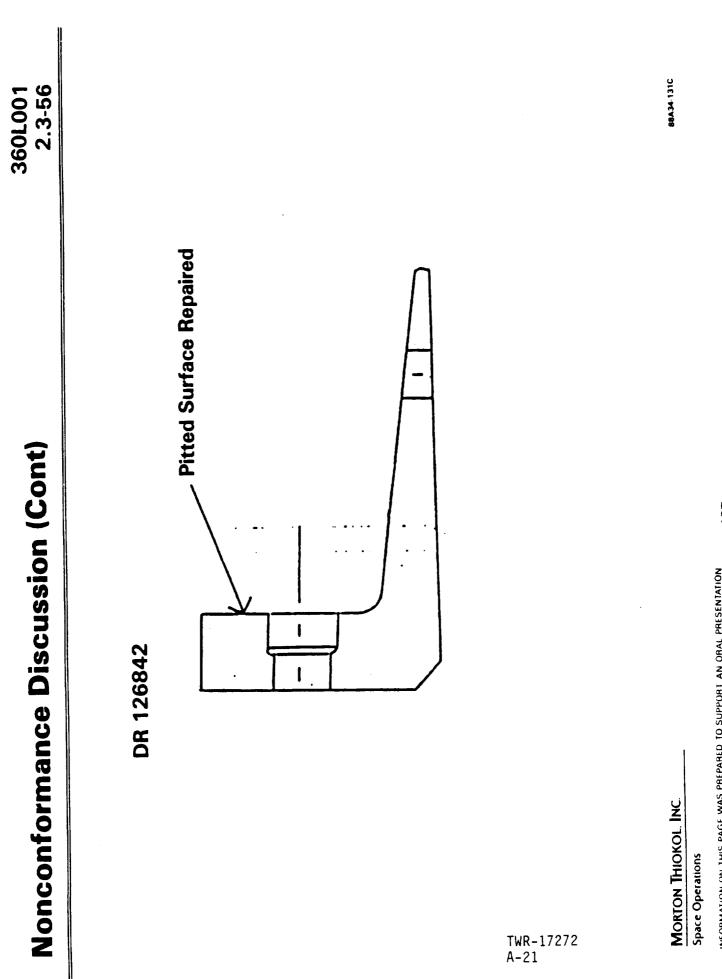
Justification

Pits have been honed out to remove sharp edges.

A worse case condition was flown on SRM-11, 8.50 in. x .350 in. x .085 in. depth.

analysis showed the M.S. was reduced from 5.26 to 4.91 using a 1.4 structural A worse case condition existed on S/N 27 Housing in an adjacent location with pits checking .075 in. depth. Thermal - structure factor of safety.

(Note: This housing has not been flown since refurbishment.)



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DR 123208-01 Aft End Ring

LEFT HAND MOTOR

### CRITICALITY 1/1R

Discrepancy

SB: The .190-32 UNF threaded hole shall not accept the NO-GO Threaded Plug Gage (TPG) more than 3 full turns

IS: 1 of 60 holes accepts the NO-GO TPG for 6.5 turns

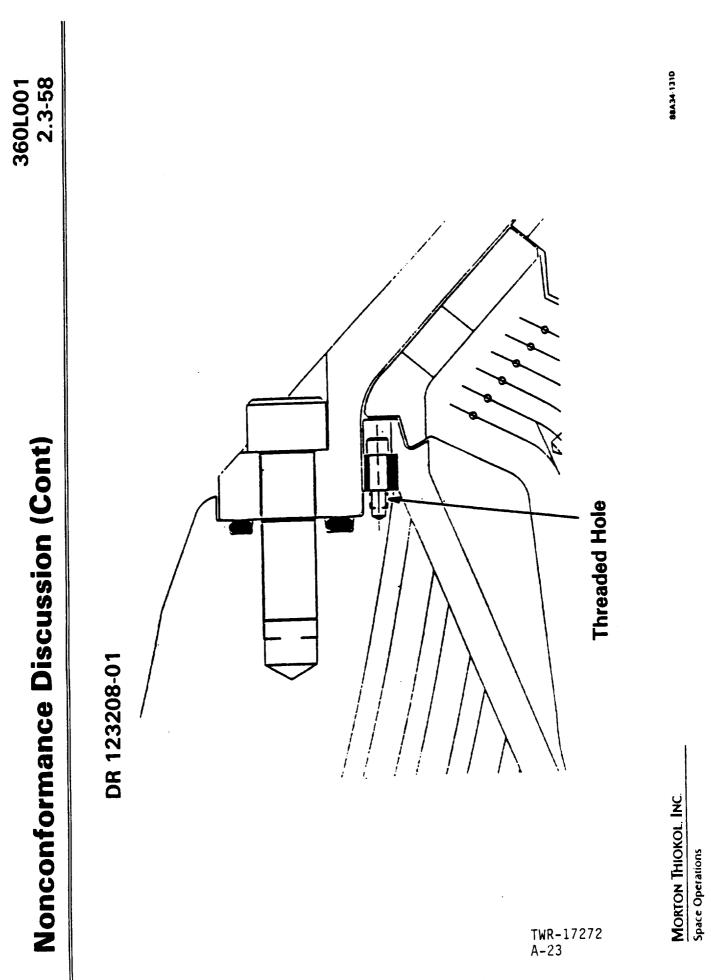
Disposition

**USE-AS-IS** 

Justification

Proper torque was verified by installing and torquing an acceptable bolt, with the hole showing no damage.

Ring and carries no pressure or thermal loads from motor operation. This bolt attaches the Inner Bearing Protector Ring to the Aft End



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DR 123439-01 Flex Bearing

LEFT HAND MOTOR

CRITICALITY 1/1R

Discrepancy

SB: Max. allowable unbond area per pad = 9 sq. in.

IS: Pad 11 (next to fwd end ring) checks with a total of 23.158 sq. in. of unbond area.

Disposition

**USE-AS-IS** 

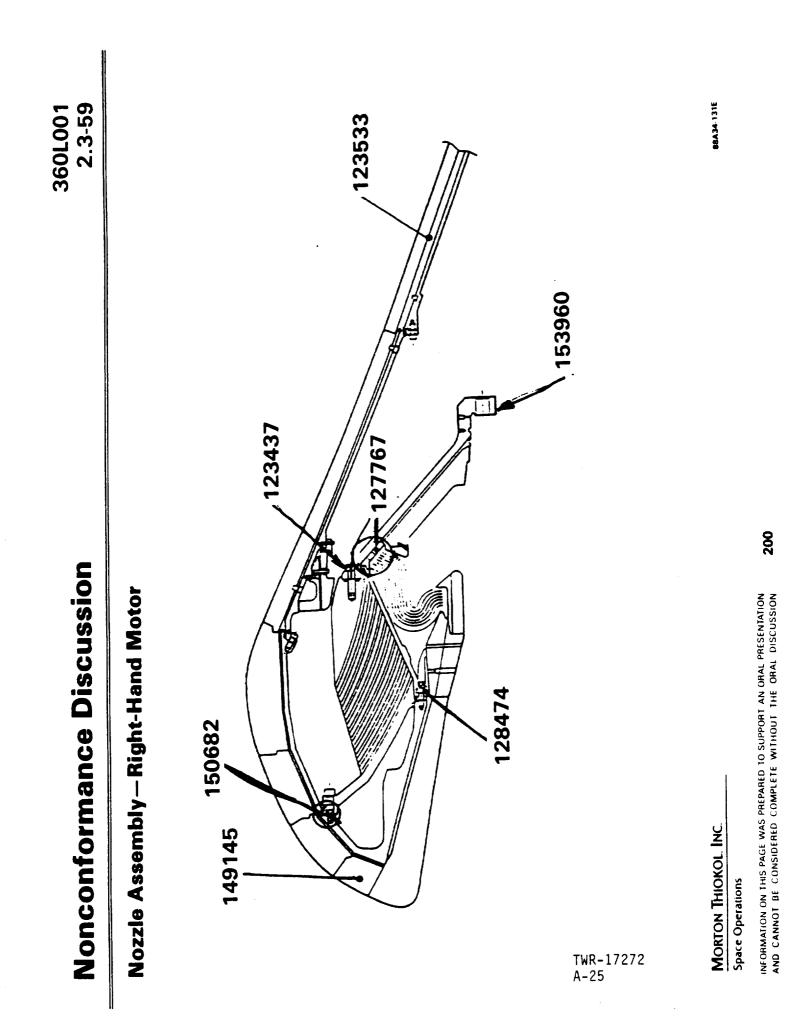
Justification

vectored more than 7 degrees under load and passed tensile leak test. Bearing was successfully acceptance tested during which it was

Bearing will be in compression during flight which will impede unbond propagation.

Limits have since been changed to 20 sq. in. per pad for refurbished bearings. The noted unbond area represents 0.36% of total bond area of pad 11.

1U51060-12, S/N 13 was successfully flown on SRM-15A with 72.1 sq. in. of unbond on a single pad and 103.7 sq. in. total assembly.



DR 153960-01 Nozzle - Aft Segment Assembly

RIGHT HAND MOTOR

SENIOR MRB CRITERIA: 8 WAIVER #: NONE

Discrepancy

Broken girth gage wire between Aft Dome Boss and Nozzle Assembly

Disposition

**USE-AS-IS** 

Justification

Joint passed leak check (both high & low pressure).

Wire is located at outboard side of joint.

Joint would require disassembly to remove wire.

Testing indicates wire is compressed to 0.002 inch thickness.

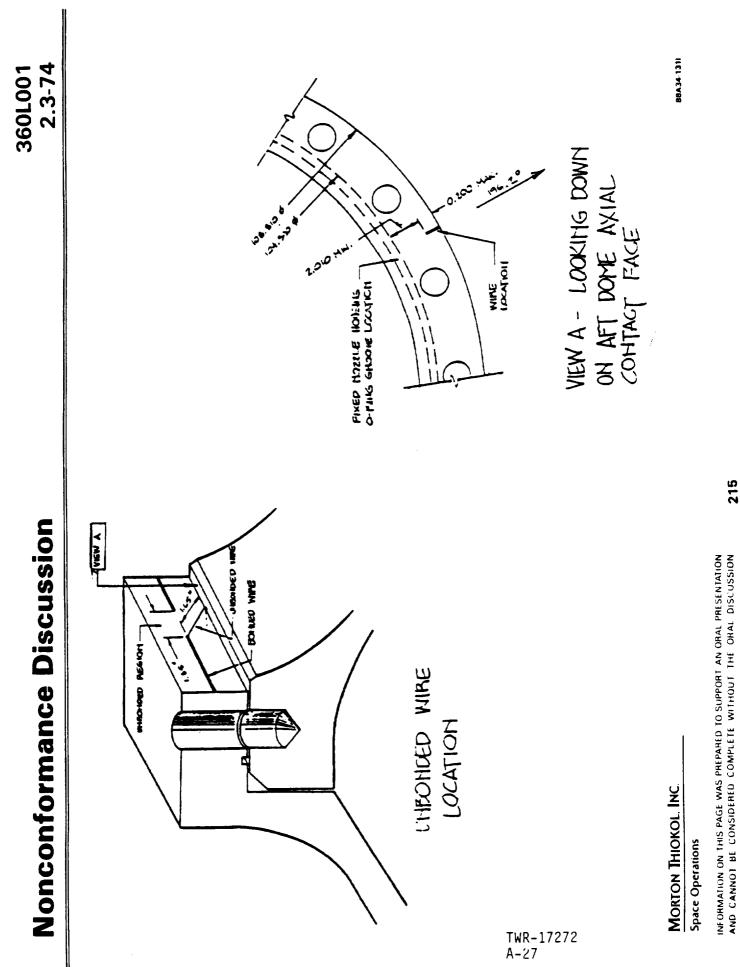
0.002 is less than housing and dome flatness requirement.

Will not affect O-ring groove gap opening.

Wire is located in low stress area (<110 ksi).

Structural integrity is not affected.

Note: Disposition submitted to MSFC 11 Mar 1988



DR 123533-01 Aft Exit Cone, Second Machine

RIGHT HAND MOTOR

SENIOR MRB CRITERIA: 9 WAIVER #: RWW 406

Discrepancy

- SB: Low density indications in glass cloth phenolic none allowed within 0.75 inches from the forward end of the component.
- IS: Low density indication in glass cloth phenolic at 45 degrees; 0.393 in. from forward end 50 configuration.

Measures 2.35 in. circum. width (3 deg), 1.20 in. long. length, and 0.131 in. radial depth.

Indication measures from 0.126 to 0.173 in. from glass 0.D. surface.

machining (primary o-ring and polysulfide grooves) indicates that the low density indication is a resin rich area located Note: Visual examination of defect area after interface and final between the two grc oves.

Disposition

USE-AS-IS

DR 123533-01 Aft Exit Cone, Second Machine

RIGHT HAND MOTOR

SENIOR MRB CRITERIA: 9 WAIVER #: RWW 406

Justification

Visual and alcohol wipe inspection of resin rich area indicates no ply separations, wetlines or delaminations within material.

Thermal - strucutral analysis shows:

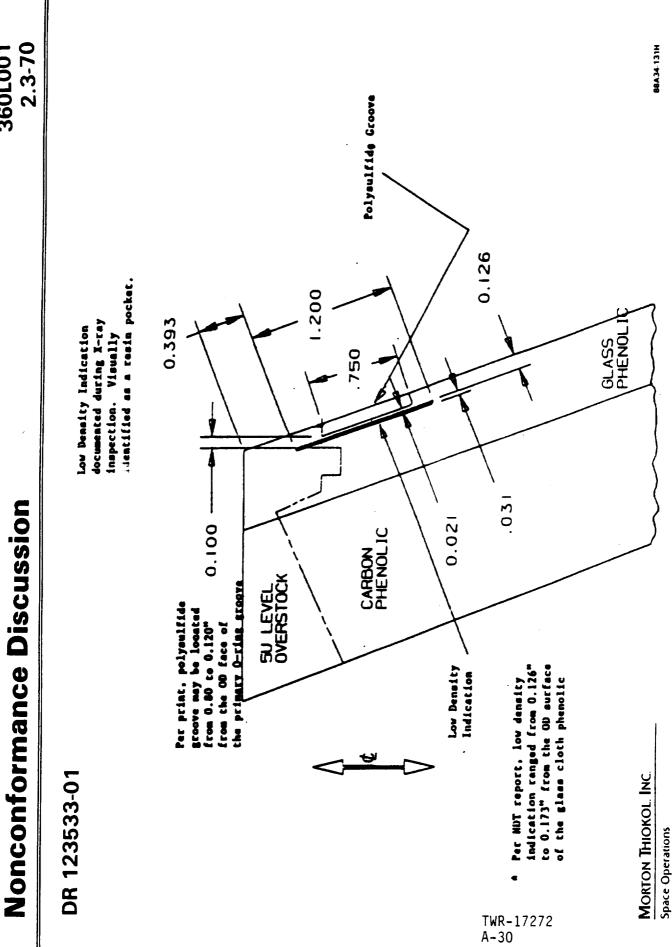
Area of defect is in across ply compression during motor operation. Maximum delamination stress yields a margin of safety of 4.5 at T = 80 seconds (Includes a 1.4 factor of safety). Normal and interlaminar shear stress at minimum margin of safety is -410 and 690 psi respectively.

to be 100% resin, with no fibers present. (Strength reduced from 12300 psi to 4000 psi for margin of safety calculation.) Inplane shear strength reduced for resin rich condition assumed

Waiver Status

Submitted to MSFC: 8 Mar 1988

Waiting approval, MSFC



360L001

INFORMATION ON THIS PAGE WAS PREPARED TO SUPPORT AN ORAL PRESENTATION AND CANNOT BE CONSIDERED COMPLETE WITHOUT THE ORAL DISCUSSION

DR 150682-01 Nose-Throat Assembly Nozzle

RIGHT HAND MOTOR

SENIOR MRB CRITERIA: 8 WAIVER #: NONE

Discrepancy

- SB: Pressurize the primary to secondary seal cavity to 740 +/- 15 psig (high pressure joint check)
- IS: Primary to secondary seal cavity was pressurized to 1020 1040 psig

Disposition

USE-AS-IS

Justification

This is a double face seal with metal to metal contact

Not a phenolic seal, thus no concern about adhesive bondline damage The joint passed leak check requirements at the elevated pressure

DR 150682-02 Nose-Throat Assembly Nozzle

RIGHT HAND MOTOR

SENIOR MRB CKITERIA: 8 WAIVER #: NONE

Discrepancy

SB: Pressurize the primary to secondary seal cavity to 30 +/- 3 psig (low pressure joint check)

IS: Primary to secondary seal cavity was pressurized to 40 psig

Disposition

USE-AS-IS

Justification

This is a double face seal with metal to metal contact

Not a phenolic seal, thus no concern about adhesive bondline damage The joint passed leak check requirements at the elevated pressure

1	Fwd First cure)	Nose Ring, hvdroclave	149145-01	ΔJ	D 149145-01 Nose Ring, Fwd First Wrap (Carbon - RIGHT HAND MOTOR	hydroclave cure)
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SENIOR MRB CRITERIA: 9 WAIVER #: NONE

Discrepancy

- While holding at 310 +/- 10 degree F, decrease pressure to 200 250 psig and hold at this level until the end of cooldown SB:
- Note: Overall average pressure decrease not to exceed rate of 50 psig/min
- IS: While decreasing pressure, pressure dropped to 168 psig for 4 minutes

Pressure remained within tolerance for the remainder of cure

Disposition

Acceptable departure

Justification

Reduction rate was Did not violate the rate change of 50 psig/min. 17.5 psig/min

Excursion was minor (4 minutes) when compared to overall cooldown time (9 hrs)

cooldown thermal stresses. Positive pressure was maintained (168 Positive pressure is desired to preclude possible affects from psig minimum) Tag end properties fall within fired HPM Forward Nose Ring database

RIGHT HAND MOTOR Nose Ring, Fwd First Wrap (Carbon hydroclave cure) 149145-01 PD

SENIOR MRB CRITERIA: 9 WAIVER #: NONE

Justification (cont.)

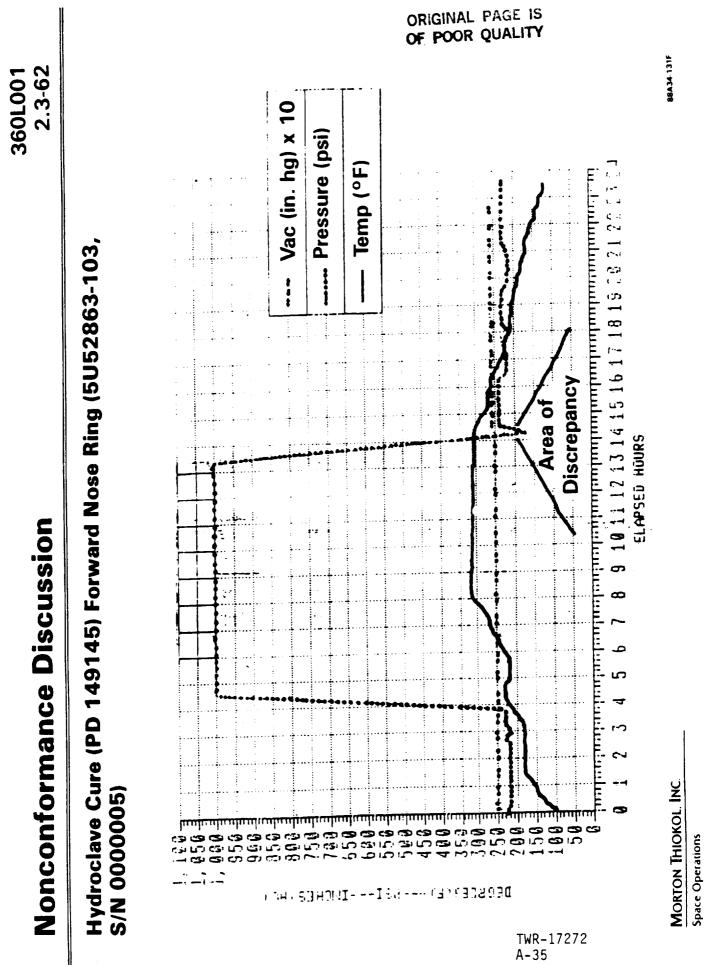
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Alcohol wipe inspection met acceptance criteria

100% radiographic (x-ray) inspection was acceptable with no low density indications or anomalies in carbon phenolic liner

Specification Limits

	Measured	Minimum	Maximum
Specific Gravity	1.48	1.40	1.55
Residual Volatiles (%)	1.77	E 1 1	3.00
Resin Content (%)	32.27	30.0	40.0
Compressive Strength (psi)	28515	18000	55000



203

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DR 128474-01 Cowl Housing

RIGHT HAND MOTOR

### CRITICALITY 1/1R

Discrepancy

SB: No interconnecting pits or irregular surfaces deeper than 0.030 in

IS: I.D. pits, maximum depth is 0.049 in

O.D. pits, maximum depth is 0.041 in

Disposition

REPAIR - Pits have been blended out to remove sharp edges and raised metal.

Justification

A worse case condition existed on S/N Cowl Housing (has not flown since refurbishment). Thermal - structural analysis shows the maximum pit depth was 0.065 with a M.S. reduced from 3.35 to 3.15 (includes 1.4 factor of safety).

DR 123437-01 Aft End Ring

RIGHT HAND MOTOR

### CRITICALITY 1/1R

Discrepancy

- SB: The .750-16 UNF threaded hole shall not accept the Threaded Plug Gage (TPG) for more than 6 full turns
- IS: 1 of 72 holes accepts the NO-GO TPG for 8 turns

Disposition

REPAIR - Hole was drilled and tapped for a helical coil insert.

Justification

Tapped hole was inspected with .750-16 UNF Screw Thread Insert (STI) GO/NO-GO gage and was acceptable.

Helical coil inserts are a standard repair of threaded holes.

RIGHT HAND MOTOR Bearing Protector, Inner Ring (Glass autoclave cure) 127767-01 PD

SENIOR MRB CRITERIA: 9 WAIVER #: NONE

Discrepancy

- SB: Maintain 15 in. HG vacuum minimum for 2 hrs minimum into 310 +/- 10 degree F hold period
- 8 minutes prior to start of 310 degree F hold, vac dropped to 14.8 in. HG :si

Vac continued to decline to a minimum level of 13 in. HG, 48 minutes into 310 degree F hold

hold, and remained above 15 in. for the remainder of the cure Vac increased to 15 in. HG at 2 hrs 49 min into 310 degree F

Disposition

Acceptable departure

Justification

Minor vacuum drop below required level not detrimental to part integrity

Vacuum bag integrity was maintained

Alcohol wipe inspection met acceptance criteria

Tag end properties are within specification limits

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RIGHT HAND MOTOR Bearing Protector, Inner Ring (Glass autoclave cure) 127767-01 PD

SENIOR MRB CRITERIA: 9 WAIVER #: NONE

Justification (cont.)

Worst case condition flew on SRM-20A. Throat Inlet Ring S/N 33, 48 minutes after 220 degree hold, lost vacuum down to 0 in. HG for remainder of the cure (ref DR 116193).

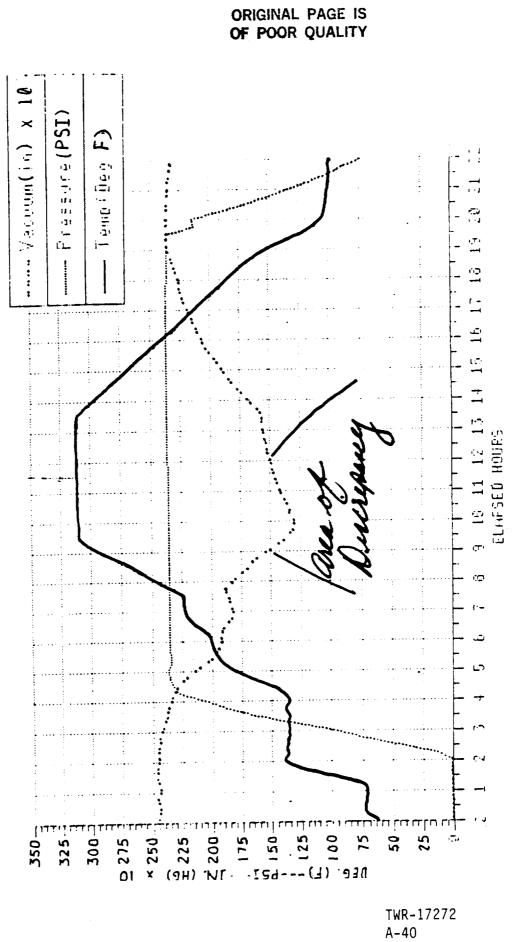
Specification Limits

	Measured	Minimum	Maximum
specific Gravity	1.97	1.70	2.15
pecifications (\$)	0.87		3.25
Resin Content (\$)	28.16	24.0	38.0
Compressive Strength (psi)	57303	16630	60000

360L001 2.3-65

# **Nonconformance Discussion**

## Autoclave Cure (PD 127767) Bearing Protector, Inner Ring (5U51130-105 S/N 0000118)



88A34 1658

INFORMATION ON THIS PAGE WAS PHEPARED TO SUPPORT AN ORAL PRESENTATION AND CANNOT BE CONSIDERED COMPLETE WITHOUT THE ORAL DISCUSSION

MORTON THIOKOL. INC.

**Space Operations** 

MORTON THIOKOL. INC.

Space Operations

Appendix B

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TWR	-17272	
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	B-1	

REVISION

POSTFIRE ANOMALY	RECORD	(PFAR)
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. PFAR NUMBER 5601001A-11		ION LOCATION T-24/T-97	4. REFERENCE S	WUAWK NUMBER	5. REFERENCE PR NUMBER PV6-111293	` 
SRM MOTOR NUMBER	 н-7 	A-2	6. REFERENCE	LFA NUMBER	7. REFERENCE SPR NUMB N/A	ER
TITLE CORROSION BETWEEN PRIMAR	Y AND SECONDARY	AFT EXIT CONE O	RINGS			
CLASSIFICATION OBSERVATION	MINOR ANO	••••	MAJOR ANOMAL	Y	CRITICAL ANOMALY	-
0. PART NUMBER 1076039-01	11. SERIAL NU 0000001	MBER   12. AF1	PART DESCRIPTION EXIT CONE ASSY			
3. REPORTED BY (NAME / C K. B. NIELSEN / N	RGANIZATION / OB	SERVATION DATE)	/ 10	/07/88		
4. RESPONSIBLE COMPONENT NOZZLE / E. L. DIE	TEAM / PROGRAM	MANAGER				
	ENGINEER (NAME / NOZZLE/FLEX BEARI	ORGANIZATION )				
	NGINEER (NAME / C NOZZLE/FLEX BEAR)	ORGANIZATION) ING DESIGN ENGIN	EERING			
7. DESCRIPTION (ATTACH Aluminum oxide corrosio o-ring in the 360L001A poted that grease in bo	n was observed by (LH) aft exit con th joints appear	ne field joint. ed lighter than	No pitting was of required on STW7-	2999.		ectors
Minor corrosion has bee	n observed within	n past flight af	t exit cone field	joints, but ha	is not been documented.	
		TELOS ENCLINEED	IG EVALUATION LIMI	 TS)		
	SSIFICATION (POS sue. It is beli observed. This owed.	is potentially a	a reuse issue if t	TS) the primary o- he grease appl	ring at splashdown, resu ication specification	
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PFAR NUMBER	3. INSPECTION LOCA	/1-97	26-0046		5. REFERENCE P PV6-111290	
60L001A-12 SRM MOTOR NUMBER 60L001A	 H-7 A-2		6. REFERENCE IF	A NUMBER	7. REFERENCE S	PR NUMBER
TITLE	AND SECONDARY AFT EXI	T CONE O-	RINGS			
CLASSIFICATION OBSERVATION	MINOR ANOMALY	X	MAJOR ANOMALY		CRITICAL ANO	
0. PART NUMBER 1052839-01	0000005	FOR	PART DESCRIPTION RWARD EXIT CONE ASS	Y 		
3. REPORTED BY (NAME /		TOM DATES	/ 10/		•••••	
NOZZLE / E. L. DIE	A REPORTED AND MANAGE	8				
5. RESPONSIBLE PROJECT	ENGINEER (NAME / ORGANI NOZZLE/FLEX BEARING PRO	TATION )				
	NGINEER (NAME / ORGANIZ NOZZLE/FLEX BEARING DES	ATION			•••••••••••••••••••••••••••••••••••••••	
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REV. 3/28/89

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PFAR NUMBER 601001A-43	3. INSPECTION KSC	T-24/T-97	4. REFERENCE SC N/A		5. REFERENCE PR NUMBER
SRM MOTOR NUMBER	H-7 X	A-2	6. REFERENCE II N/A	FA NUMBER	7. REFERENCE SPR NUMBER N/A
TITLE TV/EA913 ADHESIVE MIXING	IN JOINT 2				
CLASSIFICATION OBSERVATION	MINOR ANON	•••	MAJOR ANOMALY		CRITICAL ANOMALY
0. PART NUMBER N/A	11. SERIAL NUM   N/A	18ER   12.   CO	PART DESCRIPTION L/NOSE INLET JOINT	(JOINT 2)	
3. REPORTED BY (NAME / O R. J. GEORGE / N	OZZLE/FLEX BEAKIN		ERING / 10/	30/88	
4. RESPONSIBLE COMPONENT NOZZLE / E. L. DIEH	L 				
5. RESPONSIBLE PROJECT E D. J. WAGNER / N	OZZLE/FLEX BEAKIN	NG PROJECT CNGT	NEERING		
6. RESPONSIBLE DESIGN EN S. A. MEYER / N	OZZLE/FLEX BEARIN	NG DESIGN ENGIN			
7. DESCRIPTION (ATTACH F See continuation sheet.	FOR, FIGURES, PH	OTOGRAPHS, ETC.	)		
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### CONTINUATION SHEET FOR PFAR NUMBER 360L001A-43

#### 17. DESCRIPTION (continuation)

The EA913 adhesive used to bond the cowl insulation to the cowl housing extruded into the radial RTV bondline between the cowl ring and nose cap 360-deg. circumferentially. The adhesive that extruded into the radial bondline was typically sandwiched between two layers of RTV. Soot was observed over a majority of the joint circumference and up to the primary orring. A distinct blowpath was observed at 216 deg. Heat affected GCP and SCP were observed at the blowbath location. The charred material was approximately 0.01 in. deep. The EA913 NA adhesive adjacent to the cowl housing was eroded approximately 0.1 in. axially x 0.7 in. wide circ. at the blowbath location. There was no blowby, erosion or heat effect to the primary orring. Electrical conductivity measurements on the cowl and nose inlet housings showed no heat damage.

The mixing of the adhesive in the cowl/nose cap bondline and the presence of soot was documented on ETM-1A, DM-8, DM-9, QM-6 and QM-7. It is believed that the mixing has occurred on all previous nozzles due to assembly procedures. Charred GCP and SCP insulators have been observed at blowpath locations in the QM-6, and PV-1 nozzle internal Joint #2. Eroded EA913 NA adhesive has not previously been observed.

### 23. RESULTS OF RECOMMENDED CORRECTIVE ACTION (continuation)

1. The new assembly procedure was tested on PV-1 and QM-8 Joint #2's. Post-test inspections of these joints prompted the decision to further evaluate and refine the new assembly procedure on TEM motors.

As of 360L002, there has never been primary o-ring blowby, erosion or heat effect, or metal heat damage with Joint #2. In the 360L002 RPR8, it was decided to close out all "minor anomalies" similar to this on all previous static tests and flights. All future occurrences, including 360L002, would be considered "observations".

TWR-17198 Vol. V has been updated to include accept/reject criteria for RTV in nozzle joints. The condition noted in this "minor anomaly" is now an "acceptable" condition per this criteria.

PFAR NUMBER	3. INSPECTION LOCATION KSC X T-24/T-97	4. REFERENCE S 26-0043	WAWK NUMBER	5. REFERENCE PR PV6-111312	
SRM MOTOR NUMBER	H-7 A-2	6. REFERENCE I N/A	FA NUMBER	7. REFERENCE SPR N/A	NUMBER
	AND SECONDARY AFT EXIT CONE O	-RINGS			
CLASSIFICATION OBSERVATION	MINOR ANOMALY X	MAJOR ANOMALY	·	CRITICAL ANOMA	LY
). PART NUMBER 1076039-03	11. SERIAL NUMBER 12. 0000001 AF	PART DESCRIPTION T EXIT CONE ASSY			
	RGANIZATION / OBSERVATION DATE:	/ 10			
4. RESPONSIBLE COMPONENT NOZZLE / E. L. DIEH	TEAM / PROGRAM MANAGER				
	NGINEER (NAME / ORGANIZATION ) OZZLE/FLEX BEARING PROJECT ENG				
S. A. MEYER / N	GINEER (NAME / ORGANIZATION) OZZLE/FLEX BEARING DESIGN ENGI				
Aluminum oxide corrosion	FOR, FIGURES, PHOTOGRAPHS, ETC was observed between the prim (RH) aft exit cone field joint ease in both joints appeared l	No oitting was o	erings, and o bserved. Struct ad on STW7-299	utboard of the seco uctural Application 9.	ondary IS
Inspectors noted that a	observed within past flight a	ft exit cone field	joints, but h	as not been documen	nted.
Minor corrosion has been	observed within past it give a				
Minor corrosion has been	ooserved within past reisite				
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TWR-17272 B-6

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36010018-38	KSC X T-24/T-97	26-0048		PV6-111292
SRM MOTOR NUMBER 360L001B	H-7 A-2	6. REFER	ENCE IFA NUMBER	5. REFERENCE PR NUMBER PV6-111292 7. REFERENCE SPR NUMBER N/A
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CLASSIFICATION OBSERVATION	MINOR ANOMALY X	MAJOR A		CRITICAL ANOMALY
	11. SERIAL NUMBER 0000006	12. PART DESCRIP FORWARD EXIT CO	TION INE ASSY	
3. REPORTED BY (NAME / ORGA	NIZATION / OBSERVATION U	AIEJ	4 10 107 199	
4. RESPONSIBLE COMPONENT TE NOZZLE / E. L. DIEHL	AM / PROGRAM MANAGER			
5. RESPONSIBLE PROJECT ENGI D. J. WAGNER / NOZZ	NEED (NAME / OPGANIZATIO	N )		
6. RESPONSIBLE DESIGN ENGIN S. A. MEYER / NOZZ	EER (NAME / ORGANIZATION	) NGINEERING		
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Damage has occurred during	KSC aft exit cone demate	es on previous fl		15A and 23A forward exit cone LH) forward exit cone aft
	not inches deep during	demate by a guid	e pin.	
aft flange sealing surfact flange was also scratched (	1,002 Inches deep our ma			
flange was also scratched (			1 11115)	reuse of hardware.
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REV. 3/28/89

### CONTINUATION SHEET FOR PEAR NUMBER 360L0018-38

#### 20. RECOMMENDED CORRECTIVE ACTION (continuation)

1. Eliminate guide pins. These just add more possibilities of scratching the forward exit cone aft flange after the joint separates and recoils. Eliminating the guide pins leaves only the joint alignment pin to worry about.

2. Near term: Use anti-recoil tools to eliminate the recoil of the aft exit cone after joint separation. This would not allow the alignment pin to contact the forward exit cone aft flange.

ASAP: Design and incorporate a rail system disassembly tool similar to that used at MTI Wasatch T-24 and T-97. This tool supports the aft exit cone assembly so that there is no load on the joint alignment pin during separation. The tool also does not recoil, eliminating any possibility of damage to the forward exit cone aft flange by the alignment pin.

23. RESULTS OF RECOMMENDED CORRECTIVE ACTION (continuation)

- 1. Effective: RSRM Flight 2 (360L002)
- 2. Anti-recoil tools effective: ____

Rail system tool effective:

KSC has incorporated a load cell into the existing aft exit cone stub removal tool. This load cell allows operators to monitor the load that is being supported by the fork lift. If used correctly, the load on the joint alignment pin can be minimized during separation. This would eliminate relative vertical displacements between the aft exit cone and forward exit cone after joint separation. The load cell was used on the aft exit cone demates of RSRM flights 2 and 3 (360L002 and 360L003). Only minor raised metal was observed on the forward exit cone 91.8 degree alignment pin holes on the four joints where the load cell was used. This does not violate refurbishment requirements.

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360L001B-42	KSC X	T-24/T-97		26-0044		PV6+111324	
PFAR NUMBER 560L001B-42 SRM MOTOR NUMBER 360L001B	н-7 	A-2		6. REFERENCE 1 N/A	FA NUMBER	7. REFERENCE SPR NU N/A	MBER
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CLASSIFICATION OBSERVATION						CRITICAL ANOMALY	
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0. PART NUMBER 1U52839-01	11. SERIAL N 0000006		12. PAR FORWAR	RT DESCRIPTION RD EXIT CONE ASS	Y	•••••	• • • • • • • • •
3. REPORTED BY (NAME / K. B. NIELSEN	/ ORGANIZATION / O / MTI GA	DESERVATION DA	TE)	/ 10/	07/88		
4. RESPONSIBLE COMPONE NOZZLE / E. L. DI	ENT TEAM / PROGRAM	MANAGER				•••••	
15. RESPONSIBLE PROJECT	T ENGINEER (NAME / / NOZZLE/FLEX BEAR	CORCANIZATION	4 3				
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7. DESCRIPTION (ATTACH See continuation sheet	PFOR, FIGURES, PHO	TOGRAPHS, ET	c.)		
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REV. 3/28/89

# CONTINUATION SHEET FOR PFAR NUMBER 360L001B-44

17. DESCRIPTION (continuation)

The 360L0018 nozzle forward exit cone/throat joint (Joint #4) showed excessive grease. Grease was observed on the radial 0.D. and on the axial portions of the joint interface. It is believed that the presence of the grease at 185 racial U.D. and on the axial portions of the joint interface. It is betreved that the presence of the grease at degrees inhibited the backfill of RTV. A blowpath was located at the 185 degree location. There was no blowby, erosion or heat effect to primary o-ring.

Joint #4 on the DM-9, QM-6, QM-7 and PV-1 tests showed excessive grease on phenolic interfaces. It was believed that the excess grease inhibited the RTV backfill in these joints (classified as Minor Anomalies).

Previous flight and static test forward exit cone/throat joints have shown grease on the phenolic joint interfaces. In order to hold the primary orring on the orring groove during assembly, a thicker layer of grease is applied to the o-ring and groove.

STW7-2999 was released to control amounts of grease applied to the nozzle internal joint orrings and orring grooves. This specification was added to engineering assembly drawings and will be effective RSRM flight 4 (360T004).

18. JUSTIFICATION OF CLASSIFICATION (continuation)

The excess grease in joint #4 required corrective action but has no impact on motor performance or program schedule. The excess grease inhibited the RTV backfill at the 185 degree location.

Grease on the joint phenolic interfaces could prevent the adhesion of the RTV to the phenolic. This would reduce the capability of the RTV to act as a thermal barrier.

23. RESULTS OF RECOMMENDED CORRECTIVE ACTION (continuation)

STW7-2999 was incorporated into nozzle joint assembly planning; effective QM-8 and RSRM flight 4 (360T004).

2. QN-8 showed excess grease inhibiting RTV backfill in joint #4. The grease application specification did not reduce the excess grease in this joint. Joint #4 will be monitored by structural applications until proper grease applications are being followed. Also, TRACS classes are being set up to train/qualify nozzle joint assembly personnel (effective ١.

360L001A showed no excess grease in nozzle joints.

360L002A showed no excess grease in nozzle joints.

360L002B showed no excess grease in nozzle joints.

360L003A showed no excess grease in nozzle joints.

360L003B showed no excess grease in nozzie joints.

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PFAR NUMBER	3. INSPECTION LOCATION KSC T-24/T-97	4. REFERENCE SQU	AWK NUMBER	5. REFERENCE PR NUMBER
360L0018-45 . SRM MOTOR NUMBER 360L0018	H-7 X A-2		NUMBER	7. REFERENCE SPR NUMBER N/A
. TITLE RTV/EA913 ADHESIVE MIXING IN				
CLASSIFICATION OBSERVATION	MINOR ANOMALY X	MAJOR ANOMALY		CRITICAL ANOMALY
0. PART NUMBER 1 N/A	1. SERIAL NUMBER   12. N/A   CON	PART DESCRIPTION L/NOSE INLET JOINT (		
	HIZATION / OBSERVATION DATE)			
4. RESPONSIBLE COMPONENT TEA NOZZLE / E. L. DIEHL	MM / PROGRAM MANAGER			
5. RESPONSIBLE PROJECT ENGIN D. J. WAGNER / NOZZL	SEP (NAME / ORGANIZATION )	CEDING		
	LE/FLEX BEARING DESIGN ENGIN			
The EA913 adhesive used to be between the cowl ring and no	, FIGURES, PHOTOGRAPHS, ETC. bond the cowl insulation to ose cap 360-deg. circumferen tween two layers of RTV. So les. There was no blowby, e	the cowl nousing extr tially. The adhesive of was observed over	a maiority	of the joint circumference
The minimum of the otherive	in the coul/nose cap bondlin	e and the presence o	f soot was o	documented on ETM-1A, DM-8,
DN-9, QN-6 and QM-7. It is procedures.	believed that the mixing ha	s occurred on all pro	evious nozzl	es due to assembly
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### CONTINUATION SHEET FOR PEAR NUMBER 360L0018-45

23. RESULTS OF RECOMMENDED CORRECTIVE ACTION (continuation)

1. The new assembly procedure was tested on PV-1 and QM-8 Joint #2's. Post-test inspections of these joints prompted the decision to further evaluate and refine the new assembly procedure on TEM motors.

As of 360L002, there has never been primary o-ring blowby, erosion or heat effect, or metal heat damage within Joint #2. In the 360L002 RPR8, it was decided to close out all "minor anomalies" similar to this on all previous staic tests and flights. All future occurrences, including 360L002, would be considered "observations".

TWR-17198 Vol. V has been updated to include accept/reject criteria for RTV in nozzle joints. The condition noted in this "minor anomaly" is now an "acceptable" condition per this criteria.

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