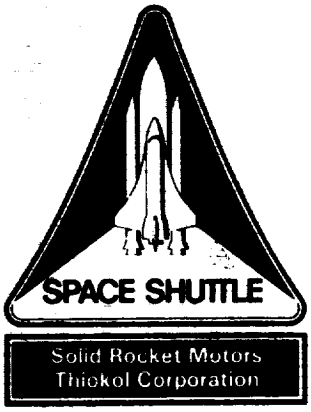
CR-184026

TWR-17546
Vol VII



Flight Set 360L007 (STS-33R) Field Joint Protection System, Thermal Protection System, and Systems Tunnel Components Final Report–Volume VII

September 1990

Prepared for:

National Aeronautics and Space Administration
George C. Marshall Space Flight Center
Marshall Space Flight Center, Alabama 35812

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Thiokol CORPORATION

SPACE OPERATIONS

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Thiokol CORPORATION
SPACE OPERATIONS

TWR-17546
Vol VII

Flight Set 360L007 (STS-33R) Field Joint Protection System, Thermal Protection System, and Systems Tunnel Components Final Report Volume VII

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Stage Hardware Design Engineer

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SR&QA

9/13/90

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9-12-90

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ECS SS-1015

9-13-90

ABSTRACT

This report documents the performance of the thermal protection system, field joint protection system, and systems tunnel components of flight set 360L007 as evaluated by postflight hardware inspection.

The condition of both motors was similar to previous flights. Four aft edge strikes were noted on the ground environment instrumentation thermal protection system. The hits all left a clean substrate, indicating that the damage was caused by nozzle severance debris and/or water impact. No National Space Transportation System debris criteria for missing thermal protection system were violated.

Two problem reports were written against the field joint protection system. The first concerned two cracks in the K5NA closeout over the trunnion/vent valve location on the left-hand aft field joint. A similar condition was observed on Flight 5 (360H005B). The second problem report referred to a number of small surface cracks between two impact marks on the left-hand forward field joint. Neither area exhibited loose material or any abnormal heat effects, and they have no impact on flight safety.

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ACRONYMS

deg	degree
FJPS	field joint protection system
ft	feet
GEI	ground environment instrumentation
hr	hour
in.	inch
IPR	interim problem report
JPS	joint protection system
KSC	Kennedy Space Center
L	launch
LCC	launch commit criteria
LH	left hand
NSTS	National Space Transportation System
PEEL	Postflight Engineering Evaluation Limit
RH	right hand
RSRM	redesigned solid rocket motor
SRB	solid rocket booster
STS	Space Transportation System
TPS	thermal protection system
V	volt
°F	degrees Fahrenheit

1

INTRODUCTION

STS-33R was launched from Kennedy Space Center (KSC) on 22 Nov 1989. Two redesigned solid rocket motors (RSRM) were used and were designated 360L007A and 360L007B. The three field joints on each motor (total of six field joints) were protected by the field joint protection system (FJPS) (Figure 1). The FJPS is used to keep the field joint O-rings above the minimum launch commit criteria (LCC) temperature during the launch countdown, to keep rain water from entering the field joint, and to protect the joint components from aerodynamic heating during flight. The igniter-to-case joint on each RSRM was fitted with an igniter heater to keep the igniter seals above minimum LCC temperature requirements during launch countdown (Figure 2).

The ground environment instrumentation (GEI) and heater power cables are protected by the thermal protection system (TPS). The purpose of the TPS is to protect the GEI and heater systems from aeroheating during flight.

After solid rocket booster (SRB) separation and splashdown, the SRBs were recovered and towed to KSC's Hangar AF for postflight inspection and disassembly. Retrieval and tow-back were delayed 24 hr by high sea states. The FJPS, TPS, systems tunnel, and igniter heater installation inspections were performed per Postflight Engineering and Evaluation Plan TWR-50050, Vol I (Reference 1).

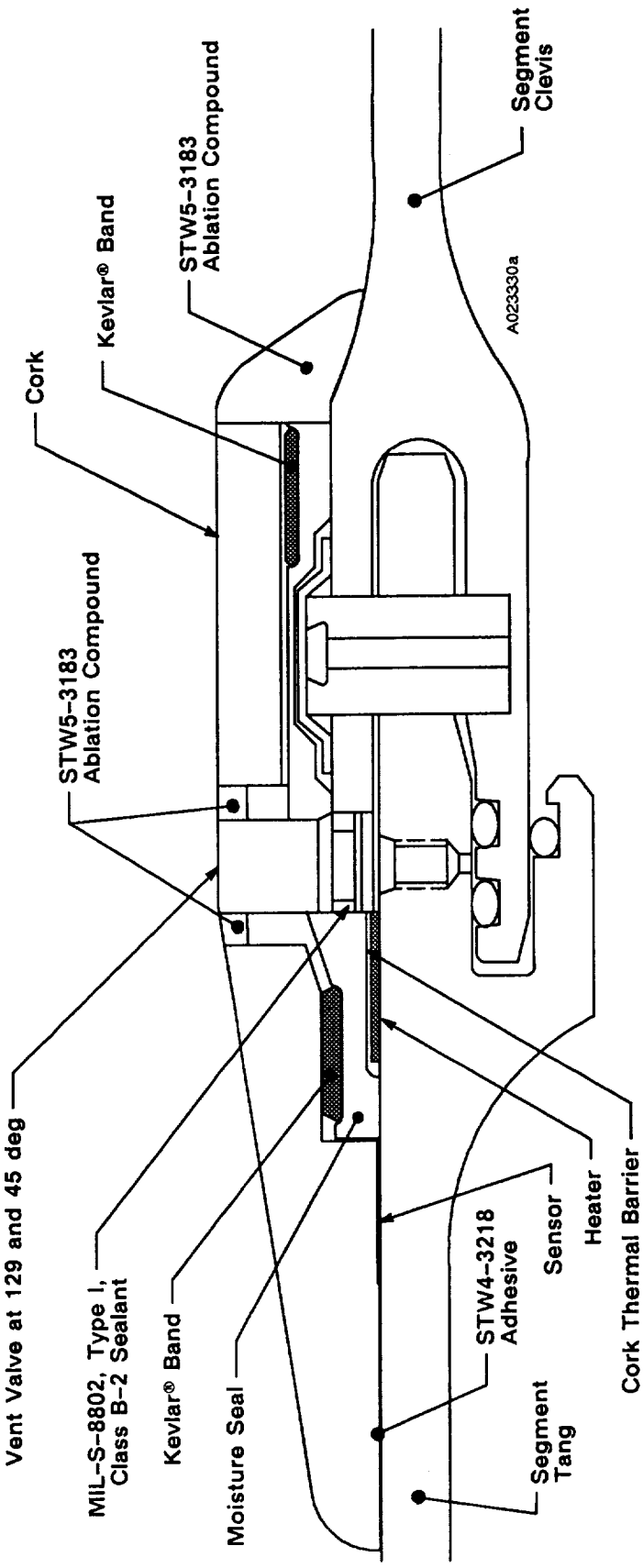
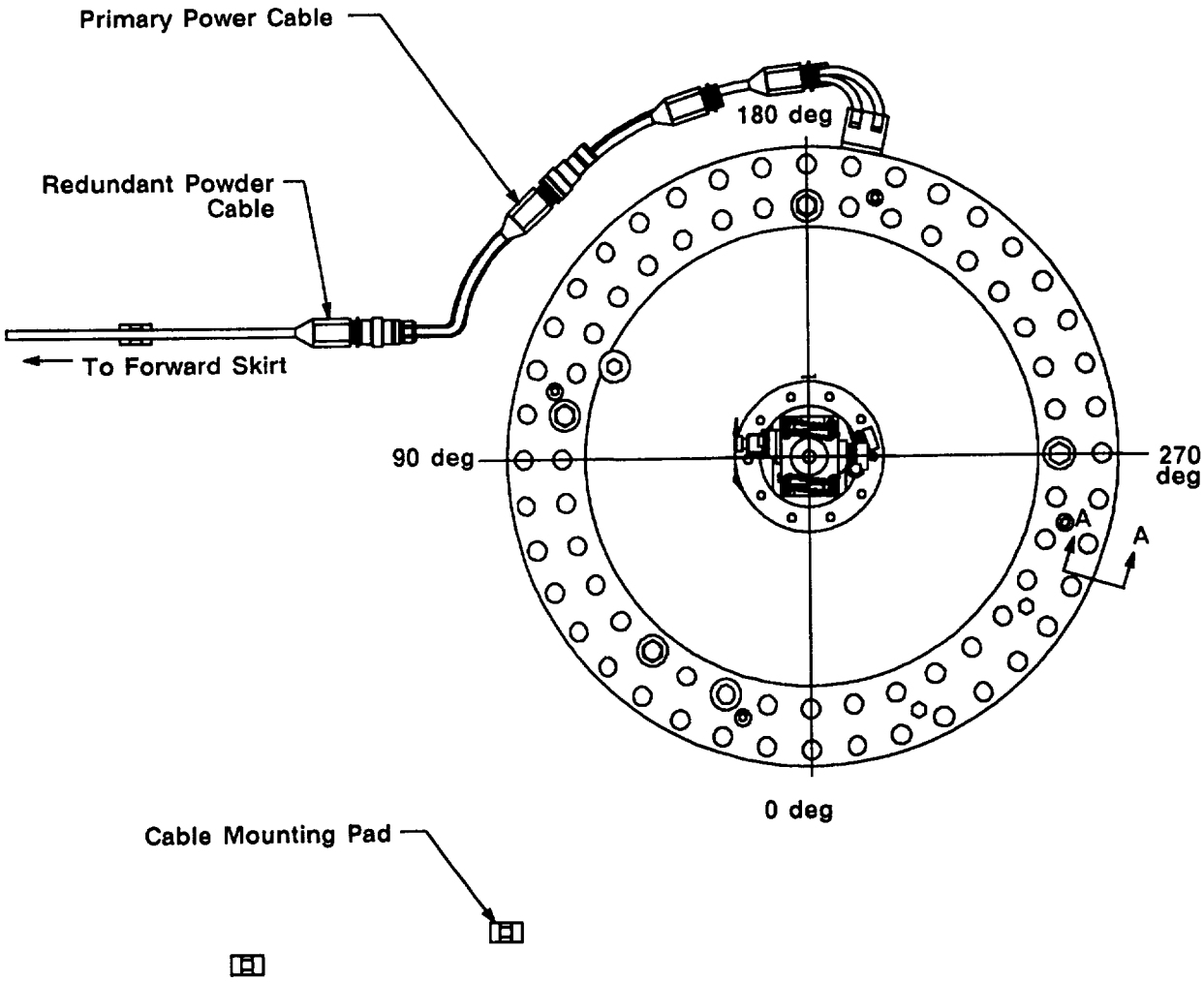


Figure 1. Field Joint Protection System



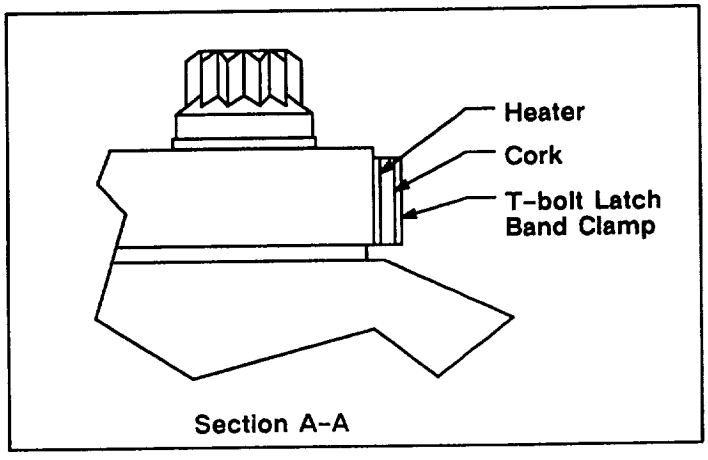


Figure 2. Igniter-to-Case Joint Heater Configuration

2

OBJECTIVE

The objective of this report is to document any heater anomalies during the launch countdown and any anomalies to the FJPS, TPS, or systems tunnel components during flight and recovery operations. This report will also address all squawks or problem reports initiated during postflight evaluation.

3

SUMMARY

Postflight assessment results indicate that all TPS and systems tunnel components were in very good to excellent condition (compared to previous flights) with typical flight heat effects and erosion. No squawks or problem reports were written against the TPS or systems tunnel. There were a total of four aft edge hits: three on the left-hand (LH) motor and one on the right-hand (RH) motor, with the largest missing piece of TPS cork measuring 2.5 by 2.5 by 0.5 inches. The hits all left a clean substrate, indicating that the damage was caused by nozzle severance debris and/or water impact. No Postflight Engineering Evaluation Limit (PEEL) requirements or National Space Transportation System (NSTS) debris criteria for missing TPS were violated.

Two anomalies were observed on the LH aft and LH forward field joints and were documented as Problem Reports PV-6-146407 and PV-6-146109, respectively. The anomaly in the LH aft field joint consisted of two circumferential cracks in the K5NA closeout over the trunnion/vent valve location. The cracks were about 2 in. long and did not exhibit loose material or any abnormal heat effects. The LH forward field joint had two small impact marks on the forward edge and a series of small surface cracks in between. These also showed no abnormal heat effects.

4

CONCLUSIONS/ RECOMMENDATIONS

The joint protection system (JPS) heaters performed as expected and maintained the field joint temperatures within the LCC required range during launch countdown. Postflight inspection verified that the TPS, FJPS, and systems tunnel all performed as designed, with typical flight heat effects and erosion. The two anomalies reported on the FJPS did not exhibit loose material or any abnormal heat effects and had no impact on flight safety or schedule.

5

DISCUSSION

5.1 PREFLIGHT HEATER CONTROL SYSTEM AND PERFORMANCE

The field joint heaters and igniter-to-case joint heaters performed nominally during the launch countdown. The igniter heaters were activated between L - 24 hr and L - 6 hr 20 minutes, and maintained the joints within the LCC temperature limits of 90° to 108°F at all times. However, the temperature control band was changed from 95° ±5°F to 95° ±1°F, resulting in more frequent cycling and better heater control.

The field joint heaters were activated between L - 11 hr 20 minutes and L - 1 minute, and maintained an acceptable 17°F sensor temperature range from 90° to 107°F during the LCC timeframe. Prior to launch, an LCC contingency was created to lower the minimum redline temperature at any field joint from 85° to 69°F in the event of a complete heater failure. An interim problem report (IPR) was written against the LH aft field joint heater, which read 290 V instead of the nominal 209 V. This IPR was dispositioned when it was determined that the voltage must have been nominal since the current reading was nominal. In addition, the heater circuit breaker was not tripped, as it would have been had the voltage actually been 290 V.

5.2 POSTFLIGHT INSPECTION OF FJPS, TPS, SYSTEMS TUNNEL, AND IGNITER HEATER INSTALLATION

The condition of both motors was similar to previous flight motors, with most of the heat effects occurring on the inboard side of the aft segments. These areas experience high aerodynamic heating normal to protuberance components. They also receive the high plume radiation and base recirculation heating induced by the adjacent SRB and space shuttle main engines on the aft-facing surfaces. There was slight charring of the TPS over the GEI cabling runs in this area, typical of previous flights.

5.2.1 Field Joint Protection System

The FJPS was in good condition overall. There were no signs of ablation on any of the JPS, with only slight paint blistering on the cork cover. The paint on the K5NA closeout aft of the cork was also slightly darkened and blistered, with occasional pitting. This condition was typical of previous flights and was probably due to aerodynamic heating and the result of nozzle severance debris and water impact.

Numerous small cracks were observed on the forward edge of the LH forward FJPS cork between 240 and 260 deg (Figure 3). Impact marks were noted on each side of the affected area approximately 3 ft apart. Problem Report PV-6-146407 was written against these cracks (Appendix A). The cracks measured approximately 0.50 in. axially by less than 0.10 in. radially and were within the current material acceptance requirements. The impact marks were most likely caused by a parachute float line. A limit was added to the PEEL stating that cracks in the FJPS that meet current acceptance criteria are acceptable and should not be reported.

Two circumferential cracks were found in the K5NA closeout over the trunnion/vent valve on the LH aft field joint at approximately 30 deg (Figure 4). The cracks were parallel (about 1.25 in. apart) and measured approximately 2.0 in. wide by less than 0.10 in. deep. The K5NA around the cracks was bulged out about 0.10 in. and could be depressed approximately 0.10 in. with hand pressure. Problem Report PV-6-146109 was written against these cracks (Appendix A). This condition was noted on a previous flight (360H005), and it was determined that a vacuum (due to vent valve operation) developed under the moisture seal during descent. This caused the moisture seal to be pulled down over the pin retainer band trunnion. The resulting stress in the K5NA induced a split. Since the condition occurred after SRB separation, there is no impact on flight safety and no corrective action was taken.

A 4- by 2-in. local blister was observed on the LH center field joint at 45 deg. There was peeling of the Hypalon paint in the area and cork was eroded from the surface approximately 0.05 to 0.10 in. deep. This damage was a first-time occurrence and was probably caused by burning debris from the nozzle severance system. No squawks or problem reports were written against this condition.

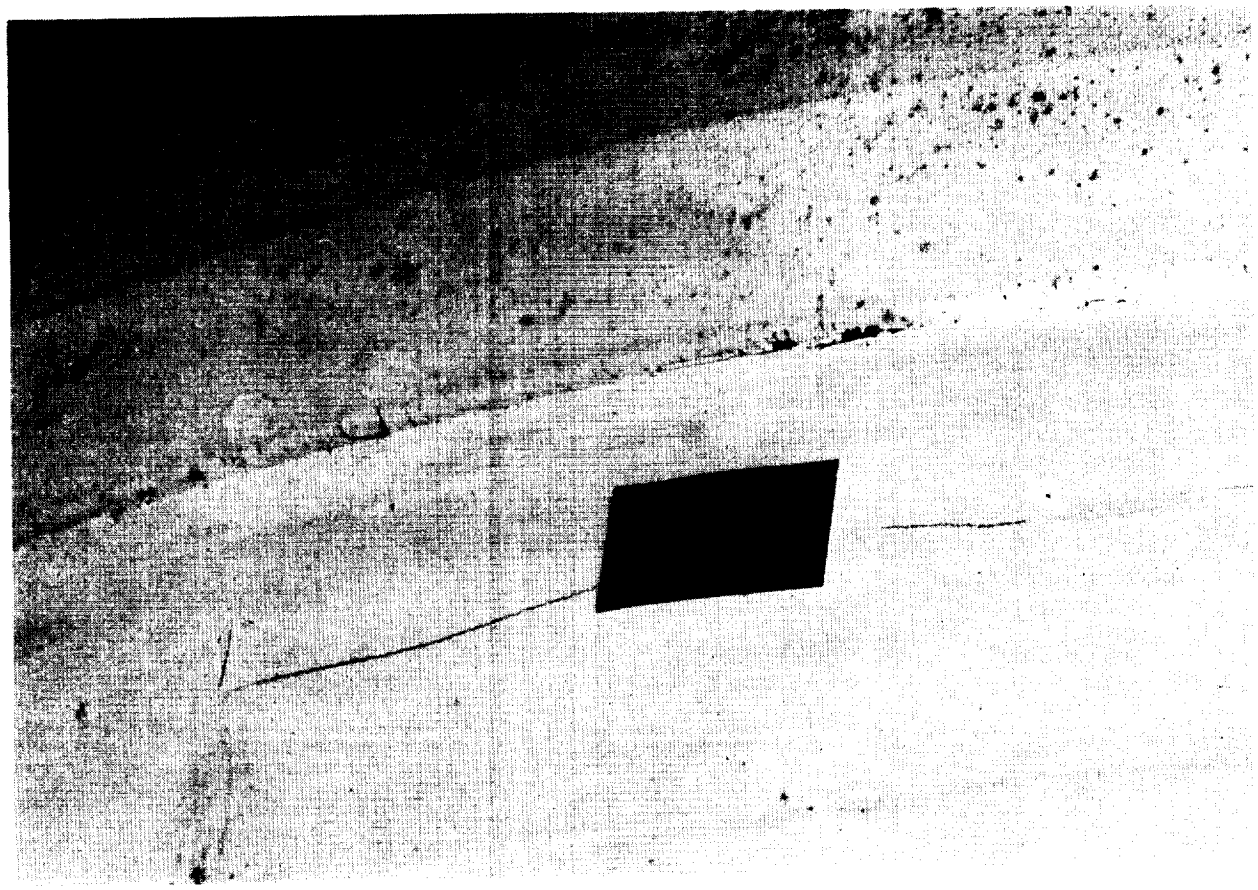


Figure 3. Impact Marks on FJPS Cork (LH forward field joint)

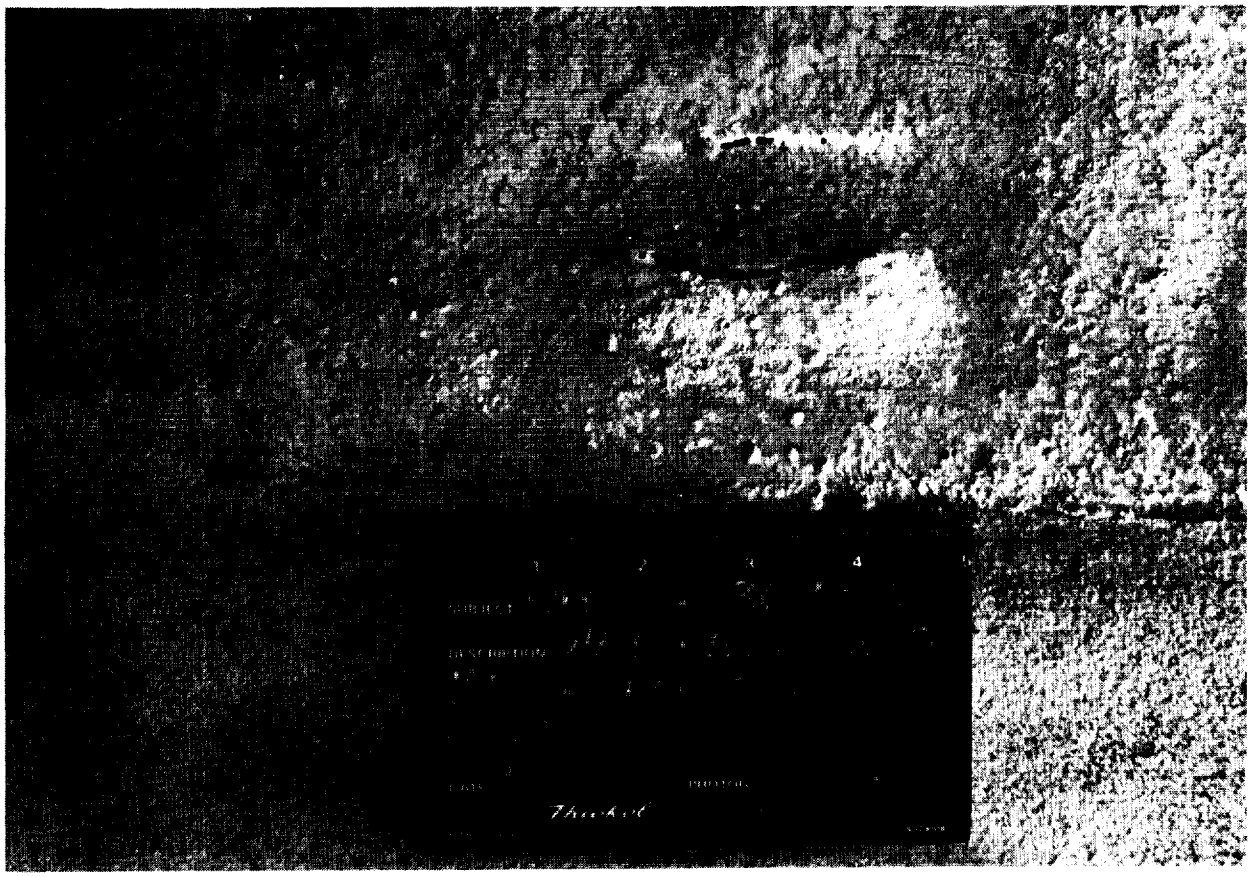


Figure 4. Splits in K5NA Ablation Compound (LH aft field joint)

5.2.2 Thermal Protection System

TPS performance was considered to be excellent during flight operation, with typical heat effects and no ablation. There were no in-flight anomalies, squawks, or problem reports written against the TPS.

There were a total of four aft edge hits: three on the LH forward center segment and one on the RH forward segment. The TPS cork pieces that were missing all left a clean substrate, indicating that the hits were caused by nozzle severance debris and/or water impact. The largest GEI cork piece missing was approximately 2.5 by 2.5 by 0.5 in., or 3.1 $in.^3$. This piece was located at Station 691 on the RH forward segment at approximately 240 deg. No PEEL requirements or NSTS debris criteria for missing TPS were violated.

5.2.3 Systems Tunnel

The cork TPS adjacent to the systems tunnel floor plate was in excellent condition. There was very little paint blistering, and all K5NA closeouts over cables and tunnel seams were in excellent condition. No in-flight anomalies, squawks, or problem reports were written against the systems tunnel.

5.2.4 Igniter Heater and Forward Dome Power Cable Installation

Postflight inspection of the igniter heater installation and power cables revealed no anomalies. The igniter heater, cork, and band clamp were removed and inspected at Hangar AF; no anomalies were noted.

6

REFERENCES

1. TWR-50050 Vol I, Book I, Rev A, KSC Postflight Engineering Evaluation Plan (Internal and External Insulation), L. E. MacCauley and T. Morgan, 21 Nov 1989.
2. TWR-17432, KSC Ten-Day Postflight Hardware Evaluation Report for 360L007, L. E. MacCauley and T. Morgan, 18 Dec 1989.
3. TWR-17546 Vol I, Flight Motor Set 360L007 (STS-33R) Final Report, D. M. Garecht, 4 Jun 1990.

Appendix A

LH Aft Field Joint Anomaly Documentation

Thiokol CORPORATION
SPACE OPERATIONS

POSTFIRE OBSERVATION RECORD (PFOR) A-4
Field Joint External Insulation Condition

Motor No.: 360L007	Side: Left (A)	Date: 11/26/89
Assessment Engineer(s): T. MORGAN, S. HICKEN		
Joint: Aft (AFT)		

Field Joint External Insulation Observations:	Yes	No	Comment #
A. Charred/Heat Affected Material (HTAFF)?		✓	
B. Missing TPS Material > 0.7 cu. In. Due To Ascent/Motor Operation (TPSVD)?		✓	
C. Missing TPS Material > 0.7 cu. In. Due To Reentry/Debris/Water Impact (TPSDM)?		✓	
D. Unbonds/Cracks (DEBND)?	✓		1
E. Evidence of Water Leakage From Field Joint (WATER)?		✓	
F. Missing/Unbonded Vent Valves (MISSG)? (FWD, CTR, and AFT joints only.)		✓	

Record the following if any of the above conditions exist:

Condition (Observation Code)	Starting Station Location (In.)	Ending Station Location (In.)	Starting Degree Location (deg.)	Ending Degree Location (deg.)	Circum-ferential Width (In.)	Axial Length (In.)	Radial Depth (In.)	Volume ($In.^3$)
DEBND	1491.5	N/A	~ 45	N/A	2 IN.	N/A	< .10	N/A

Notes / Comments

1. CRACKS IN KEVNA CLOSEOUT OVER TRUNNION

Clarification sheet(s) attached? ____ no A-4B yes (Provide clarification number(s).)

REVISION ____

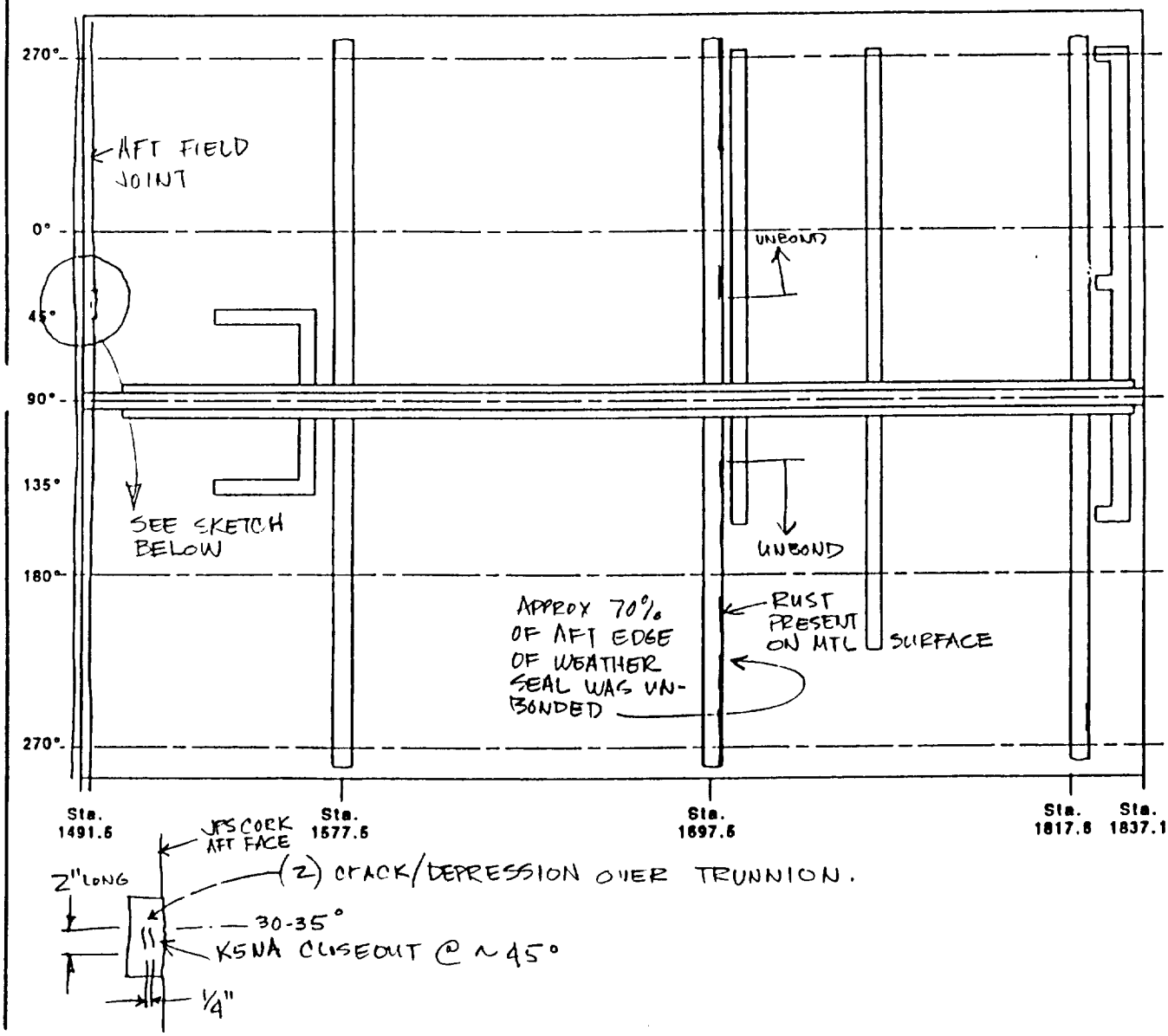
DOC NO. TWR-17546 VOL VII
SEC PAGE

Thiokol CORPORATION
SPACE OPERATIONS

Aft Segment TPS Clarification Form

Motor No.: 360L007	Side: ☒ Left (A) ☐ Right (B)	Date: 11/26/89
Assessment Engineer(s): T. MORGAN, S. HICKEN		

Sketch Aft Segment TPS Observations Below:



Clarification Number: A-4B

Corresponding Comment Number(s): 1

REVISION ____

SRB/SRM POSTFLIGHT HARDWARE ASSESSMENT SQUAWK SHEET

Page 1 of 1

2. DETECTED DURING: OPEN ASSESSMENT	3. WORK AREA: ON DOCK	4. SQUAWK ID NUMBER:	4A. SRB SIDE: [X] LH [ ] RH	
5. WORK UNIT CODE: INSULATION	6. PART NAME: FIELD JOINT PROTECTION SYSTEM	7. PART NUMBER: 1U76803-01	8. SERIAL NUMBER: —	9. QUANTITY: 1
11. MIA/PN: FINAL	12. STS NUMBER: 33	13. REPORTED BY (NAME/ORG): S. HICKEN / THIOKOL	14. DATE/TIME: 26 NOV 87 / 12:00	
15. PHOTOGRAPH ID NUMBER: 114472-1		15A. PHOTO ORGANIZATION: [ ] USBI [X] MTI [ ] OTHER		

16. ITEM	17. PROBLEM DESCRIPTION
	The left hand aft field joint trunnion location at 45° which was potted in with K5NA had two cracks. The cracks were parallel (1.25 inches apart) and extended 2 inches circumferentially. The cracks were opened approximately 0.1 inch. The material between the cracks could be depressed by moderate thumb pressure.

18. ASSESSMENT TEAM CONCURRENCE

Steve Hicken — CONTRACTOR ASSESSMENT ENGINEER

David L. Gamm — MSFC ASSESSMENT ENGINEER

19. EXECUTIVE BOARD DISPOSITION: PR REQUIRED [ ] PR NOT REQUIRED [ ]

20. PR NUMBER

21. EXECUTIVE BOARD REMARKS

22. APPROVALS

CONTRACTOR BOARD MEMBER/DATE

BOARD CHAIRMAN/DATE

POSTFIRE ANOMALY RECORD (PFAR)

1. PFAR NUMBER	3. INSPECTION LOCATION	4. REFERENCE SQUAWK NUMBER	5. REFERENCE PR NUMBER
360L007A-03	KSC X T-24/T-97	33-030	PV6-146109
2. SRM MOTOR NUMBER	H-7 A-2	6. REFERENCE IFA NUMBER	7. REFERENCE SPR NUMBER
360L007A		N/A	N/A

8. TITLE
CRACK IN K5NA CLOSEOUT OVER FJPS TRUNNION

9. CLASSIFICATION
OBSERVATION X MINOR ANOMALY ... MAJOR ANOMALY ... CRITICAL ANOMALY ...

10. PART NUMBER	11. SERIAL NUMBER	12. PART DESCRIPTION
1U76803-01	N/A	FIELD JOINT PROTECTION SYSTEM

13. REPORTED BY (NAME / ORGANIZATION / OBSERVATION DATE)
S. V. HICKEN / THERMAL INSULATION DESIGN ENGINEERING / 11/26/89

14. RESPONSIBLE COMPONENT TEAM / PROGRAM MANAGER
JPS / G. L. STEPHENS

15. RESPONSIBLE PROJECT ENGINEER (NAME / ORGANIZATION)
R. S. JENSEN / SYSTEMS INTEGRATION ENGINEERING

16. RESPONSIBLE DESIGN ENGINEER (NAME / ORGANIZATION)
C. L. PROKOP / STAGE HARDWARE DESIGN

17. DESCRIPTION (ATTACH PFOR, FIGURES, PHOTOGRAPHS, ETC.)
Two circumferential splits were found in the K5NA on the aft field joint at approximately 30 degrees measuring approximately 2.0 inches wide by 0.10 inch deep. The splits were about 1.25 inches apart. The K5NA around the splits was bulged out approximately 0.10 inch, was spongy, and could be depressed approximately 0.10 inch with hand pressure.

18. JUSTIFICATION OF CLASSIFICATION (POSTFIRE ENGINEERING EVALUATION LIMITS)
The K5NA split occurred during descent. This condition was noted on a previous flight (360H005) and has no impact on flight schedule or safety. No new corrective action will be implemented.

19. CAUSE
Vacuum under the moisture seal during descent caused the moisture seal to be pulled down over the pin retainer band trunnion. The resulting stress in the K5NA induced a split.

20. RECOMMENDED CORRECTIVE ACTION
None.

21. ANOMALY APPROVAL SIGNATURE
RPRB SECRETARY: /S/S. T. MUNSON DATE: 12/13/89

22. OBSERVATION/ANOMALY APPROVAL SIGNATURES
PE: /S/R. S. JENSEN DATE: 12/20/89
PM: /S/G. L. STEPHENS DATE: 01/05/90

23. RESULTS OF RECOMMENDED CORRECTIVE ACTION
N/A

24. REPORT RESULTS TO RPRB? YES ... NO X

25. RPRB CLOSURE SIGNATURE
(REQUIRED ONLY IF BLOCK 24 CHECKED "YES")
RPRB SECRETARY: N/A DATE: N/A

26. OBSERVATION/ANOMALY CLOSURE SIGNATURE
PM: /S/G. L. STEPHENS DATE: 01/05/90

27. ORIGINATION DATE	28. REQUIRED STATUS DATE	29. PR CLOSURE DATE	30. PFAR CLOSURE DATE
12/13/89	12/15/89		01/05/89

REV. 3/28/89

PR CLOSURE APPROVAL

Ref. P.F.A.R. Number: 360L007A-03

Engineering Approval

Signature W. N. Hamil

Date 2/6/90

Quality Assurance Approval

M B Johnson
Signature

2/13/90
Date

N.A.S.A. Resident Q.A. Approval

J. G. Lewis
Signature

2/13/90
Date

N.A.S.A. R.M.O. Manager Approval

E. J. Grobiszewski
Signature

2/13/90
Date

N.A.S.A. S.R.M. Chief Engineer Approval

K. Ross FOR K. JONES
Signature

2-20-90
Date

NASA National Aeronautics and Space Administration — USAF Department of the Air Force United States of America

Kennedy Space Center/Vandenberg Air Force Base

☐ INTERIM PROBLEM REPORT _____
☒ PROBLEM REPORT PV-6-146109
☐ DISCREPANCY REPORT _____

PAGE 1 OF

PRESS FIRMLY – ALL COPIES MUST BE LEGIBLE

2. DETECTED DURING	3. WORK AREA	4. END ITEM CONTROL NUMBER		
OPEN ASSESSMENT	HANGAR AF	D-BI-0344-0008		
5. WORK UNIT CODE	6. PART/PROG NAME: FIELD JOINT PROTECTION SYSTEM	7. PART/PROG NO.: 1U76803-01	8. SER./REV NO.: N/A	9. QTY: 1
10. FSCM/VENDOR: 07703	11. NHA/PN/TAPE/DISC ID.: 10100-001	12. STS #/EFF.: 000-B-0344	13. REPORTED BY (NAME/ORG): S. HICKEN TH1 8160 3-5838	14. DATE: 1200 11-26-89

15. SOFTWARE PROBLEM LOCATOR — DATE _____ TIME _____

☐ DUMP ☐ TRANSLATOR OUTPUT ☐ LINE PRINTER OUTPUT ☐ COMPILER LISTING ☐ OTHER (SPECIFY)

16. ITEM	17. PROBLEM DESCRIPTION / 17A. VALIDATION
	Richard K. Smyth per telecon D. Johnson TH1 QA Sup 11-28-89
1.0	L/H AFT FIELD TRUNNION LOCATION AT 45° WHICH WAS POTTED IN WITH KSNA HAD TWO CRACKS. THE CRACKS WERE PARALLEL (1.25 INCHES APART) AND EXTENDED (2) INCHES CIRCUMFERENTIALLY. THE CRACKS WERE OPENED APPX. 0.1 INCH. THE MATERIAL BETWEEN THE CRACKS COULD BE DEPRESSED BY MODERATE THUMB PRESSURE.
	REF. SQUAWK 33030

18. CRIT. SKILLS	19. ENG. CHANGE REQ.	20. CONSTRAINTS	21. CRIT	22. RESP ORG.
☐ YES ☒ NO ITEMS:	☐ YES ☒ NO ITEMS:	☐ YES ☒ NO TO:	3/3	LSOC

23. WEIGHT REQD	24. RETEST REQD	25. HAZARDOUS OP	26. MR REQD	27. TIME/CYCLE	28. FRACTURE CRIT
☐ YES ☒ NO ITEMS:	☐ YES ☒ NO ITEMS:	☐ YES ☒ NO ITEMS:	☐ YES ☒ NO ITEMS:	☐ YES ☒ NO ITEMS:	☐ YES ☒ NO ITEMS:

29. ITEM	30. DISPOSITION/CAUSE/CORRECTIVE ACTION	31. TECH	CONTR QA	GOVT QA
	SEE PG 2 FOR DISPO			
	Pat Nolt LSOC 1740 11-29-89			

32. SYSTEM RESTORED (SIGNATURE) DATE	33. FINAL ACCEP DATE NOV 29 '89 (SPC 247)

34. DATA CODE	35. REPL. S/N	36. RELATED REPORTS
B 0 8 P -		

37. RC ACTION REQD	38. RC CONSTRAINT (SIGNATURE DATE)	39. RC CLOSURE (SIGNATURE) (DATE)
☐ YES ☒ NO ITEMS:	TO:	

KSC FORM 2 151 (REV. 12/81)

Kennedy Space Center/Vandenberg Air Force Base

NONCONFORMANCE SYSTEM
(CONTINUATION SHEET)

☒ PR PV6-146109
☐ DR
☐ CAAR

6 OF

2. DETECTED DURING	3. RESERVED	4. END ITEM CONTROL NO.
		D-B1-034L-0008

PRESS FIRMLY - ALL COPIES MUST BE LEGIBLE

5. ITEM	6. TECH	7. CONTR QA	8. GOVT QA
1.1 TRANSFER THIS PR TO THIOKOL CORP. RECORD TRACKING NUMBER.		SPC 247 NOV 29	
TRACKING NUMBER: 360L0074-03			
ACCEPTED BY: John Colley MTI LSS-QE 11/29/89			
SUMMARY CLOSURE			
PR WAS TRANSFERED TO THIOKOL CORP.			
1.2 CLOSE THIS PR.		SPC 247 NOV 29	
LSOC SE: Robert Ramm rr-46 11/29/89			
NASA SE: Bruce Hardman TV-MSA-24 11/29/89			
THI LSS: Mike Nordby 11/29/89			
SPC QE: Mark Bell QE 156 SPC 11/29/89			

9. CLOSURE NOV 29 SPC 247

KSC FORM 2-155 (REV. 6/84)

ORIGINAL A-7

ORIGINAL

Appendix B

LH Forward Field Joint Anomaly Documentation

Thiokol CORPORATION
SPACE OPERATIONS

POSTFIRE OBSERVATION RECORD (PFOR) A-4
Field Joint External Insulation Condition

Motor No.: 360L007	Side: Left (A)	Date: 11/26/19
Assessment Engineer(s): T. MORGAN, S. HICKEN		
Joint: Forward (FWD)		

Field Joint External Insulation Observations:	Yes	No	Comment #
A. Charred/Heat Affected Material (HTAFF)?		✓	
B. Missing TPS Material > 0.7 cu. in. Due To Ascent/Motor Operation (TPSVD)?		✓	
C. Missing TPS Material > 0.7 cu. in. Due To Reentry/Debris/Water Impact (TPSDM)?		✓	
D. Unbonds/Cracks (DEBND)?	✓		1
E. Evidence of Water Leakage From Field Joint (WATER)?		✓	
F. Missing/Unbonded Vent Valves (MISSG)? (FWD, CTR, and AFT joints only.)			

Record the following if any of the above conditions exist:

Condition (Observation Code)	Starting Station Location (In.)	Ending Station Location (In.)	Starting Degree Location (deg.)	Ending Degree Location (deg.)	Circum-ferential Width (In.)	Axial Length (In.)	Radial Depth (In.)	Volume (In.^{3})
DEBND	N/A	N/A	240	260	~3 FT.	~.50 IN.	<.10	N/A

Notes / Comments

1. NUMEROUS SMALL CRACKS ON FWD EDGE OF JPS CORK. TWO IMPACT MARKS (POSSIBLE PARACHUTE FLOAT LINE) ON EACH SIDE OF AFFECTED AREA

Clarification sheet(s) attached? ____ no A-4A yes (Provide clarification number(s).)

REVISION ____

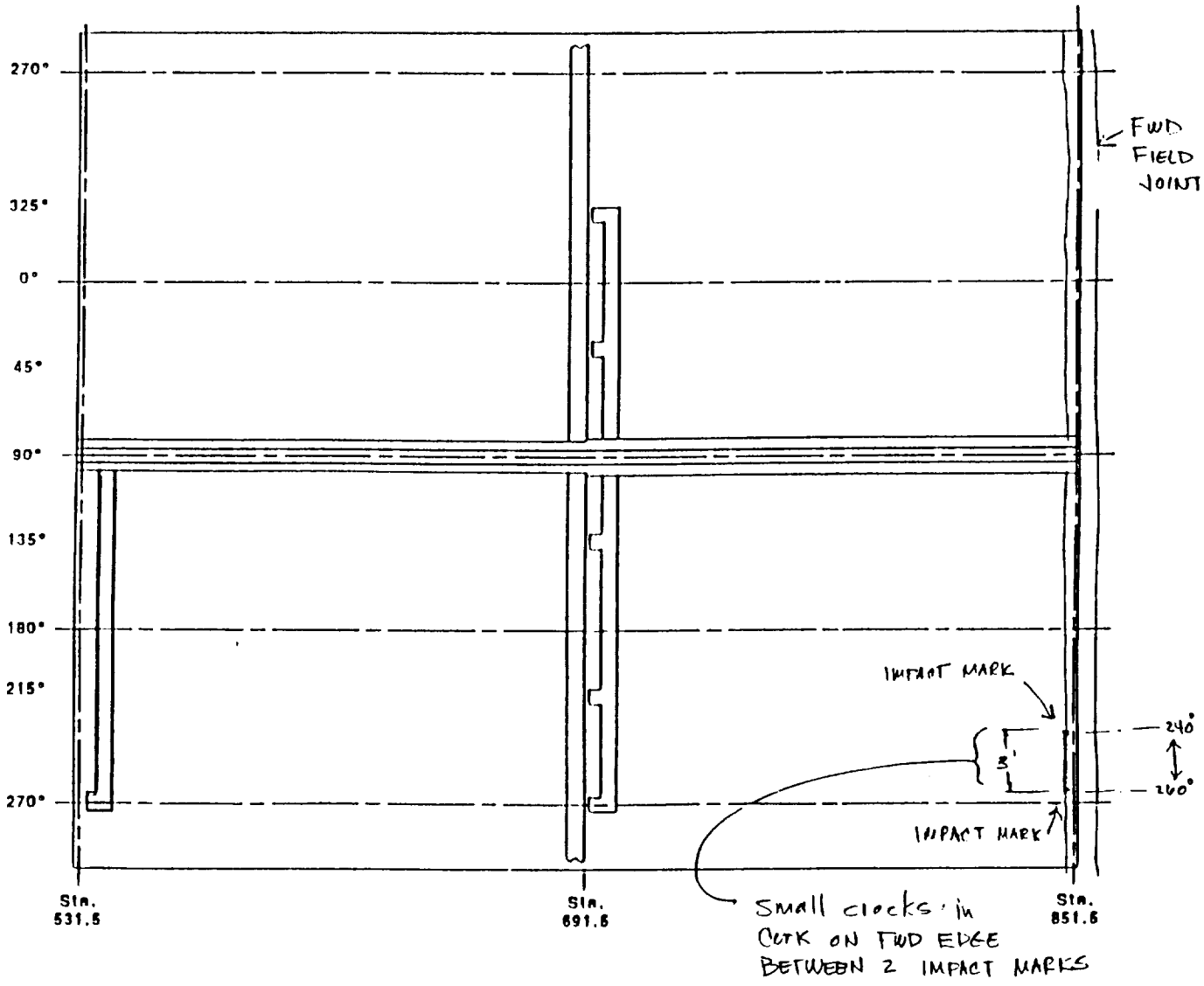
DOC NO. TWR-17546 VOL VII
SEC PAGE

Thiokol CORPORATION
SPACE OPERATIONS

Forward Segment TPS Clarification Form

Motor No.: 360L007	Side: ☒ Left (A) ☐ Right (B)	Date: 11/26/89
Assessment Engineer(s): T. MORGAN, S. HICKEL		

Sketch Forward Segment TPS Observations Below:



Clarification Number: A-4A

Corresponding Comment Number(s): 1

REVISION ___

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SRB/SRM POSTFLIGHT HARDWARE ASSESSMENT SQUAWK SHEET

Page 1 of 1

2. DETECTED DURING: OPEN ASSESSMENT	3. WORK AREA: ON DOCK	4. SQUAWK ID NUMBER	4A. SRB SIDE: [X] LH [ ] RH	
5. WORK UNIT CODE: INSULATION	6. PART NAME: FIELD JOINT PROTECTION SYSTEM	7. PART NUMBER: 1076803-01	8. SERIAL NUMBER: —	9. QUANTITY: 1
11. MIA/PN: FINAL	12. STS NUMBER: 33	13. REPORTED BY (NAME/ORG): S. HICKEN / THIOKOL	14. DATE/TIME: 26 NOV 89 / 12:00	
16. PHOTOGRAPH ID NUMBER: 114470-5		16A. PHOTO ORGANIZATION: [ ] USBI [X] MTI [ ] OTHER		

16. ITEM	17. PROBLEM DESCRIPTION
	The left hand forward field joint forward edge from 240° to 260° exhibited two possible impact marks approximately 3 feet apart. Numerous small surface cracks were on the forward facing edge between the marks.

18. ASSESSMENT TEAM CONCURRENCE

Steve Hicken
CONTRACTOR ASSESSMENT ENGINEER

Don L. Thomas
MSFC ASSESSMENT ENGINEER

19. EXECUTIVE BOARD DISPOSITION: PR REQUIRED [ ] PR NOT REQUIRED [ ]

20. PR NUMBER

21. EXECUTIVE BOARD REMARKS

22. APPROVALS

CONTRACTOR BOARD MEMBER/DATE

BOARD CHAIRMAN/DATE

POSTFIRE ANOMALY RECORD (PFAR)

1. PFAR NUMBER	3. INSPECTION LOCATION	4. REFERENCE SQUAWK NUMBER	5. REFERENCE PR NUMBER
360L007A-05	KSC X T-24/T-97 --- ---	33-031	PV6-146407
2. COMPONENT PROGRAM TEAM	H-7 --- A-2 ---	6. REFERENCE IFA NUMBER	7. REFERENCE SPR NUMBER
JPS		N/A	N/A

8. TITLE
IMPACT MARKS/SURFACE CRACKS ON FORWARD FIELD JOINT FJPS

9. CLASSIFICATION
OBSERVATION --- MINOR ANOMALY X --- MAJOR ANOMALY --- CRITICAL ANOMALY ---

10. JUSTIFICATION OF CLASSIFICATION
This is a first-time occurrence but this condition imposes no impact on flight safety or schedule.

11. PART NUMBER	12. SERIAL NUMBER	13. PART DESCRIPTION
1U76803-01	N/A	FIELD JOINT PROTECTION SYSTEM

14. REPORTED BY (NAME / ORGANIZATION / OBSERVATION DATE)
S. V. HICKEN / THERMAL INSULATION DESIGN ENGINEERING / 11/26/89

15. RESPONSIBLE PROGRAM MANAGER (NAME / ORGANIZATION)	16. RESPONSIBLE POSTFIRE ENGINEER (NAME / ORGANIZATION)
G. L. STEPHENS / JPS PROGRAM MANAGEMENT	G. S. NIELSON / POSTFIRE HARDWARE ENGINEERING
17. RESPONSIBLE INTEGRATION ENGINEER (NAME / ORGANIZATION)	18. RESPONSIBLE ACTIONEE (NAME / ORGANIZATION)
R. S. JENSEN / SYSTEMS INTEGRATION ENGINEERING	C. L. PROKOP / STAGE HARDWARE DESIGN

19. DESCRIPTION (ATTACH PFORS, FIGURES, PHOTOGRAPHS, ETC.)
Numerous small cracks were observed on the forward edge of the forward field joint FJPS cork from 240-to-260 degrees. Impact marks were noted on each side of the affected area approximately 3 feet apart. The cracks measured approximately 0.50 inch axially by less than 0.10 inch radially.

20. HISTORY
None. This is the first time that cracks of this type have been reported.

21. CAUSE
Cracks of this size meet the current material acceptance requirements. The impact marks were most likely caused by a parachute float line.

22. CORRECTIVE ACTION
Add a limit to the PEEL stating that cracks in the FJPS that meet current acceptance criteria are acceptable and should not be reported.

23. RESULTS
TWR-50050, Vol. I, Rev. C will state "Cracked cork or K5NA with no missing material - Acceptable".

24. REPORT RESULTS TO RPRB?	26. APPROVAL THROUGH CORRECTIVE ACTION		27. CLOSURE	
YES --- NO X ---	RPRB SECRETARY: /S/S. T. MUNSON	DATE: 12/13/89	RPRB SECRETARY: N/A	DATE: N/A
25. RPRB MEETING DATES	SIE: /S/R. S. JENSEN	DATE: 12/20/89	PM: G L Stephens	DATE: 10 July 90
ORIGINATION: 12/13/89	PM: /S/G. L. STEPHENS	DATE: 01/05/90		
CLOSURE: N/A				

REV. 2/1/90

PR CLOSURE APPROVAL *Ref. P.F.A.R. Number: 360L007A-05*

Engineering Approval

Signature **Date** 2/6/90

Quality Assurance Approval

Signature **Date** 2/13/90

N.A.S.A. Resident Q.A. Approval

Signature **Date** 2/13/90

N.A.S.A. R.M.O. Manager Approval

Signature **Date** 2/13/90

N.A.S.A. S.R.M. Chief Engineer Approval

Signature **Date** 2-20-90

NASA — National Aeronautics and Space Administration
USAF — Department of the Air Force, United States of America
Kennedy Space Center/Vandenberg Air Force Base

1. REPORT NUMBER
☐ INTERIM PROBLEM REPORT _____
☒ PROBLEM REPORT PV6 146407
☐ DISCREPANCY REPORT _____

PAGE _____ OF

2. DETECTED DURING	3. WORK AREA	4. END ITEM CONTROL NUMBER	
OPEN ASSESMENT	HANGAR A.F	D-B1034L-0011	

5. WORK UNIT CODE	6. PART/PROG NAME	7. PART/PROG NO.	8. SER./REV NO.	9. QTY
	FIELD JOINT PROTECTION SYSTEM	1476803-01	N/A	1

10. FSCM/VENDOR	11. NHA/PN/TAPE/DISC ID.	12. STS #/EFF.	13. REPORTED BY (NAME/ORG)	14. DATE
07703	10100-001	000B034L	S. HICKEN THI 8160 3-5838	1200 11-26-89

15. SOFTWARE PROBLEM LOCATOR — DATE _____ TIME _____
☐ DUMP ☐ TRANSLATOR OUTPUT ☐ LINE PRINTER OUTPUT ☐ COMPILER LISTING ☐ OTHER (SPECIFY)

16. ITEM	17. PROBLEM DESCRIPTION	17A. VALIDATION
1.0	L/H FWD FIELD JOINT FORWARD EDGE FROM 240° TO 260° EXHIBITED TWO POSSIBLE IMPACT MARKS APPX. 3 FEET APART. NUMEROUS SMALL SURFACE CRACKS WERE ON THE FORWARD FACING EDGE BETWEEN THE MARKS. REF SQUAWK 33-031	Kirby K Lynch per Eileen D. Thomas THI QA Spc 11-30-89

18. CRIT. SKILLS	19. ENG. CHANGE REQ.	20. CONSTRAINTS: ☐ YES ☒ NO	21. CRIT	22. RESP ORG.
☐ YES ☒ NO ITEMS:	☐ YES ☒ NO ITEMS:	TO:	3/3	LSOC

23. WEIGHT REQD	24. RETEST REQD	25. HAZARDOUS OP	26. MR REQD	27. TIME/CYCLE	28. FRACTURE CRIT
☐ YES ☒ NO ITEMS:	☐ YES ☒ NO ITEMS:	☐ YES ☒ NO ITEMS:	☐ YES ☒ NO ITEMS:	☐ YES ☒ NO ITEMS:	☐ YES ☒ NO ITEMS:

29. ITEM	30. DISPOSITION/CAUSE/CORRECTIVE ACTION	31. TECH	CONTR QA	GOVT QA
	SEE PG 2 FOR DISPO			
	Patti Nutt LSOC1740 12-1-89			

32. SYSTEM RESTORED (SIGNATURE) DATE	33. FINAL ACCEP DATE

34. DATA CODE	35. REPL. S/N	36. RELATED REPORTS
B08P		

37. RC ACTION REQD	38. RC CONSTRAINT (SIGNATURE DATE)	39. RC CLOSURE (SIGNATURE) (DATE)
☐ YES ☒ NO ITEMS:	TO:	

PRESS FIRMLY – ALL COPIES MUST BE LEGIBLE

KSC FORM 2-151 (REV. 12/81)

NASA / USAF — Kennedy Space Center/Vandenberg Air Force Base

NONCONFORMANCE SYSTEM (CONTINUATION SHEET)

1. REPORT NUMBER: ☐ IPR ☑ PR PV6-196407 ☐ DR ☐ CAAR

PAGE 2 OF

2. DETECTED DURING | 3. RESERVED | 4. END ITEM CONTROL NO. D-B1034L-0011

PRESS FIRMLY - ALL COPIES MUST BE LEGIBLE

5. ITEM		6. TECH	7. CONTR QA	8. GOVT QA
1.1	TRANSFER THIS PR TO THI CORP.			
	TRACKING NO 56DL00TA-05			
	ACCEPTED BY: [signature] 12/1/89 TC-USS-QC			
	SUMMARY CLOSURE			
	PR WAS TRANSFERRED TO THIOKOL CORP			
1-2	CLOSE THIS PR			
	LSOC SE: [signature] 12-1-89			
	NASA SE: [signature] R. MILLER 11-30-89 MUELLER.			
	THI CSS: [signature] 12/1/89			
	SPC QE:			

9. CLOSURE

KSC FORM 2-155 (REV. 6/84)

ORIGINAL

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