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SPACE SHUTTLE

Solid Rocket Motors
Thiokol Corporation

The Full-Scale Process and Design Changes for Elimination of Insulation Edge Separations and Voids in Tang Flap Area Final Report

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Thiokol CORPORATION

SPACE OPERATIONS

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The Full-Scale Process and Design Changes for Elimination of Insulation Edge Separations and Voids in Tang Flap Area Final Report

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ABSTRACT

Qualification of the full-scale process and design changes for elimination of redesigned solid rocket motor tang nitrile butadiene rubber insulation edge separations and voids was performed from 24 March to 3 December 1990. The objectives of this test were: 1) to qualify design and process changes on flight hardware using a tie ply between the redesigned solid rocket motor steel case and the nitrile butadiene rubber insulation over the tang capture feature, 2) to qualify the use of methyl ethyl ketone in the tang flap region to reduce voids, and 3) to determine if holes in the separator film reduce voids in the tang flap region. The tie ply is intended to aid insulation flow during the insulation cure process, and thus reduce or eliminate edge unbonds. Methyl ethyl ketone is intended to reduce voids in the tang flap area by providing better tacking characteristics. The perforated film was intended to provide possible vertical breathe paths to reduce voids in the tang area.

Tang tie ply testing consisted of 270 deg of the tang circumference using a new layup method and 90 deg of the tang circumference using the current layup methods. Tang insulation inspection revealed no unbonds in the area where the new process was used (270 deg of the tang circumference). There were insulation unbonds found in the area where the current process was used (90 deg of the tang circumference). The clevis end consisted of 270 deg of the current layup and 90 deg of the new layup. There were no unbonds found in either of these areas.

Tie ply process success was defined as a reduction of insulation unbonds. Lack of any insulation edge unbonds on the tang area where the new process was used, and presence of 17 unbonds with the current process, proves the test to be a success. Successful completion of this test has qualified the new processes.

For the methyl ethyl ketone testing, 180 deg of the tang end insulation contained TCA and 180 deg contained methyl ethyl ketone. Neither region contained any defects. Thus, methyl ethyl ketone is qualified for use as an activator in the tang flap region.

It was impossible to determine the effects of normal, perforated and prepunched holes in the flap separator film since no defects were found in the tang flap region.

CONTENTS

FIGURES

TABLES

ABBREVIATIONS AND ACRONYMS

RSRM .... redesigned solid rocket motor
NBR .... nitrile butadiene rubber
MEK .... methel ethyl keytone
LDI .... low density indication
TCA .... methyl chloroform

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INTRODUCTION

This report presents the results from the Phase III full-scale process and design change test for the elimination of insulation edge separations on both tang and clevis ends and voids within the tang flap area. The objectives of this test were: 1) to qualify the design and process changes on flight hardware using a tie ply between the redesigned solid rocket motor (RSRM) steel case and the nitrile butadiene rubber (NBR) insulation over the tang capture feature, 2) to qualify the use of methyl ethyl ketone (MEK) in the tang flap region to reduce voids and, 3) to determine if holes in the separator film reduce voids in the tang flap region. The tie ply is intended to aid insulation flow during the insulation cure process, and thus reduce or eliminate edge unbonds. MEK is intended to reduce voids in the tang flap area by providing better tacking characteristics. The perforated film was intended to provide possible vertical breathe paths to reduce voids in the tang area. Testing was performed from 24 March to 3 December 1990 at Thiokol buildings H-7, M-111, and M-39. Testing was in accordance with CTP-0166, Revision B.

1.1 TEST ARTICLE DESCRIPTION

The test article consisted of a full-scale nonflight RSRM center segment case. Equipment, process procedures, specifications, and materials used in the test were consistent with those used in standard production processes, except as noted. A single RSRM center segment cylinder (1U51633-14) with capture feature and sealing surfaces was used to properly simulate edge effects and processing variables. The case segment was insulated with standard NBR sheet insulation and NBR extrusion stock per Drawings 5U77147-101 and 7U77147. The case segment was insulated with a full inhibitor. A tie ply was installed on 270 deg of the steel inner case wall on the tang capture feature (Figure 1a) prior to mold ring installation. On the clevis end (Figure 1b), the tie ply was applied using 270 deg of the current production method and 90 deg of the new method. For the current method, the mold ring was installed to the clevis case first. The tie ply was then applied to the extrusion, and then the extrusion/tie ply assembly was installed. For the new method, the tie ply was applied to the clevis case first. Then the mold ring and the extrusion were installed.

Process Simulation Test Article—Phase III

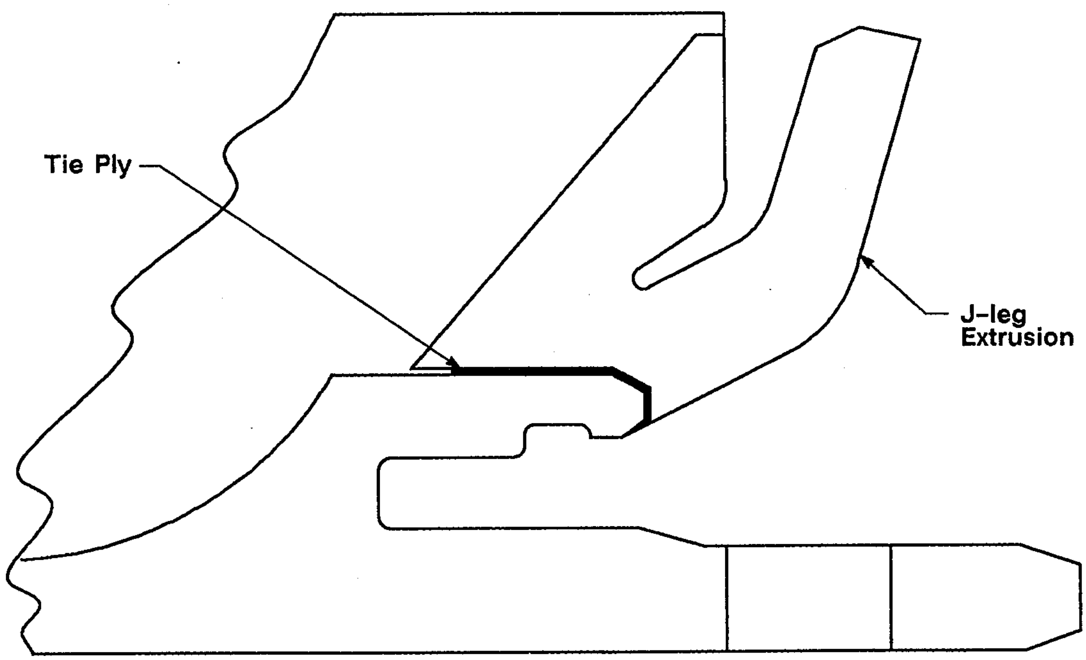

Figure 1a. Tang End Tie Ply Layups

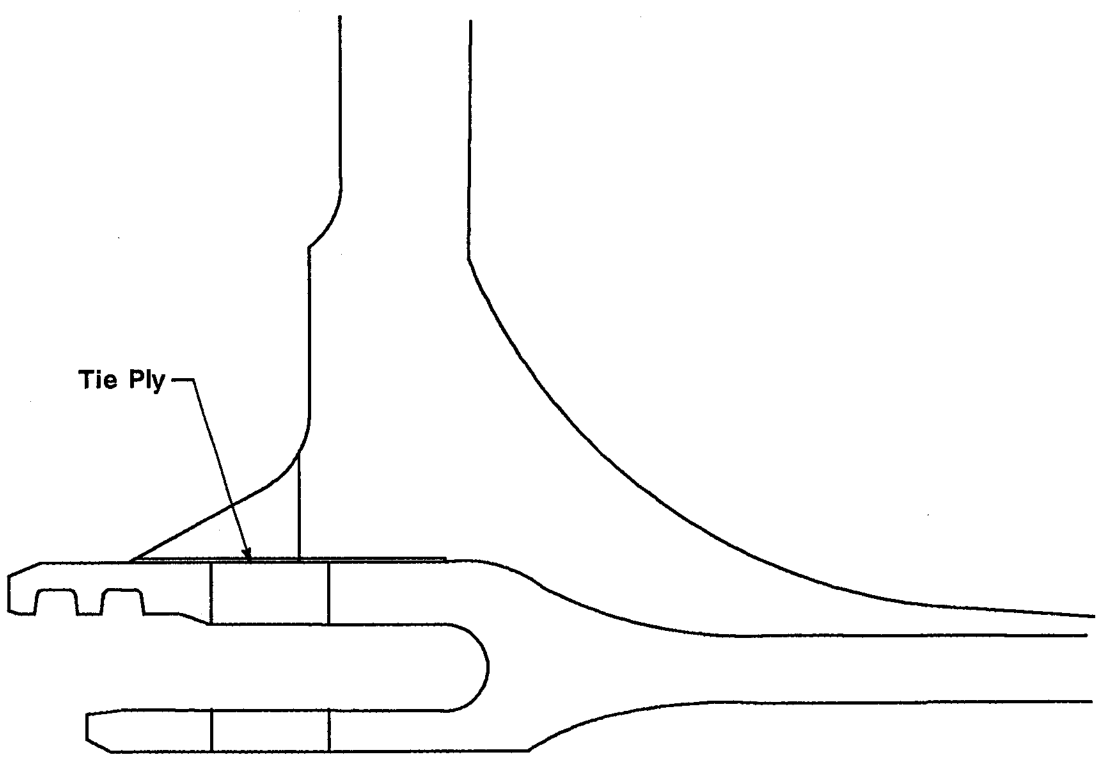

Figure 1b. Clevis End Tie Ply

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OBJECTIVES

The objectives of test plan CTP-0166, Revision B were:

A. Qualify the design and process changes using the shear ply in aiding insulation flow and eliminating edge unbonds. (Shear ply referred to in this document is the tie ply.)

B. Qualify the use of MEK in the tang flap area to reduce voids.

C. Determine if holes in the separator film reduce voids in the tang flap area.

3

EXECUTIVE SUMMARY

3.1 SUMMARY

This section contains an executive summary of the key results from test data evaluation and post-test inspection. Additional information and details can be found in Section 6, Results and Discussion.

3.2 CONCLUSIONS

The following section discusses conclusions for specific test objectives. Additional information about the conclusions is in Section 6, Results and Discussions.

Objective	Conclusions
a. Qualify the design and process changes using the shear ply in aiding insulation flow and eliminating edge unbonds. (Shear ply referred to in this document as tie ply.)	Qualified. The design process change was successfully evaluated. There were no edge separations found in the areas where the new process was used on the clevis and tang ends.
b. Qualify the use of MEK in the tang flap area to reduce voids.	Qualified. There were no defects detected in the MEK-treated region of the tang flap.
c. Determine if holes in the separator film reduce voids in the tang flap area.	Not Determined. There were no defects detected in any of the three different separator films (non-perforated and perforated). Therefore, it was impossible to determine the effects of each separator film.

3.3 RECOMMENDATIONS

With the results from the testing (per CTP-0166, Revision B) the process changes used on the tang end should be incorporated into the process as soon as possible. The use of the tie ply on the tang end will eliminate most, if not all, of the unbonds and unflows in this region. Since no defects were detected in either area of the clevis layup methods, it is recommended that both clevis end tie ply application methods be considered qualified.

Since there were no defects detected in the MEK-treated area, it is recommended that MEK be considered a qualified activator in the tang flap region.

Since it was impossible to determine the effects of the different separator films, it is recommended that the study of perforated film be dropped from further consideration.

4
INSTRUMENTATION

The instrumentation in this test were consistent with that used in a standard production RSRM segment.

Standard laboratory equipment, with calibrations traceable to the National Institute of Standards and Technology, was used to support this test. All calibrated measuring and test equipment used to support this test was in compliance with MIL-STD-45662. All instruments were operationally verified and electrically zeroed before and after each test and, when required, by the operating limits of the test.

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PHOTOGRAPHY

Still color photographs were taken during post-test. Copies of the photographs taken (Series No. 117100, 117149, 118567, and 120696) are available from Thiokol's Photography department.

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RESULTS AND DISCUSSION

6.1 ASSEMBLY

This qualification test used nonflight hardware and standard tooling. A single RSRM center segment cylinder (1U51633-14) with capture feature and sealing surfaces was used to properly simulate edge effects and processing variables.

The cylinder surface preparation performed for this qualification test was identical to standard flight practices and procedures of a center segment. The segment was grit blasted at H-7; the tang and clevis ends were cosmetically grit blasted at M-52; and the Chemlok® 205 primer and 233 adhesive were applied in the M-111 paint pit.

6.2 TEST

Insulation layup was conducted per Drawing 5U77147-101. The cylinder was processed per normal manufacturing planning, except for the items listed below. The tang tie ply was used as outlined in the Table 1 test matrix. This included applying the tang tie ply to the capture feature (Figure 1a) for 270 deg shortly after the segment was placed in the assembly stand prior to mold ring installation. The cylinder was then moved to the M-111 Annex for insulation layup. Rubber layup was accomplished in the standard horizontal position using the layup platform up to the debulk operation. Changes to the standard flight layup incorporated into this configuration are detailed below.

a. The application of the tie plies (Figure 1) as discussed above.

b. The use of perforated (punch hole and pin prick) separator films.

c. MEK activation for 180 deg in the tang flap region.

The vacuum bag was installed extending the full length of the segment. Dacron® pattern cloth, Dacron® breather cloth, and Chickopee strips were positioned as per a normal flight segment. The vacuum bag was sealed to the inhibitor mold ring on the clevis end and the outside diameter of the segment on the tang end. Vacuum was

Table 1. Tang End RSRM Edge Separation Full-Scale Test Article Test Matrix

	0 deg			90 deg			180 deg			270 deg			360 deg
Section No.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	
Layup													
Normal Layup Process (per 5U77147-101)							X	X	X				
Tie Ply (over capture feature), applied just prior to mold ring installation	X	X	X	X	X	X				X	X	X	
Activation Solvent													
TCA	X	X	X							X	X	X	
MEK				X	X	X	X	X	X				
Flap Separator Film													
Normal Etched FEP Film (no holes)		X		X					X		X		
Punched Hole (0.045 on 0.05-in. centers)	X				X			X		X			
Pin Prick (on 0.25-in. centers)			X			X	X					X	

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pulled through the tang and clevis mold rings as on a flight center segment. The assembly was then cured using the center segment autoclave cycle monitored by embedded thermocouple in the insulation.

6.3 RESULTS

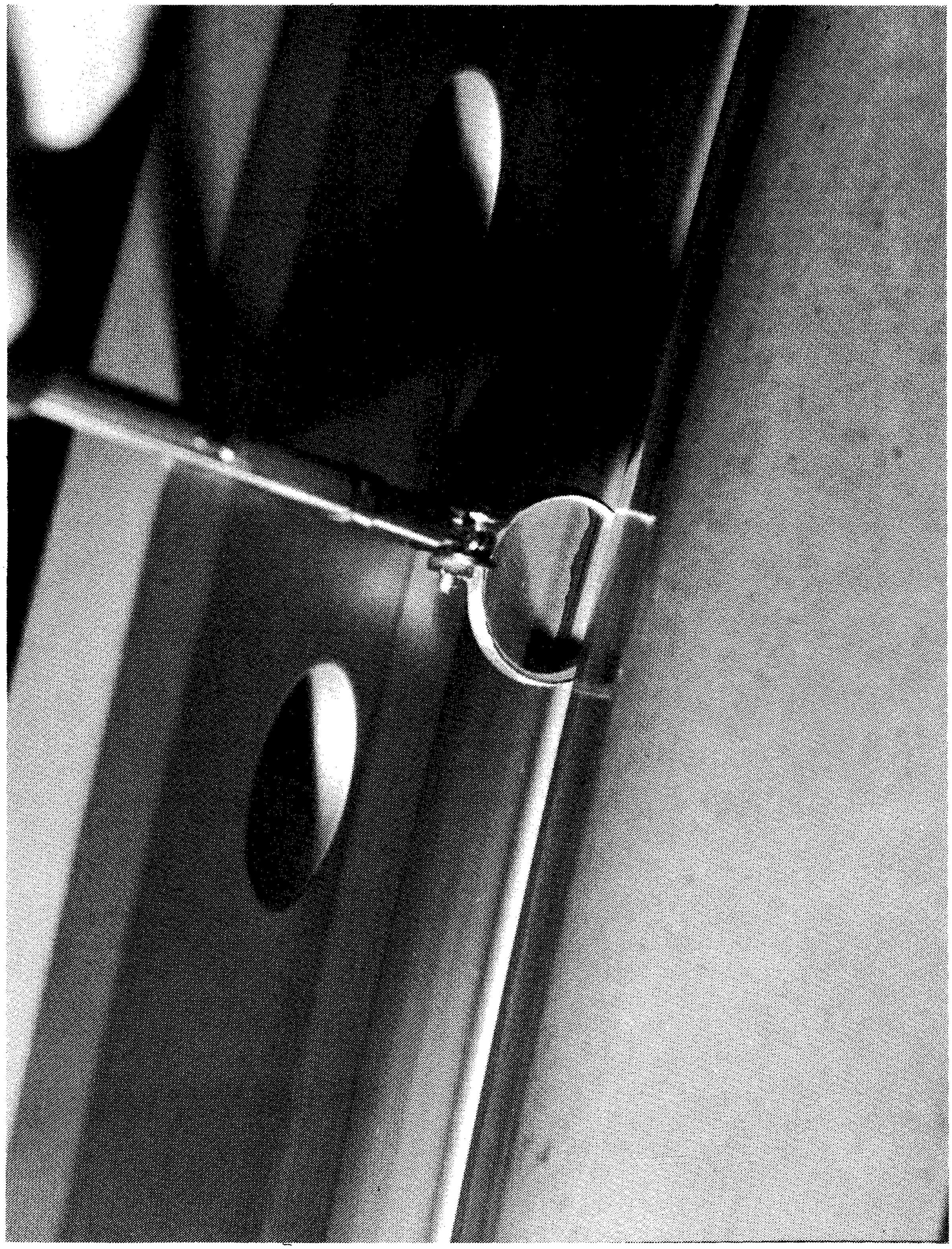
The following sections contain summaries of the test results.

6.3.1 Tang End

All trimming, probing, and visual inspections were conducted per normal flight hardware processing. Postcure visual inspection determined there was normal flashing in the 90-deg area where the tie ply was not used (Figure 2) and exceptionally good flow (even into the O-ring groove) in the 270-deg area where the tie ply was used (Figure 3). The transition between the interface of the tie ply to the normal layup (no tie ply) demonstrates the difference in the insulation flow between the two test areas and the obvious advantage of using the tie ply (Figure 4). Probe inspections conducted by Manufacturing and Quality Assurance, after trim and after one month of aging, detected 17 unbonds in the 90-deg area where normal layup occurred and only one defect in the 270-deg area with the tie ply (Appendixes A and B). This one defect was an obvious tear caused during the probing operation. Since this testing showed no layup-related defects in the 270-deg area, the new layup process has been qualified.

X-ray inspection was performed on the tang flap and flap bulb regions. This inspection revealed one low density indication (LDI) which may have been a case-to-insulation unbond. The LDI was seen rising to tangent position from 318 to 327 deg. Measurements were taken at 327 deg and showed that the LDI was located 7.530 in. forward of the tang end. The LDI had a length of 1.540 in. and a depth of 0.126 inch. The LDI was seen coming off tangent at 336 deg. Due to scatter caused by the outer case diameter, the LDI was lost from view between 330 and 333 deg (Appendix C).

Six sections were removed from the flap region. The strips were dissected into approximately 0.75-in. strips for visual inspection for void and unbonds. The sections were centered at 15, 75, 135, 195, 255, and 327 deg, and each section extended approximately 7 in. circumferentially in each direction. Historical database has shown



N117149-1

Figure 2. Non-tie Ply Region of Segment

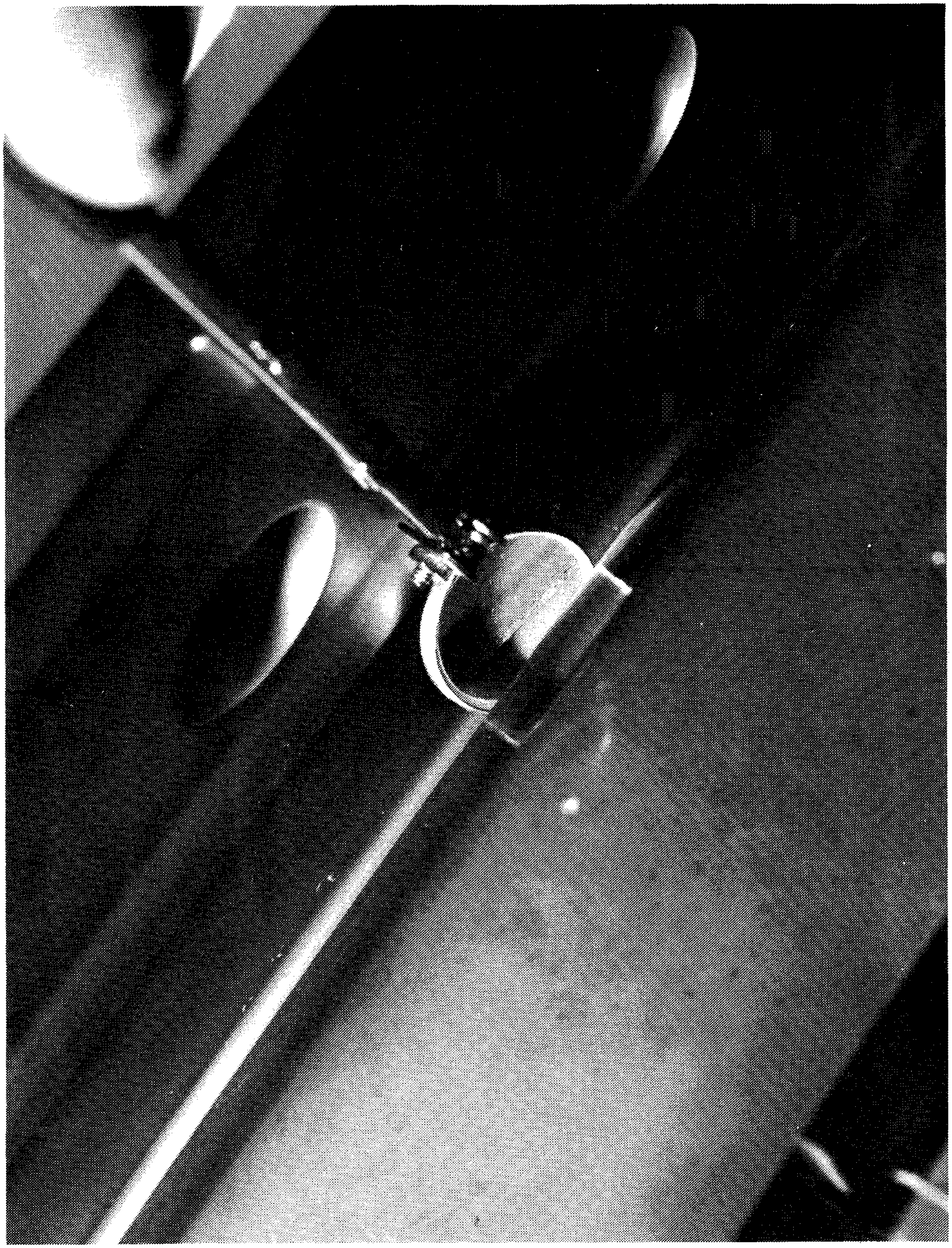


Figure 3. Tie Ply Region of Segment

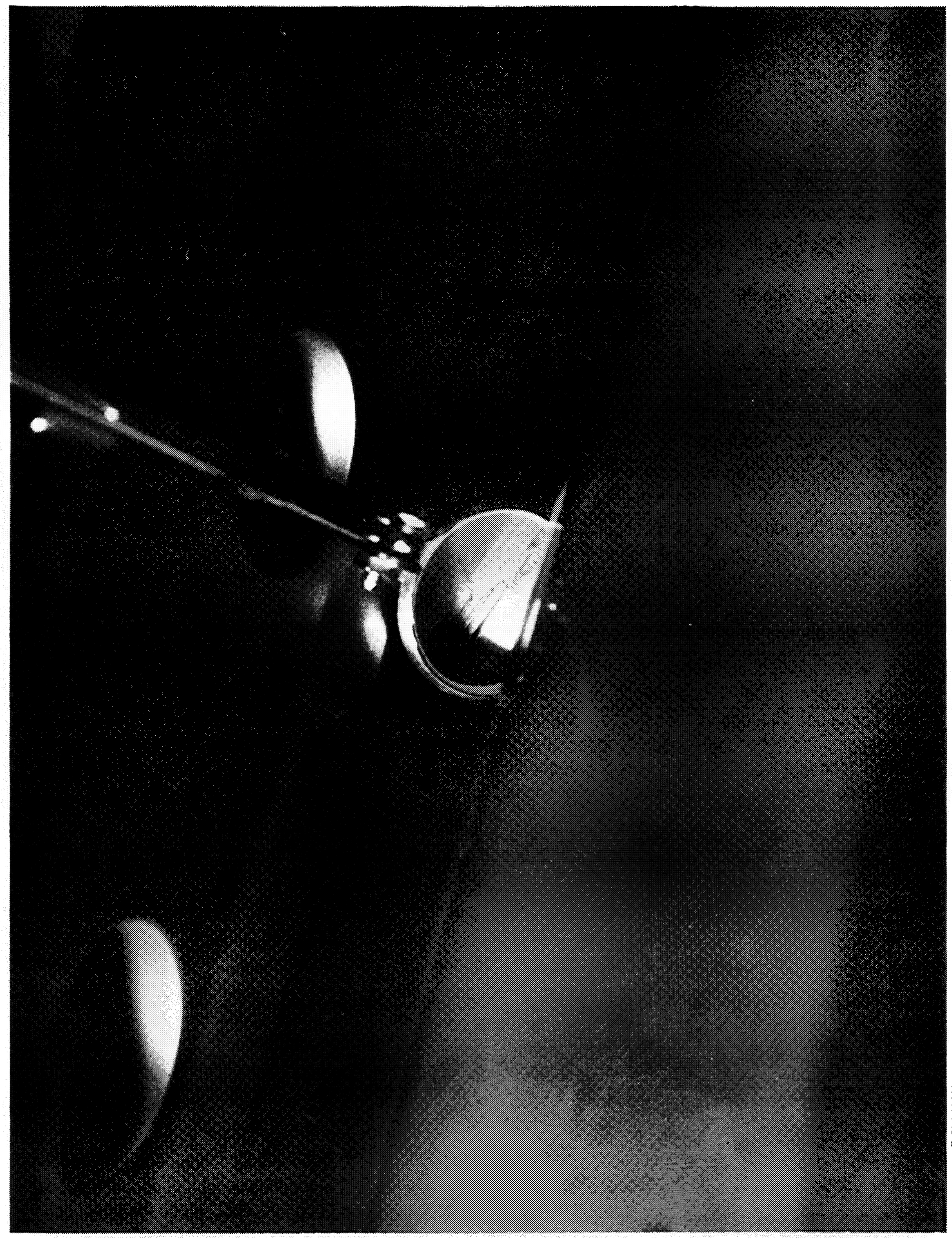


Figure 4. Tie Ply-to-Non-tie Ply Interface

that this area is where most defects occur. The dissected areas started approximately 8.5 in. aft of the tang and extended approximately 19 in. (Figures 5 and 6). The insulation aft of the dissected regions was removed and used in the resiliency testing conducted per WTP-0232.

The dissected areas were chosen to provide good comparisons between TCA and MEK and between perforated and nonperforated separator film. No defects were found in any of the sections including the section centered at 327 deg (LDI location). Since the TCA and MEK-activated regions contained no defects, MEK is qualified for use as an activator in the tang flap region. It was impossible to determine the effects of normal, perforated, and prepunched holes in the flap separator film since no defects were found in any of the areas.

CTP-0166, Revision B, called for a final inspection of the tang end tie ply. The test plan specified that a small section of the tang J-leg insulation was to be removed and dissected to determine if the 0.050-in. NBR tie ply had flowed during the autoclave cure cycle and formed a knitting bond with the NBR J-leg extrusion. Approximately 12 in. of the tang insulation was removed before Quality Assurance and Air Force inspectors had verified the final visual inspection of the removed insulation surface. However, the edge was probed and the resulting data were recorded prior to insulation removal. Also, the section that was removed was available for inspection. Engineering determined that the small section that was removed did not affect the qualification effort of the tang tie ply.

6.3.2 Clevis End

Postcure visual inspection revealed normal flashing over the full circumference of the segment. There were no visual indications between the area with the normal tie ply application and the area with the tie ply applied prior to mold ring installation. Probe inspections did not detect any edge unbonds on the clevis end.

CTP-0166, Revision B specified that the tie ply was to be installed with the stock No. 3014 extrusion (normal layup) in Sections 7, 8, and 9 (180 to 270 deg) and prior to mold ring installation in Sections 1 through 6 and 10 through 12 (0 to 180 deg and

N120696-3

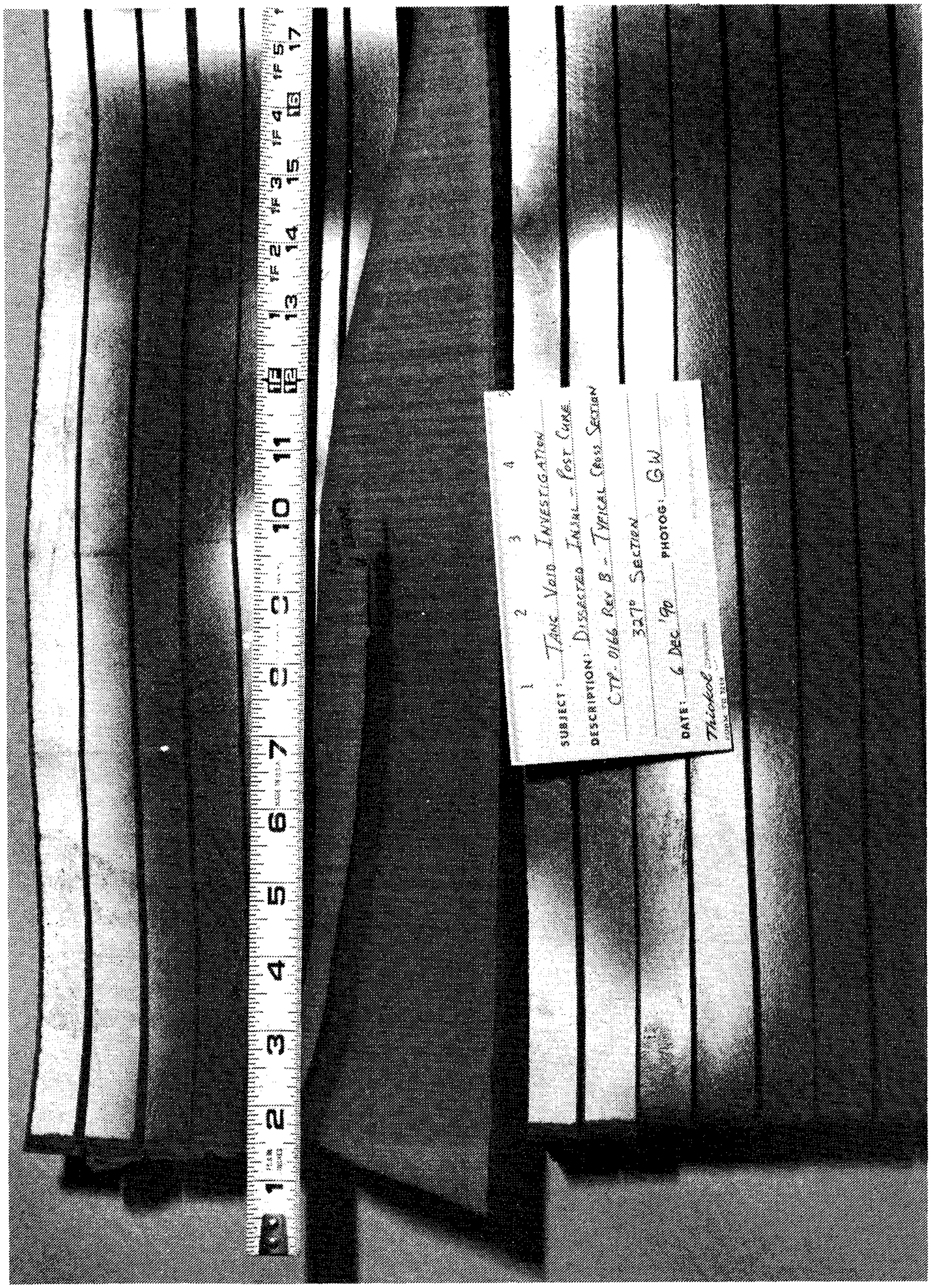


Figure 5. Typical Dissected Section of Tang Flap Region

N120696-4

Figure 6. Dissected Strips From the 327-deg Area of the Tang Flap

270 to 360 deg). However, the 5U77147 drawing specified an exact opposite layup procedure (Table 2). This error was not detected until after the clevis end mold ring was installed and after the segment was moved to the rotation dolly. Therefore, it was not feasible to correct the mistake for this testing.

The use of the tie ply in the insulation layup of the clevis end had already been approved and implemented on flight hardware, and this resulted in a very substantial reduction of clevis insulation edge unbonds. This test variable was intended to qualify the installation of the tie ply to the case hardware prior to mold ring installation on the RSRM segment.

This installation change was expected to reduce contamination to the Chemlok adhesive surface. The inadvertent installation of only 90 deg instead of 270 deg of tie ply produced a test area with a circumferential length of 115 inches. The Edge Separation Team determined that this error did not affect the final results of this testing.

The test plan specified that the flashing edge would be probed before and after the flashing was trimmed. Probing was not performed before the flashing was trimmed. This inspection was to provide engineering information only. This inspection is not made during normal RSRM production. However, normal probe inspections were conducted on the clevis end after the flashing was trimmed. This inspection provided the critical inspection data for acceptance or rejection of the test results.

Edge separation growth, cause, and repair methods could not be analyzed because there were no edge unbonds detected. As an alternate method, the tie ply on RSRM segments may be installed on the clevis leg prior to mold ring installation.

The optional simulated storage stress test discussed in CTP-0166, Revision B, Section 8.3.1 was not performed because the test segment was needed for other tests.

Since no edge unbonds were detected on the clevis end for either of the two methods, the installation of the tie ply to the case hardware prior to mold ring installation is considered a qualified process.

Table 2. Clevis End Test Matrix

	Degree											
	0		90			180			270			360
Section No.	1	2	3	4	5	6	7	8	9	10	11	12
Layup												
Normal layup process							X	X	X			
Layup shear ply (on the case wall) just prior to installation of mold ring	X	X	X	X	X	X				X	X	X

CTP-0166, Revision B, Specified Layup

	Degree											
	0		90			180			270			360
Section No.	1	2	3	4	5	6	7	8	9	10	11	12
Layup												
Normal layup process	X	X	X	X	X	X				X	X	X
Layup shear ply (on the case wall) just prior to installation of mold ring							X	X	X			

Actual layup per 5U77147

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APPLICABLE DOCUMENTS

The latest revision of the following documents, unless otherwise specified, is applicable to the extent specified herein.

Document	Title
CTP-0166 Revision B	Qualification Test for Full-Scale Process and Design Changes for the Elimination of Insulation Edge Separations and Voids in the (Tang) Flap Area
TWR-16433	Phase II Testing for Full-Scale Process Evaluation of Insulation Edge Separation
TWR-17925	Test Report for Full-Scale Evaluation of Insulation Edge Separation
WTP-0162	RSRM Field Joint Edge Debond Investigation
WTP-0179 Revision A	Phase II Testing for Full-Scale Process Evaluation of Insulation Edge Separations
WTP-0232	Effects of Two Insulation Autoclave Cures on J-joint Resiliency
Government	
MIL-STD-45662	Calibration Systems Requirements
Drawings	
1U51633-14	Case Components, Reidentified
5U77147-101	Rubber Layup Drawing
7U77147	Full-Scale Evaluation, Edge Separation Test Article

Appendix A

Tang End RSRM Internal Insulation Edge Unbonds After Trim

A

RSRM INTERNAL INSULATION EDGE UNBONDS

INSPECTION ACCEPTED BY	BADGE NO	DATE	EXTENSION
BRETT WHITAKER	16145	23 APR 90	2576

SEGMENT DESIGNATION	BUILDING NO	CPI
CYL Clevis UNBOND TEST	M-111	4B29G

PART NO	SERIAL NO	SEGMENT END
7U77147-01(904)	0000001	Tang

SEGMENT LEVEL: [X] INSULATION [ ] FINAL [ ] H-7 [ ] OTHER ____

INSPECTION

- [ ] BEFORE EXERCISE
- [X] AFTER EXERCISE
- [ ] BEFORE REPAIR
- [ ] AFTER REPAIR
- [ ] FINAL-AS SHIPPED
- [X] SHIMSTOCK

OTHER INFORMATION: INCLUDE MRI, DR OR SUPPLEMENT INFORMATION PERTINENT TO INSPECTION

* AT 149 DEG. INSULATION WAS TORN CAUSING THE UNBOND DURING PROBING.
SL-45981

UNBOND DIMENSIONS						FAILURE MODE IF OVER .025 INCH DEPTH (M-111) IF OVER .050 INCH DEPTH (FINAL)			
DEGREE LOCATION	CIRCUMFERENTIAL LENGTH	LONGITUDINAL DEPTH	RADIAL WIDTH	DR NO	REPAIRED YES OR NO	R	RC	CP	M
* 149	.100	.040	.015	NO	NO	N			
224	.100	.020	.010						
224	.100	.020	.010						
226.2	.100	.020	.010						
226.4	.100	.020	.005						
227.0	.200	.020	.010						
227.5	.100	.020	.010						
228	1.00	.015	.005						
229	.750	.015	.005						
230	1.00	.015	.005						A

NOTES: 1. ALL EDGE UNBONDS WILL BE REPORTED ON THIS SHEET.
2. IF UNBOND EXCEEDS ENGINEERING LIMITS, THE DR NO WILL BE ENTERED IN APPROPRIATE COLUMN.
3. IF UNBOND EXCEEDS ONE DEGREE IN CIRCUMFERENTIAL LENGTH; THEN LONGITUDINAL DEPTH WILL BE RECORDED AT EVERY DEGREE.
4. SHEETS TO BE FORWARDED TO INSULATION QUALITY ENGINEERING, M/S 811 WITHIN 24 HOURS FROM COMPLETION.

FORM SP 9044

A

RSRM INTERNAL INSULATION EDGE UNBONDS CONTINUATION

SEGMENT DESIGNATION	PART NO	SERIAL NO	DATE	PAGE
Clevis UNBOND TEST	7U77147-01 (904)	0000001	23APR90	2 OF 2

SEGMENT END: Tang

161.15 23APR90

UNBOND DIMENSIONS						FAILURE MODE IF OVER .025 INCH DEPTH (M-111) IF OVER .050 INCH DEPTH (FINAL)			
DEGREE LOCATION	CIRCUMFERENTIAL LENGTH	LONGITUDINAL DEPTH	RADIAL WIDTH	DR NO	REPAIRED YES OR NO	R	RC	CP	M
231	1.00"	.015	.005	NO	NO	N			
232	1.00"	.015	.005						
233	1.00"	.020	.010						
234	1.00"	.050	.020						
235	1.00"	.020	.010						
236	1.00"	.030	.010						
237	1.00"	.050	.020						
238	1.00"	.020	.005						
N									
					A				A

A-3

FORM SP 9044-701

Appendix B

Tang End RSRM Internal Insulation Edge Unbonds After One Month of Aging

B

RSRM INTERNAL INSULATION EDGE UNBONDS

INSPECTION ACCEPTED BY	BADGE NO.	DATE	EXTENSION
K. HANSEN	19791	23 MAY 90	2576

SEGMENT DESIGNATION CLEVIS UNBOND TEST CYL TSTG FOR CLEVIS UNBOND & TANG

BUILDING NO. M-111

CPI 4B29G

PART NO. 7U77147-01(904)

SERIAL NO. 0000001

SEGMENT END TANG

SEGMENT LEVEL [X] INSULATION [ ] FINAL [ ] H-7 [ ] OTHER ______

INSPECTION

- [ ] BEFORE EXERCISE
- [X] AFTER EXERCISE
- [X] BEFORE REPAIR
- [ ] AFTER REPAIR
- [ ] FINAL–AS SHIPPED
- [X] SHIMSTOCK

RECORD SL/SA NUMBER OF INSTRUMENT USED SL-45981

OTHER INFORMATION: INCLUDE MRI, DR OR SUPPLEMENT INFORMATION PERTINENT TO INSPECTION

N/A

UNBOND DIMENSIONS

DEGREE LOCATION	CIRCUMFERENTIAL LENGTH	LONGITUDINAL DEPTH	RADIAL WIDTH	DR NO.	REPAIR REQUIRED YES OR NO	PREVIOUS REPAIRS YES OR NO
149	.100	.040	.015	N/A	NO	NO
224	.100	.020	.010			
226	.100	.020	.010			
226.3	.200	.025	.010			
227	.250	.025	.005			
227.5	.150	.025	.005			
228-238	20.5"	.020	.005			
229		.020	.005			
230		.020	.005			
231		.015	.005			

NOTES:
1. ALL EDGE UNBONDS WILL BE REPORTED ON THIS SHEET.
2. IF UNBOND EXCEEDS ENGINEERING LIMITS, THE DR NO. WILL BE ENTERED IN APPROPRIATE COLUMN.
3. IF UNBOND EXCEEDS ONE DEGREE IN CIRCUMFERENTIAL LENGTH, THEN LONGITUDINAL DEPTH WILL BE RECORDED AT EVERY DEGREE.
4. SHEETS TO BE FORWARDED TO INSULATION QUALITY ENGINEERING, M/S 811, WITHIN 24 HOURS FROM COMPLETION.
5. RUBBER PROPERTY–ADHESION TO RUBBER SUBSTRATES REFERENCE ASTM D 429–31
6. CHECK ALL APPLICABLE BLOCKS ON FORM.
7. ENSURE CONTINUOUS UNBONDS ARE MEASURED AT EVERY DEGREE.

FORM SP 9044 (REV 3-90)

B

RSRM INTERNAL INSULATION EDGE UNBONDS CONTINUATION

SEGMENT DESIGNATION	PART NO.	SERIAL NO.	DATE	PAGE
CLEVIS UNBOND TEST	7U77147-01 (904)	0000001	23 MAY 90	2 OF 2

SEGMENT END

TANG

UNBOND DIMENSIONS

DEGREE LOCATION	CIRCUMFERENTIAL LENGTH	LONGITUDINAL DEPTH	RADIAL WIDTH	DR NO.	REPAIR REQUIRED YES OR NO	PREVIOUS REPAIRS YES OR NO
232		.020	.005	NA	NO	NO
233		.025	.010			
234		.050	.020			
235		.025	.010			
236		.030	.010			
237		.050	.020			
238		.025	.005			
NA					NA	NA

FORM SP 9044-701 (REV 3-90)

B-3

Appendix C

NDT X-ray Report

NDT X-RAY REPORT

SERIAL NO.	PART NAME	PART NO.	DATE	GROUP LEADER/FOREMAN REVIEW	PAGE
0000029	Insul. Cylinder [illegible]	1U511 [illegible] -14	[illegible]	[signature]	1 OF 1

SPECIFICATION NO. Eng. [illegible]	JOB NO.	PROJECT NO.
BP1U51133-14	[illegible]	4AS[illegible]1-07-20

FILM I.D.		DISCONTINUITY		DISCONTINUITY		SIZE			
FILM POSITION (SECTION)	INSP. AREA T-TANGENT B-BODY R-RADIAL	DEG	INDICATION IDENTIFICATION AND DESCRIPTION	FIRST READER'S INITIAL	REVIEW READER'S INITIAL	LENGTH (LONG)	WIDTH (CIR)	DEPTH (RAD)	CLASSIFI-CATION
V 1	T	0°-49°	No Defects Detected	[initials]	[initials]				
		51°-204°	NO DEFECTS DETECTED	[initials]					
		207°-336°	ONE LOW DENSITY INDICATION, [illegible] CASE / INSULATION	[initials]					
			UNBOND. LDI IS SEEN RISING TO [illegible] POSITION [illegible] 318°-327°.						
			MEASUREMENTS TAKEN AT 327° SHOW THE LDI 7.530" [illegible] OF			1.540		.126	
			TANG END. THE LDI IS SEEN COMING DOWN [illegible] ON						
			336°. BECAUSE OF CASE O.D. [illegible], THE INDICATION [illegible] LOST						
			FROM VIEW @ 330°-333°.	[initials]					
		339°-357°	NO DEFECTS DETECTED	[initials]					

FORM TC 4558 (REV 12-83)

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