

NASA/TM—2006–214603



Qualification Testing of Solid Rocket Booster Diagonal Strut Restraint Cable Assembly Part Number 10176–0031–102/103

T.W. Malone

Marshall Space Flight Center, Marshall Space Flight Center, Alabama

September 2006

The NASA STI Program Office...in Profile

Since its founding, NASA has been dedicated to the advancement of aeronautics and space science. The NASA Scientific and Technical Information (STI) Program Office plays a key part in helping NASA maintain this important role.

The NASA STI Program Office is operated by Langley Research Center, the lead center for NASA's scientific and technical information. The NASA STI Program Office provides access to the NASA STI Database, the largest collection of aeronautical and space science STI in the world. The Program Office is also NASA's institutional mechanism for disseminating the results of its research and development activities. These results are published by NASA in the NASA STI Report Series, which includes the following report types:

- **TECHNICAL PUBLICATION.** Reports of completed research or a major significant phase of research that present the results of NASA programs and include extensive data or theoretical analysis. Includes compilations of significant scientific and technical data and information deemed to be of continuing reference value. NASA's counterpart of peer-reviewed formal professional papers but has less stringent limitations on manuscript length and extent of graphic presentations.
- **TECHNICAL MEMORANDUM.** Scientific and technical findings that are preliminary or of specialized interest, e.g., quick release reports, working papers, and bibliographies that contain minimal annotation. Does not contain extensive analysis.
- **CONTRACTOR REPORT.** Scientific and technical findings by NASA-sponsored contractors and grantees.

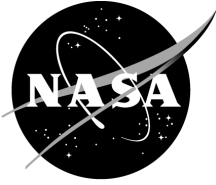
- **CONFERENCE PUBLICATION.** Collected papers from scientific and technical conferences, symposia, seminars, or other meetings sponsored or cosponsored by NASA.
- **SPECIAL PUBLICATION.** Scientific, technical, or historical information from NASA programs, projects, and mission, often concerned with subjects having substantial public interest.
- **TECHNICAL TRANSLATION.** English-language translations of foreign scientific and technical material pertinent to NASA's mission.

Specialized services that complement the STI Program Office's diverse offerings include creating custom thesauri, building customized databases, organizing and publishing research results...even providing videos.

For more information about the NASA STI Program Office, see the following:

- Access the NASA STI Program Home Page at <http://www.sti.nasa.gov>
- E-mail your question via the Internet to help@sti.nasa.gov
- Fax your question to the NASA Access Help Desk at 301-621-0134
- Telephone the NASA Access Help Desk at 301-621-0390
- Write to:
NASA Access Help Desk
NASA Center for AeroSpace Information
7121 Standard Drive
Hanover, MD 21076-1320
301-621-0390

NASA/TM—2006–214603



Qualification Testing of Solid Rocket Booster Diagonal Strut Restraint Cable Assembly Part Number 10176–0031–102/103

T.W. Malone

Marshall Space Flight Center, Marshall Space Flight Center, Alabama

National Aeronautics and
Space Administration

Marshall Space Flight Center • MSFC, Alabama 35812

September 2006

Acknowledgments

The author would like to acknowledge the assistance of several individuals who aided in the preparation of this document. James Hodo (Marshall Space Flight Center Mechanical Metallurgy & Corrosion Engineering Team/ED33) and Robert Bond (Morgan Research Corporation) conducted mechanical testing and provided test results and photographic documentation. Quality assurance and buy-off on test results were performed for NASA's Safety & Mission Assurance by Steve Presti (Hernandez Engineering, Inc.) and for United Space Alliance (USA) by Toni Andreoni (USA). Mark Hill (Space Shuttle Propulsion Office, Solid Rocket Booster Project/MP41) and Shane Canerday (USA) were instrumental in the coordination of the testing effort. Susan Hessler (Morgan Research Corporation) performed an editorial review of this document.

Available from:

NASA Center for AeroSpace Information
7121 Standard Drive
Hanover, MD 21076-1320
301-621-0390

National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
703-487-4650

TABLE OF CONTENTS

1. INTRODUCTION	1
2. BACKGROUND	2
3. TESTING AND EVALUATION	4
3.1 Testing	4
3.2 Evaluation	4
4. CONCLUSIONS	7
APPENDIX A—PHOTOGRAPHS BEFORE AND AFTER TESTING	8
APPENDIX B—PROCEDURE CHECKLISTS	31
REFERENCES	93

LIST OF FIGURES

1.	Strut retainer assembly	2
2.	Strut retainer assembly installation	2
3.	071081-RT-1 (a) before testing and (b) after testing	8
4.	071081-RT-2 (a) before testing and (b) after testing	9
5.	071081-RT-3 (a) before testing and (b) after testing	9
6.	071081-RT-4 (a) before testing and (b) after testing	10
7.	071081-RT-5 (a) before testing and (b) after testing	10
8.	071081-ELV-6 (a) before testing and (b) after testing	11
9.	071081-ELV-7 (a) before testing and (b) after testing	12
10.	071081-ELV-8 (a) before testing and (b) after testing	13
11.	071081-ELV-9 (a) before testing and (b) after testing	14
12.	071081-ELV-10 (a) before testing and (b) after testing	15
13.	104236-RT-1 (a) before testing and (b) after testing	16
14.	104236-RT-2 (a) before testing and (b) after testing	16
15.	104236-RT-3 (a) before testing and (b) after testing	17
16.	104236-RT-4 (a) before testing and (b) after testing	17
17.	104236-RT-5 (a) before testing and (b) after testing	18
18.	104236-ELV-6 (a) before testing and (b) after testing	19
19.	104236-ELV-7 (a) before testing and (b) after testing	20
20.	104236-ELV-8 (a) before testing and (b) after testing	21

LIST OF FIGURES (Continued)

21.	104236–ELV–9 (a) before testing and (b) after testing	22
22.	104236–ELV–10 (a) before testing and (b) after testing	23
23.	5369–RT–1 (a) before testing and (b) after testing	24
24.	5369–RT–2 (a) before testing and (b) after testing	24
25.	5369–RT–3 (a) before testing and (b) after testing	25
26.	5369–RT–4 (a) before testing and (b) after testing	25
27.	5369–RT–5 (a) before testing and (b) after testing	26
28.	5369–ELV–6 (a) before testing and (b) after testing	26
29.	5369–ELV–7 (a) before testing and (b) after testing	27
30.	5369–ELV–8 (a) before testing and (b) after testing	28
31.	5369–ELV–9 (a) before testing and (b) after testing	29
32.	5369–ELV–10 (a) before testing and (b) after testing	30

LIST OF ACRONYMS AND ABBREVIATIONS

ELV	elevated temperature
RT	room temperature
SRB	solid rocket booster
TM	Technical Memorandum
USA	United Space Alliance

TECHNICAL MEMORANDUM

QUALIFICATION TESTING OF SOLID ROCKET BOOSTER DIAGONAL STRUT RESTRAINT CABLE ASSEMBLY PART NUMBER 10176-0031-102/103

1. INTRODUCTION

This Technical Memorandum (TM) presents qualification test results for solid rocket booster (SRB) diagonal strut restraint cable assembly part no. 10176-0031-102/103. During flight, this assembly is exposed to a range of temperatures. MIL-W-83420 defines the breaking strength of the cable to be 798 kg (1,760 lb) at room temperature; however, it does not define cable strength at 669 °C (1,236 °F), the maximum temperature to which the cable is exposed during the first 2 min of flight.¹ The cable, which is able to be built from different corrosion-resistant steel alloys, may also vary in its chemical, physical, and mechanical properties at the tested temperatures.

Analysis of the cable at the tested temperature, when using the standard knockdown factors for untested requirements given in MSFC-HDBK-505, "Structural Strength Program Requirements," produced negative margins of safety.² However, MSFC-HDBK-505 also stipulates conditions where a less conservative safety factor of 1.4 and less conservative knockdown factors are appropriate if they have been verified by testing.² SRB document 90PLN-0064 provides requirements for qualification testing the strut retainer assembly.³

2. BACKGROUND

The restraint cable assembly is a steel cable with two terminal wire-rope clevis ends, pins, and cotter pins. The clevis ends and pins are picked from standard military specification hardware to interface with the external tank attachment ring and the diagonal strut assembly (figs. 1 and 2). The terminal wire-rope clevis ends are swaged onto the steel cable in accordance with MIL-T-6117.⁴

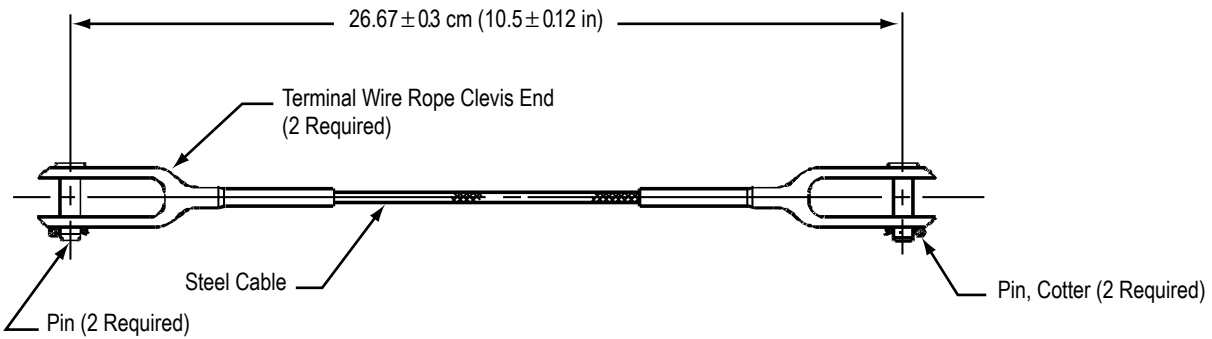


Figure 1. Strut retainer assembly.

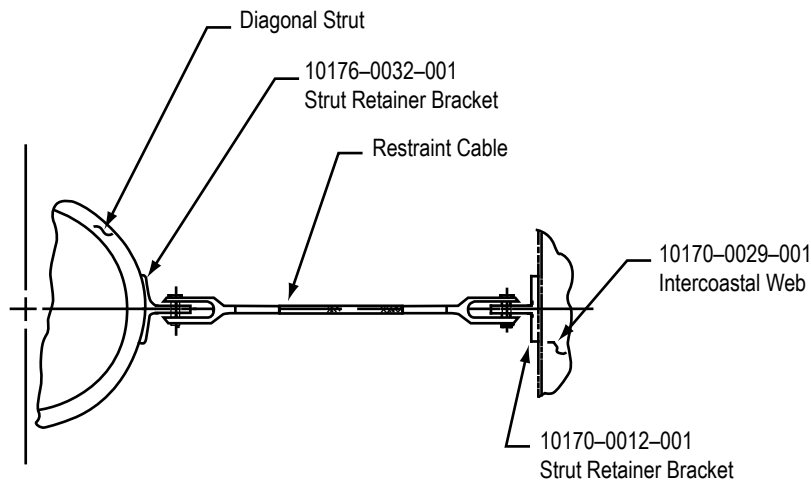


Figure 2. Strut retainer assembly installation.

This TM presents test results for three lots of MIL-W-83420, 0.317-cm (0.125- or 1/8-in) diameter, type 1 (nonjacketed) cable to loads required to restrain the diagonal strut during the first 2 min of flight and, ultimately, to failure.¹ The first lot consisted of available flight cable assemblies that existed in United Space Alliance (USA) stock. The other two lots were obtained from new procurements, with

documentation that the wire ropes are from two different wire lots or spools. Test results qualified the available restraint cable assemblies and all future buys of restraint cables manufactured under the same procurement specifications for flight.

3. TESTING AND EVALUATION

3.1 Testing

Mechanical testing was completed June 6, 2004 and was performed in accordance with ASTM-E-8 and test procedure SRB-QUAL-04-0064 for the first lot of cables.^{5,6} Five restraint cables were each pulled to failure at room temperature and at 671 ± 5 °C ($1,240 \pm 10$ °F) in accordance with the referenced procedure, 90PLN-0064, and memorandum MP41 (04-063).^{3,7} Testing was completed for the other two lots on August 6, 2004. Ten additional restraint cables were each pulled to failure at room temperature and at 677 °C (1,250 °F) in accordance with the referenced procedure and plan.³

Table 1 shows analysis of the test results, including the calculation of a knockdown factor using methods described in chapter 9 of MIL-HDBK-5.⁸

Each cable was photographed before and after testing. All tests at room temperature were video-taped, and appendix A shows still images taken from the videos.

Procedure checklists were used for each test, in accordance with SRB-QUAL-04-0064, and they are shown in appendix B of this TM.⁶

3.2 Evaluation

A value, R , was calculated for each pair of room temperature and elevated temperature tests. This value is the reduced ratio for the peak load tests at the elevated temperature, 677 °C (1,250 °F), and room temperature. Mean and standard deviations were then calculated for the R value.

Table 1. Mechanical test results.

ID	Test Temperature (°F)	Peak Load (lb)	Ratio, r
5369RT-1 (408899)	73	1776.7	–
5369RT-2 (408899)	72	1781.9	–
5369RT-3 (408899)	72	1797.7	–
5369RT-4 (408899)	72	1792.5	–
5369RT-5 (408899)	71	1779.8	–
104236RT-1	71	1900.3	–
104236RT-2	71	1863.3	–
104236RT-3	71	1899.4	–
104236RT-4	71	2008.5	–
104236RT-5	71	1981.6	–
071081RT-1	70	1956.8	–
071081RT-2	70	1954.4	–
071081RT-3	71	1891.5	–
071081RT-4	70	1925.6	–
071081RT-5	71	1939.8	–
Average	–	1883.32	–
5369ELV-6 (408899)	1,250	322.2	0.1813
5369ELV-7 (408899)	1,259	342.1	0.192
5369ELV-8 (408899)	1,258	323	0.1797
5369ELV-9 (408899)	1,254	330.3	0.1843
5369ELV-10 (408899)	1,254	337.8	0.1898
104236ELV-6	1,253	387.8	0.2041
104236ELV-7	1,259	370.6	0.1989
104236ELV-8	1,251	399.8	0.2105
104236ELV-9	1,250	392.7	0.1955
104236ELV-10	1,251	402.4	0.2031
071081ELV-6	1,251	374.7	0.1915
071081ELV-7	1,254	383.2	0.1961
071081ELV-8	1,252	388.8	0.2056
071081ELV-9	1,258	358	0.1859
071081ELV-10	1,240	361.3	0.1863
		sum =	2.9
		r-bar =	0.1936
		s =	0.0094
At 677 °C (1,250 °F), knockdown factor R =			0.1892

At the working temperature of 677 °C (1,250 °F), the lower 95-percent confidence interval estimate, or reduced ratio, of the mean percentage was determined from percentage values for each lot at that temperature. If r equals percentage values, r -bar equals the average of these values, and n equals the number of such percentages, estimated standard deviation, s , and reduced ratio, R , can be determined using the equation:

$$S^2 = \text{sum}(r - r\text{-bar})^2 / (n - 1) , \quad (1)$$

or

$$S^2 = \left[\text{sum}(r^2) - (\text{sum } r)^2 / n \right] / (n - 1) , \quad (2)$$

and

$$R = \bar{r} - ts/n^{1/2} , \quad (3)$$

where t is a 0.95 fractal of the t distribution corresponding to $n-1$ degrees of freedom. In this case, the t used was $t=1.753$ for $\alpha = 0.95$ and $n=30$.

4. CONCLUSIONS

A calculated knockdown factor of 0.1892 was determined for the restraint cables. That value will be used during structural analysis of the restraint cables in the elevated temperature condition. When combined with the minimum breaking strength of 0.317-cm (0.125- or 1/8-in) diameter, type 1 composition rope according to table 1A of MIL-W-83420, this knockdown factor provides a minimum breaking strength of 151 kg (333 lb) at 677 °C (1,250 °F).¹

APPENDIX A — PHOTOGRAPHS BEFORE AND AFTER TESTING

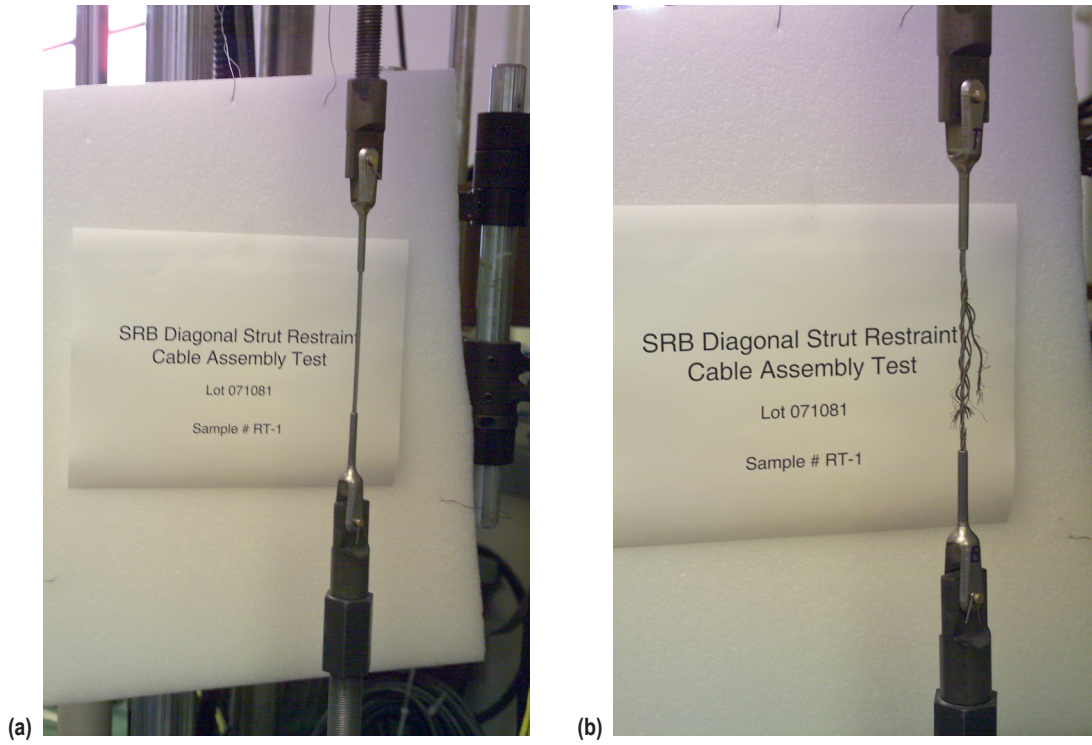


Figure 3. 071081–RT–1 (a) before testing and (b) after testing.

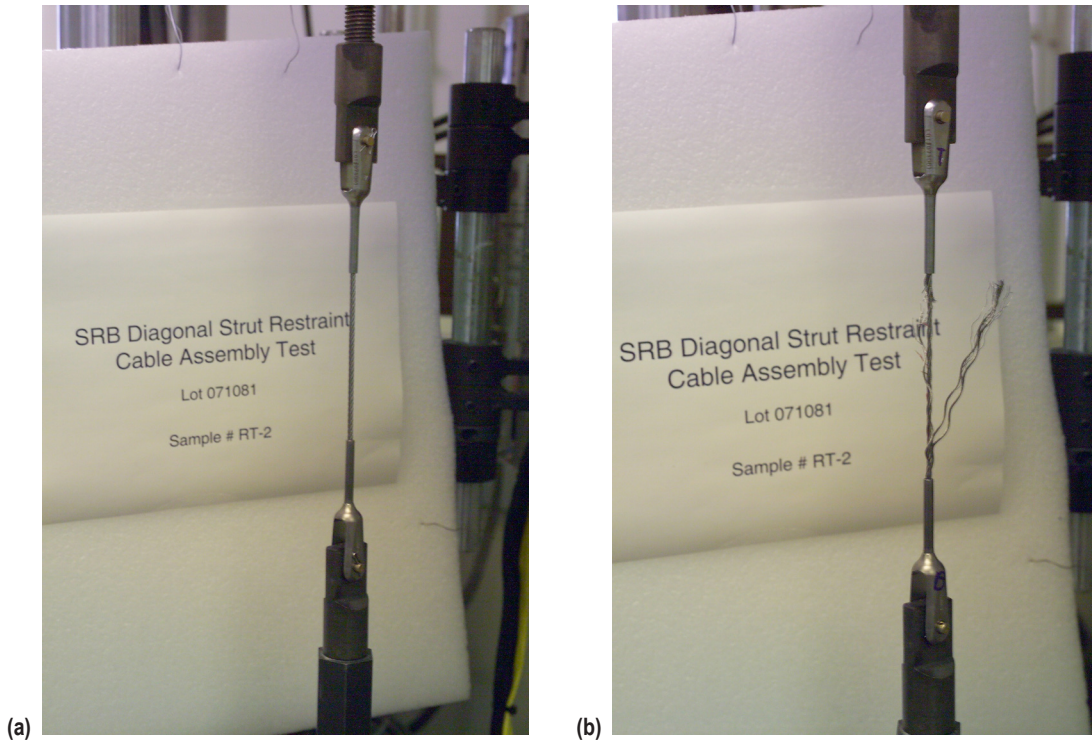


Figure 4. 071081-RT-2 (a) before testing and (b) after testing.

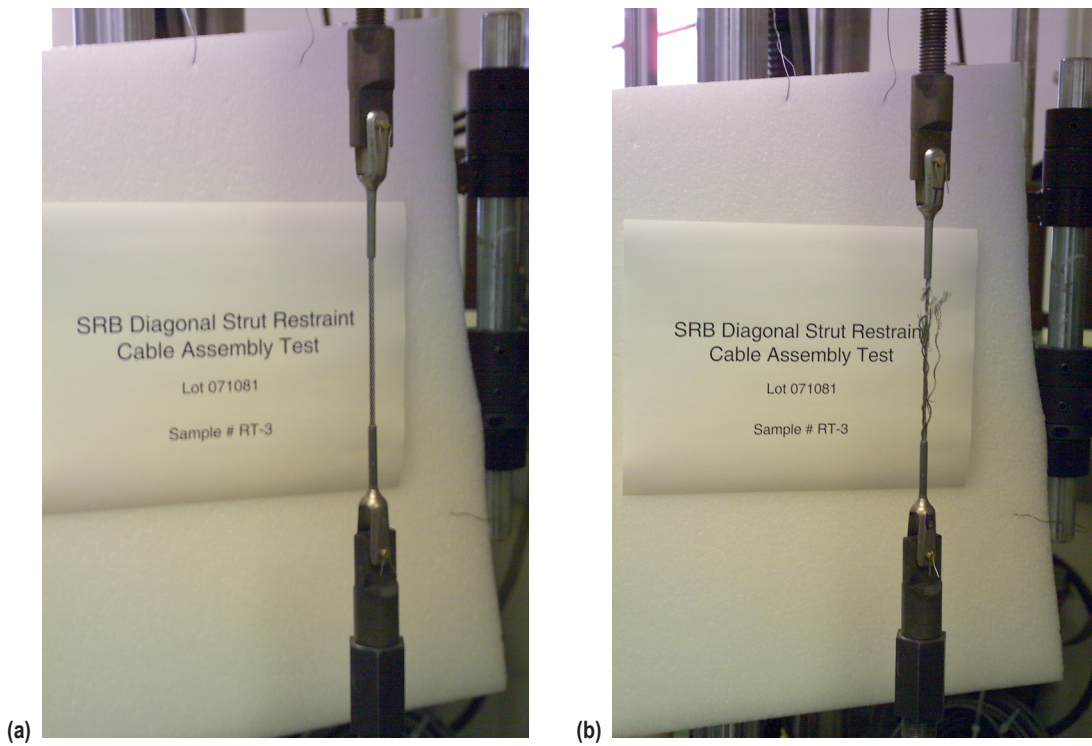


Figure 5. 071081-RT-3 (a) before testing and (b) after testing.

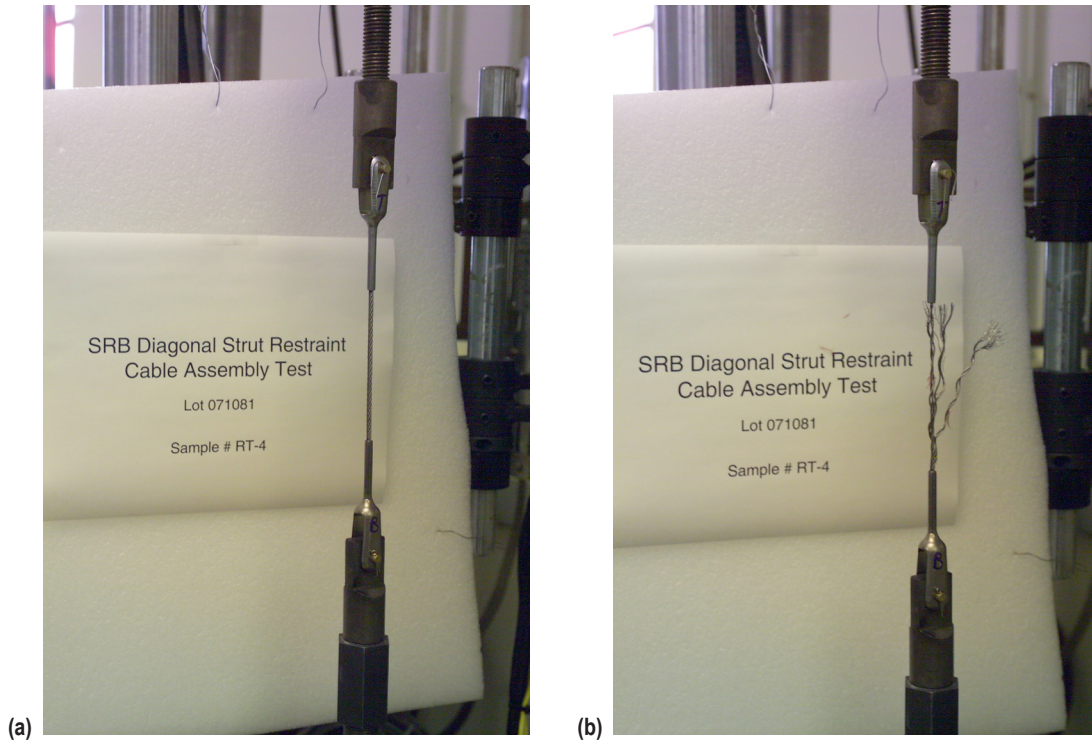


Figure 6. 071081-RT-4 (a) before testing and (b) after testing.

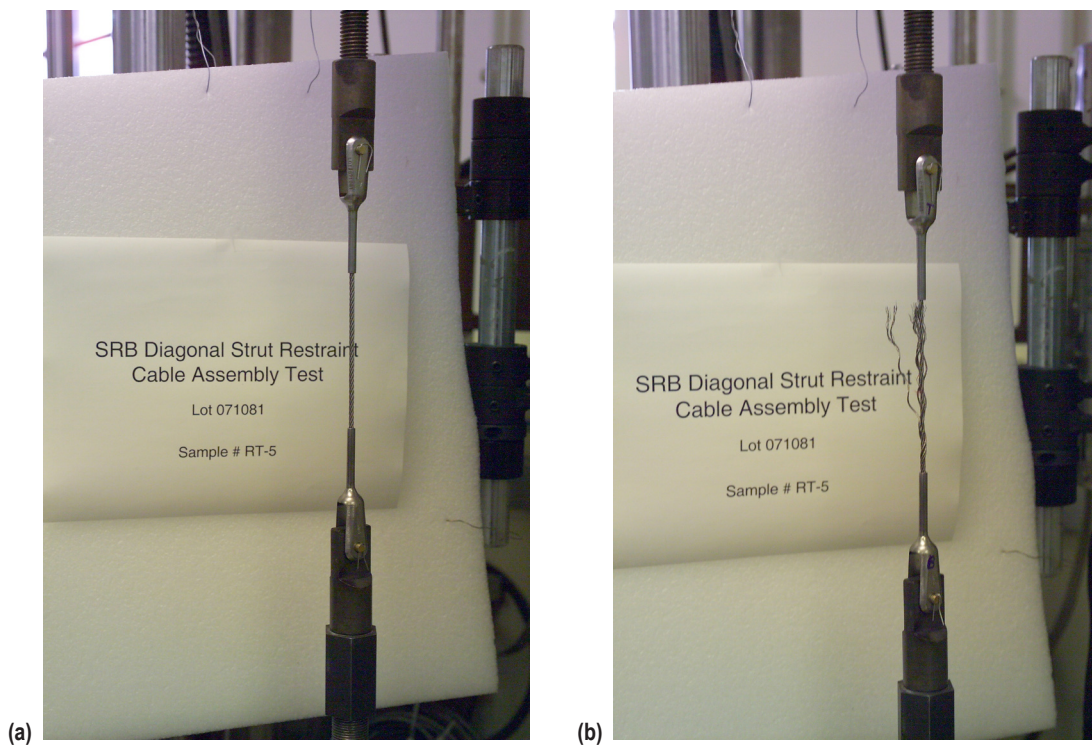


Figure 7. 071081-RT-5 (a) before testing and (b) after testing.

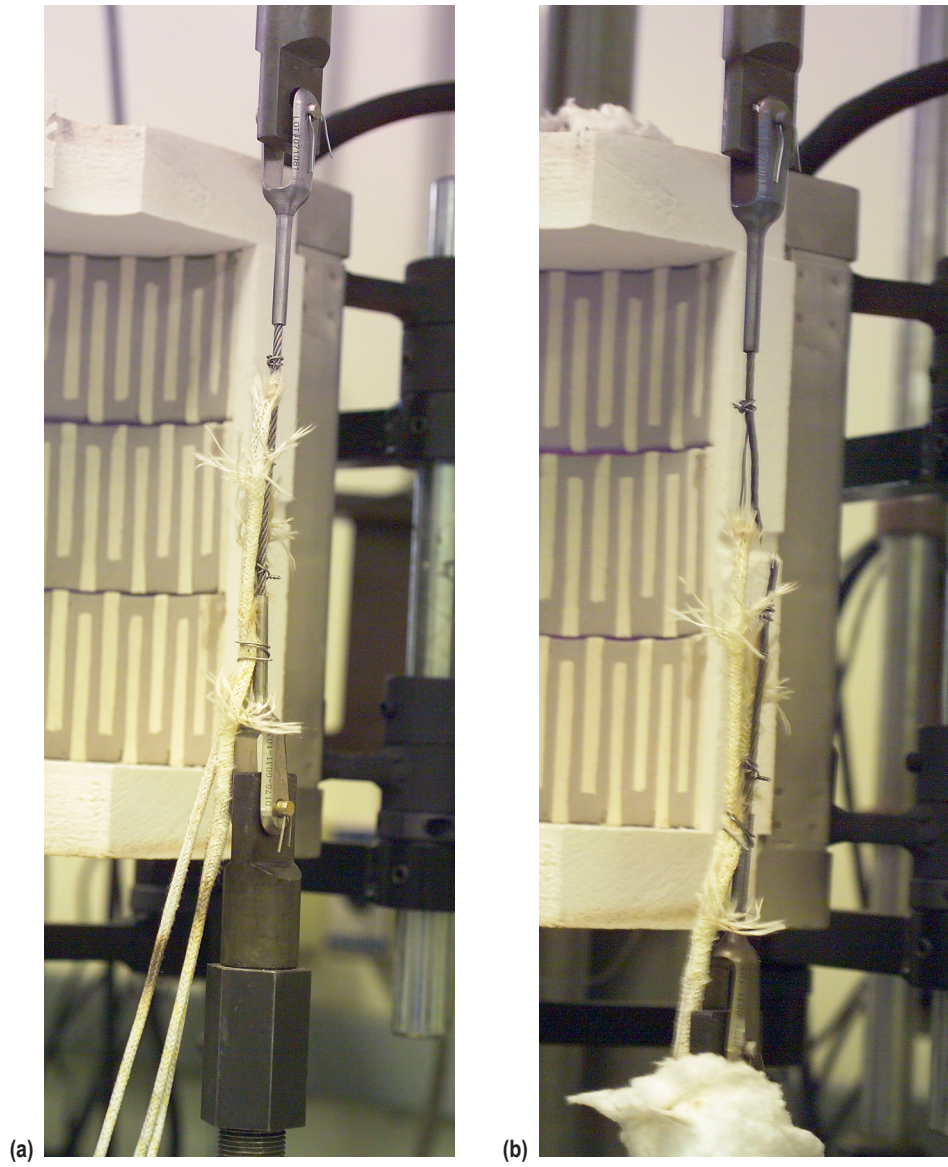


Figure 8. 071081-ELV-6 (a) before testing and (b) after testing.

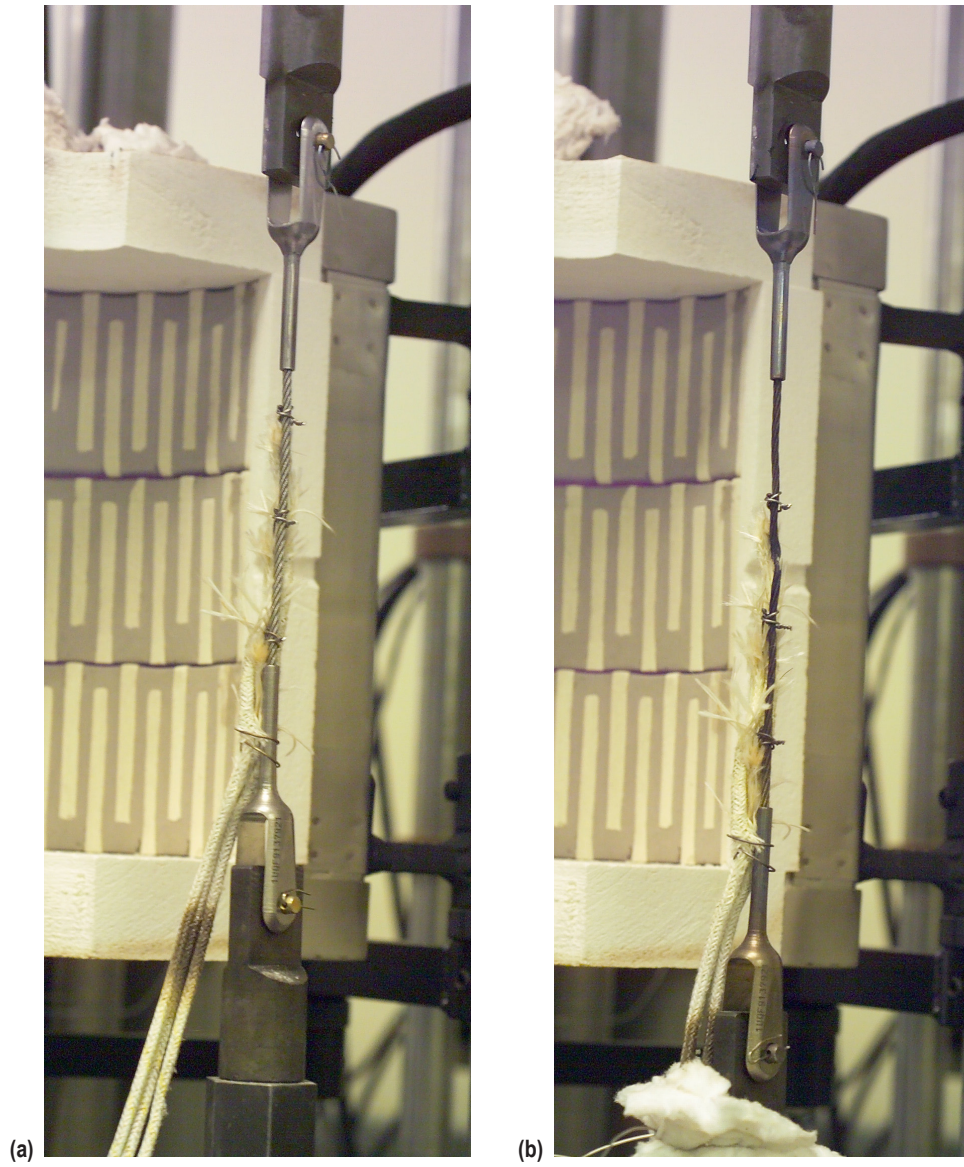


Figure 9. 071081-ELV-7 (a) before testing and (b) after testing.

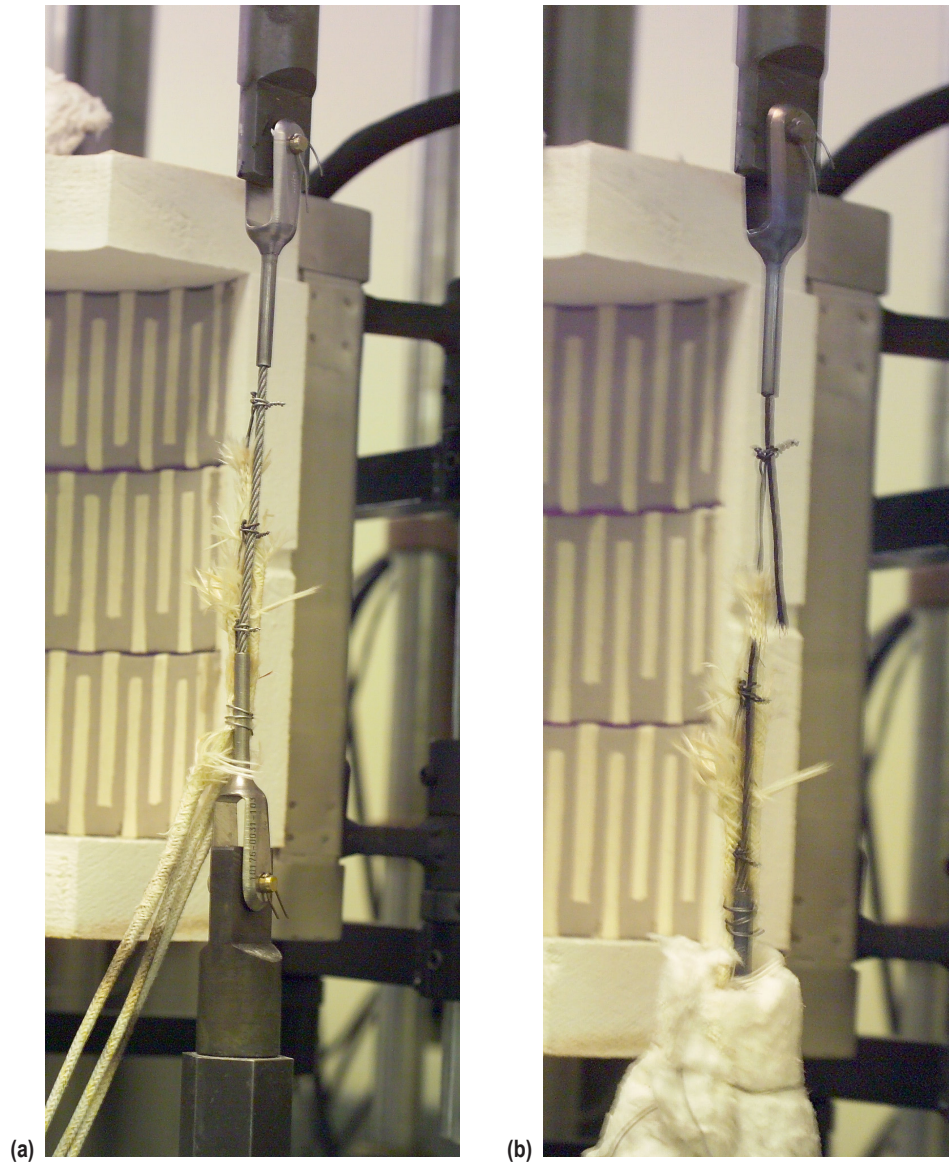


Figure 10. 071081-ELV-8 (a) before testing and (b) after testing.



Figure 11. 071081-ELV-9 (a) before testing and (b) after testing.

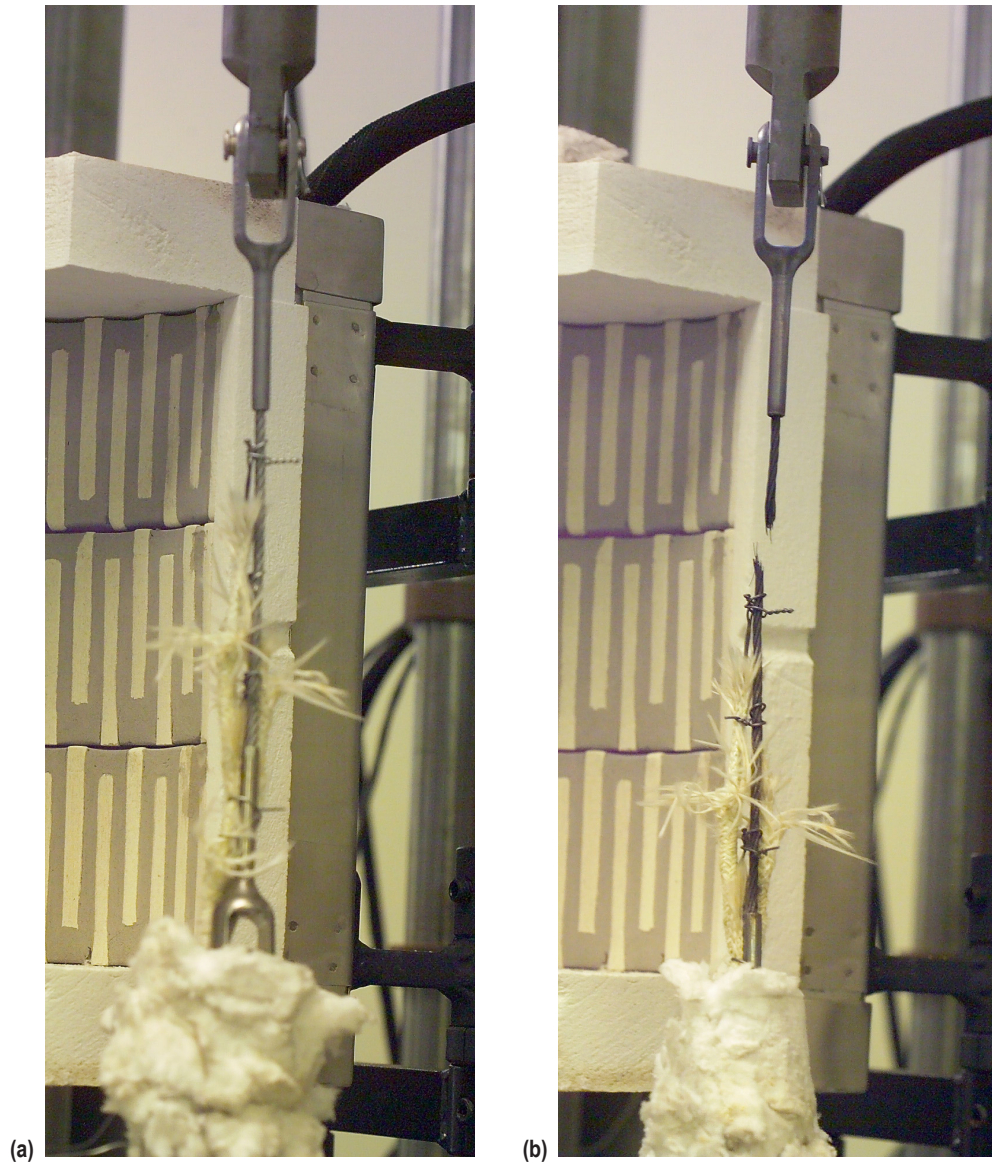


Figure 12. 071081-ELV-10 (a) before testing and (b) after testing.

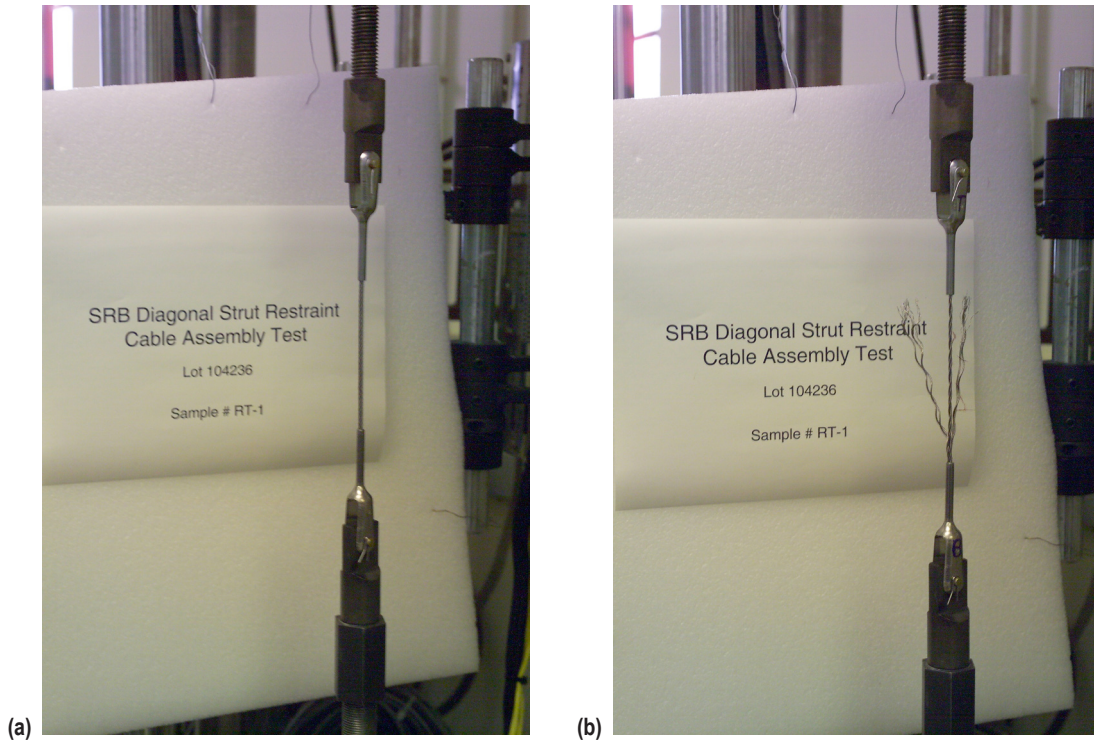


Figure 13. 104236–RT–1 (a) before testing and (b) after testing.

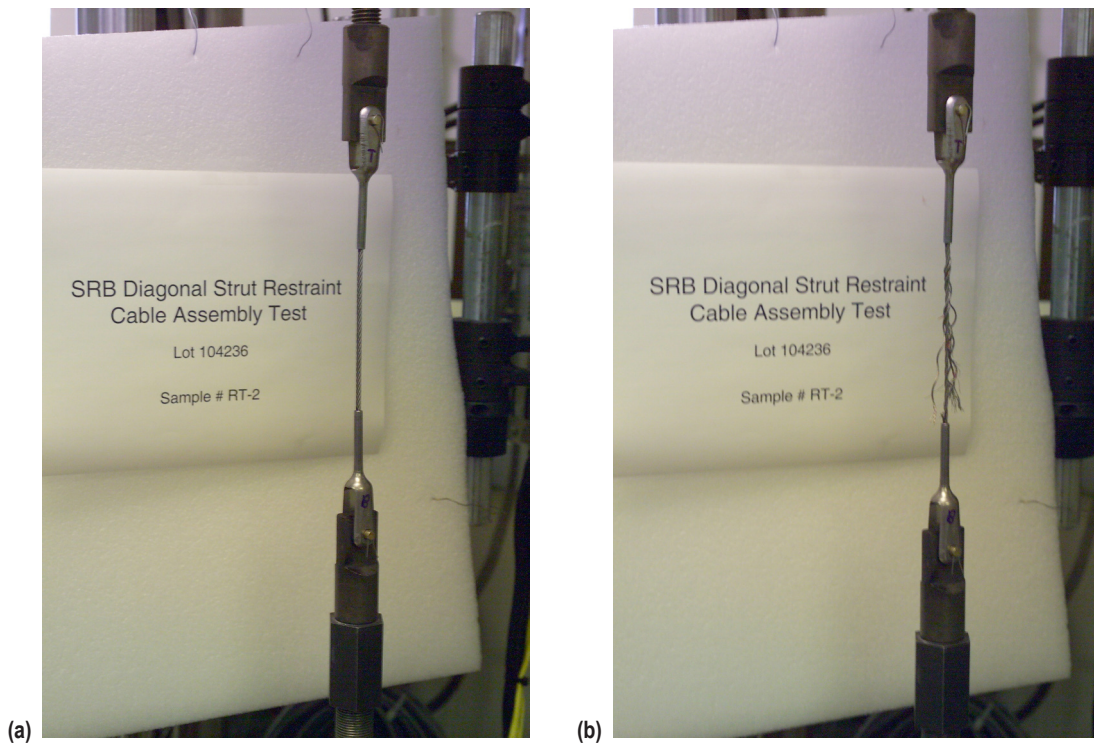


Figure 14. 104236–RT–2 (a) before testing and (b) after testing.

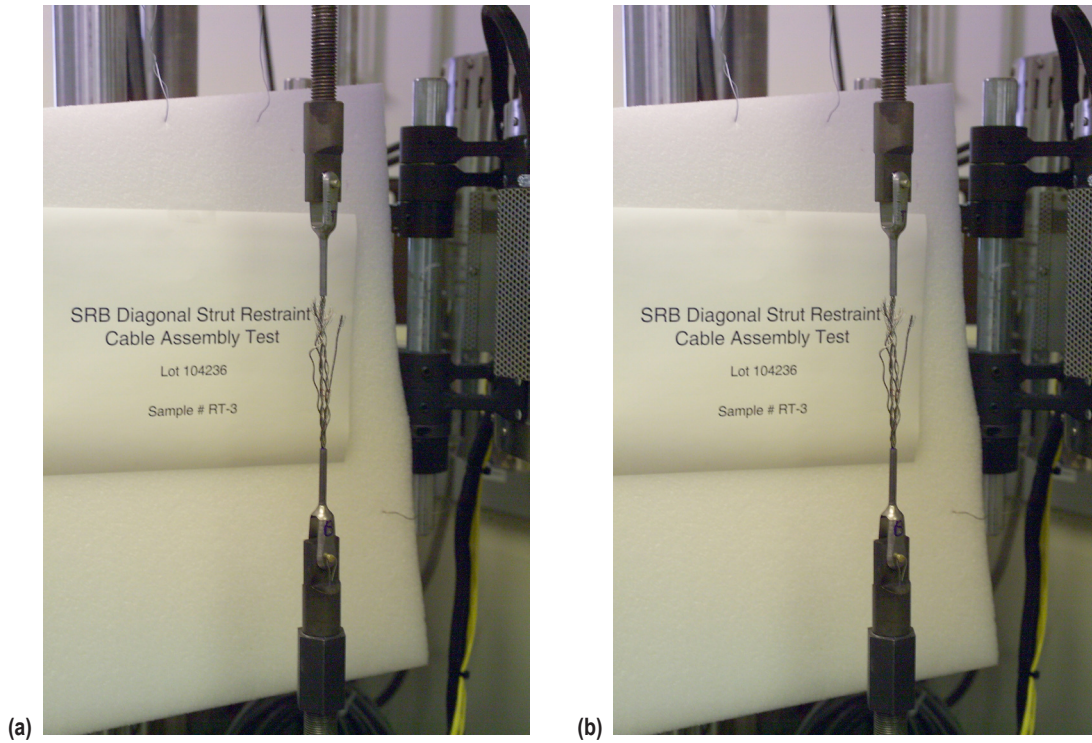


Figure 15. 104236–RT–3 (a) before testing and (b) after testing.

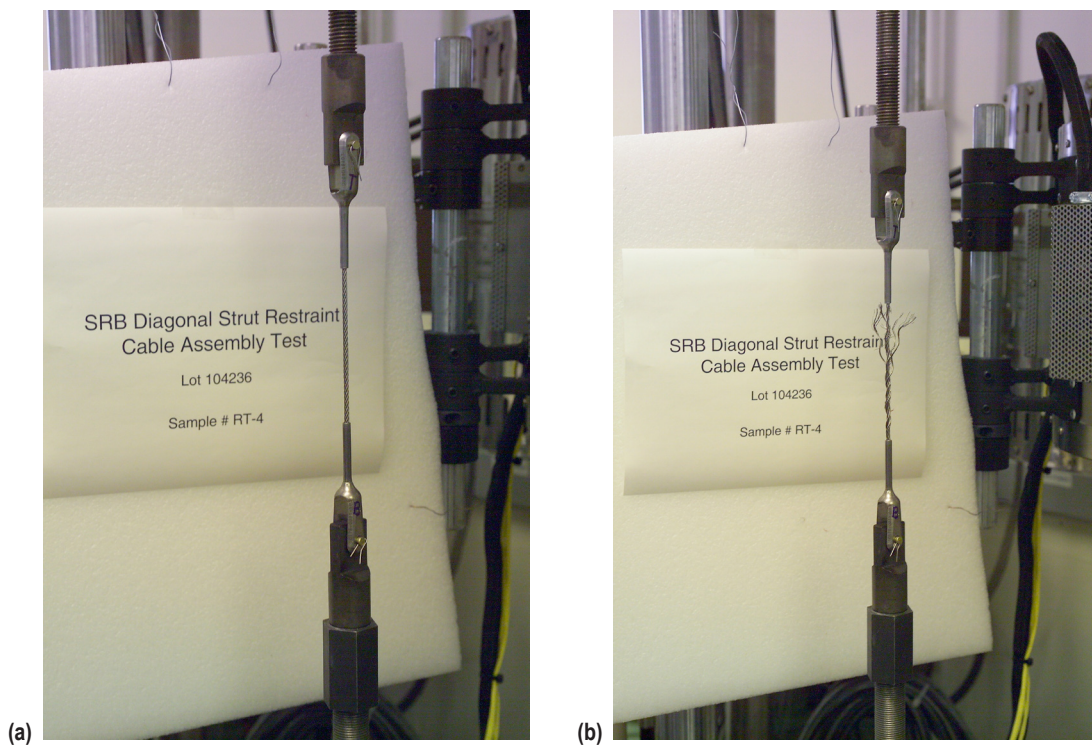


Figure 16. 104236–RT–4 (a) before testing and (b) after testing.

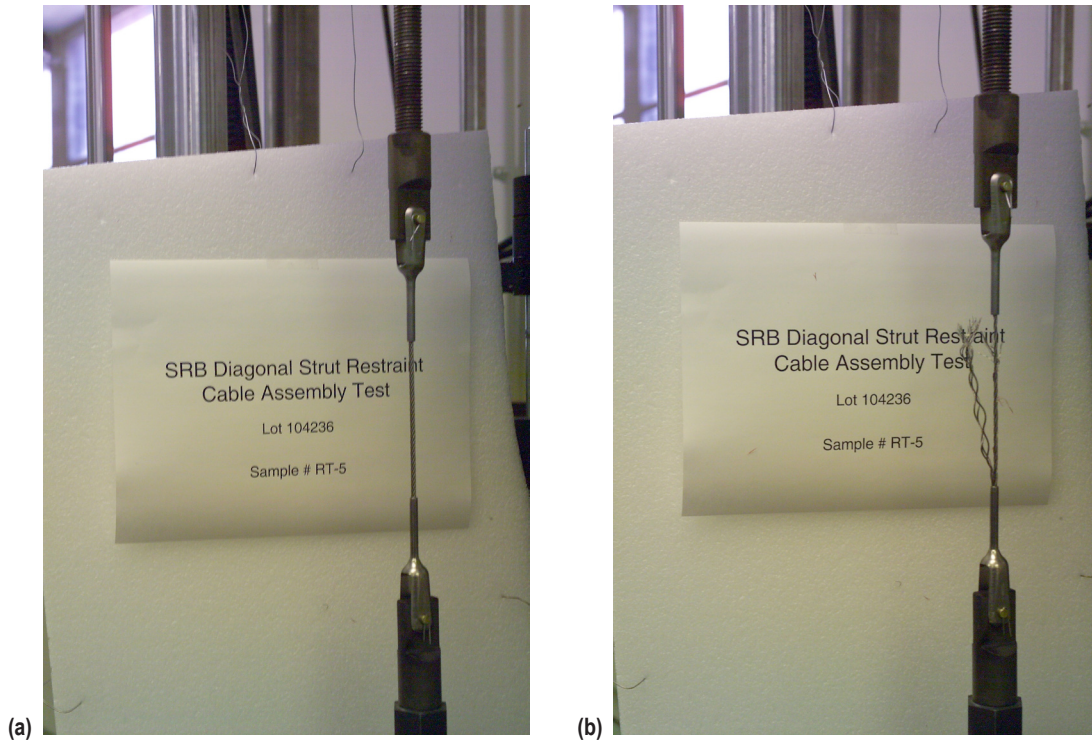


Figure 17. 104236–RT–5 (a) before testing and (b) after testing.

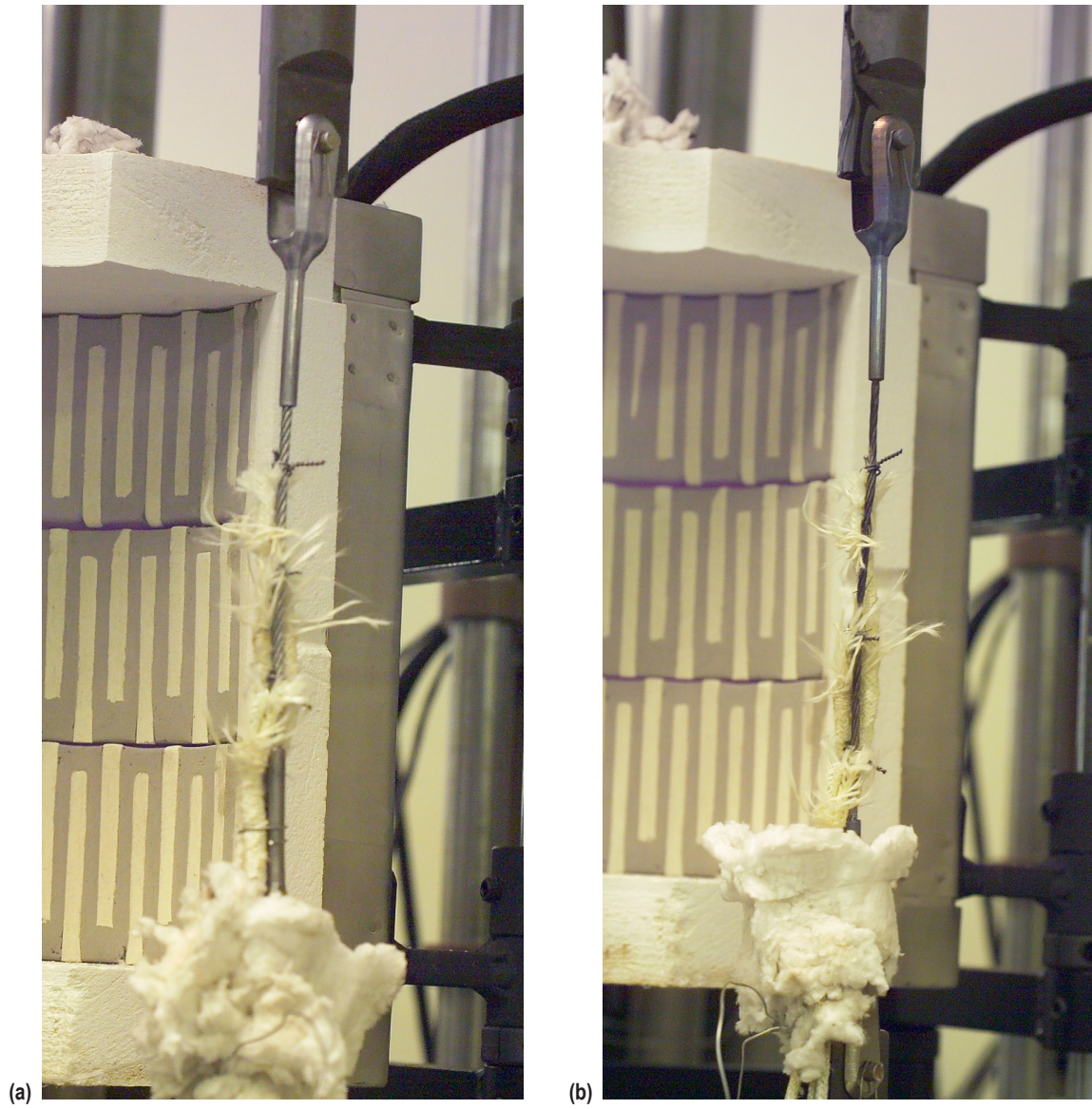


Figure 18. 104236-ELV-6 (a) before testing and (b) after testing.

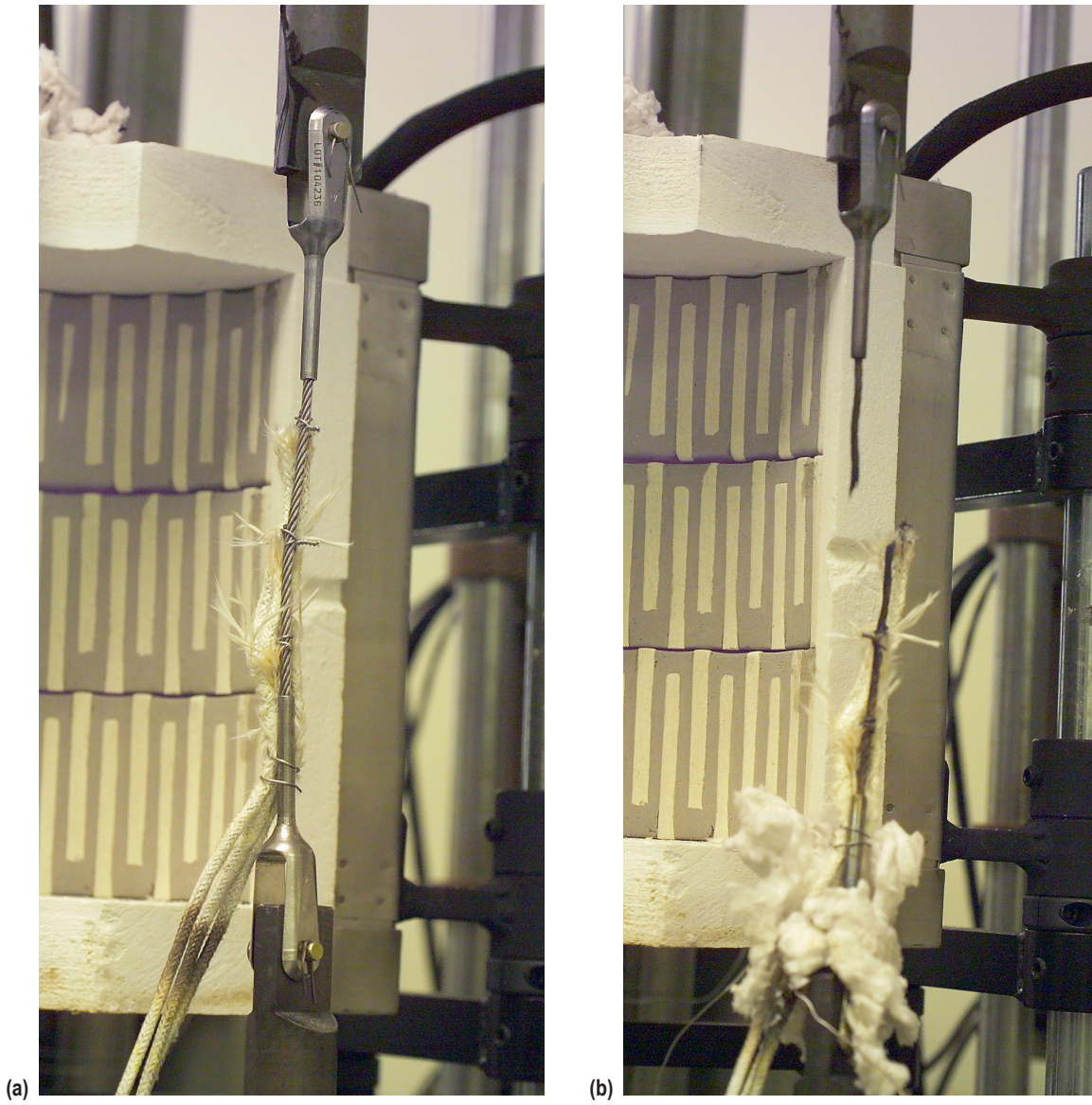


Figure 19. 104236-ELV-7 (a) before testing and (b) after testing.

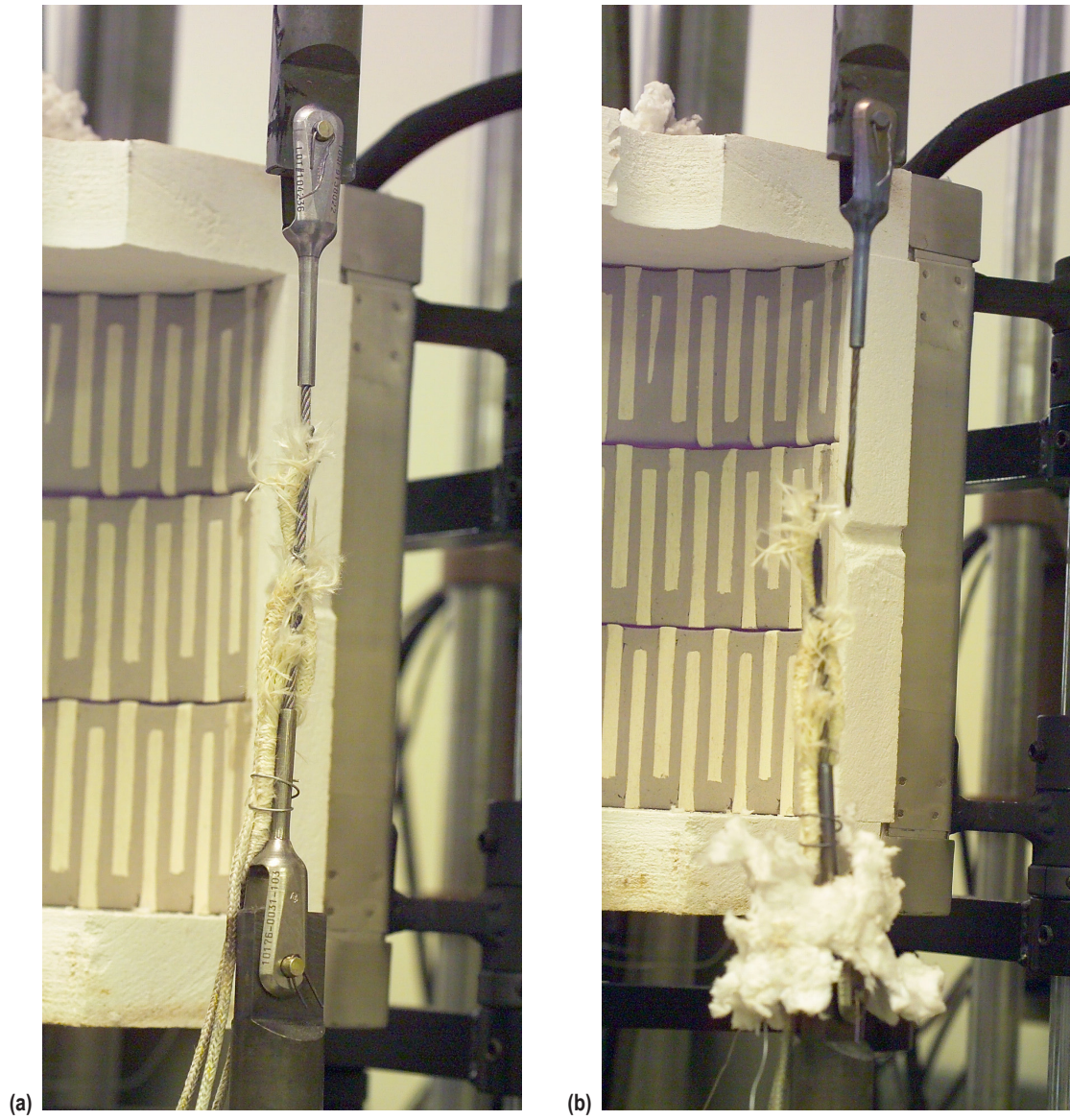


Figure 20. 104236-ELV-8 (a) before testing and (b) after testing.

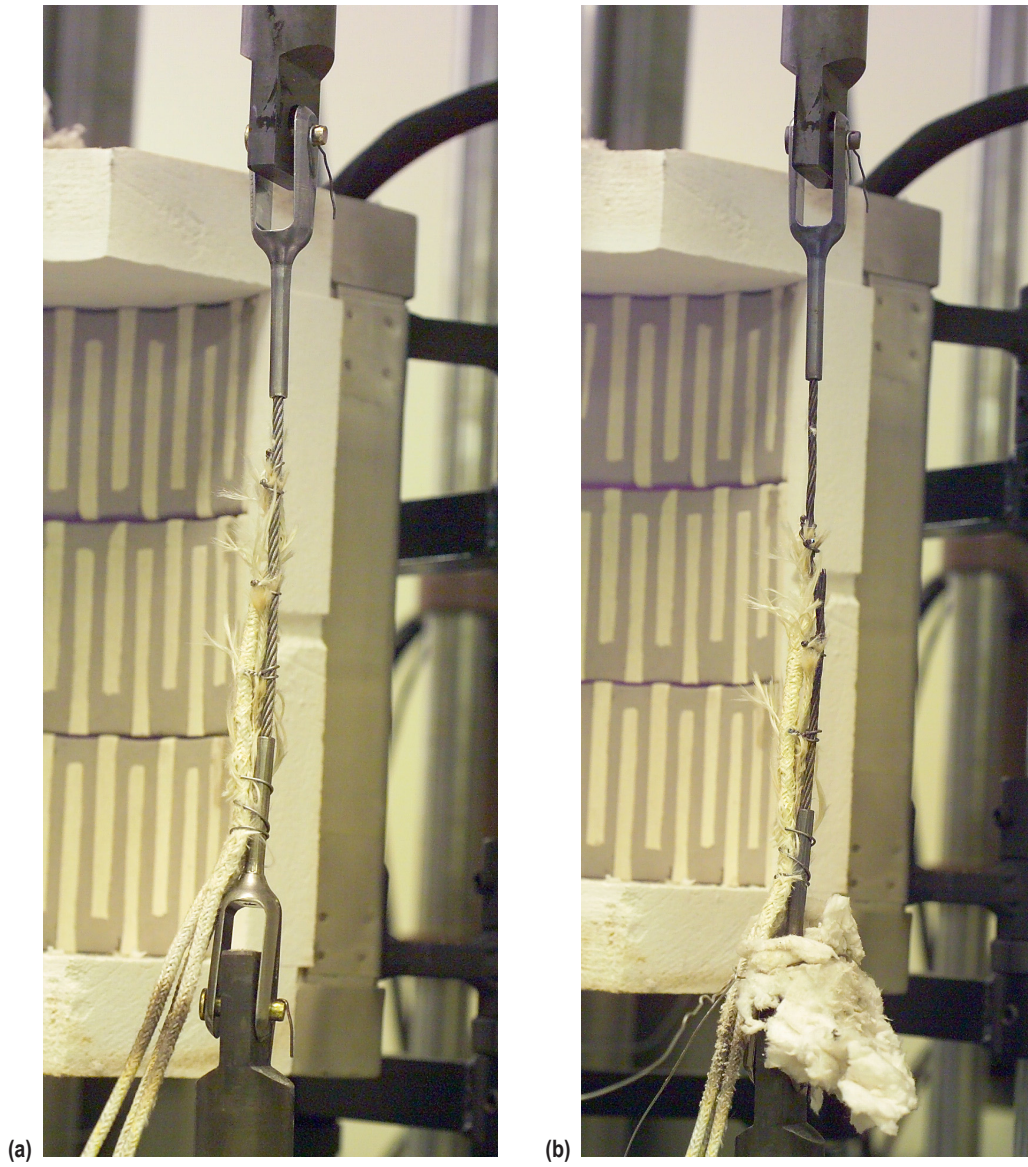


Figure 21. 104236-ELV-9 (a) before testing and (b) after testing.

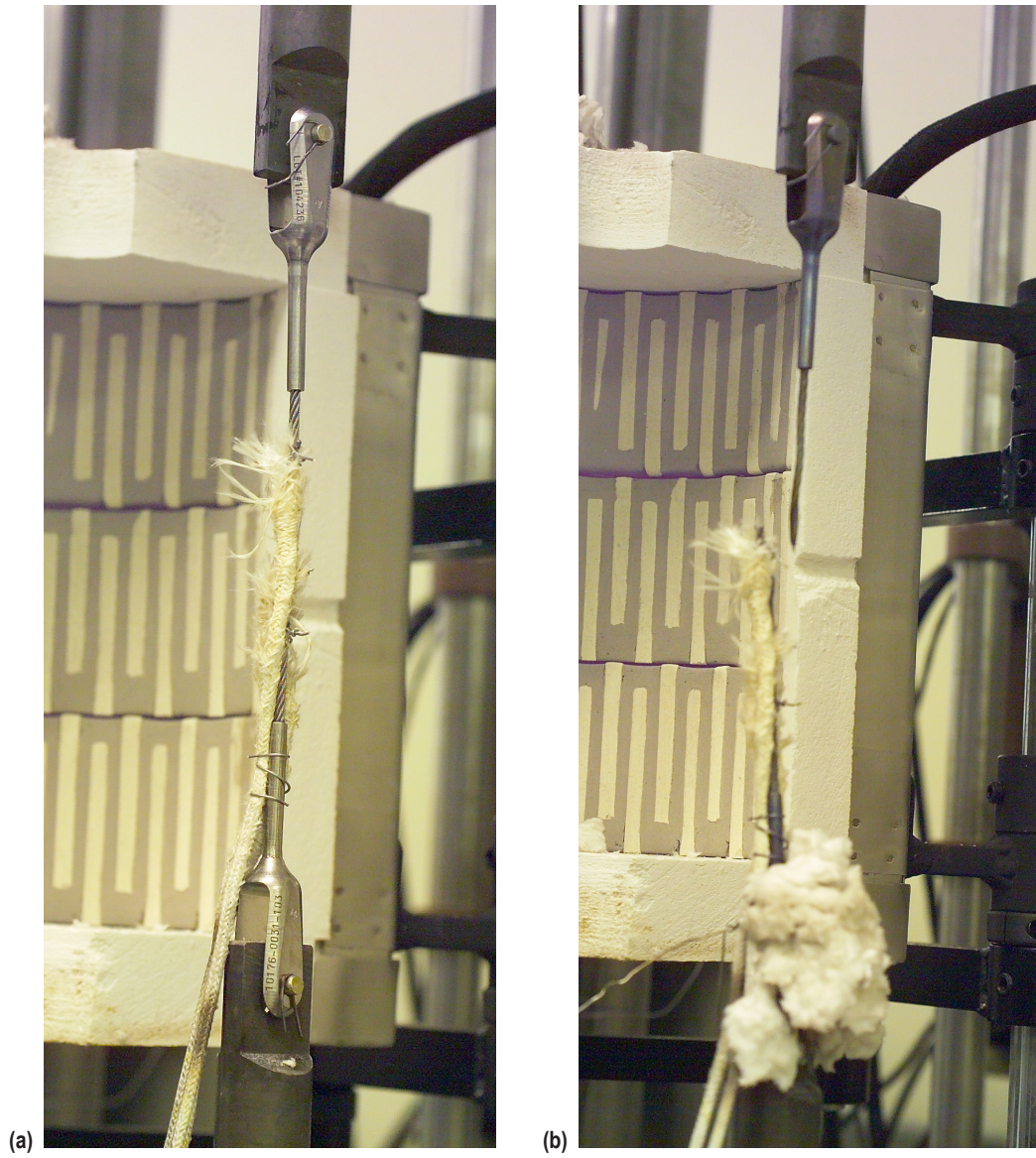


Figure 22. 104236-ELV-10 (a) before testing and (b) after testing.

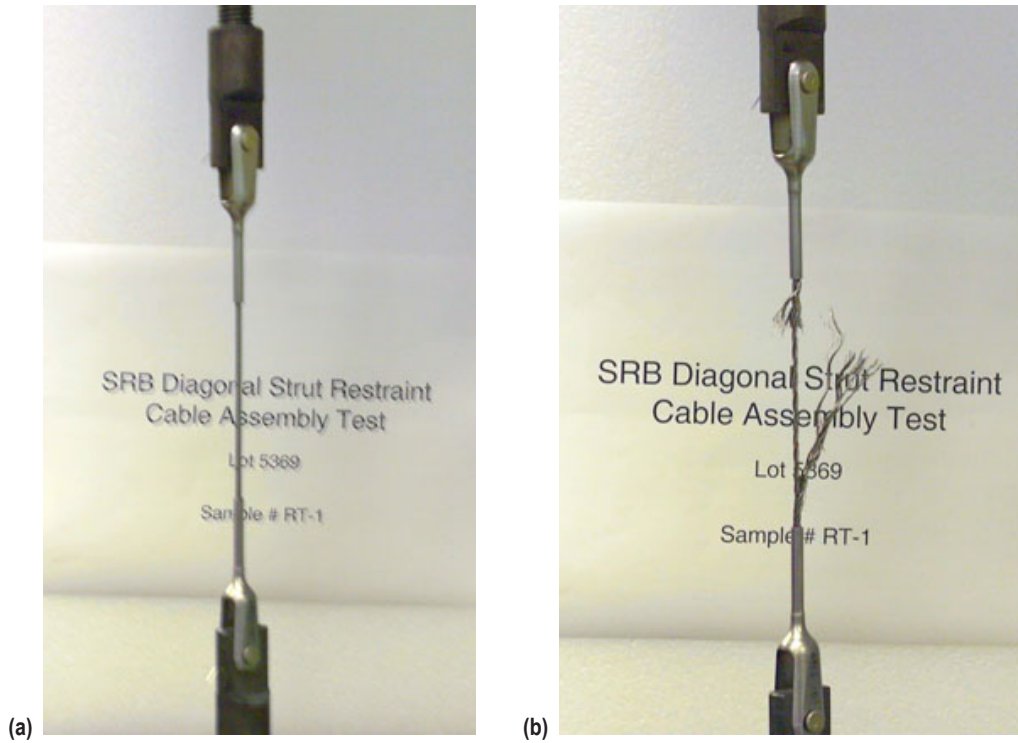


Figure 23. 5369-RT-1 (a) before testing and (b) after testing.

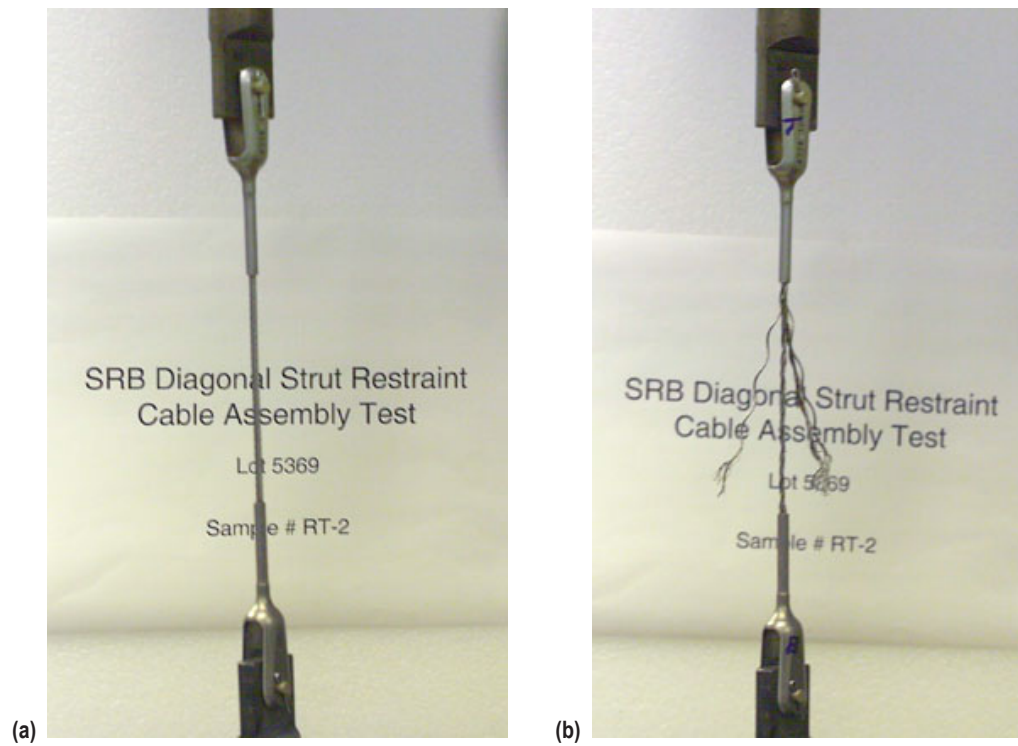


Figure 24. 5369-RT-2 (a) before testing and (b) after testing.

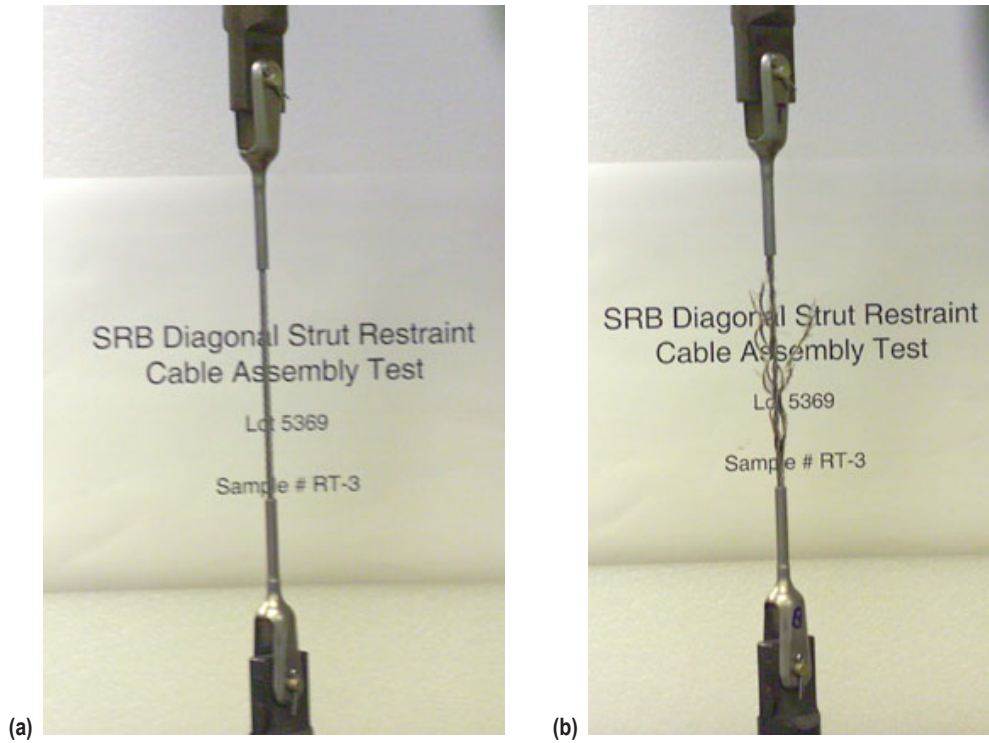


Figure 25. 5369-RT-3 (a) before testing and (b) after testing.

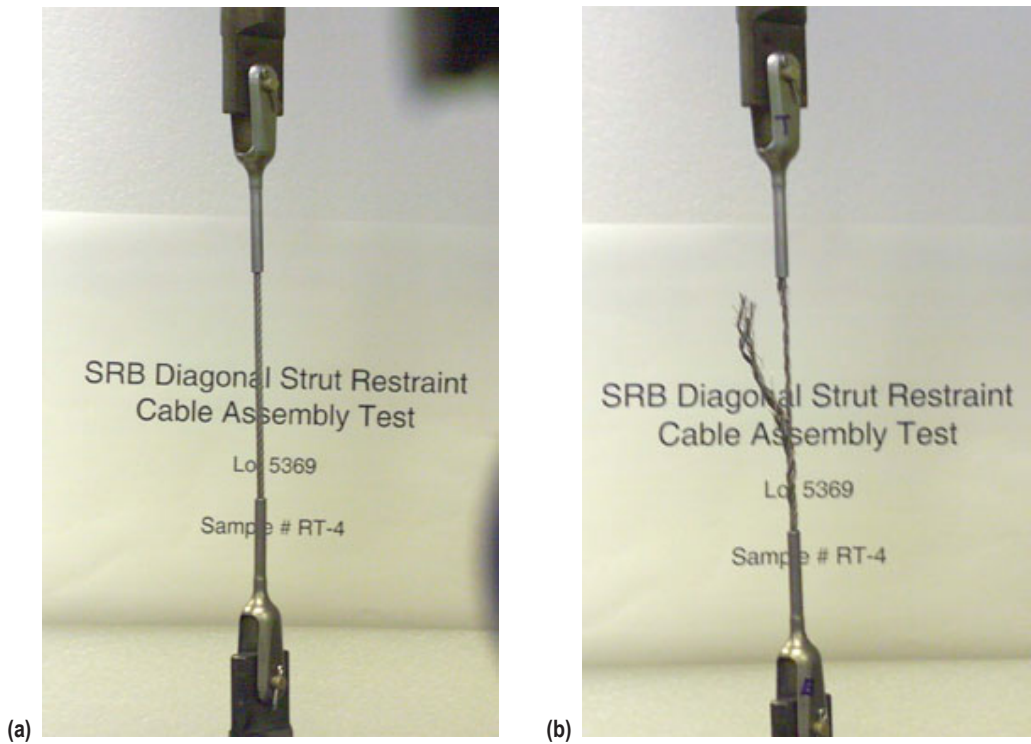


Figure 26. 5369-RT-4 (a) before testing and (b) after testing.

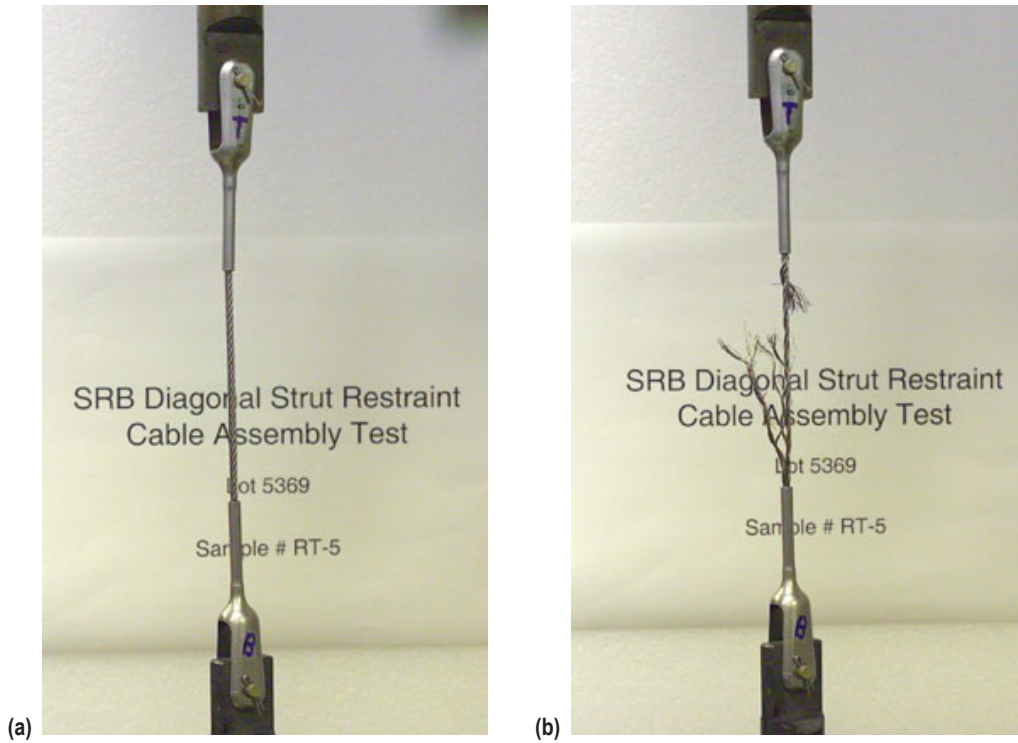


Figure 27. 5369-RT-5 (a) before testing and (b) after testing.



Figure 28. 5369-ELV-6 (a) before testing and (b) after testing.



Figure 29. 5369-ELV-7 (a) before testing and (b) after testing.



Figure 30. 5369-ELV-8 (a) before testing and (b) after testing.



Figure 31. 5369-ELV-9 (a) before testing and (b) after testing.



























Figure 32. 5369-ELV-10 (a) before testing and (b) after testing.

APPENDIX B—PROCEDURE CHECKLISTS

Attachment 1

ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly QUALIFICATION TEST	SRB-QUAL-04-0064 Date: 7/26/04	Revision: Basic Page 6 of 9

6.0 TEST OPERATION

- | | | |
|---------|---|--|
| 6.0.1 | Verify calibration is current for all calibrated test equipment in accordance with ED33-WI-012 Mechanical Testing Calibration and Verification Procedures | 

Verify PQAR ✓ |
| 6.0.2 | Note serial number or other identification for the Restraint Cable in test:
<u>Lot 5369 RT-1</u> | 

Verify PQAR ✓ |
| 6.0.3 | Mount the Restraint Cable into the fixture. | 

Verify PQAR ✓ |
| X 6.0.4 | Apply three thermocouples, one at the top, middle and bottom of the Restraint Cable. | N/A


Verify PQAR N/A ✓ |
| 6.0.5 | Photograph set-up. | 

N/A ✓ |
| X 6.0.6 | Install furnace and heat to 1250F (HT tests only). | N/A


Verify PQAR N/A ✓ |
| 6.0.7 | Begin video. | 

N/A ✓ |
| X 6.0.8 | Verify all thermocouples read 1250F +/- 10 degrees (HT tests only). | N/A


Verify PQAR N/A ✓ |
| 6.0.9 | Document temperature of test article. <u>730 F</u> | 

Witness PQAR ✓ |
| 6.0.10 | Ramp load to approximately 45 pounds at a load rate not to exceed 5 inches per minute.
<u>42.4 lbs</u> | 

Witness PQAR ✓ |
| 6.0.11 | Verify load is at approximately 45 pounds and all instrumentation is functioning. | 

Verify PQAR ✓ |
| 6.0.12 | Continue increase load until failure occurs.: | 

Witness PQAR ✓ |




ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly QUALIFICATION TEST	SRB-QUAL-04-0064	Revision: Basic
	Date: 7/26/04	Page 7 of 9

6.0.13 Verify load and instrumentation.

Verify PQAR  7-28-04 ✓

6.0.14 Stop video.


 7-28-04 ✓

6.0.15 Document load and location of failure:


Failure load 1726.7

Failure location:


N/A swage
4" - Top inches from cable end Center Line
N/A other Top Pin

Verify PQAR 

6.0.16 Photograph set-up.

 7-28-04 ✓

6.0.17 Place broken Restraint Cable debris in Ziploc bag and identify.

Verify PQAR  7-28-04 ✓



6.0.18 IF any anomaly or test failure occurs below the expected minimum values, contact the following within 24 hours:

Richard Knochelmänn (321) 867-9813 or Chris Epler (321) 867-9309

Cary Cox (321) 867-1757

Pat Roberts (321) 867-1757



















Mark Hill (256) 544-4327 or Brian Pung (256) 544-9346

  7-28-04

Attachment #2

ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064	Revision: Basic
QUALIFICATION TEST	Date: 7/26/04	Page 6 of 9

6.0 TEST OPERATION

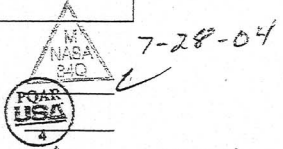
- | | | |
|------------------|---|--|
| 6.0.1 | Verify calibration is current for all calibrated test equipment in accordance with ED33-WI-012 Mechanical Testing Calibration and Verification Procedures |  7-28-04
 ✓
Verify PQAR |
| 6.0.2 | Note serial number or other identification for the Restraint Cable in test:
<u>Lot 5369 RT-2</u> |  7-28-04
 ✓
Verify PQAR |
| 6.0.3 | Mount the Restraint Cable into the fixture. |  7-28-04
 ✓
Verify PQAR |
| 6.0.4 | Apply three thermocouples, one at the top, middle and bottom of the Restraint Cable. |  7-28-04
N/A
Verify PQAR <u>N/A</u> |
| 6.0.5 | Photograph set-up. |  7-28-04 |
| 6.0.6 | Install furnace and heat to 1250F (HT tests only). |  7-28-04
N/A
Verify PQAR <u>N/A</u> |
| 6.0.7 | Begin video. |  7-28-04
 ✓ |
| 6.0.8 | Verify all thermocouples read 1250F +/- 10 degrees (HT tests only). |  7-28-04
N/A
Verify PQAR <u>N/A</u> |
| 6.0.9 | Document temperature of test article. <u>720 F</u> |  ✓
Witness PQAR |
| 6.0.10 | Ramp load to approximately 45 pounds at a load rate not to exceed 5 inches per minute. <u>41.1</u> |  7-28-04
 ✓
Witness PQAR |
| 6.0.11 | Verify load is at approximately 45 pounds and all instrumentation is functioning. |  7-28-04
 ✓
Verify PQAR |
| 6.0.12 | Continue increase load until failure occurs.: |  ✓
Witness PQAR |



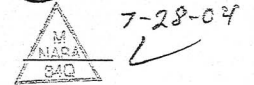
ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly QUALIFICATION TEST	SRB-QUAL-04-0064	Revision: Basic
	Date: 7/26/04	Page 7 of 9

6.0.13 Verify load and instrumentation.

Verify PQAR



6.0.14 Stop video.



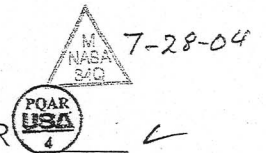
6.0.15 Document load and location of failure:

Failure load 1781.9

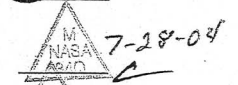
Failure location:

N/A swage
7 3/4 - 7 inches from cable end
N/A other

Verify PQAR

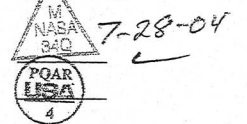


6.0.16 Photograph set-up.



6.0.17 Place broken Restraint Cable debris in Ziploc bag and identify.

Verify PQAR



6.0.18 IF any anomaly or test failure occurs below the expected minimum values, contact the following within 24 hours:

Richard Knochelmann (321) 867-9813 or Chris Epler (321) 867-9309

Cary Cox (321) 867-1757

Pat Roberts (321) 867-1757

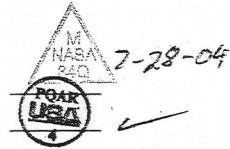


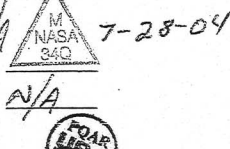
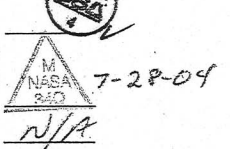
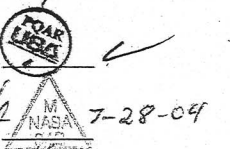
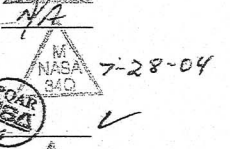

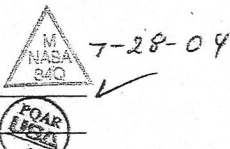
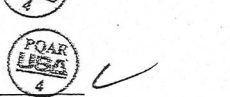

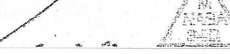
Mark Hill (256) 544-4327 or Brian Pung (256) 544-9346



Attachment #3

ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly QUALIFICATION TEST	SRB-QUAL-04-0064	Revision: Basic
	Date: 7/26/04	Page 6 of 9

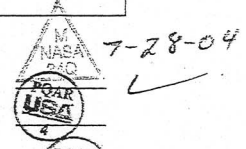
6.0 TEST OPERATION

- | | | |
|---------|---|---|
| 6.0.1 | Verify calibration is current for all calibrated test equipment in accordance with ED33-WI-012 Mechanical Testing Calibration and Verification Procedures |  |
| 6.0.2 | Note serial number or other identification for the Restraint Cable in test:
<u>Lot 5369 RT-3</u> |  |
| 6.0.3 | Mount the Restraint Cable into the fixture. |  |
| X 6.0.4 | Apply three thermocouples, one at the top, middle and bottom of the Restraint Cable. |  |
| 6.0.5 | Photograph set-up. |  |
| X 6.0.6 | Install furnace and heat to 1250F (HT tests only). |  |
| 6.0.7 | Begin video. |  |
| X 6.0.8 | Verify all thermocouples read 1250F +/- 10 degrees (HT tests only). |  |
| 6.0.9 | Document temperature of test article. <u>720°F</u> |  |
| 6.0.10 | Ramp load to approximately 45 pounds at a load rate not to exceed 5 inches per minute. <u>41.1 lbs</u> |  |
| 6.0.11 | Verify load is at approximately 45 pounds and all instrumentation is functioning. |  |
| 6.0.12 | Continue increase load until failure occurs.: |  |

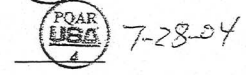
ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly QUALIFICATION TEST	SRB-QUAL-04-0064	Revision: Basic
	Date: 7/26/04	Page 7 of 9

6.0.13 Verify load and instrumentation.

Verify PQAR



6.0.14 Stop video.



6.0.15 Document load and location of failure:

Failure load 1797.7

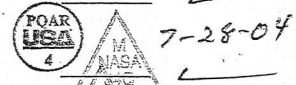
Failure location:

N/A swage
3 1/2 - T inches from cable end
N/A other

Verify PQAR

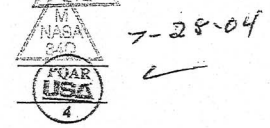


6.0.16 Photograph set-up.



6.0.17 Place broken Restraint Cable debris in Ziploc bag and identify.

Verify PQAR



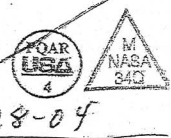
6.0.18 IF any anomaly or test failure occurs below the expected minimum values, contact the following within 24 hours:

Richard Knochelmann (321) 867-9813 or Chris Epler (321) 867-9309

Cary Cox (321) 867-1757

Pat Roberts (321) 867-1757

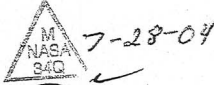

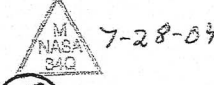

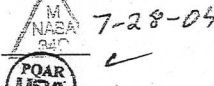




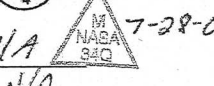
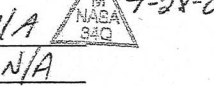






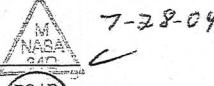
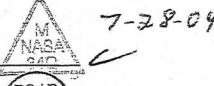

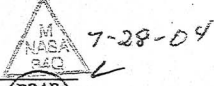



Mark Hill (256) 544-4327 or Brian Pung (256) 544-9346



Attachment 4

ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064	Revision: Basic
QUALIFICATION TEST	Date: 7/26/04	Page 6 of 9

6.0 TEST OPERATION

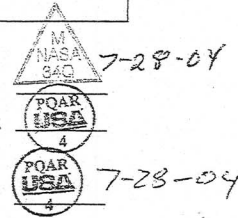
- | | | |
|---------|---|---|
| 6.0.1 | Verify calibration is current for all calibrated test equipment in accordance with ED33-WI-012 Mechanical Testing Calibration and Verification Procedures | 
 Verify PQAR |
| 6.0.2 | Note serial number or other identification for the Restraint Cable in test:
<u>Lot 5369 RT-4</u> | 
 Verify PQAR |
| 6.0.3 | Mount the Restraint Cable into the fixture. | 
 Verify PQAR |
| X 6.0.4 | Apply three thermocouples, one at the top, middle and bottom of the Restraint Cable. | 
 Verify PQAR |
| 6.0.5 | Photograph set-up. | 
 |
| X 6.0.6 | Install furnace and heat to 1250F (HT tests only). | 
 Verify PQAR |
| 6.0.7 | Begin video. | 
 |
| X 6.0.8 | Verify all thermocouples read 1250F +/- 10 degrees (HT tests only). | 
 Verify PQAR |
| 6.0.9 | Document temperature of test article. <u>720 F</u> | 
 Witness PQAR |
| 6.0.10 | Ramp load to approximately 45 pounds at a load rate not to exceed 5 inches per minute.
<u>44.2 lbs</u> | 
 Witness PQAR |
| 6.0.11 | Verify load is at approximately 45 pounds and all instrumentation is functioning. | 
 Verify PQAR |
| 6.0.12 | Continue increase load until failure occurs.: | 
 Witness PQAR |



ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly QUALIFICATION TEST	SRB-QUAL-04-0064	Revision: Basic
	Date: 7/26/04	Page 7 of 9

6.0.13 Verify load and instrumentation.

Verify PQAR



6.0.14 Stop video.

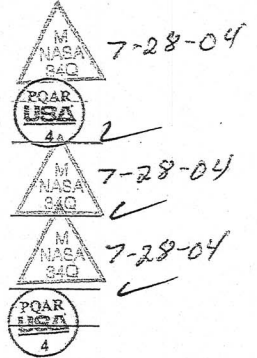
6.0.15 Document load and location of failure:

Failure load 1792.5

Failure location:

N/A swage
3/4-T inches from cable end
N/A other

Verify PQAR



6.0.16 Photograph set-up.

6.0.17 Place broken Restraint Cable debris in Ziploc bag and identify.

Verify PQAR

6.0.18 IF any anomaly or test failure occurs below the expected minimum values, contact the following within 24 hours:

Richard Knochelmann (321) 867-9813 or Chris Epler (321) 867-9309

Cary Cox (321) 867-1757

Pat Roberts (321) 867-1757







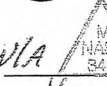
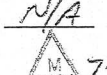

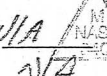
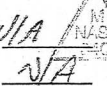


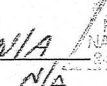
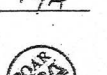




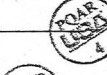

Mark Hill (256) 544-4327 or Brian Pung (256) 544-9346



Attachment #5

ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064	Revision: Basic
QUALIFICATION TEST	Date: 7/26/04	Page 6 of 9

6.0 TEST OPERATION

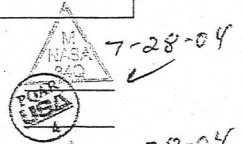
- | | | | |
|---------|---|--------------|---|
| 6.0.1 | Verify calibration is current for all calibrated test equipment in accordance with ED33-WI-012 Mechanical Testing Calibration and Verification Procedures | Verify PQAR |  7-28-04
 ✓ |
| 6.0.2 | Note serial number or other identification for the Restraint Cable in test:
<u>Lot 5369 RT-5</u> | Verify PQAR |  7-28-04
 ✓ |
| 6.0.3 | Mount the Restraint Cable into the fixture. | Verify PQAR |  7-28-04
 ✓ |
| X 6.0.4 | Apply three thermocouples, one at the top, middle and bottom of the Restraint Cable. | Verify PQAR |  7-28-04
N/A
 N/A |
| 6.0.5 | Photograph set-up. | |  7-28-04
 ✓ |
| X 6.0.6 | Install furnace and heat to 1250F (HT tests only). | Verify PQAR |  7-28-04
N/A
 N/A |
| 6.0.7 | Begin video. | |  ✓ |
| X 6.0.8 | Verify all thermocouples read 1250F +/- 10 degrees (HT tests only). | Verify PQAR |  7-28-04
N/A
 N/A |
| 6.0.9 | Document temperature of test article. <u>710 F</u> | Witness PQAR |  ✓ |
| 6.0.10 | Ramp load to approximately 45 pounds at a load rate not to exceed 5 inches per minute. <u>41.5</u> | Witness PQAR |  7-28-04
 ✓ |
| 6.0.11 | Verify load is at approximately 45 pounds and all instrumentation is functioning. | Verify PQAR |  7-28-04
 ✓ |
| 6.0.12 | Continue increase load until failure occurs.: | Witness PQAR |  ✓ |



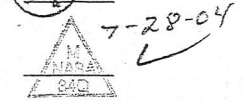
ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly QUALIFICATION TEST	SRB-QUAL-04-0064	Revision: Basic
	Date: 7/26/04	Page 7 of 9

6.0.13 Verify load and instrumentation.

Verify PQAR



6.0.14 Stop video.



6.0.15 Document load and location of failure:

Failure load 1779.8

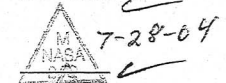
Failure location:

N/A swage
444-T inches from cable end
N/A other

Verify PQAR

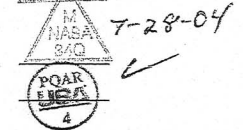


6.0.16 Photograph set-up.



6.0.17 Place broken Restraint Cable debris in Ziploc bag and identify.

Verify PQAR



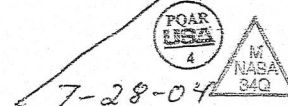
6.0.18 IF any anomaly or test failure occurs below the expected minimum values, contact the following within 24 hours:

Richard Knochemann (321) 867-9813 or Chris Epler (321) 867-9309

Cary Cox (321) 867-1757

Pat Roberts (321) 867-1757

Mark Hill (256) 544-4327 or Brian Pung (256) 544-9346



Attachment #6

ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064	Revision: Basic
QUALIFICATION TEST	Date: 7/26/04	Page 6 of 9

6.0 TEST OPERATION

6.0.1 Verify calibration is current for all calibrated test equipment in accordance with ED33-WI-012 Mechanical Testing Calibration and Verification Procedures

Verify PQAR ✓

6.0.2 Note serial number or other identification for the Restraint Cable in test:

Lot 5369 EIV-6

Verify PQAR ✓

6.0.3 Mount the Restraint Cable into the fixture.

Verify PQAR ✓

6.0.4 Apply three thermocouples, one at the top, middle and bottom of the Restraint Cable.

Verify PQAR ✓

6.0.5 Photograph set-up.

 ✓

6.0.6 Install furnace and heat to 1250F (HT tests only).

Verify PQAR ✓

~~6.0.7~~ Begin video.

N/A  7-28-04

6.0.8 Verify all thermocouples read 1250F +/- 10 degrees (HT tests only).

Verify PQAR

6.0.9 Document temperature of test article. 1258

Witness PQAR ✓

6.0.10 Ramp load to approximately 45 pounds at a load rate not to exceed 5 inches per minute. 45.1 lbs

Witness PQAR ✓

6.0.11 Verify load is at approximately 45 pounds and all instrumentation is functioning.

Verify PQAR ✓

6.0.12 Continue increase load until failure occurs.:

Witness PQAR ✓

ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly QUALIFICATION TEST	SRB-QUAL-04-0064	Revision: Basic
	Date: 7/26/04	Page 7 of 9

6.0.13 Verify load and instrumentation. * Verify PQAR

6.0.14 Stop video.

6.0.15 Document load and location of failure: *
 Failure load _____
 Failure location: 5 3/4 - T swage inches from cable end
 other _____
Verify PQAR

6.0.16 Photograph set-up.

6.0.17 Place broken Restraint Cable debris in Ziploc bag and identify.
Verify PQAR

6.0.18 IF any anomaly or test failure occurs below the expected minimum values, contact the following within 24 hours:
 Richard Knocheimann (321) 867-9813 or Chris Epler (321) 867-9309
 Cary Cox (321) 867-1757
 Pat Roberts (321) 867-1757
 Mark Hill (256) 544-4327 or Brian Pung (256) 544-9346

Changed Load Rate from 0.02 IN/min. to 0.2 IN/min.

198.8 lbs. max at 0.2 IN/min.

*302.2 lbs. Impact Load to Break Sample.
 Machine piston out of Range.*

Attachment #17

ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly QUALIFICATION TEST	SRB-QUAL-04-0064	Revision: Basic
	Date: 7/26/04	Page 6 of 9



6.0 TEST OPERATION

6.0.1 Verify calibration is current for all calibrated test equipment in accordance with ED33-WI-012 Mechanical Testing Calibration and Verification Procedures



Verify PQAR   7-28-04

6.0.2 Note serial number or other identification for the Restraint Cable in test:



Lot 5369 FIV-7

Verify PQAR   7-28-04



6.0.3 Mount the Restraint Cable into the fixture.

Verify PQAR   7-28-04

6.0.4 Apply three thermocouples, one at the top, middle and bottom of the Restraint Cable.

Verify PQAR   7-28-04

6.0.5 Photograph set-up.

  7-28-04



6.0.6 Install furnace and heat to 1250F (HT tests only).

Verify PQAR   7-28-04



X6.0.7 Begin video.

N/A



6.0.8 Verify all thermocouples read 1250F +/- 10 degrees (HT tests only).

Verify PQAR   7-28-04



6.0.9 Document temperature of test article. 1259

Witness PQAR   7-28-04



6.0.10 Ramp load to approximately 45 pounds at a load rate not to exceed 5 inches per minute. 41.5965

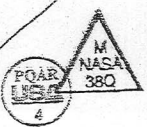
Witness PQAR   7-28-04

6.0.11 Verify load is at approximately 45 pounds and all instrumentation is functioning.

Verify PQAR   7-28-04

6.0.12 Continue increase load until failure occurs.:



Witness PQAR   7-28-04



ED33 / MECHANICAL METALLURGY AND CORROSION TEAM

SRB Diagonal Strut Restraint Cable Assembly QUALIFICATION TEST	SRB-QUAL-04-0064 Date: 7/26/04	Revision: Basic Page 7 of 9
---	-----------------------------------	--------------------------------

6.0.13 Verify load and instrumentation.

Verify PQAR   7-28-04 ✓
N/A

X 6.0.14 Stop video.



6.0.15 Document load and location of failure:

Failure load 349.1

Failure location:

N/A swage
5" - T inches from cable end
N/A other

NOTE: LOAD RATE
0.8 in/min
PER TELECON

Verify PQAR   7-28-04 ✓

6.0.16 Photograph set-up.

  7-28-04 ✓

6.0.17 Place broken Restraint Cable debris in Ziploc bag and identify.

Verify PQAR   7-28-04 ✓

6.0.18 IF any anomaly or test failure occurs below the expected minimum values, contact the following within 24 hours:

Richard Knochemann (321) 867-9813 or Chris Epler (321) 867-9309

Cary Cox (321) 867-1757

Pat Roberts (321) 867-1757

Mark Hill (256) 544-4327 or Brian Pung (256) 544-9346

  7-28-04 ✓

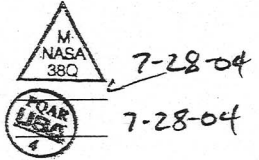
Attachment # 8

ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly QUALIFICATION TEST	SRB-QUAL-04-0064	Revision: Basic
	Date: 7/26/04	Page 6 of 9

6.0 TEST OPERATION

6.0.1 Verify calibration is current for all calibrated test equipment in accordance with ED33-WI-012 Mechanical Testing Calibration and Verification Procedures

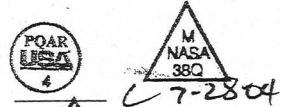
Verify PQAR



6.0.2 Note serial number or other identification for the Restraint Cable in test:

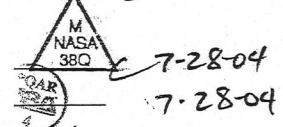
Lot 5369 EIV-8

Verify PQAR



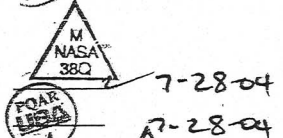
6.0.3 Mount the Restraint Cable into the fixture.

Verify PQAR



6.0.4 Apply three thermocouples, one at the top, middle and bottom of the Restraint Cable.

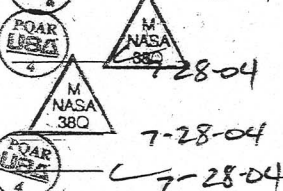
Verify PQAR



6.0.5 Photograph set-up.

6.0.6 Install furnace and heat to 1250F (HT tests only).

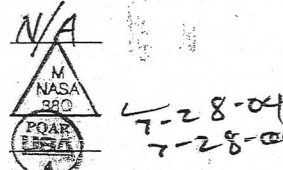
Verify PQAR



X 6.0.7 Begin video.

6.0.8 Verify all thermocouples read 1250F +/- 10 degrees (HT tests only).

Verify PQAR



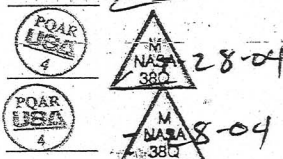
6.0.9 Document temperature of test article. 1258 °F

Witness PQAR



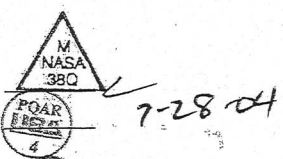
6.0.10 Ramp load to approximately 45 pounds at a load rate not to exceed 5 inches per minute. 43.1/65

Witness PQAR



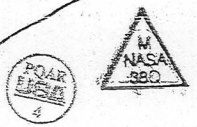
6.0.11 Verify load is at approximately 45 pounds and all instrumentation is functioning.

Verify PQAR



6.0.12 Continue increase load until failure occurs.:

Witness PQAR




ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly QUALIFICATION TEST	SRB-QUAL-04-0064	Revision: Basic
	Date: 7/26/04	Page 7 of 9

6.0.13 Verify load and instrumentation.

Verify PQAR   7-28-04

X6.0.14 Stop video.

 N/A 7-28-04

6.0.15 Document load and location of failure:

Failure load 323.0

Failure location:

N/A swage
5 3/8 - T inches from cable end
N/A other

Note: Load Rate

2.8 in/min
Per Telecon

Verify PQAR   7-28-04

6.0.16 Photograph set-up.

  7-28-04

6.0.17 Place broken Restraint Cable debris in Ziploc bag and identify.

Verify PQAR  7-28-04

6.0.18 IF any anomaly or test failure occurs below the expected minimum values, contact the following within 24 hours:

Richard Knochemann (321) 867-9813 or Chris Epler (321) 867-9309

Cary Cox (321) 867-1757

Pat Roberts (321) 867-1757

Mark Hill (256) 544-4327 or Brian Pung (256) 544-9346



7-28-04

Attachment 9

ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly QUALIFICATION TEST	SRB-QUAL-04-0064	Revision: Basic
	Date: 7/26/04	Page 6 of 9



6.0 TEST OPERATION

6.0.1 Verify calibration is current for all calibrated test equipment in accordance with ED33-WI-012 Mechanical Testing Calibration and Verification Procedures



Verify PQAR   7-28-04 ✓

6.0.2 Note serial number or other identification for the Restraint Cable in test:



Lot 5369 EIV-9

Verify PQAR   7-28-04 ✓

6.0.3 Mount the Restraint Cable into the fixture.

Verify PQAR   7-28-04 ✓


6.0.4 Apply three thermocouples, one at the top, middle and bottom of the Restraint Cable.

Verify PQAR   7-28-04 ✓

6.0.5 Photograph set-up.

  7-28-01 ✓


6.0.6 Install furnace and heat to 1250F (HT tests only).

Verify PQAR   7-28-01 ✓



X6.0.7 Begin video.

NA





6.0.8 Verify all thermocouples read 1250F +/- 10 degrees (HT tests only).

Verify PQAR   7-28-01 ✓



6.0.9 Document temperature of test article. 1254°

Witness PQAR   7-28-01 ✓


6.0.10 Ramp load to approximately 45 pounds at a load rate not to exceed 5 inches per minute. 43.8

Witness PQAR   7-28-01 ✓
  7-28-01 ✓



6.0.11 Verify load is at approximately 45 pounds and all instrumentation is functioning.

Verify PQAR   7-28-01 ✓

6.0.12 Continue increase load until failure occurs.:

Witness PQAR  7-28-01 ✓



7-28-04  

ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly QUALIFICATION TEST	SRB-QUAL-04-0064	Revision: Basic
	Date: 7/26/04	Page 7 of 9

6.0.13 Verify load and instrumentation.

Verify PQAR

M
NASA
380
7-28-01
POAR
NASA
4
N/A

X6.0.14 Stop video.

6.0.15 Document load and location of failure:

Failure load 330.3

Failure location:

N/A swage
6 1/4 - T inches from cable end
N/A other

Note: Load Rate
0.8 in/min Per Telecon

Verify PQAR

POAR
NASA
4
M
NASA
380
7-28-01
M
NASA
380
7-28-01

6.0.16 Photograph set-up.

6.0.17 Place broken Restraint Cable debris in Ziploc bag and identify.

Verify PQAR

M
NASA
380
POAR
NASA
4
7-28-01

6.0.18 IF any anomaly or test failure occurs below the expected minimum values, contact the following within 24 hours:

Richard Knochelmann (321) 867-9813 or Chris Epler (321) 867-9309

Cary Cox (321) 867-1757

Pat Roberts (321) 867-1757

























Mark Hill (256) 544-4327 or Brian Pung (256) 544-9346

POAR
NASA
4
7-28-04
M
NASA
380

Attachment 10

ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly QUALIFICATION TEST	SRB-QUAL-04-0064	Revision: Basic
	Date: 7/26/04	Page 6 of 9


6.0 TEST OPERATION

- | | | |
|---|--------------|--|
| 6.0.1 Verify calibration is current for all calibrated test equipment in accordance with ED33-WI-012 Mechanical Testing Calibration and Verification Procedures | Verify PQAR | 
 7-28-04 |
| 6.0.2 Note serial number or other identification for the Restraint Cable in test:
<u>Lot 5369 Elv-10</u> | Verify PQAR | 
 7-28-04 |
| 6.0.3 Mount the Restraint Cable into the fixture. | Verify PQAR | 
 7-28-04 |
| 6.0.4 Apply three thermocouples, one at the top, middle and bottom of the Restraint Cable. | Verify PQAR | 
 7-28-04 |
| 6.0.5 Photograph set-up. | | 
 7-28-04 |
| 6.0.6 Install furnace and heat to 1250F (HT tests only). | Verify PQAR | 
 7-28-04 |
| X6.0.7 Begin video. | | NA 7 |
| 6.0.8 Verify all thermocouples read 1250F +/- 10 degrees (HT tests only). | Verify PQAR | 
 7-28-04 |
| 6.0.9 Document temperature of test article. <u>1254</u> | Witness PQAR | 
 7-28-04 |
| 6.0.10 Ramp load to approximately 45 pounds at a load rate not to exceed 5 inches per minute. <u>43.8</u> | Witness PQAR | 
 7-28-04

 7-28-04 |
| 6.0.11 Verify load is at approximately 45 pounds and all instrumentation is functioning. | Verify PQAR | 
 7-28-04 |
| 6.0.12 Continue increase load until failure occurs.: | Witness PQAR | 
 7-28-04 |



ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly QUALIFICATION TEST	SRB-QUAL-04-0064	Revision: Basic
	Date: 7/26/04	Page 7 of 9

6.0.13 Verify load and instrumentation.

Verify PQAR  7-28-04 ✓

X6.0.14 Stop video.

NA



6.0.15 Document load and location of failure:

Failure load 337.8

Failure location:



5 3/4 - T swage
inches from cable end
other

Note: Load Rate
0.8 in/min per Telecom

Verify PQAR  7-28-04
 7-28-04

6.0.16 Photograph set-up.

6.0.17 Place broken Restraint Cable debris in Ziploc bag and identify.

Verify PQAR  7-28-04
 7-28-04



6.0.18 IF any anomaly or test failure occurs below the expected minimum values, contact the following within 24 hours:

Richard Knochemann (321) 867-9813 or Chris Epler (321) 867-9309

Cary Cox (321) 867-1757

Pat Roberts (321) 867-1757














Mark Hill (256) 544-4327 or Brian Pung (256) 544-9346

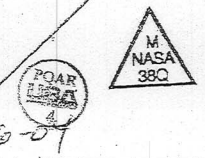
 7-28-04


Attachment #1

ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly QUALIFICATION TEST	SRB-QUAL-04-0064	Revision: Basic
	Date: 7/26/04	Page 6 of 9

6.0 TEST OPERATION

- | | | | | |
|--------|---|--------------|--|--------|
| 6.0.1 | Verify calibration is current for all calibrated test equipment in accordance with ED33-WI-012 Mechanical Testing Calibration and Verification Procedures | Verify PQAR | 
 | 8-6-04 |
| 6.0.2 | Note serial number or other identification for the Restraint Cable in test:
<u>Lot 071081 RT-1</u> | Verify PQAR |  | 8-6-04 |
| 6.0.3 | Mount the Restraint Cable into the fixture. | Verify PQAR | 
 | 8-6-04 |
| *6.0.4 | Apply three thermocouples, one at the top, middle and bottom of the Restraint Cable. | Verify PQAR | N/A | |
| 6.0.5 | Photograph set-up. | |  | 8-6-04 |
| *6.0.6 | Install furnace and heat to 1250F (HT tests only). | Verify PQAR | N/A | |
| 6.0.7 | Begin video. | |  | 8-6-04 |
| *6.0.8 | Verify all thermocouples read 1250F +/- 10 degrees (HT tests only). | Verify PQAR | N/A | |
| 6.0.9 | Document temperature of test article. <u>70°F</u> | Witness PQAR |  | 8-6-04 |
| 6.0.10 | Ramp load to approximately 45 pounds at a load rate not to exceed 5 inches per minute. | Witness PQAR | 
 | 8-6-04 |
| 6.0.11 | Verify load is at approximately 45 pounds and all instrumentation is functioning.
<u>46 lbs</u> | Verify PQAR | 
 | 8-6-04 |
| 6.0.12 | Continue increase load until failure occurs.: | Witness PQAR |  | 8-6-04 |



ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly QUALIFICATION TEST	SRB-QUAL-04-0064 Date: 7/26/04	Revision: Basic Page 7 of 9

6.0.13 Verify load and instrumentation.

Verify PQAR



8-6-04

6.0.14 Stop video.



8-6-04

6.0.15 Document load and location of failure:

Failure load 1956.8

Failure location:

2/A swage
7/8" - T inches from cable end
2/A other

Verify PQAR



8-6-04

6.0.16 Photograph set-up.



✓

6.0.17 Place broken Restraint Cable debris in Ziploc bag and identify.

Verify PQAR



8-6-04

6.0.18 IF any anomaly or test failure occurs below the expected minimum values, contact the following within 24 hours:
Richard Knochemann (321) 867-9813 or Chris Epler (321) 867-9309
Cary Cox (321) 867-1757
Pat Roberts (321) 867-1757
Mark Hill (256) 544-4327 or Brian Pung (256) 544-9346






















8-6-04

Attachment #2

ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064	Revision: Basic
QUALIFICATION TEST	Date: 7/26/04	Page 6 of 9

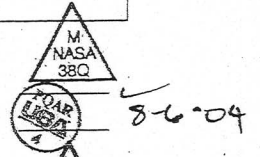
6.0 TEST OPERATION

- | | | | | |
|--------|---|-----------|--|-----------------|
| 6.0.1 | Verify calibration is current for all calibrated test equipment in accordance with ED33-WI-012 Mechanical Testing Calibration and Verification Procedures | | 
 | 8-6-04 ✓ |
| 6.0.2 | Note serial number or other identification for the Restraint Cable in test:
<u>Lot 071081 RT-2</u> | |  | 8-6-04 ✓ |
| 6.0.3 | Mount the Restraint Cable into the fixture. | | 
 | 8-6-04 ✓ |
| *6.0.4 | Apply three thermocouples, one at the top, middle and bottom of the Restraint Cable. | 8-6-04 SP | 
 | N/A
8-6-04 ✓ |
| 6.0.5 | Photograph set-up. | |  | 8-6-04 ✓ |
| *6.0.6 | Install furnace and heat to 1250F (HT tests only). | | 
 | N/A
8-6-04 ✓ |
| 6.0.7 | Begin video. | |  | 8-6-04 ✓ |
| *6.0.8 | Verify all thermocouples read 1250F +/- 10 degrees (HT tests only): | | 
 | N/A
8-6-04 ✓ |
| 6.0.9 | Document temperature of test article. <u>70% F</u> | |  | 8-6-04 ✓ |
| 6.0.10 | Ramp load to approximately 45 pounds at a load rate not to exceed 5 inches per minute. | | 
 | 8-6-04 ✓ |
| 6.0.11 | Verify load is at approximately 45 pounds and all instrumentation is functioning.
<u>47.6</u> | | 
 | 8-6-04 ✓ |
| 6.0.12 | Continue increase load until failure occurs.: | |  | 8-6-04 ✓ |

ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly QUALIFICATION TEST	SRB-QUAL-04-0064	Revision: Basic
	Date: 7/26/04	Page 7 of 9

6.0.13 Verify load and instrumentation.

Verify PQAR



6.0.14 Stop video.

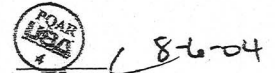
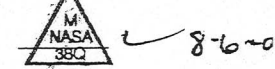
6.0.15 Document load and location of failure:

Failure load 1954.4

Failure location:

N/A swage
3 3/4" - T inches from cable end
N/A other

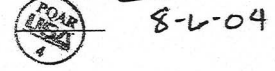
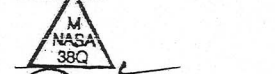
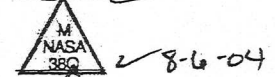
Verify PQAR



6.0.16 Photograph set-up.

6.0.17 Place broken Restraint Cable debris in Ziploc bag and identify.

Verify PQAR



6.0.18 IF any anomaly or test failure occurs below the expected minimum values, contact the following within 24 hours:

Richard Knochelmann (321) 867-9813 or Chris Epler (321) 867-9309

Cary Cox (321) 867-1757

Pat Roberts (321) 867-1757

Mark Hill (256) 544-4327 or Brian Pung (256) 544-9346
















8-6-04

ATTACHMENT # 3

ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly QUALIFICATION TEST	SRB-QUAL-04-0064	Revision: Basic
	Date: 7/26/04	Page 6 of 9

6.0 TEST OPERATION

- | | | | | |
|--------|---|--------------|--|--------|
| 6.0.1 | Verify calibration is current for all calibrated test equipment in accordance with ED33-WI-012 Mechanical Testing Calibration and Verification Procedures | Verify PQAR | 
 | 8-6-04 |
| 6.0.2 | Note serial number or other identification for the Restraint Cable in test:
<u>LOT 071081 RT-3</u> | Verify PQAR |  | 8-6-04 |
| 6.0.3 | Mount the Restraint Cable into the fixture. | Verify PQAR | 
 | 8-6-04 |
| *6.0.4 | Apply three thermocouples, one at the top, middle and bottom of the Restraint Cable. | Verify PQAR | N/A
N/A | 8-6-04 |
| 6.0.5 | Photograph set-up. | |  | 8-6-04 |
| *6.0.6 | Install furnace and heat to 1250F (HT tests only). | Verify PQAR | N/A
N/A | 8-6-04 |
| 6.0.7 | Begin video. | |  | 8-6-04 |
| *6.0.8 | Verify all thermocouples read 1250F +/- 10 degrees (HT tests only). | Verify PQAR | N/A
N/A | 8-6-04 |
| 6.0.9 | Document temperature of test article. <u>710F</u> | Witness PQAR |  | 8-6-04 |
| 6.0.10 | Ramp load to approximately 45 pounds at a load rate not to exceed 5 inches per minute. | Witness PQAR | 
 | 8-6-04 |
| 6.0.11 | Verify load is at approximately 45 pounds and all instrumentation is functioning.
<u>47.6 lbs</u> | Verify PQAR | 
 | 8-6-04 |
| 6.0.12 | Continue increase load until failure occurs.: | Witness PQAR |  | 8-6-04 |

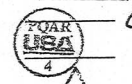


8-6-04

ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly QUALIFICATION TEST	SRB-QUAL-04-0064	Revision: Basic
	Date: 7/26/04	Page 7 of 9

6.0.13 Verify load and instrumentation.

Verify PQAR



8-6-04

6.0.14 Stop video.



8-6-04

6.0.15 Document load and location of failure:

Failure load 1891.5 (1953.3) second Peak Load

Failure location:

N/A swage

3 3/4" - 7 inches from cable end

N/A other

Verify PQAR



8-6-04

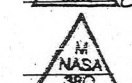
6.0.16 Photograph set-up.



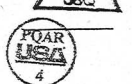
8-6-04

6.0.17 Place broken Restraint Cable debris in Ziploc bag and identify.

Verify PQAR



8-6-04



6.0.18 IF any anomaly or test failure occurs below the expected minimum values, contact the following within 24 hours:

Richard Knochelmann (321) 867-9813 or Chris Epler (321) 867-9309

Cary Cox (321) 867-1757

Pat Roberts (321) 867-1757














Mark Hill (256) 544-4327 or Brian Pung (256) 544-9346



8-6-04



ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly QUALIFICATION TEST	SRB-QUAL-04-0064	Revision: Basic
	Date: 7/26/04	Page 6 of 9

6.0 TEST OPERATION


- 6.0.1 Verify calibration is current for all calibrated test equipment in accordance with ED33-WI-012 Mechanical Testing Calibration and Verification Procedures
Verify PQAR   8-6-04 ✓
- 6.0.2 Note serial number or other identification for the Restraint Cable in test:
Lot ~~071081~~ RT-4
Verify PQAR  8-6-04 ✓
- 6.0.3 Mount the Restraint Cable into the fixture.
Verify PQAR   8-6-04 ✓
- *6.0.4 Apply three thermocouples, one at the top, middle and bottom of the Restraint Cable.
Verify PQAR N/A N/A 8-6-04
- 6.0.5 Photograph set-up.
 8-6-04 ✓
- *6.0.6 Install furnace and heat to 1250F (HT tests only).
Verify PQAR N/A N/A 8-6-04
- 6.0.7 Begin video.
 8-6-04 ✓
- *6.0.8 Verify all thermocouples read 1250F +/- 10 degrees (HT tests only).
Verify PQAR N/A N/A 8-6-04
- 6.0.9 Document temperature of test article. 709F
Witness PQAR  8-6-04 ✓
- 6.0.10 Ramp load to approximately 45 pounds at a load rate not to exceed 5 inches per minute.
Witness PQAR   8-6-04 ✓
- 6.0.11 Verify load is at approximately 45 pounds and all instrumentation is functioning.
44.7 lbs
Verify PQAR   8-6-04 ✓
- 6.0.12 Continue increase load until failure occurs.:
Witness PQAR  8-6-04 ✓

ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly QUALIFICATION TEST	SRB-QUAL-04-0064	Revision: Basic
	Date: 7/26/04	Page 7 of 9

6.0.13 Verify load and instrumentation.

Verify PQAR   8-6-04

6.0.14 Stop video.

 8-6-04

6.0.15 Document load and location of failure:


Failure load 1905.6

Failure location:


Inside Top swage

N/A inches from cable end

N/A other

Verify PQAR  8-6-04

6.0.16 Photograph set-up.

 8-6-04

6.0.17 Place broken Restraint Cable debris in Ziploc bag and identify.

Verify PQAR   8-6-04

6.0.18 IF any anomaly or test failure occurs below the expected minimum values, contact the following within 24 hours:

Richard Knochelmann (321) 867-9813 or Chris Epler (321) 867-9309

Cary Cox (321) 867-1757

Pat Roberts (321) 867-1757

Mark Hill (256) 544-4327 or Brian Pung (256) 544-9346














 

8-6-04

Attachment # 5



ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064	Revision: Basic
QUALIFICATION TEST	Date: 7/26/04	Page 6 of 9

6.0 TEST OPERATION

- | | | | | |
|--------|---|--------------|--|--------|
| 6.0.1 | Verify calibration is current for all calibrated test equipment in accordance with ED33-WI-012 Mechanical Testing Calibration and Verification Procedures | Verify PQAR | 
 | 8-6-04 |
| 6.0.2 | Note serial number or other identification for the Restraint Cable in test:
<u>LOT 071081 RT-5</u> | Verify PQAR |  | 8-6-04 |
| 6.0.3 | Mount the Restraint Cable into the fixture. | Verify PQAR | 
 | 8-6-04 |
| *6.0.4 | Apply three thermocouples, one at the top, middle and bottom of the Restraint Cable. | Verify PQAR | N/A
N/A | 8-6-04 |
| 6.0.5 | Photograph set-up. | |  | 8-6-04 |
| *6.0.6 | Install furnace and heat to 1250F (HT tests only). | Verify PQAR | N/A
N/A | 8-6-04 |
| 6.0.7 | Begin video. | |  | 8-6-04 |
| *6.0.8 | Verify all thermocouples read 1250F +/- 10 degrees (HT tests only): | Verify PQAR | N/A
N/A | 8-6-04 |
| 6.0.9 | Document temperature of test article. <u>710 F</u> | Witness PQAR |  | 8-6-04 |
| 6.0.10 | Ramp load to approximately 45 pounds at a load rate not to exceed 5 inches per minute. | Witness PQAR | 
 | 8-6-04 |
| 6.0.11 | Verify load is at approximately 45 pounds and all instrumentation is functioning.
<u>47.9 lbs</u> | Verify PQAR | 
 | 8-6-04 |
| 6.0.12 | Continue increase load until failure occurs.: | Witness PQAR |  | 8-6-04 |

ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064	Revision: Basic
QUALIFICATION TEST	Date: 7/26/04	Page 7 of 9

6.0.13 Verify load and instrumentation.

Verify PQAR   8-6-04

6.0.14 Stop video.


 8-6-04

6.0.15 Document load and location of failure:


Failure load 1939.8

Failure location:



Inside TOP swage
N/A inches from cable end
N/A other

Verify PQAR  8-6-04

6.0.16 Photograph set-up.



 8-6-04

6.0.17 Place broken Restraint Cable debris in Ziploc bag and identify.

Verify PQAR   8-6-04

6.0.18 IF any anomaly or test failure occurs below the expected minimum values, contact the following within 24 hours:























Richard Knochelmann (321) 867-9813 or Chris Epler (321) 867-9309
 Cary Cox (321) 867-1757
 Pat Roberts (321) 867-1757
 Mark Hill (256) 544-4327 or Brian Pung (256) 544-9346

  8-6-04

Attachment #6



ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly QUALIFICATION TEST	SRB-QUAL-04-0064	Revision: Basic
	Date: 7/26/04	Page 6 of 9

6.0 TEST OPERATION

- | | | | | |
|--------|---|--------------|--|----------|
| 6.0.1 | Verify calibration is current for all calibrated test equipment in accordance with ED33-WI-012 Mechanical Testing Calibration and Verification Procedures | Verify PQAR | 
 | ✓ 8-6-04 |
| 6.0.2 | Note serial number or other identification for the Restraint Cable in test:
<u>LOT 071081 E16-6</u> | Verify PQAR | 
 | ✓ 8-6-04 |
| 6.0.3 | Mount the Restraint Cable into the fixture. | Verify PQAR | 
 | ✓ 8-6-04 |
| 6.0.4 | Apply three thermocouples, one at the top, middle and bottom of the Restraint Cable. | Verify PQAR | 
 | ✓ 8-6-04 |
| 6.0.5 | Photograph set-up. | | 
 | ✓ 8-6-04 |
| 6.0.6 | Install furnace and heat to 1250F (HT tests only). | Verify PQAR | 
 | ✓ 8-6-04 |
| *6.0.7 | Begin video. | | N/A | |
| 6.0.8 | Verify all thermocouples read 1250F +/- 10 degrees (HT tests only): | Verify PQAR | 
 | ✓ 8-6-04 |
| 6.0.9 | Document temperature of test article. <u>1251°F</u> | Witness PQAR | 
 | ✓ 8-6-04 |
| 6.0.10 | Ramp load to approximately 45 pounds at a load rate not to exceed 5 inches per minute. | Witness PQAR | 
 | ✓ 8-6-04 |
| 6.0.11 | Verify load is at approximately 45 pounds and all instrumentation is functioning.
<u>46.2 lbs</u> | Verify PQAR | 
 | ✓ 8-6-04 |
| 6.0.12 | Continue increase load until failure occurs.: | Witness PQAR | 
 | ✓ 8-6-04 |

ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064	Revision: Basic
QUALIFICATION TEST	Date: 7/26/04	Page 7 of 9

6.0.13 Verify load and instrumentation.

Verify PQAR   8-6-04
 N/A

* 6.0.14 Stop video.

6.0.15 Document load and location of failure:


Failure load 374.7

Failure location:



N/A swage
6.0"-7 inches from cable end
N/A other

Verify PQAR  8-6-04

6.0.16 Photograph set-up.



 8-6-04

6.0.17 Place broken Restraint Cable debris in Ziploc bag and identify.

Verify PQAR   8-6-04

6.0.18 IF any anomaly or test failure occurs below the expected minimum values, contact the following within 24 hours:

Richard Knochelmann (321) 867-9813 or Chris Epler (321) 867-9309
 Cary Cox (321) 867-1757
 Pat Roberts (321) 867-1757
 Mark Hill (256) 544-4327 or Brian Pung (256) 544-9346



  8-6-04

Attachment #7


ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly QUALIFICATION TEST	SRB-QUAL-04-0064	Revision: Basic
	Date: 7/26/04	Page 6 of 9

6.0 TEST OPERATION



- 6.0.1 Verify calibration is current for all calibrated test equipment in accordance with ED33-WI-012 Mechanical Testing Calibration and Verification Procedures



Verify PQAR 8-6-04
- 6.0.2 Note serial number or other identification for the Restraint Cable in test:
LOT 071081 E1v-7





Verify PQAR 8-6-04
- 6.0.3 Mount the Restraint Cable into the fixture.



Verify PQAR 8-6-04
- 6.0.4 Apply three thermocouples, one at the top, middle and bottom of the Restraint Cable.

Verify PQAR 8-6-04
- 6.0.5 Photograph set-up.






Verify PQAR 8-6-04
- 6.0.6 Install furnace and heat to 1250F (HT tests only).





Verify PQAR 8-6-04
- ~~6.0.7~~ Begin video.



N/A
- 6.0.8 Verify all thermocouples read 1250F +/- 10 degrees (HT tests only):



Verify PQAR 8-6-04
- 6.0.9 Document temperature of test article. 1254⁰F




Witness PQAR 8-6-04
- 6.0.10 Ramp load to approximately 45 pounds at a load rate not to exceed 5 inches per minute.

Witness PQAR 8-6-04
- 6.0.11 Verify load is at approximately 45 pounds and all instrumentation is functioning.
43,0 lbs

Verify PQAR 8-6-04
- 6.0.12 Continue increase load until failure occurs.:





Witness PQAR 8-6-04



ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly QUALIFICATION TEST	SRB-QUAL-04-0064	Revision: Basic
	Date: 7/26/04	Page 7 of 9

6.0.13 Verify load and instrumentation.

Verify PQAR   8-6-04

* 6.0.14 Stop video.


N/A 8-6-04

6.0.15 Document load and location of failure:


Failure load 383.2

Failure location:



N/A swage
6.0" - T inches from cable end
N/A other

Verify PQAR  8-6-04



6.0.16 Photograph set-up.

 ← 8-6-04

6.0.17 Place broken Restraint Cable debris in Ziploc bag and identify.

Verify PQAR   ← 8-6-04



















6.0.18 IF any anomaly or test failure occurs below the expected minimum values, contact the following within 24 hours:
Richard Knochelmann (321) 867-9813 or Chris Epler (321) 867-9309
Cary Cox (321) 867-1757
Pat Roberts (321) 867-1757
Mark Hill (256) 544-4327 or Brian Pung (256) 544-9346

  8-6-04

Attachment # 8

ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064	Revision: Basic
QUALIFICATION TEST	Date: 7/26/04	Page 6 of 9

6.0 TEST OPERATION

- | | | | |
|---|--------------|--|--------|
| 6.0.1 Verify calibration is current for all calibrated test equipment in accordance with ED33-WI-012 Mechanical Testing Calibration and Verification Procedures | Verify PQAR | 
 | 8-6-04 |
| 6.0.2 Note serial number or other identification for the Restraint Cable in test: <u>LOT 071081 EIV-8</u> | Verify PQAR |  | 8-6-04 |
| 6.0.3 Mount the Restraint Cable into the fixture. | Verify PQAR | 
 | 8-6-04 |
| 6.0.4 Apply three thermocouples, one at the top, middle and bottom of the Restraint Cable. | Verify PQAR | 
 | 8-6-04 |
| 6.0.5 Photograph set-up. | | 
 | 8-6-04 |
| 6.0.6 Install furnace and heat to 1250F (HT tests only). | Verify PQAR |  | 8-6-04 |
| *6.0.7 Begin video. | | N/A | L |
| 6.0.8 Verify all thermocouples read 1250F +/- 10 degrees (HT tests only): | Verify PQAR | 
 | 8-6-04 |
| 6.0.9 Document temperature of test article. <u>1250°F</u> | Witness PQAR |  | 8-6-04 |
| 6.0.10 Ramp load to approximately 45 pounds at a load rate not to exceed 5 inches per minute. | Witness PQAR | 
 | 8-6-04 |
| 6.0.11 Verify load is at approximately 45 pounds and all instrumentation is functioning. <u>46 lbs</u> | Verify PQAR | 
 | 8-6-04 |
| 6.0.12 Continue increase load until failure occurs.: | Witness PQAR |  | 8-6-04 |

ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly QUALIFICATION TEST	SRB-QUAL-04-0064	Revision: Basic
	Date: 7/26/04	Page 7 of 9

6.0.13 Verify load and instrumentation.

Verify PQAR



8-6-04

*6.0.14 Stop video.

N/A

6.0.15 Document load and location of failure:

Failure load 388.8 lbs

Failure location:

N/A swage
6.0" T inches from cable end
N/A other

Verify PQAR



8-6-04

6.0.16 Photograph set-up.



8-6-04

6.0.17 Place broken Restraint Cable debris in Ziploc bag and identify.

Verify PQAR



8-6-04

6.0.18 IF any anomaly or test failure occurs below the expected minimum values, contact the following within 24 hours:

Richard Knochelmann (321) 867-9813 or Chris Epler (321) 867-9309
Cary Cox (321) 867-1757
Pat Roberts (321) 867-1757
Mark Hill (256) 544-4327 or Brian Pung (256) 544-9346


























8-6-04

Attachment # 9

ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064	Revision: Basic
QUALIFICATION TEST	Date: 7/26/04	Page 6 of 9

6.0 TEST OPERATION



- | | | | |
|--|--------------|--|--------|
| <p>6.0.1 Verify calibration is current for all calibrated test equipment in accordance with ED33-WI-012 Mechanical Testing Calibration and Verification Procedures</p> | Verify PQAR | 
 | 8-6-04 |
| <p>6.0.2 Note serial number or other identification for the Restraint Cable in test:
<u>LOT 071081 E14-9</u></p> | Verify PQAR | 
 | 8-6-04 |
| <p>6.0.3 Mount the Restraint Cable into the fixture.</p> | Verify PQAR | 
 | 8-6-04 |
| <p>6.0.4 Apply three thermocouples, one at the top, middle and bottom of the Restraint Cable.</p> | Verify PQAR | 
 | 8-6-04 |
| <p>6.0.5 Photograph set-up.</p> | |  | 8-6-04 |
| <p>6.0.6 Install furnace and heat to 1250F (HT tests only).</p> | Verify PQAR | 
 | 8-6-04 |
| <p>*6.0.7 Begin video.</p> | | N/A | |
| <p>6.0.8 Verify all thermocouples read 1250F +/- 10 degrees (HT tests only):</p> | Verify PQAR | 
 | 8-6-04 |
| <p>6.0.9 Document temperature of test article. <u>1258 °F</u></p> | Witness PQAR | 
 | 8-6-04 |
| <p>6.0.10 Ramp load to approximately 45 pounds at a load rate not to exceed 5 inches per minute.</p> | Witness PQAR | 
 | 8-6-04 |
| <p>6.0.11 Verify load is at approximately 45 pounds and all instrumentation is functioning.
<u>44 lbs</u></p> | Verify PQAR | 
 | 8-6-04 |
| <p>6.0.12 Continue increase load until failure occurs.:</p> | Witness PQAR | 
 | 8-6-04 |



 8-6-04

ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064	Revision: Basic
QUALIFICATION TEST	Date: 7/26/04	Page 7 of 9

6.0.13 Verify load and instrumentation.

Verify PQAR



 8-6-04
 N/A

*6.0.14 Stop video.


6.0.15 Document load and location of failure:

Failure load 358.0

Failure location:

~~N/A~~ swage
~~4 3/8" - 7~~ inches from cable end
~~N/A~~ other




Verify PQAR


 8-6-04

6.0.16 Photograph set-up.



6.0.17 Place broken Restraint Cable debris in Ziploc bag and identify.

Verify PQAR




 8-6-04

6.0.18 IF any anomaly or test failure occurs below the expected minimum values, contact the following within 24 hours:

Richard Knochelmann (321) 867-9813 or Chris Epler (321) 867-9309
 Cary Cox (321) 867-1757
 Pat Roberts (321) 867-1757
 Mark Hill (256) 544-4327 or Brian Pung (256) 544-9346





 8-6-04

Attachment # 10

ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly QUALIFICATION TEST	SRB-QUAL-04-0064 Date: 7/26/04	Revision: Basic Page 6 of 9

6.0 TEST OPERATION

6.0.1 Verify calibration is current for all calibrated test equipment in accordance with ED33-WI-012 Mechanical Testing Calibration and Verification Procedures



Verify PQAR  8-6-04


6.0.2 Note serial number or other identification for the Restraint Cable in test:

LOT 071081 E/V-10

Verify PQAR  8-6-04


6.0.3 Mount the Restraint Cable into the fixture.

Verify PQAR  8-6-04


6.0.4 Apply three thermocouples, one at the top, middle and bottom of the Restraint Cable.

Verify PQAR  8-6-04


6.0.5 Photograph set-up.

 8-6-04

6.0.6 Install furnace and heat to 1250F (HT tests only).

Verify PQAR  8-6-04


*6.0.7 Begin video.

N/A



6.0.8 Verify all thermocouples read 1250F +/- 10 degrees (HT tests only):

Verify PQAR  8-6-04


6.0.9 Document temperature of test article. 1240°F



Witness PQAR  8-6-04

6.0.10 Ramp load to approximately 45 pounds at a load rate not to exceed 5 inches per minute.

Witness PQAR  8-6-04


6.0.11 Verify load is at approximately 45 pounds and all instrumentation is functioning.

43.5 lbs

Verify PQAR  8-6-04


6.0.12 Continue increase load until failure occurs.:

Witness PQAR  8-6-04

ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly QUALIFICATION TEST	SRB-QUAL-04-0064	Revision: Basic
	Date: 7/26/04	Page 7 of 9

6.0.13 Verify load and instrumentation.

Verify PQAR



8-6-04

*6.0.14 Stop video.

6.0.15 Document load and location of failure:

Failure load 361.3 lbs

Failure location:

N/A swage
4 1/8" - T inches from cable end
N/A other

Verify PQAR



8-6-04

8-6-04

8-6-04

6.0.16 Photograph set-up.

6.0.17 Place broken Restraint Cable debris in Ziploc bag and identify.

Verify PQAR



6.0.18 IF any anomaly or test failure occurs below the expected minimum values, contact the following within 24 hours:

Richard Knochelmann (321) 867-9813 or Chris Epler (321) 867-9309
Cary Cox (321) 867-1757
Pat Roberts (321) 867-1757
Mark Hill (256) 544-4327 or Brian Pung (256) 544-9346
















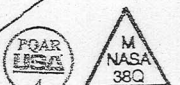
8-6-04

attachment # 1

ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly QUALIFICATION TEST	SRB-QUAL-04-0064	Revision: Basic
	Date: 7/26/04	Page 6 of 9



6.0 TEST OPERATION

- 6.0.1 Verify calibration is current for all calibrated test equipment in accordance with ED33-WI-012 Mechanical Testing Calibration and Verification Procedures
Verify PQAR   8-6-04
- 6.0.2 Note serial number or other identification for the Restraint Cable in test:
Lot 104236 RT-1
Verify PQAR  8-6-04
- 6.0.3 Mount the Restraint Cable into the fixture.
Verify PQAR   8-6-04
- *6.0.4 Apply three thermocouples, one at the top, middle and bottom of the Restraint Cable.
Verify PQAR N/A N/A 8-6-04
- 6.0.5 Photograph set-up.
 8-6-04
- *6.0.6 Install furnace and heat to 1250F (HT tests only).
Verify PQAR N/A N/A 8-6-04
- 6.0.7 Begin video.
 8-6-04
- *6.0.8 Verify all thermocouples read 1250F +/- 10 degrees (HT tests only):
Verify PQAR N/A N/A 8-6-04
- 6.0.9 Document temperature of test article. 71 °F
Witness PQAR  8-6-04
- 6.0.10 Ramp load to approximately 45 pounds at a load rate not to exceed 5 inches per minute.
Witness PQAR   8-6-04
- 6.0.11 Verify load is at approximately 45 pounds and all instrumentation is functioning. 47.8 lbs
Verify PQAR   8-6-04
- 6.0.12 Continue increase load until failure occurs.:
Witness PQAR  8-6-04




ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064	Revision: Basic
QUALIFICATION TEST	Date: 7/26/04	Page 7 of 9

6.0.13 Verify load and instrumentation.

Verify PQAR   8-6-04 ✓

6.0.14 Stop video.


 8-6-04 ✓

6.0.15 Document load and location of failure:



Failure load 1900.3

Failure location:

Inside Top swage
N/A inches from cable end
N/A other

Verify PQAR  8-6-04 ✓

6.0.16 Photograph set-up.

 8-6-04 ✓


6.0.17 Place broken Restraint Cable debris in Ziploc bag and identify.

Verify PQAR  8-6-04 ✓



6.0.18 IF any anomaly or test failure occurs below the expected minimum values, contact the following within 24 hours:

Richard Knochelmann (321) 867-9813 or Chris Epler (321) 867-9309

Cary Cox (321) 867-1757

Pat Roberts (321) 867-1757



















Mark Hill (256) 544-4327 or Brian Pung (256) 544-9346

 
 8-6-04

Attachment #2

ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064	Revision: Basic
QUALIFICATION TEST	Date: 7/26/04	Page 6 of 9

6.0 TEST OPERATION

- | | | | | |
|--------|---|--------------|--|--------|
| 6.0.1 | Verify calibration is current for all calibrated test equipment in accordance with ED33-WI-012 Mechanical Testing Calibration and Verification Procedures | Verify PQAR | 
 | 8-6-04 |
| 6.0.2 | Note serial number or other identification for the Restraint Cable in test:
<u>LOT 104236 RT-2</u> | Verify PQAR | 
 | 8-6-0 |
| *6.0.3 | Mount the Restraint Cable into the fixture. | Verify PQAR | 
 | 8-6-0 |
| *6.0.4 | Apply three thermocouples, one at the top, middle and bottom of the Restraint Cable. | Verify PQAR | N/A
 | 8-6-0 |
| 6.0.5 | Photograph set-up. | |  | 8-6-0 |
| *6.0.6 | Install furnace and heat to 1250F (HT tests only). | Verify PQAR | N/A
 | |
| 6.0.7 | Begin video. | |  | 8-6-04 |
| *6.0.8 | Verify all thermocouples read 1250F +/- 10 degrees (HT tests only): | Verify PQAR | N/A
 | |
| 6.0.9 | Document temperature of test article. <u>710F</u> | Witness PQAR | 
 | 8-6-04 |
| 6.0.10 | Ramp load to approximately 45 pounds at a load rate not to exceed 5 inches per minute. | Witness PQAR | 
 | 8-6-0 |
| 6.0.11 | Verify load is at approximately 45 pounds and all instrumentation is functioning.
<u>47.4 lbs</u> | Verify PQAR | 
 | 8-6-04 |
| 6.0.12 | Continue increase load until failure occurs.: | Witness PQAR |  | 8-6-04 |

ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064	Revision: Basic
QUALIFICATION TEST	Date: 7/26/04	Page 7 of 9

6.0.13 Verify load and instrumentation.

Verify PQAR



8-6-04

8-6-04

6.0.14 Stop video.

6.0.15 Document load and location of failure: Third Peak Load
 Failure load 1863.3 (1969.2) ~~swage~~
 Failure location: N/A swage

7/8" - T inches from cable end
N/A other

Verify PQAR



8-6-04

8-6-04

6.0.16 Photograph set-up.

6.0.17 Place broken Restraint Cable debris in Ziploc bag and identify.

Verify PQAR



8-6-04

6.0.18 IF any anomaly or test failure occurs below the expected minimum values, contact the following within 24 hours:
 Richard Knochelmann (321) 867-9813 or Chris Epler (321) 867-9309
 Cary Cox (321) 867-1757
 Pat Roberts (321) 867-1757
 Mark Hill (256) 544-4327 or Brian Pung (256) 544-9346
















8-6-04

Attachment #3



ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly QUALIFICATION TEST	SRB-QUAL-04-0064	Revision: Basic
	Date: 7/26/04	Page 6 of 9

6.0 TEST OPERATION


- | | | |
|---------|---|--|
| 6.0.1 | Verify calibration is current for all calibrated test equipment in accordance with ED33-WI-012 Mechanical Testing Calibration and Verification Procedures | 
Verify PQAR  8-6-04 |
| 6.0.2 | Note serial number or other identification for the Restraint Cable in test:
<u>LOT 104236 RT-3</u> | Verify PQAR  8-6-04 |
| * 6.0.3 | Mount the Restraint Cable into the fixture. | Verify PQAR 
 8-6-04 |
| * 6.0.4 | Apply three thermocouples, one at the top, middle and bottom of the Restraint Cable. | Verify PQAR <u>N/A</u> 8-6-04
<u>N/A</u> |
| 6.0.5 | Photograph set-up. |  8-6-04 |
| * 6.0.6 | Install furnace and heat to 1250F (HT tests only). | Verify PQAR <u>N/A</u> 8-6-04
<u>N/A</u> |
| 6.0.7 | Begin video. |  8-6-04 |
| * 6.0.8 | Verify all thermocouples read 1250F +/- 10 degrees (HT tests only): | Verify PQAR <u>N/A</u>
<u>N/A</u> |
| 6.0.9 | Document temperature of test article. <u>710 F</u> | Witness PQAR  8-6-04 |
| 6.0.10 | Ramp load to approximately 45 pounds at a load rate not to exceed 5 inches per minute. | 
Witness PQAR  8-6-04 |
| 6.0.11 | Verify load is at approximately 45 pounds and all instrumentation is functioning. <u>47.4</u> | 
Verify PQAR  8-6-04 |
| 6.0.12 | Continue increase load until failure occurs.: | Witness PQAR  8-6-04 |

ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly QUALIFICATION TEST	SRB-QUAL-04-0064	Revision: Basic
	Date: 7/26/04	Page 7 of 9

6.0.13 Verify load and instrumentation.

Verify PQAR   8-6-04

6.0.14 Stop video.


 8-6-04

6.0.15 Document load and location of failure:


Failure load 1899.4

Failure location:


N/A swage
3 1/2" - 7 inches from cable end
N/A other

Verify PQAR  8-6-04

6.0.16 Photograph set-up.



 8-6-04

6.0.17 Place broken Restraint Cable debris in Ziploc bag and identify.

Verify PQAR  8-6-04


6.0.18 IF any anomaly or test failure occurs below the expected minimum values, contact the following within 24 hours:














Richard Knochemann (321) 867-9813 or Chris Epler (321) 867-9309
Cary Cox (321) 867-1757
Pat Roberts (321) 867-1757
Mark Hill (256) 544-4327 or Brian Pung (256) 544-9346

  8-6-04

Attachment #4

ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064	Revision: Basic
QUALIFICATION TEST	Date: 7/26/04	Page 6 of 9

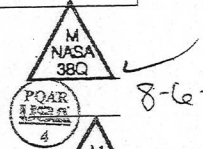
6.0 TEST OPERATION

- | | | |
|--------|---|---|
| 6.0.1 | Verify calibration is current for all calibrated test equipment in accordance with ED33-WI-012 Mechanical Testing Calibration and Verification Procedures | Verify PQAR

 8-6-04 |
| 6.0.2 | Note serial number or other identification for the Restraint Cable in test:
<u>LOT 104236 RT-4</u> | Verify PQAR
 8-6-04 |
| 6.0.3 | Mount the Restraint Cable into the fixture. | Verify PQAR

 8-6-04 |
| *6.0.4 | Apply three thermocouples, one at the top, middle and bottom of the Restraint Cable. | Verify PQAR
N/A
N/A 8-6-04 |
| 6.0.5 | Photograph set-up. |  8-6-04 |
| *6.0.6 | Install furnace and heat to 1250F (HT tests only). | Verify PQAR
N/A
N/A |
| 6.0.7 | Begin video. |  8-6-04 |
| *6.0.8 | Verify all thermocouples read 1250F +/- 10 degrees (HT tests only): | Verify PQAR
N/A
N/A |
| 6.0.9 | Document temperature of test article. <u>71 °F</u> | Witness PQAR
 8-6-04 |
| 6.0.10 | Ramp load to approximately 45 pounds at a load rate not to exceed 5 inches per minute. | Witness PQAR

 8-6-04 |
| 6.0.11 | Verify load is at approximately 45 pounds and all instrumentation is functioning.
<u>48.6 lbs</u> | Verify PQAR

 8-6-04 |
| 6.0.12 | Continue increase load until failure occurs.. | Witness PQAR
 8-6-04 |

ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064	Revision: Basic
QUALIFICATION TEST	Date: 7/26/04	Page 7 of 9

6.0.13 Verify load and instrumentation.

Verify PQAR



6.0.14 Stop video.

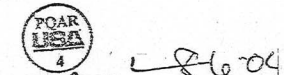
6.0.15 Document load and location of failure:

Failure load 2008.5

Failure location:

N/A swage
3 1/2" - 7 inches from cable end
N/A other

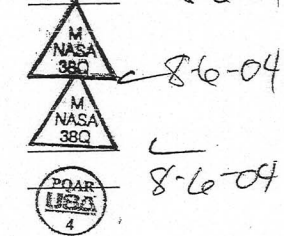
Verify PQAR



6.0.16 Photograph set-up.

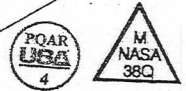
6.0.17 Place broken Restraint Cable debris in Ziploc bag and identify.

Verify PQAR



6.0.18 IF any anomaly or test failure occurs below the expected minimum values, contact the following within 24 hours:

Richard Knochelmann (321) 867-9813 or Chris Epler (321) 867-9309
 Cary Cox (321) 867-1757
 Pat Roberts (321) 867-1757
 Mark Hill (256) 544-4327 or Brian Pung (256) 544-9346
















8-6-04

Attachment # 5



ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly QUALIFICATION TEST	SRB-QUAL-04-0064	Revision: Basic
	Date: 7/26/04	Page 6 of 9

6.0 TEST OPERATION

- | | | | | |
|--------|---|--------------|--|--------|
| 6.0.1 | Verify calibration is current for all calibrated test equipment in accordance with ED33-WI-012 Mechanical Testing Calibration and Verification Procedures | Verify PQAR | 
 | 8-6-04 |
| 6.0.2 | Note serial number or other identification for the Restraint Cable in test: <u>LOT 104236 RT-5</u> | Verify PQAR |  | 8-6-04 |
| 6.0.3 | Mount the Restraint Cable into the fixture. | Verify PQAR | 
 | 8-6-04 |
| *6.0.4 | Apply three thermocouples, one at the top, middle and bottom of the Restraint Cable. | Verify PQAR | <u>N/A</u>
<u>N/A</u> | |
| 6.0.5 | Photograph set-up. | |  | 8-6-04 |
| *6.0.6 | Install furnace and heat to 1250F (HT tests only). | Verify PQAR | <u>N/A</u>
<u>N/A</u> | |
| 6.0.7 | Begin video. | |  | 8-6-04 |
| *6.0.8 | Verify all thermocouples read 1250F +/- 10 degrees (HT tests only): | Verify PQAR | <u>N/A</u>
<u>N/A</u> | |
| 6.0.9 | Document temperature of test article. <u>710 F</u> | Witness PQAR |  | 8-6-04 |
| 6.0.10 | Ramp load to approximately 45 pounds at a load rate not to exceed 5 inches per minute. | Witness PQAR | 
 | 8-6-04 |
| 6.0.11 | Verify load is at approximately 45 pounds and all instrumentation is functioning. <u>48.1 lbs</u> | Verify PQAR | 
 | 8-6-04 |
| 6.0.12 | Continue increase load until failure occurs.: | Witness PQAR |  | 8-6-04 |

ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly	SRB-QUAL-04-0064	Revision: Basic
QUALIFICATION TEST	Date: 7/26/04	Page 7 of 9

6.0.13 Verify load and instrumentation.

Verify PQAR  86-04


6.0.14 Stop video.


 86-04

6.0.15 Document load and location of failure:


Failure load 1981.6 lbs

Failure location:



N/A swage
3/4 - 7 inches from cable end
N/A other

Verify PQAR  86-04

6.0.16 Photograph set-up.



 86-04

6.0.17 Place broken Restraint Cable debris in Ziploc bag and identify.

Verify PQAR  86-04


6.0.18 IF any anomaly or test failure occurs below the expected minimum values, contact the following within 24 hours:

Richard Knochelmann (321) 867-9813 or Chris Epler (321) 867-9309
 Cary Cox (321) 867-1757
 Pat Roberts (321) 867-1757
 Mark Hill (256) 544-4327 or Brian Pung (256) 544-9346



 86-04


Attachment # 6

ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly QUALIFICATION TEST	SRB-QUAL-04-0064 Date: 7/26/04	Revision: Basic Page 6 of 9

6.0 TEST OPERATION

6.0.1 Verify calibration is current for all calibrated test equipment in accordance with ED33-WI-012 Mechanical Testing Calibration and Verification Procedures



Verify PQAR   8-6-04 ✓

6.0.2 Note serial number or other identification for the Restraint Cable in test:



LOT 104236 # E/L-6

Verify PQAR  8-6-04 ✓


6.0.3 Mount the Restraint Cable into the fixture.

Verify PQAR   8-6-04 ✓



6.0.4 Apply three thermocouples, one at the top, middle and bottom of the Restraint Cable.

Verify PQAR   8-6-04 ✓

6.0.5 Photograph set-up.

 8-6-04 ✓


6.0.6 Install furnace and heat to 1250F (HT tests only).

Verify PQAR   8-6-04 ✓


*6.0.7 Begin video.

N/A



6.0.8 Verify all thermocouples read 1250F +/- 10 degrees (HT tests only):

Verify PQAR   8-6-04 ✓



6.0.9 Document temperature of test article. 1253

Witness PQAR  8-6-04 ✓


6.0.10 Ramp load to approximately 45 pounds at a load rate not to exceed 5 inches per minute.

Witness PQAR   8-6-04 ✓

6.0.11 Verify load is at approximately 45 pounds and all instrumentation is functioning. 44.7

Verify PQAR   8-6-04 ✓

6.0.12 Continue increase load until failure occurs.:


Witness PQAR  8-6-04 ✓

ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly QUALIFICATION TEST	SRB-QUAL-04-0064 Date: 7/26/04	Revision: Basic Page 7 of 9

6.0.13 Verify load and instrumentation.

Verify PQAR   8-6-04

*6.0.14 Stop video.


 N/A

6.0.15 Document load and location of failure:


Failure load 387.8 lbs

Failure location:



N/A swage
5.0" - T inches from cable end
N/A other

Verify PQAR  8-6-04

6.0.16 Photograph set-up.

 8-6-04

6.0.17 Place broken Restraint Cable debris in Ziploc bag and identify.

Verify PQAR   8-6-04

6.0.18 IF any anomaly or test failure occurs below the expected minimum values, contact the following within 24 hours:

Richard Knochelman (321) 867-9813 or Chris Epler (321) 867-9309

Cary Cox (321) 867-1757

Pat Roberts (321) 867-1757

Mark Hill (256) 544-4327 or Brian Pung (256) 544-9346



















 

8-6-04

Attachment # 7

ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly QUALIFICATION TEST	SRB-QUAL-04-0064	Revision: Basic
	Date: 7/26/04	Page 6 of 9

6.0 TEST OPERATION

- | | | | | |
|--------|---|--------------|--|--------|
| 6.0.1 | Verify calibration is current for all calibrated test equipment in accordance with ED33-WI-012 Mechanical Testing Calibration and Verification Procedures | Verify PQAR | 
 | 8-6-04 |
| 6.0.2 | Note serial number or other identification for the Restraint Cable in test:
<u>LOT 104236 E/v-7</u> | Verify PQAR |  | 8-6-04 |
| 6.0.3 | Mount the Restraint Cable into the fixture. | Verify PQAR | 
 | 8-6-04 |
| 6.0.4 | Apply three thermocouples, one at the top, middle and bottom of the Restraint Cable. | Verify PQAR | 
 | 8-6-04 |
| 6.0.5 | Photograph set-up. | |  | 8-6-04 |
| 6.0.6 | Install furnace and heat to 1250F (HT tests only). | Verify PQAR | 
 | 8-6-04 |
| *6.0.7 | Begin video. | | N/A | |
| 6.0.8 | Verify all thermocouples read 1250F +/- 10 degrees (HT tests only): | Verify PQAR | 
 | 8-6-04 |
| 6.0.9 | Document temperature of test article. <u>1259 F</u> | Witness PQAR |  | 8-6-04 |
| 6.0.10 | Ramp load to approximately 45 pounds at a load rate not to exceed 5 inches per minute. | Witness PQAR | 
 | 8-6-04 |
| 6.0.11 | Verify load is at approximately 45 pounds and all instrumentation is functioning. <u>44.9</u> | Verify PQAR | 
 | 8-6-04 |
| 6.0.12 | Continue increase load until failure occurs.: | Witness PQAR |  | 8-6-04 |



ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly QUALIFICATION TEST	SRB-QUAL-04-0064	Revision: Basic
	Date: 7/26/04	Page 7 of 9

6.0.13 Verify load and instrumentation.

Verify PQAR



8-6-04

*6.0.14 Stop video.

N/A

6.0.15 Document load and location of failure:

Failure load 370.6 lbs

Failure location:

N/A
SKT
N/A

swage

inches from cable end

other

Verify PQAR



8-6-04

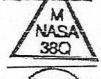
6.0.16 Photograph set-up.



8-6-04

6.0.17 Place broken Restraint Cable debris in Ziploc bag and identify.

Verify PQAR



8-6-04

6.0.18 IF any anomaly or test failure occurs below the expected minimum values, contact the following within 24 hours:

Richard Knochelmann (321) 867-9813 or Chris Epler (321) 867-9309

Cary Cox (321) 867-1757

Pat Roberts (321) 867-1757

Mark Hill (256) 544-4327 or Brian Pung (256) 544-9346






















85

Attachment # 8



ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly QUALIFICATION TEST	SRB-QUAL-04-0064 Date: 7/26/04	Revision: Basic Page 6 of 9

6.0 TEST OPERATION

- | | | |
|---|--------------|--|
| 6.0.1 Verify calibration is current for all calibrated test equipment in accordance with ED33-WI-012 Mechanical Testing Calibration and Verification Procedures | Verify PQAR | 

8-6-04 |
| 6.0.2 Note serial number or other identification for the Restraint Cable in test:
<u>LOT 104236 E12-8</u> | Verify PQAR | 

8-6-04 |
| 6.0.3 Mount the Restraint Cable into the fixture. | Verify PQAR | 

8-6-04 |
| 6.0.4 Apply three thermocouples, one at the top, middle and bottom of the Restraint Cable. | Verify PQAR | 

8-6-04 |
| 6.0.5 Photograph set-up. | | 
8-6-04 |
| 6.0.6 Install furnace and heat to 1250F (HT tests only). | Verify PQAR | 

8-6-04 |
| 6.0.7 Begin video. | | N/A |
| 6.0.8 Verify all thermocouples read 1250F +/- 10 degrees (HT tests only): | Verify PQAR | 

8-6-04 |
| 6.0.9 Document temperature of test article. <u>1251 °F</u> | Witness PQAR | 
8-6-04 |
| 6.0.10 Ramp load to approximately 45 pounds at a load rate not to exceed 5 inches per minute. | Witness PQAR | 

8-6-04 |
| 6.0.11 Verify load is at approximately 45 pounds and all instrumentation is functioning.
<u>44.1</u> | Verify PQAR | 

8-6-04 |
| 6.0.12 Continue increase load until failure occurs.: | Witness PQAR | 
8-6-04 |

ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly QUALIFICATION TEST	SRB-QUAL-04-0064	Revision: Basic
	Date: 7/26/04	Page 7 of 9

6.0.13 Verify load and instrumentation.

Verify PQAR  8-6-04


*6.0.14 Stop video.

N/A

6.0.15 Document load and location of failure:


Failure load 399.8 lbs

Failure location:


N/A swage

5 1/8" - 7 inches from cable end



N/A other

Verify PQAR  8-6-04

6.0.16 Photograph set-up.

 8-6-04

6.0.17 Place broken Restraint Cable debris in Ziploc bag and identify.

Verify PQAR  8-6-04




6.0.18 IF any anomaly or test failure occurs below the expected minimum values, contact the following within 24 hours:

Richard Knochelmann (321) 867-9813 or Chris Epler (321) 867-9309

Cary Cox (321) 867-1757

Pat Roberts (321) 867-1757

Mark Hill (256) 544-4327 or Brian Pung (256) 544-9346



















 

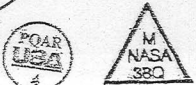
8-6-04

Attachment #9

ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly QUALIFICATION TEST	SRB-QUAL-04-0064	Revision: Basic
	Date: 7/26/04	Page 6 of 9

6.0 TEST OPERATION

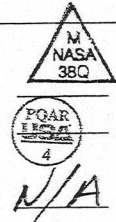
- | | | | | |
|------------------|---|--------------|--|-------------------|
| 6.0.1 | Verify calibration is current for all calibrated test equipment in accordance with ED33-WI-012 Mechanical Testing Calibration and Verification Procedures | Verify PQAR | 
 | ✓
8-6-04 |
| 6.0.2 | Note serial number or other identification for the Restraint Cable in test:
<u>LOT 104236 E14-9</u> | Verify PQAR |  | ✓ 8-6-04 |
| 6.0.3 | Mount the Restraint Cable into the fixture. | Verify PQAR | 
 | 8-6-04 |
| 6.0.4 | Apply three thermocouples, one at the top, middle and bottom of the Restraint Cable. | Verify PQAR | 
 | ✓ 8-6-04 |
| 6.0.5 | Photograph set-up. | |  | ✓ 8-6-04 |
| 6.0.6 | Install furnace and heat to 1250F (HT tests only). | Verify PQAR | 
 | ✓ 8-6-04 |
| 6.0.7 | Begin video. | | N/A | |
| 6.0.8 | Verify all thermocouples read 1250F +/- 10 degrees (HT tests only): | Verify PQAR | 
 | ✓ 8-6-04 |
| 6.0.9 | Document temperature of test article. <u>1250°F</u> | Witness PQAR |  | 18-6-04 |
| 6.0.10 | Ramp load to approximately 45 pounds at a load rate not to exceed 5 inches per minute. | Witness PQAR | 
 | 18-6-04
8-6-04 |
| 6.0.11 | Verify load is at approximately 45 pounds and all instrumentation is functioning. <u>43.7</u> | Verify PQAR | 
 | 8-6-04 |
| 6.0.12 | Continue increase load until failure occurs.: | Witness PQAR |  | 18-6-04 |



ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly QUALIFICATION TEST	SRB-QUAL-04-0064	Revision: Basic
	Date: 7/26/04	Page 7 of 9

6.0.13 Verify load and instrumentation.

Verify PQAR



*6.0.14 Stop video.

6.0.15 Document load and location of failure:

Failure load 392.7 lbs

Failure location:

N/A swage
5 3/4" - T inches from cable end
N/A other

Verify PQAR



6.0.16 Photograph set-up.



6.0.17 Place broken Restraint Cable debris in Ziploc bag and identify.

Verify PQAR



6.0.18 IF any anomaly or test failure occurs below the expected minimum values, contact the following within 24 hours:

Richard Knochelmann (321) 867-9813 or Chris Epler (321) 867-9309

Cary Cox (321) 867-1757

Pat Roberts (321) 867-1757










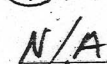






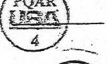

Mark Hill (256) 544-4327 or Brian Pung (256) 544-9346



Attachment # 10


ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly QUALIFICATION TEST	SRB-QUAL-04-0064	Revision: Basic
	Date: 7/26/04	Page 6 of 9

6.0 TEST OPERATION

- | | | | |
|---|--------------|--|-------------------|
| 6.0.1 Verify calibration is current for all calibrated test equipment in accordance with ED33-WI-012 Mechanical Testing Calibration and Verification Procedures | Verify PQAR | 
 | 8-6-04 |
| 6.0.2 Note serial number or other identification for the Restraint Cable in test:
<u>LOT 104936 ELV-10</u> | Verify PQAR |  | 8-6-04 |
| 6.0.3 Mount the Restraint Cable into the fixture. | Verify PQAR | 
 | 8-6-04 |
| 6.0.4 Apply three thermocouples, one at the top, middle and bottom of the Restraint Cable. | Verify PQAR | 
 | 8-6-04 |
| 6.0.5 Photograph set-up. | |  | 8-6-04 |
| 6.0.6 Install furnace and heat to 1250F (HT tests only). | Verify PQAR | 
 | 8-6-04 |
| *6.0.7 Begin video. | | N/A | 8-6-04 |
| 6.0.8 Verify all thermocouples read 1250F +/- 10 degrees (HT tests only): | Verify PQAR | 
 | 8-6-04 |
| 6.0.9 Document temperature of test article. <u>1251 °F</u> | Witness PQAR |  | 8-6-04 |
| 6.0.10 Ramp load to approximately 45 pounds at a load rate not to exceed 5 inches per minute. | Witness PQAR | 
 | 8-6-04 |
| 6.0.11 Verify load is at approximately 45 pounds and all instrumentation is functioning. <u>42.7 lbs</u> | Verify PQAR | 
 | 8-6-04 |
| 6.0.12 Continue increase load until failure occurs.: | Witness PQAR |  | 8-6-04 |

ED33 / MECHANICAL METALLURGY AND CORROSION TEAM		
SRB Diagonal Strut Restraint Cable Assembly QUALIFICATION TEST	SRB-QUAL-04-0064	Revision: Basic
	Date: 7/26/04	Page 7 of 9

6.0.13 Verify load and instrumentation.

Verify PQAR  8-6-04

*6.0.14 Stop video.


N/A

6.0.15 Document load and location of failure:


Failure load 400.4 lbs

Failure location:



N/A swage
5/8" - T inches from cable end
N/A other

Verify PQAR  8-6-04



6.0.16 Photograph set-up.

 8-6-04

6.0.17 Place broken Restraint Cable debris in Ziploc bag and identify.

Verify PQAR  8-6-04


6.0.18 IF any anomaly or test failure occurs below the expected minimum values, contact the following within 24 hours:
Richard Knochelmann (321) 867-9813 or Chris Epler (321) 867-9309
Cary Cox (321) 867-1757
Pat Roberts (321) 867-1757
Mark Hill (256) 544-4327 or Brian Pung (256) 544-9346

 8-6-04 

REFERENCES

1. “Wire Rope, Flexible, for Aircraft Control,” *MIL-W-83420*, Rev. E, Department of Defense, Philadelphia, PA, June 6, 1994.
2. “Structural Strength Program Requirements,” *MSFC-HDBK-505*, Rev. B, Marshall Space Flight Center, MSFC, AL, April 15, 2005.
3. “Strut Retainer Assembly, Aft Ring Qualification Plan,” *QTP 90PLN-0064*, Marshall Space Flight Center, MSFC, AL, July 20, 2004.
4. “Terminal, Cable Assemblies, Swaged Type,” *MIL-T-6117*, Rev. D, Department of Defense, Philadelphia, PA, December 1, 1994.
5. “Test Methods for Tension Testing of Metallic Materials,” *ASTM-E-8*, American Society for Testing and Materials, May 1, 2004.
6. “SRB Diagonal Strut Restraint Cable Assembly P/N 10176-102/103 Qualification Test,” *SRB-QUAL-04-0064*, Marshall Space Flight Center, MSFC, AL.
7. Martin, D.M.: “Contract NAS9-1000000, Submittal of United Space Alliance SRB Element Prepared Qualification Test Plan (QTP) 90PLN-0064, Revision Basic Dated 7/19/2004 for the Strut Retainer Assembly Aft Ring,” *MP41 (04-063)*, Marshall Space Flight Center, MSFC, AL, July 26, 2004.
8. “Metallic Materials and Elements for Aerospace Vehicle Structures,” *MIL-HDBK-5*, Rev. J, Department of Defense, Philadelphia, PA, January 1, 2003.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operation and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503

1. AGENCY USE ONLY <i>(Leave Blank)</i>	2. REPORT DATE September 2006	3. REPORT TYPE AND DATES COVERED Technical Memorandum	
4. TITLE AND SUBTITLE Qualification Testing of Solid Rocket Booster Diagonal Strut Restraint Cable Assembly Part Number 10176-0031-102/103			5. FUNDING NUMBERS
6. AUTHORS T.W. Malone			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) George C. Marshall Space Flight Center Marshall Space Flight Center, AL 35812			8. PERFORMING ORGANIZATION REPORT NUMBER M-1172
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) National Aeronautics and Space Administration Washington, DC 20546-0001			10. SPONSORING/MONITORING AGENCY REPORT NUMBER NASA/TM-2006-214603
11. SUPPLEMENTARY NOTES Prepared by the Materials and Processes Laboratory Engineering Directorate Supplemental DVD containing video footage of tests is available upon request			
12a. DISTRIBUTION/AVAILABILITY STATEMENT Unclassified-Unlimited Subject Category 26 Availability: NASA CASI 301-621-0390			12b. DISTRIBUTION CODE
13. ABSTRACT <i>(Maximum 200 words)</i> This Technical Memorandum presents qualification test results for solid rocket booster diagonal strut restraint cable part number 101276-00313-102/103. During flight this assembly is exposed to a range of temperatures. MIL-W-83420 shows the breaking strength of the cable as 798 kg (1,760 lb) at room temperature but does not define cable strength at the maximum temperature to which the cable is exposed during the first 2 min of flight; 669 °C (1,236 °F). The cable, which can be built from different corrosion resistant steel alloys, may also vary in its chemical, physical, and mechanical properties at temperature. Negative margins of safety were produced by analysis of the cable at temperature using standard knockdown factors. However, MSFC-HDBK-5 allows the use of a less conservative safety factor of 1.4 and knockdown factors verified by testing. Test results allowed a calculated knockdown factor of 0.1892 to be determined for the restraint cables, which provides a minimum breaking strength of 151 kg (333 lb) at 677 °C (1,250 °F) when combined with the minimum breaking strength of 0.317-cm (0.125- or 1/8-in) diameter, type 1 composition rope.			
14. SUBJECT TERMS SRB diagonal strut restraint cable assembly, materials tension testing, MSFC-HDBK-5, MIL-W-83420			15. NUMBER OF PAGES 100
			16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT Unlimited

National Aeronautics and

Space Administration

IS20

George C. Marshall Space Flight Center

Marshall Space Flight Center, Alabama

35812