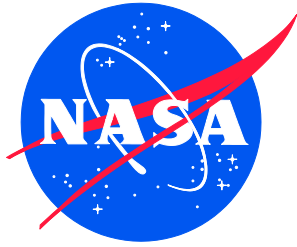


NASA/TM-2015-218781/Volume II/Part 2  
NESC-RP-12-00783



# Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

## *Appendices*

*Steven J. Gentz/NESC  
Langley Research Center, Hampton, Virginia*

*David O. Ordway, David S. Parsons, Craig M. Garrison, C. Steven Rodgers, and Brian W. Collins  
Marshall Space Flight Center, Huntsville, Alabama*

## NASA STI Program . . . 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 plays a key part in helping NASA maintain this important role.

The NASA STI program operates under the auspices of the Agency Chief Information Officer. It collects, organizes, provides for archiving, and disseminates NASA's STI. The NASA STI program provides access to the NTRS Registered and its public interface, the NASA Technical Reports Server, thus providing one of the largest collections of aeronautical and space science STI in the world. Results are published in both non-NASA channels and 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 counter-part 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.

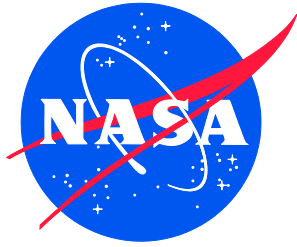
- **CONFERENCE PUBLICATION.** Collected papers from scientific and technical conferences, symposia, seminars, or other meetings sponsored or co-sponsored by NASA.
- **SPECIAL PUBLICATION.** Scientific, technical, or historical information from NASA programs, projects, and missions, often concerned with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

Specialized services also include organizing and publishing research results, distributing specialized research announcements and feeds, providing information desk and personal search support, and enabling data exchange services.

For more information about the NASA STI program, see the following:

- Access the NASA STI program home page at <http://www.sti.nasa.gov>
- E-mail your question to [help@sti.nasa.gov](mailto:help@sti.nasa.gov)
- Phone the NASA STI Information Desk at 757-864-9658
- Write to:  
NASA STI Information Desk  
Mail Stop 148  
NASA Langley Research Center  
Hampton, VA 23681-2199

NASA/TM-2015-218781/Volume II/Part 2  
NESC-RP-12-00783



# Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

## *Appendices*

*Steven J. Gentz/NESC  
Langley Research Center, Hampton, Virginia*

*David O. Ordway, David S. Parsons, Craig M. Garrison, C. Steven Rodgers, and Brian W. Collins  
Marshall Space Flight Center, Huntsville, Alabama*

National Aeronautics and  
Space Administration

Langley Research Center  
Hampton, Virginia 23681-2199

July 2015

## Acknowledgments

The team would like to acknowledge the following for providing their expertise:

Dr. Curt Larsen/Johnson Space Center (JSC), of the NESC, for championing the Pyroshock Characterization of Composites task.

Mr. Ken Johnson/MSFC for his tireless support statistically analyzing the post-processed acceleration data.

Mr. Lee Allen/MSFC for supporting Ken Johnson in statistically analyzing the post-processed data


Ms. Barbara Breithaupt/MSFC for post-processing the pseudo-velocity data.

Mr. Justin Jackson/MSFC for providing his expertise in composite test panel fabrication.

The use of trademarks or names of manufacturers in the report is for accurate reporting and does not constitute an official endorsement, either expressed or implied, of such products or manufacturers by the National Aeronautics and Space Administration.

Available from:

NASA STI Program / Mail Stop 148  
NASA Langley Research Center  
Hampton, VA 23681-2199  
Fax: 757-864-6500


	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP- 12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>			Page #: 1 of 832

**Empirical Model Development for Predicting Shock Response on Composite  
Materials Subjected to Pyroshock Loading**

**Volume II: Appendices**

**Part 2**


**April 16, 2015**

	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 2 of 832	

## Table of Contents

### Technical Assessment Report Volume 2; Part 2


B3.	Group II (Sandwich Panel Tests).....	3
B4.	Group III (Sandwich Panel Tests).....	314

	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 3 of 832	

## Appendix B. Pyroshock Test Reports (continued)

### B3. Group II (Sandwich Panel Tests)

The test report documenting the test results for the Group II composite sandwich panel tests are documented in the attachment below.

	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 4 of 832	

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



January 27, 2015

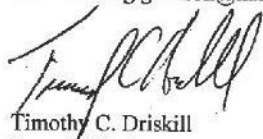
Reply to Asth of: ET40-15-007

TO: EV32/David O. Ordway  
 FROM: ET40/Timothy C. Driskill  
 SUBJECT: Composite Materials Pyroshock Development Test, Group II – Tests 11-18,  
 NESC-DEV-13-026  
 REF: ED73.1

The composite sandwich panel test articles were tested in the ET40 Pyrotechnic Shock Facility, building 4619, room 170. Testing was completed on August 19, 2013. The test was run in accordance with Test and Checkout Procedure, (TCP) NESC-DEV-13-026. Eight tests were run on 8 different composite sandwich panels.

The accelerometer test setup is shown in the photographs section of this report. The aluminum LSC panel did not completely sever in Group II Test No. 11, panel 11. No visual damage to the test articles was noted.

Please direct any questions or comments regarding this test to Mr. Craig Garrison at (256) 544-7197 or [craig.garrison@nasa.gov](mailto:craig.garrison@nasa.gov).




Timothy C. Driskill  
 Branch Chief  
 Structural Dynamics Test Branch

Enclosure


cc:

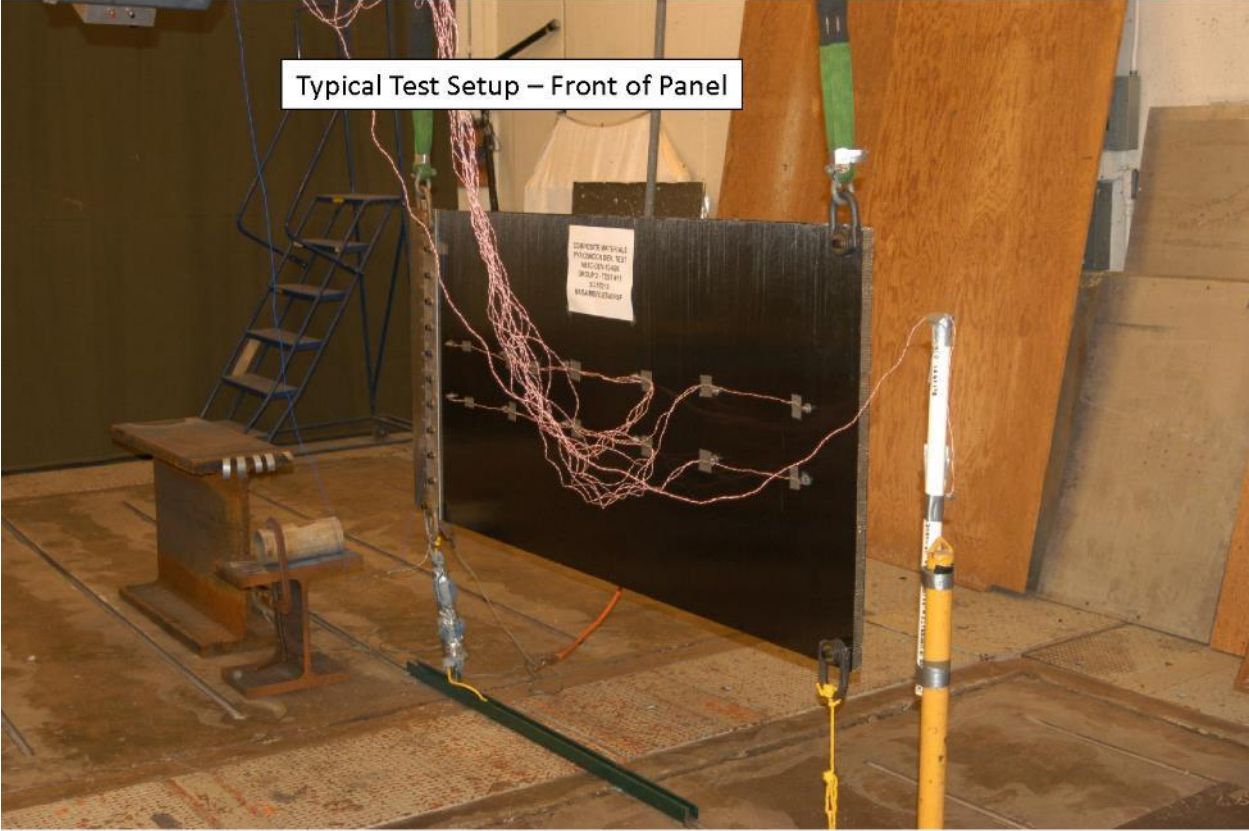
ET01/File (w/o enclosure)  
 C105/Steven J. Gentz  
 ES22/David S. Parsons




	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP- 12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>			Page #: 5 of 832

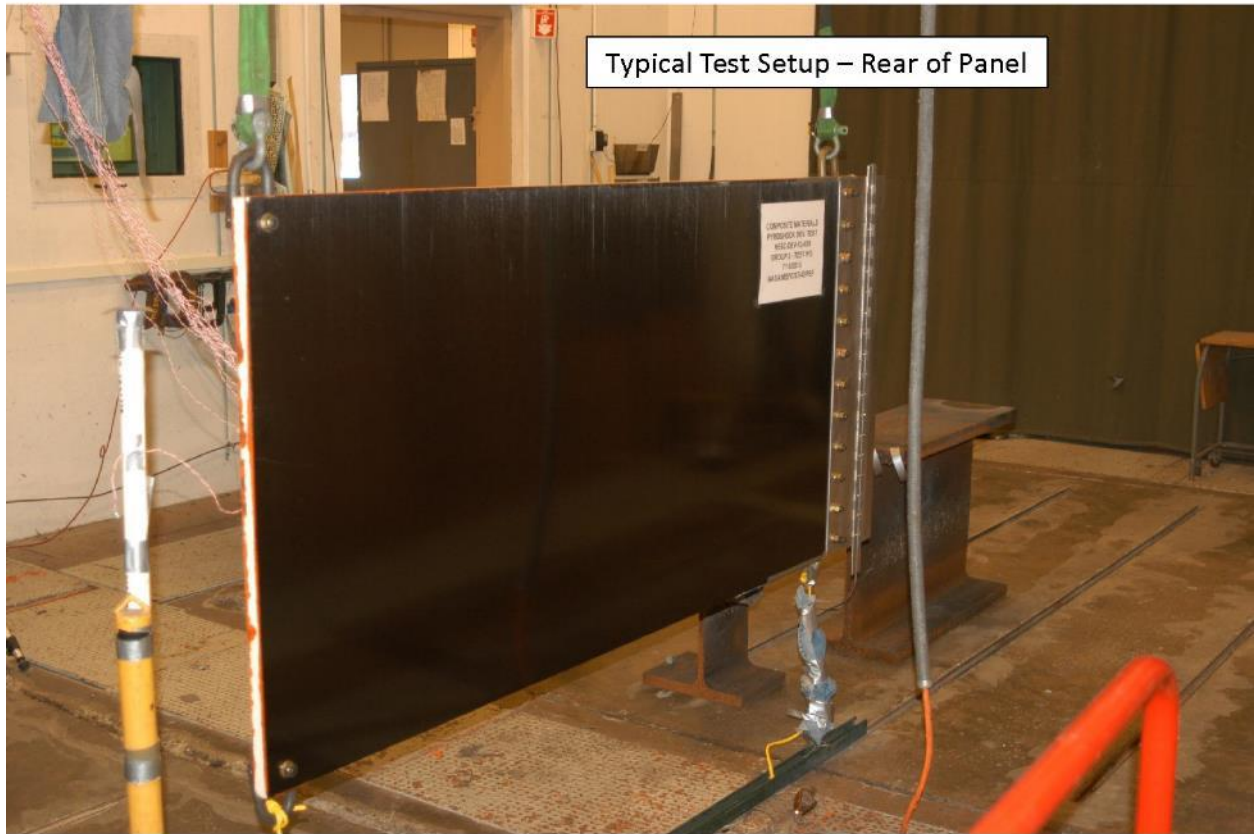
**NESC-DEV-13-026  
Composite Materials  
Shock Test  
  
General Test Setup**

	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 6 of 832</p>	



3 of 310

	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 7 of 832</p>	



4 of 310



# NASA Engineering and Safety Center Technical Assessment Report

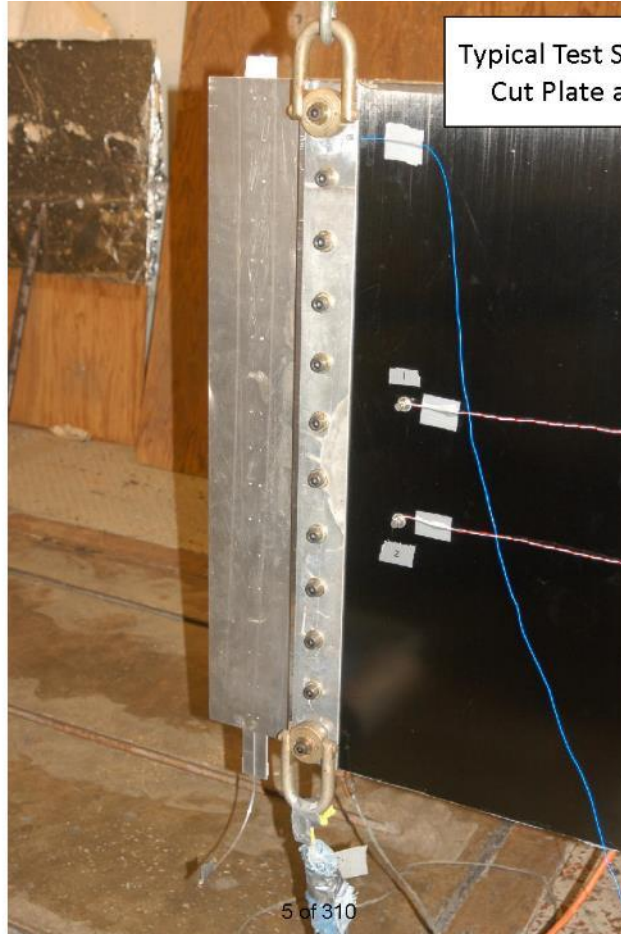
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
8 of 832





# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**


Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading


Page #:  
9 of 832

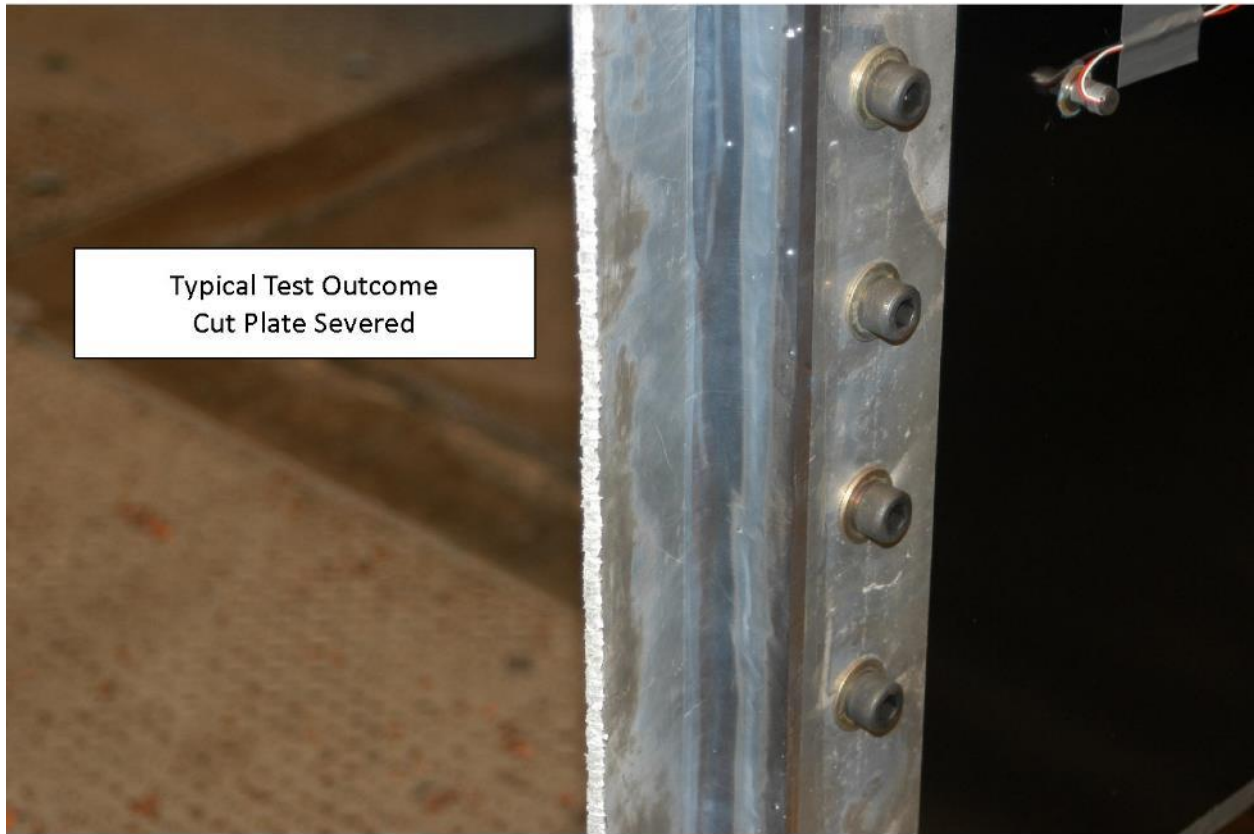


	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>			Page #: 10 of 832



7 of 310

	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 11 of 832</p>	



Typical Test Outcome  
Cut Plate Severed



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**

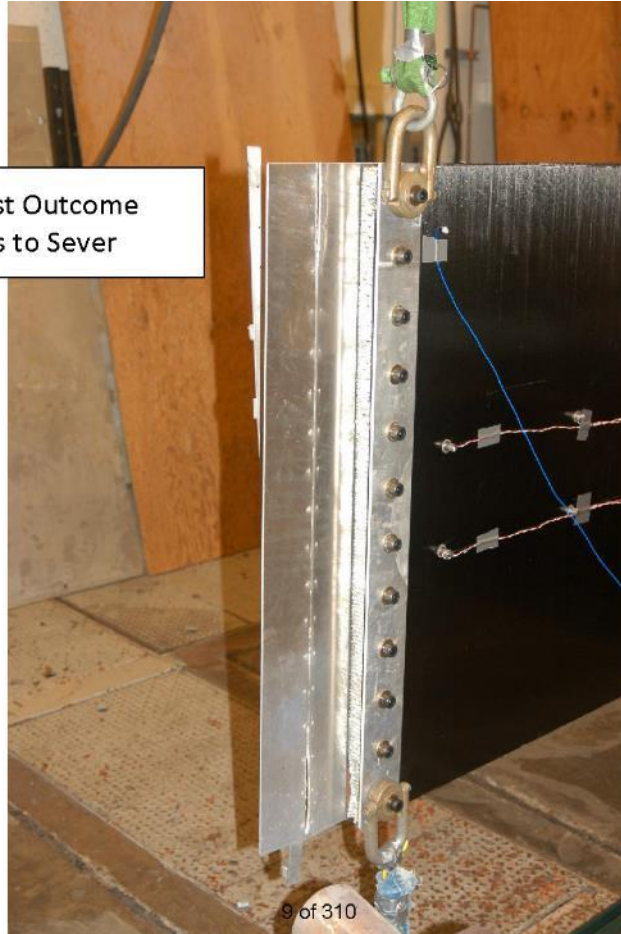
Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
12 of 832

Non-Typical Test Outcome  
Cut Plate Fails to Sever







# NASA Engineering and Safety Center Technical Assessment Report

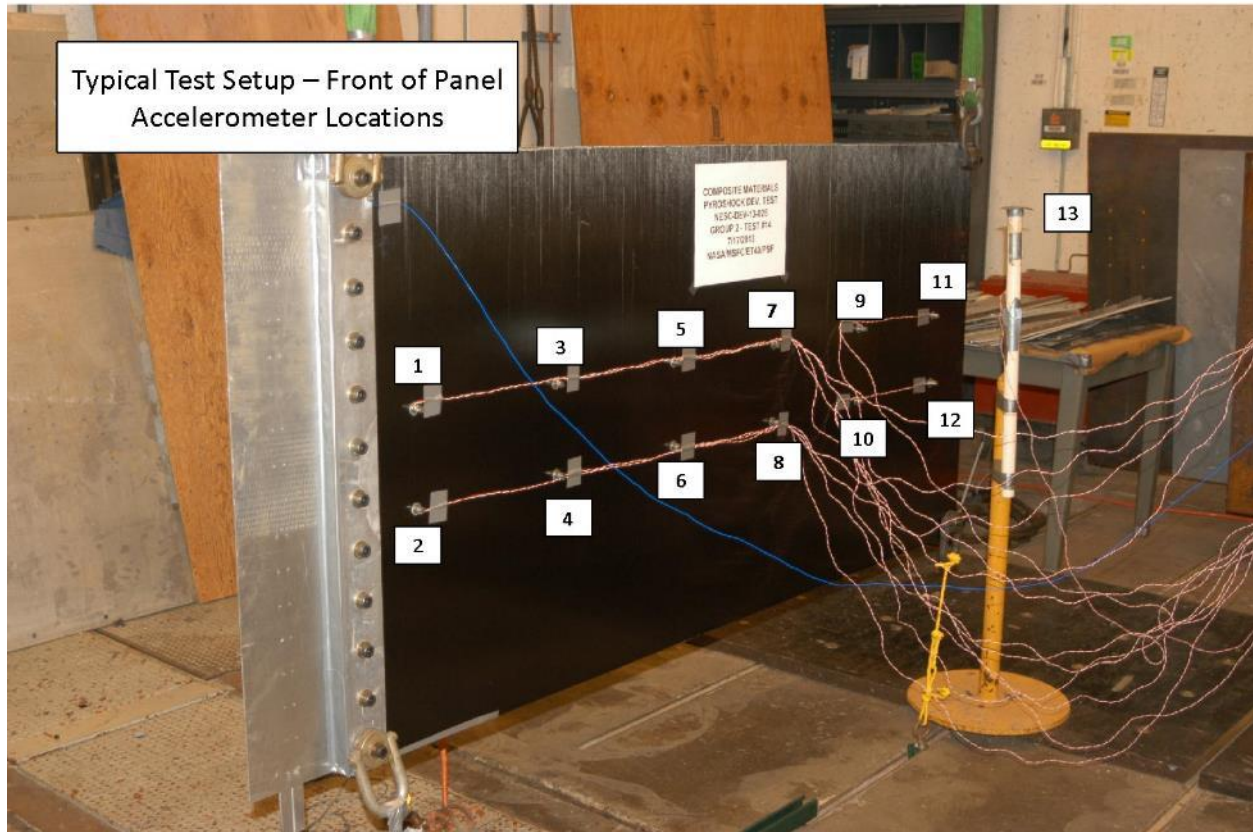
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
13 of 832



10 of 310



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
14 of 832

Test Matrix As Run			
Test	Date	Panel ID	Test ID
1	5-31-13	0332A011	Group 2 Test 11
2	6-28-13	0332A014	Group 2 Test 12
3	7-16-13	0332A013	Group 2 Test 13
4	7-17-13	0332A012	Group 2 Test 14
5	7-18-13	0332A016	Group 2 Test 15
6	7-23-13	0332A018	Group 2 Test 16
7	8-9-13	0332A015	Group 2 Test 17
8	8-19-13	0332A017	Group 2 Test 18



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
15 of 832

Panel Location	Set 1 Accelerometers	Set 2 Accelerometers
1	350C02 31334	350D02 43026
2	350D02 43026	350C02 31340
3	350D02 43028	350C02 31338
4	350C02 31331	350D02 43028
5	350C02 31328	350D02 43029
6	350D02 43029	350C02 31333
7	350D02 43179	350C02 40292
8	350C02 31351	350D02 43179
9	350C02 31330	350D02 43180
10	350D02 43180	350C02 40295
11	350D02 43181	350C02 31336
12	350C02 40274	350D02 43181
13	350B02 11439	350B02 11439

Set 1 used in tests 1, 3, 7, and 8  
Set 2 used in tests 2, 4, 5, and 6



# NASA Engineering and Safety Center Technical Assessment Report

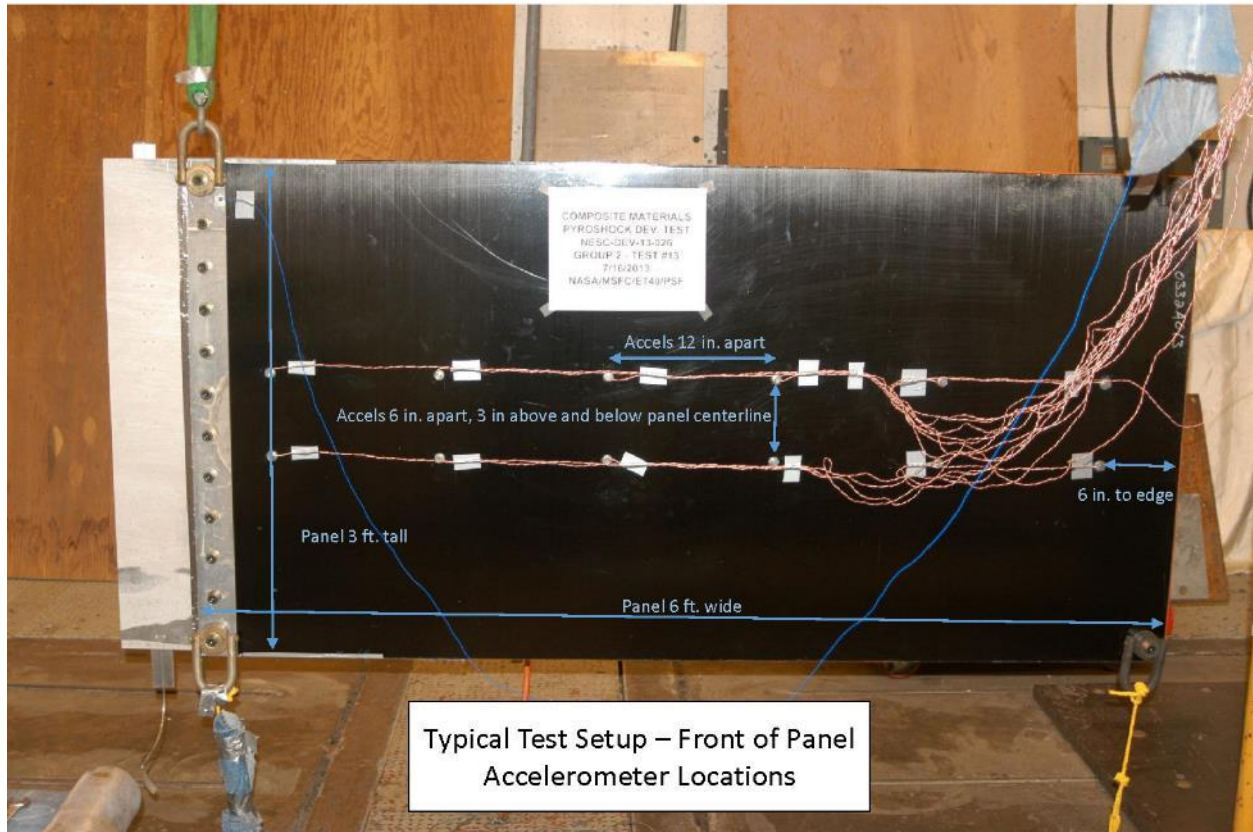
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**


Title:

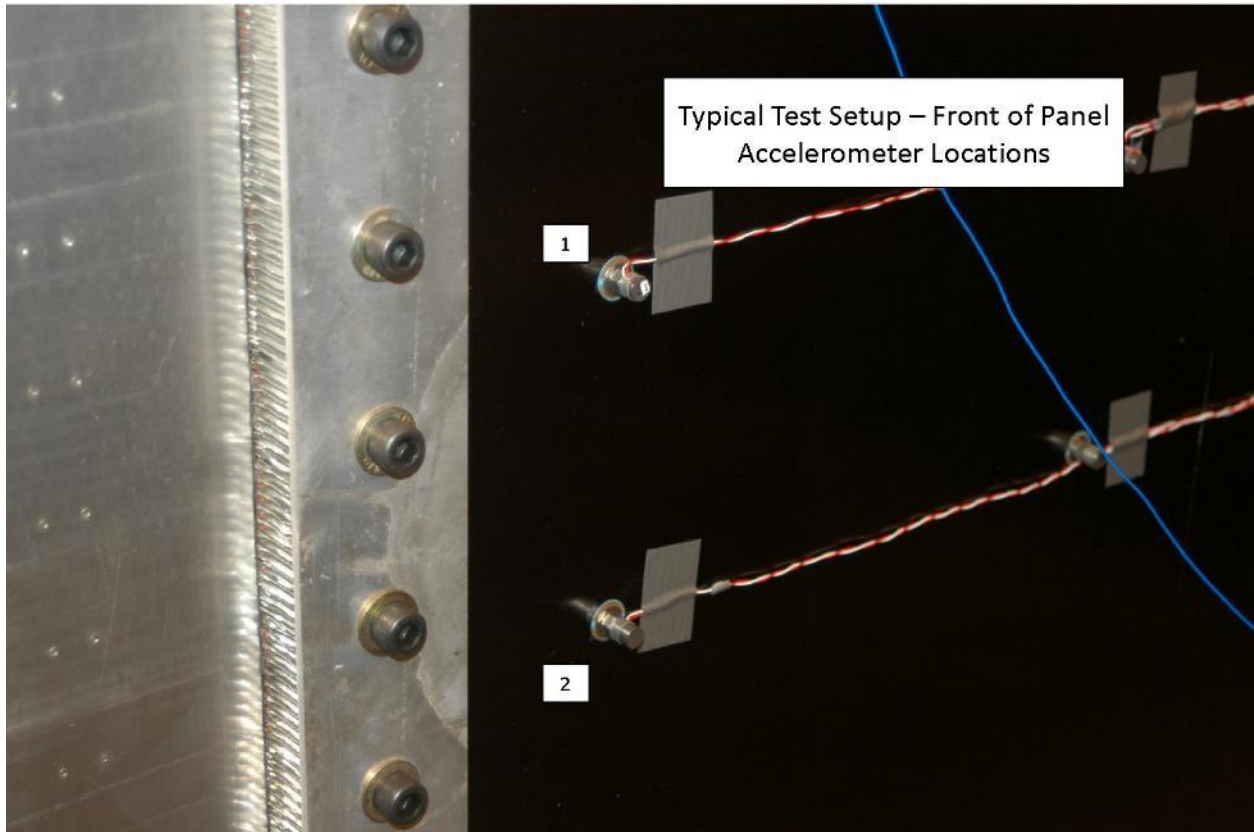
**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**


Page #:  
16 of 832

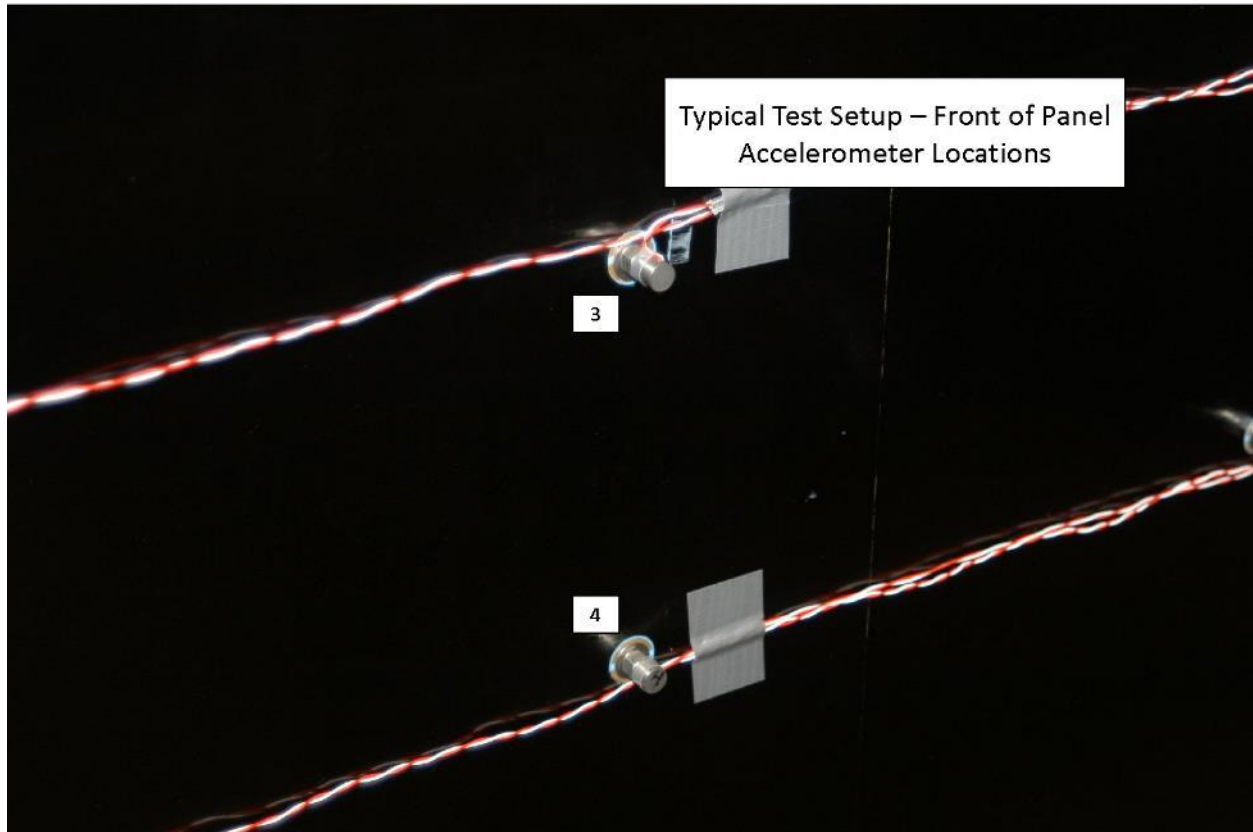



13 of 310

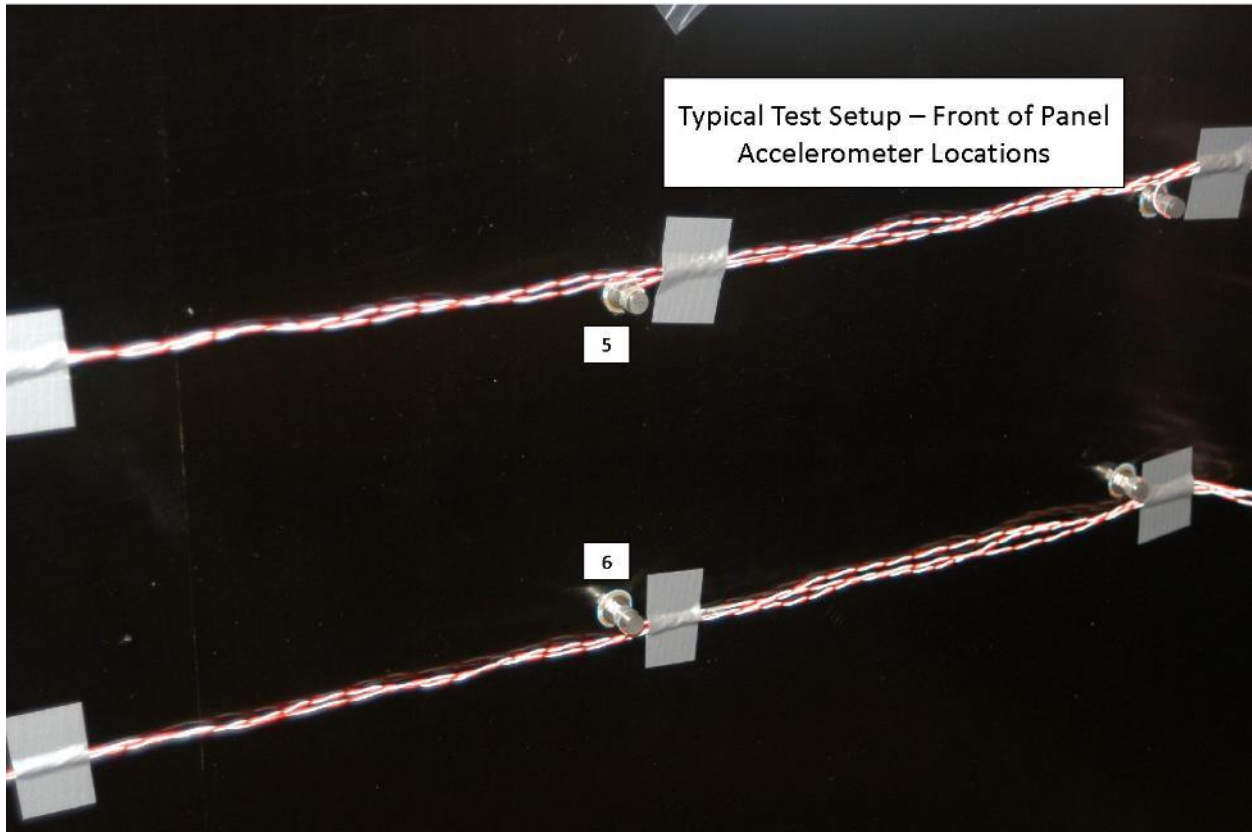
	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 17 of 832</p>	




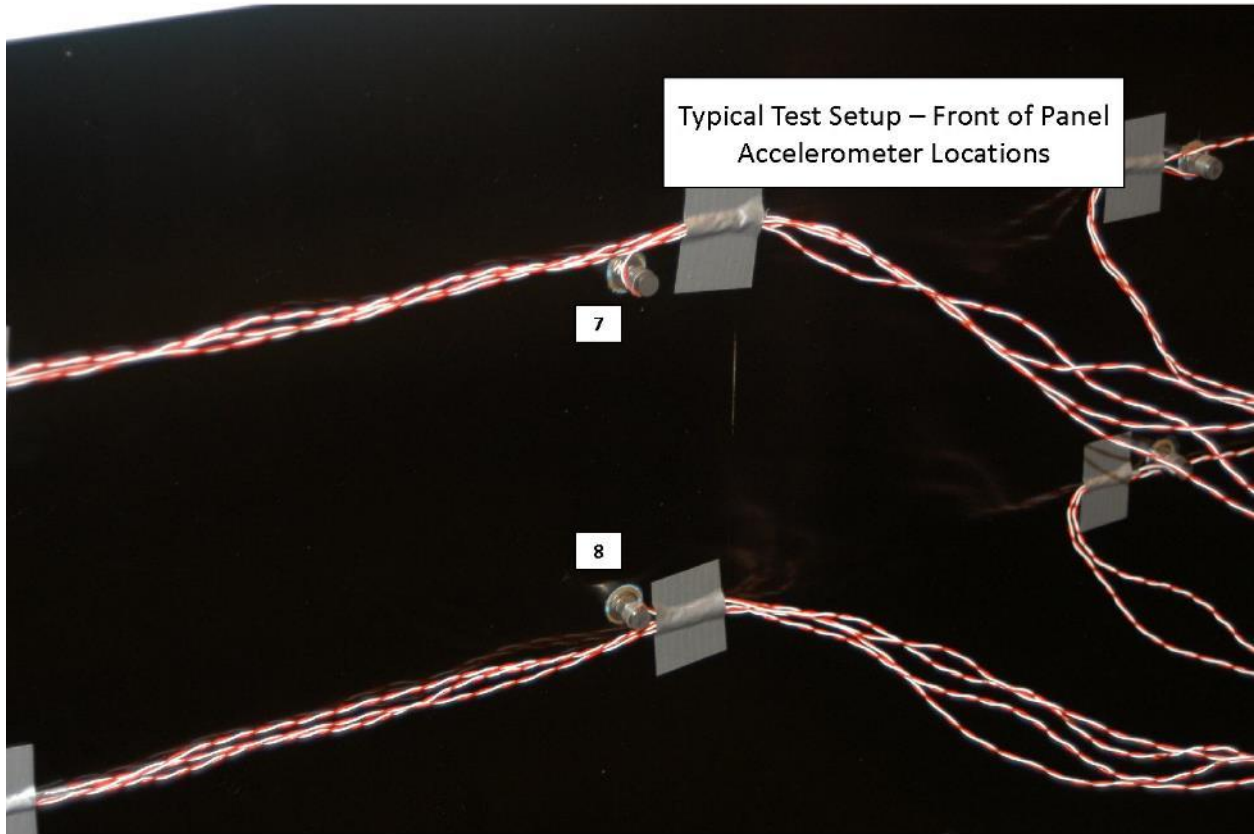
	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 18 of 832	




	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 19 of 832</p>	

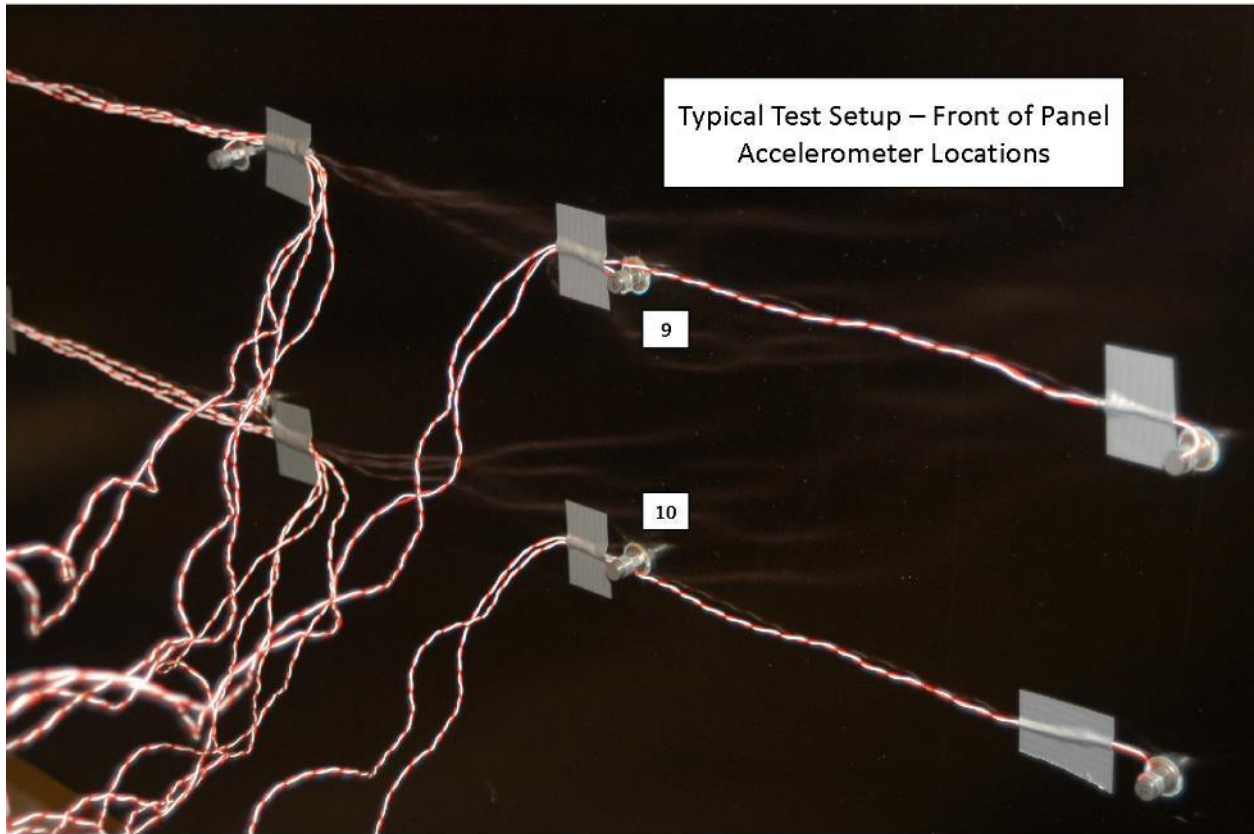



	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 20 of 832</p>	

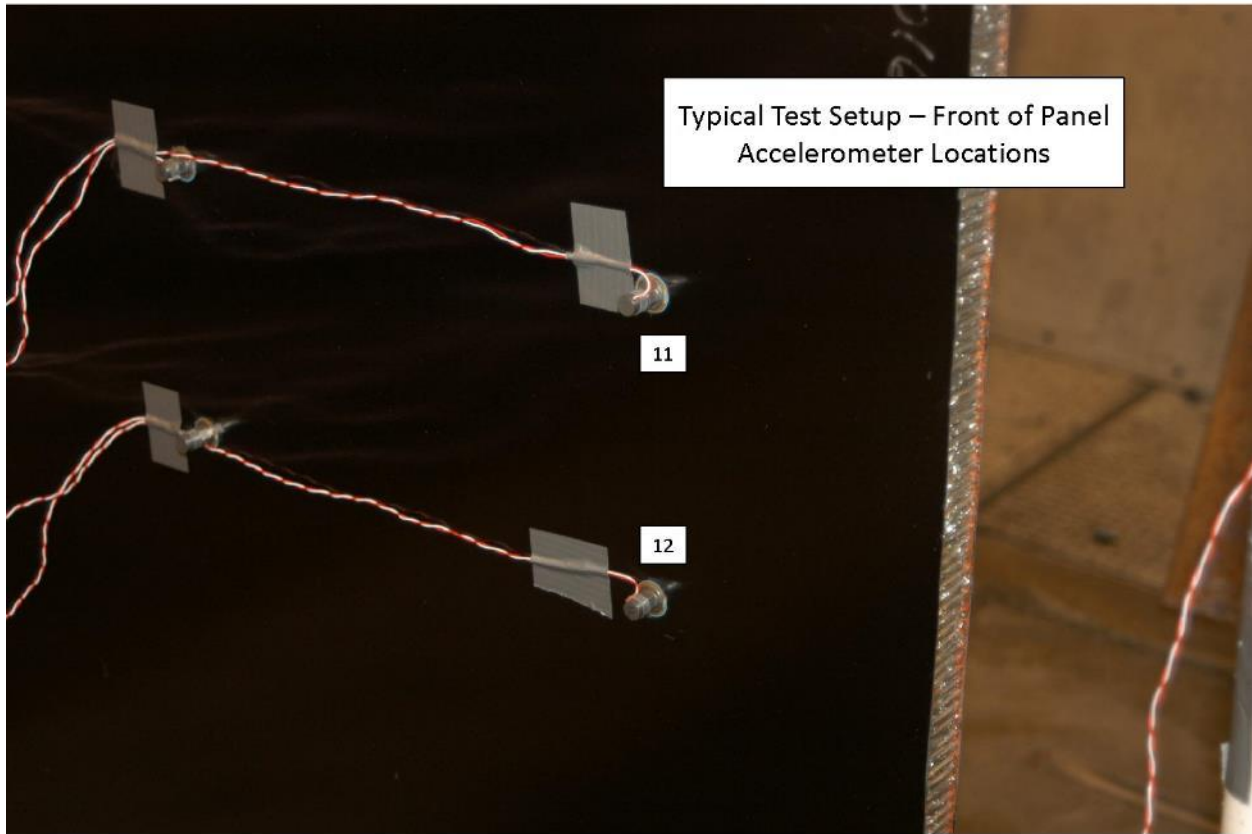




	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 21 of 832</p>	



	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 22 of 832</p>	





# NASA Engineering and Safety Center Technical Assessment Report

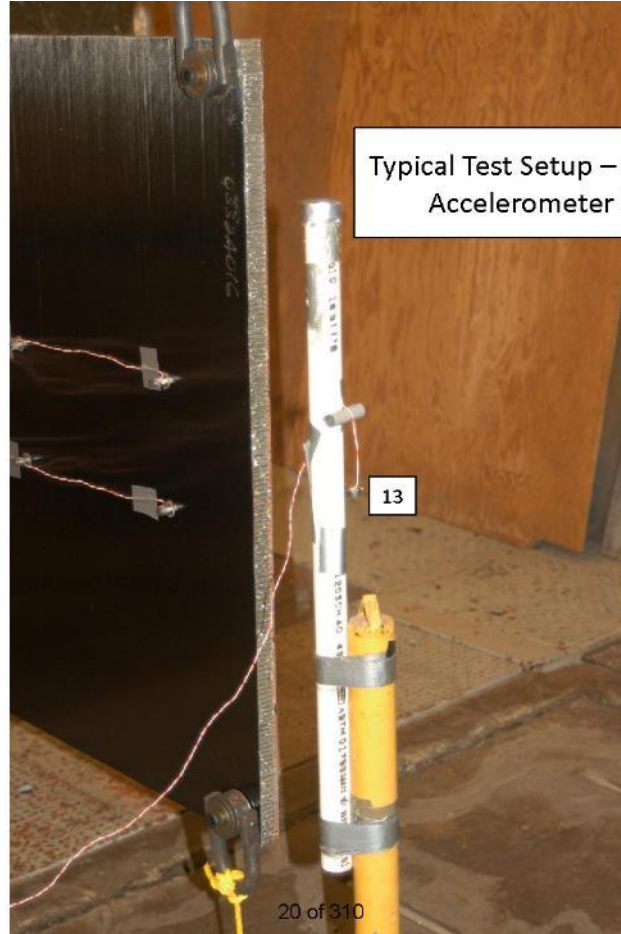
Document #:  
**NESC-RP-  
12-00783**


Version:  
**1.0**

Title:


## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

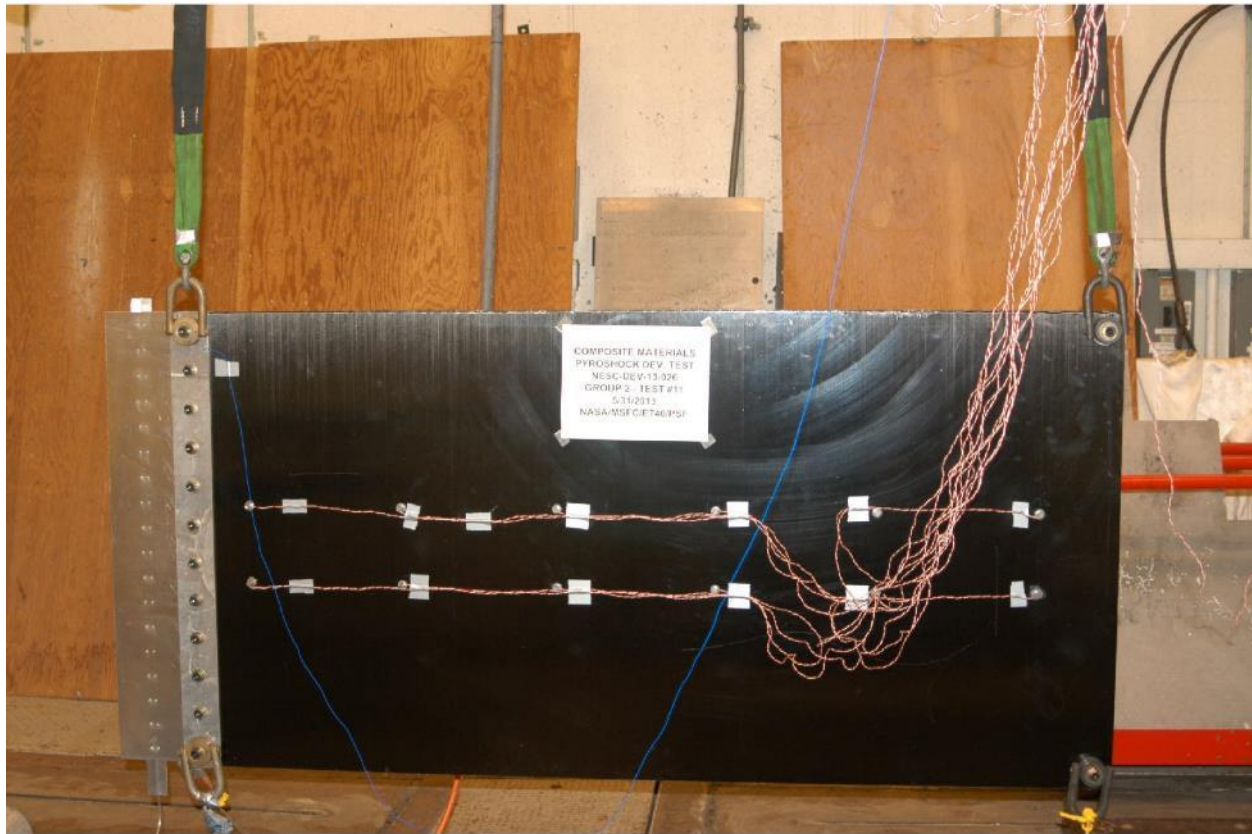
Page #:  
23 of 832



	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 24 of 832</p>	

**NESC-DEV-13-026**  
**Composite Materials**  
**Shock Test**  
  
**Test #1 Setup**

	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 25 of 832	



22 of 310



# NASA Engineering and Safety Center Technical Assessment Report

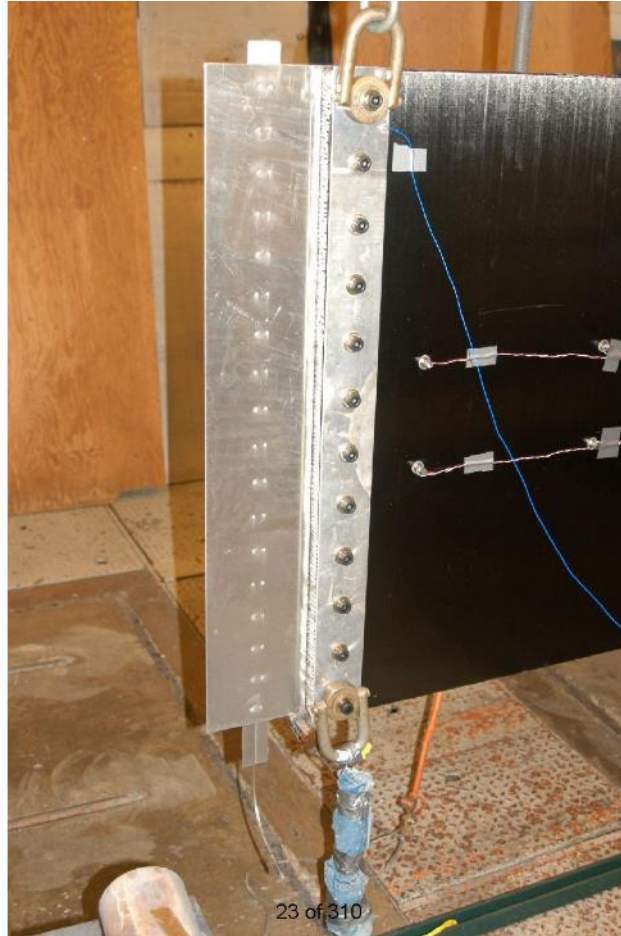
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
26 of 832





# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**


Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
27 of 832




	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 28 of 832</p>	




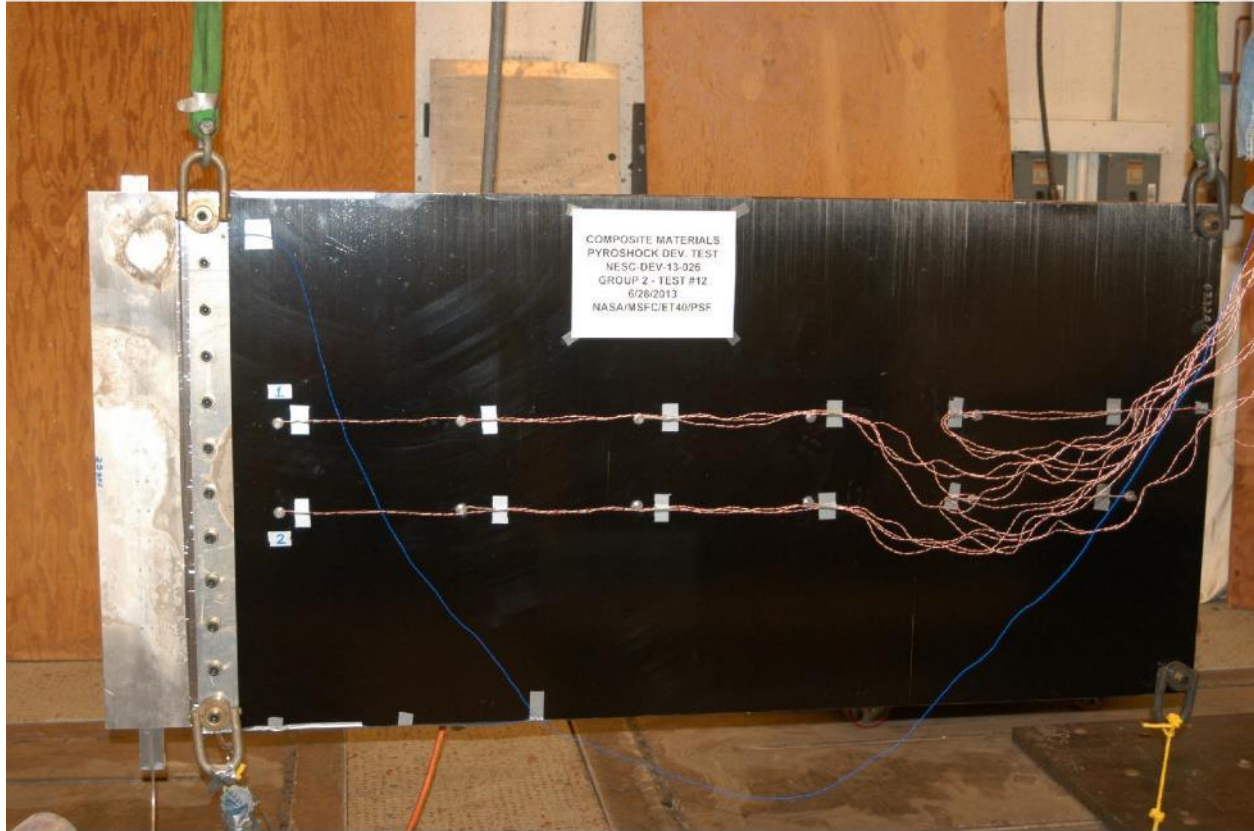
25 of 310



	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 29 of 832</p>	

**NESC-DEV-13-026**  
**Composite Materials**  
**Shock Test**  
  
**Test #2 Setup**

	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 30 of 832</p>	



27 of 310



# NASA Engineering and Safety Center Technical Assessment Report

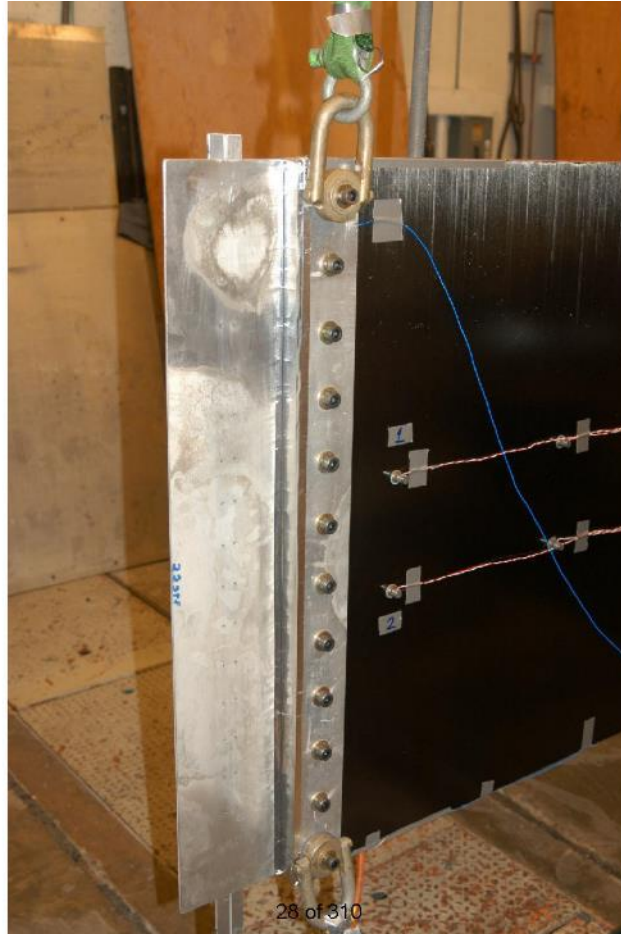
Document #:  
**NESC-RP-  
12-00783**


Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**


Page #:  
31 of 832



	<b>NASA Engineering and Safety Center          Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 32 of 832	




29 of 310


	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 33 of 832	

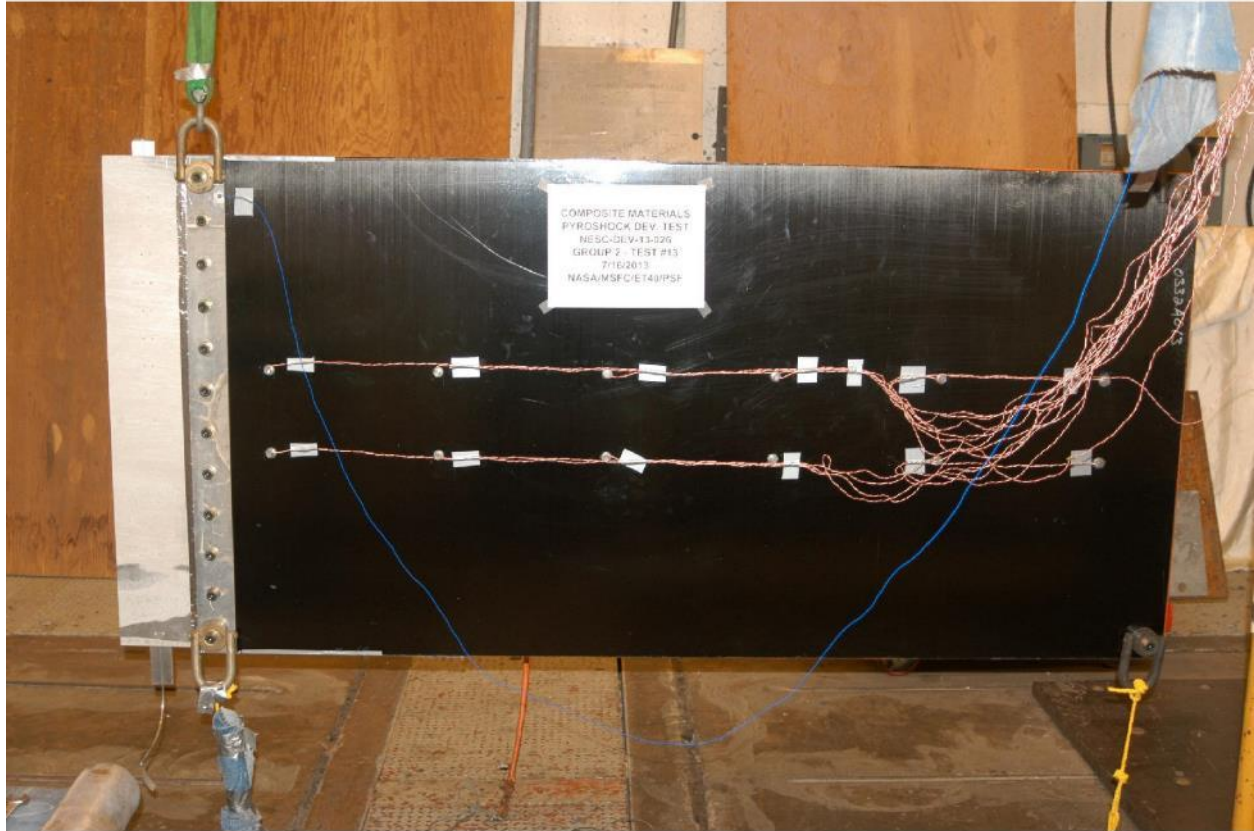


30 of 310

	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 34 of 832	

**NESC-DEV-13-026**  
**Composite Materials**  
**Shock Test**  
  
**Test #3 Setup**

	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 35 of 832</p>	





# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**


Title:

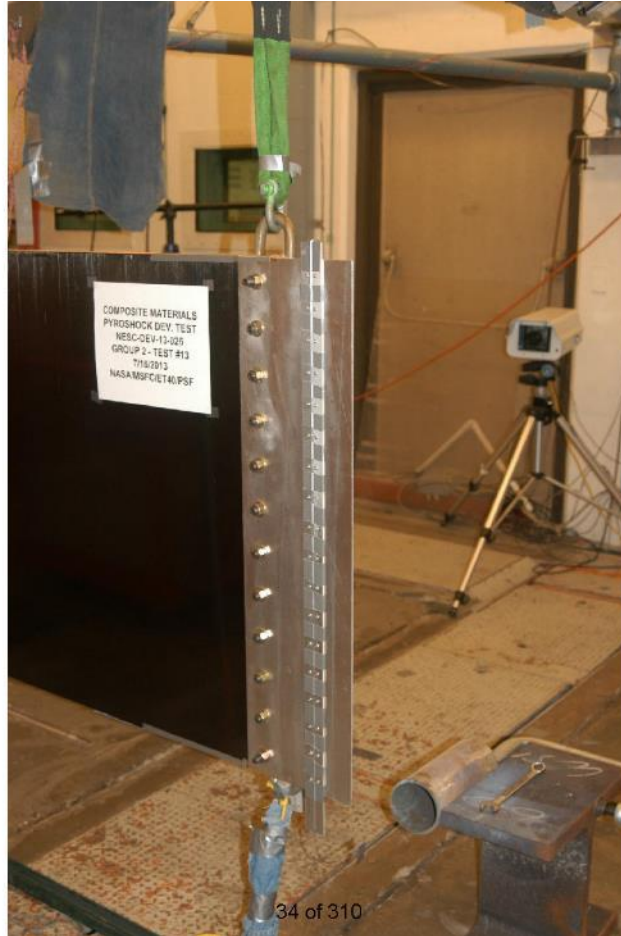
**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
36 of 832






	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 37 of 832	




34 of 310


	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 38 of 832</p>	

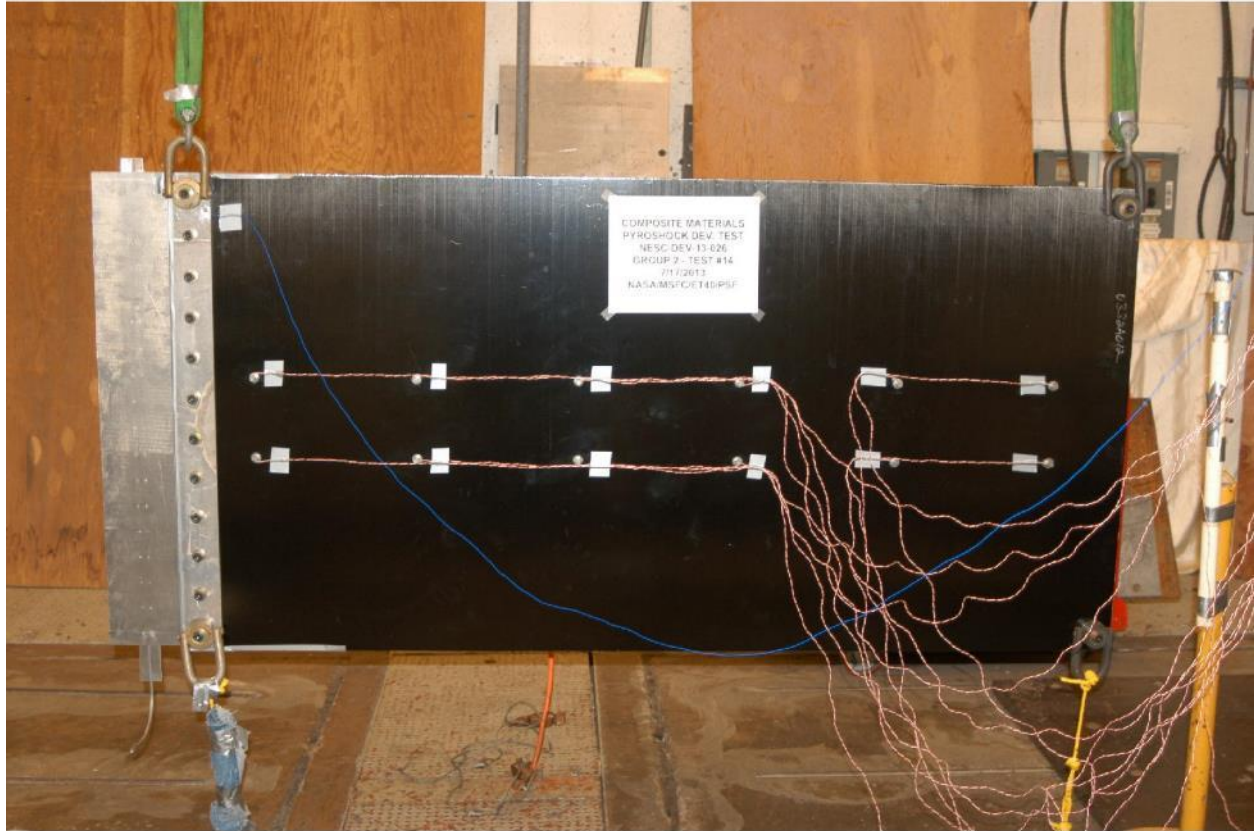


35 of 310

	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 39 of 832	

**NESC-DEV-13-026**  
**Composite Materials**  
**Shock Test**  
  
**Test #4 Setup**

	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 40 of 832</p>	



37 of 310



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
41 of 832





# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
42 of 832





# NASA Engineering and Safety Center Technical Assessment Report

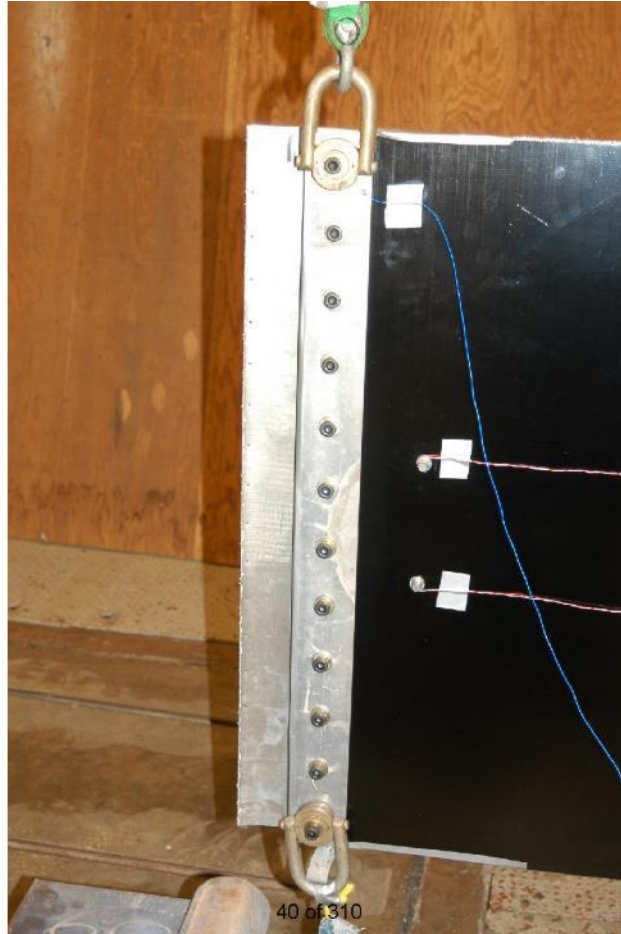
Document #:  
**NESC-RP-  
12-00783**


Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**


Page #:  
43 of 832

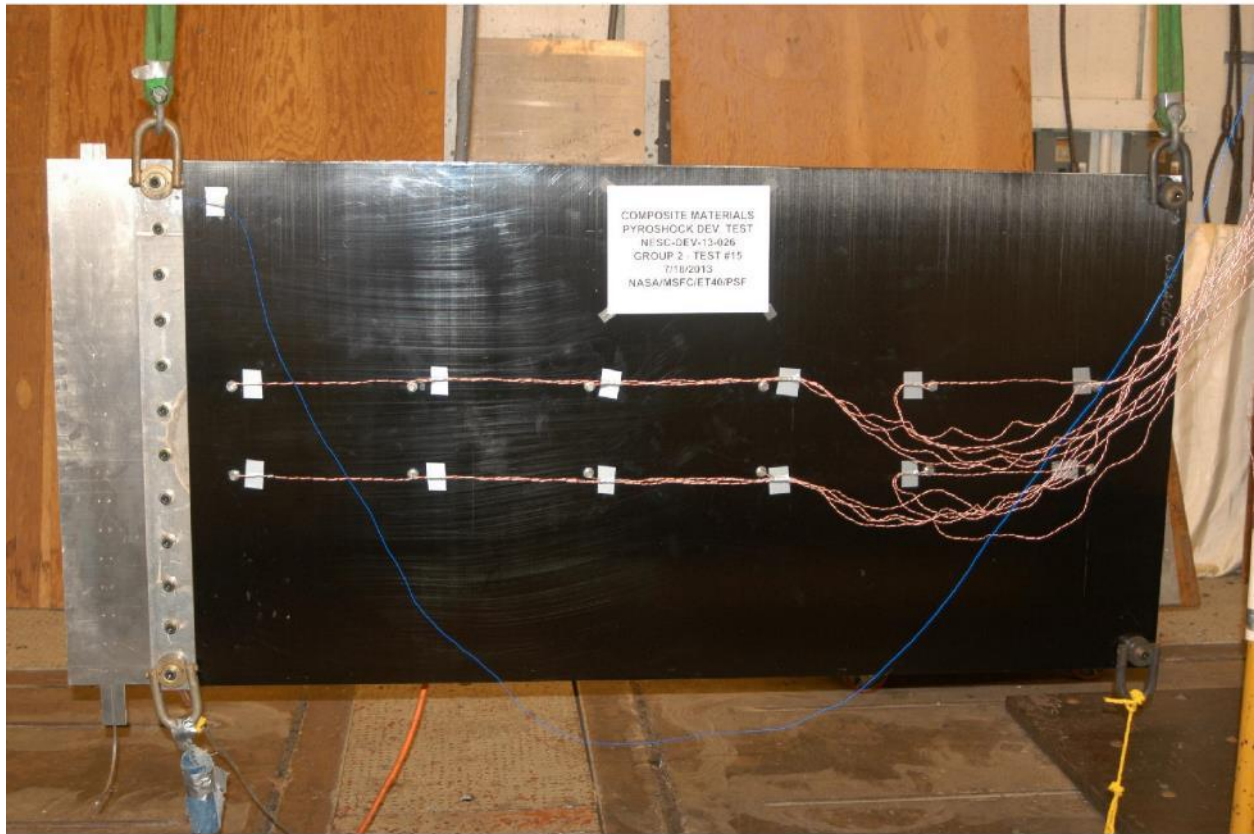


	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP- 12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 44 of 832	

**NESC-DEV-13-026  
Composite Materials  
Shock Test  
  
Test #5 Setup**



	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 45 of 832</p>	



42 of 310



# NASA Engineering and Safety Center Technical Assessment Report

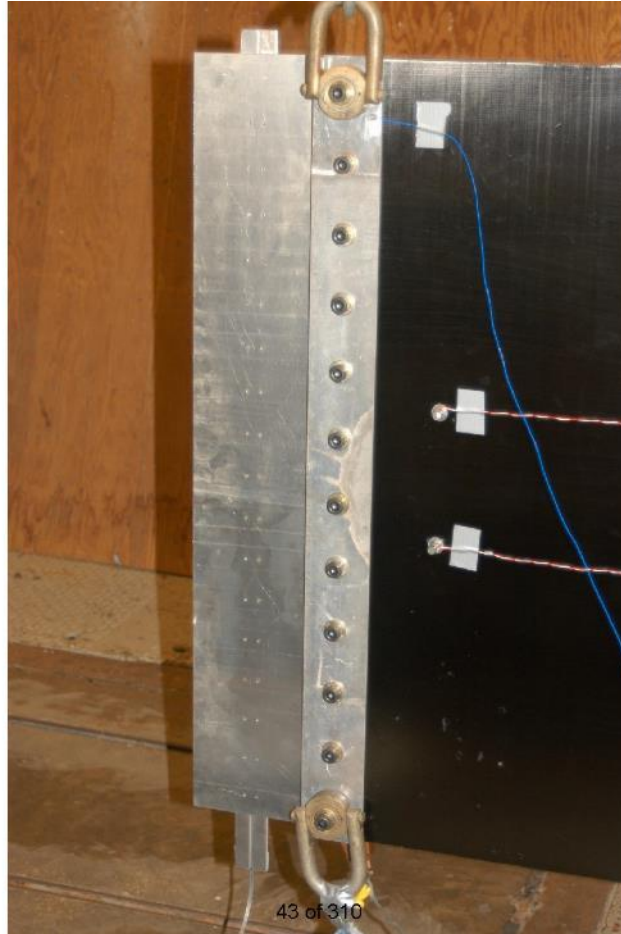
Document #:  
**NESC-RP-  
12-00783**


Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
46 of 832



	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 47 of 832	





# NASA Engineering and Safety Center Technical Assessment Report

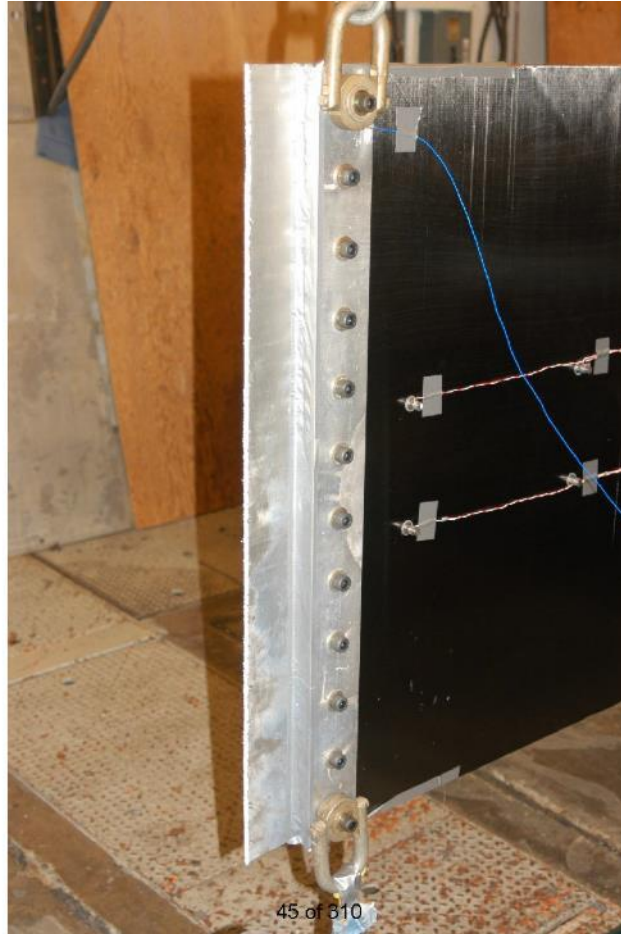
Document #:  
**NESC-RP-  
12-00783**


Version:  
**1.0**

Title:


**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

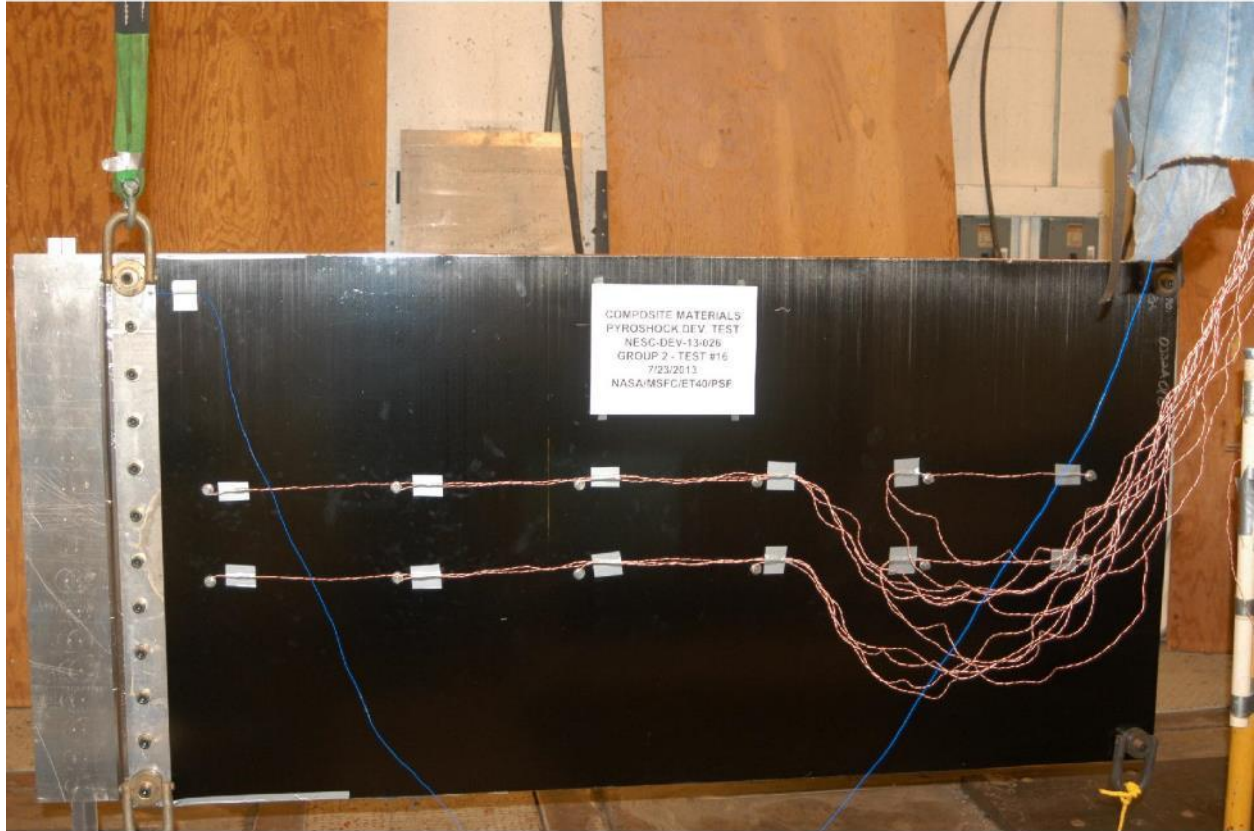
Page #:  
48 of 832



	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 49 of 832	

**NESC-DEV-13-026**  
**Composite Materials**  
**Shock Test**  
  
**Test #6 Setup**

	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 50 of 832	





# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
51 of 832



48 of 310



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**


Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
52 of 832







	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 53 of 832</p>	

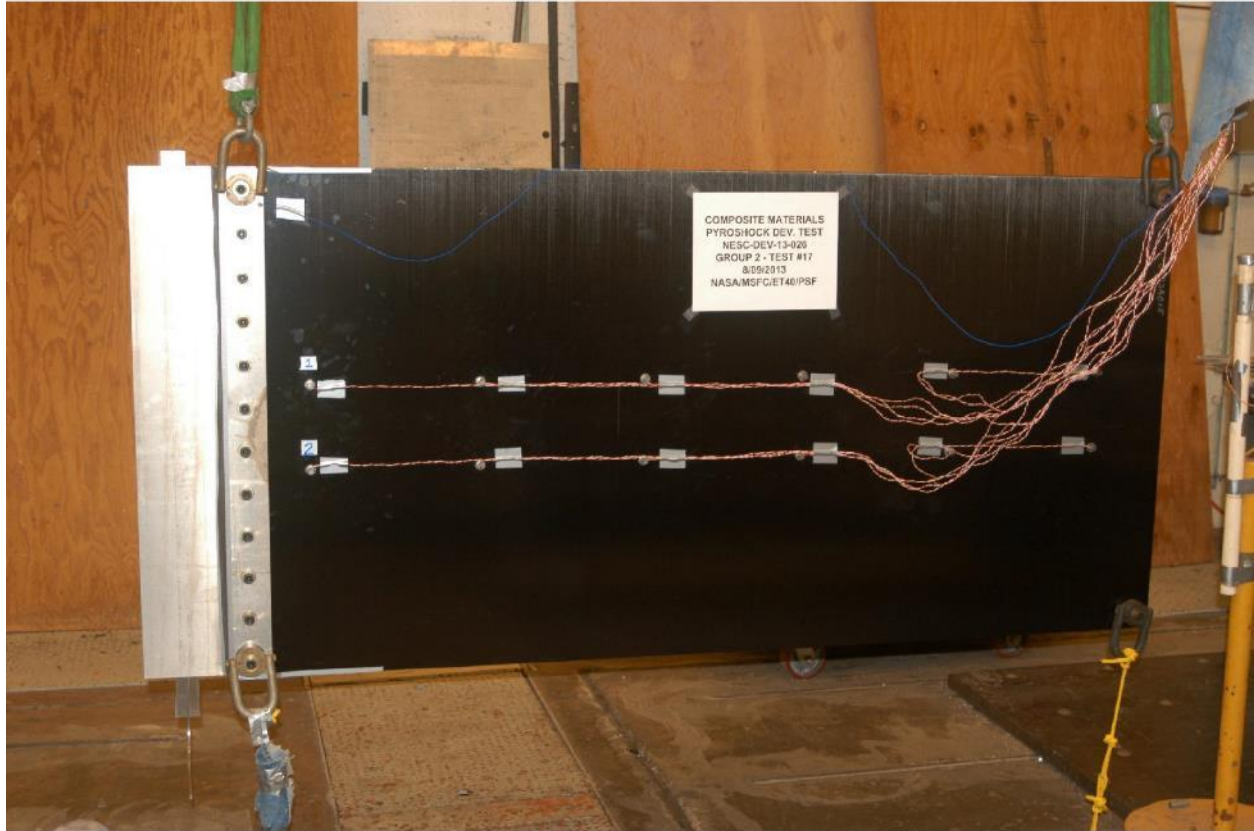


50 of 310

	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 54 of 832</p>	

**NESC-DEV-13-026**  
**Composite Materials**  
**Shock Test**  
  
**Test #7 Setup**

	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 55 of 832</p>	





# NASA Engineering and Safety Center Technical Assessment Report

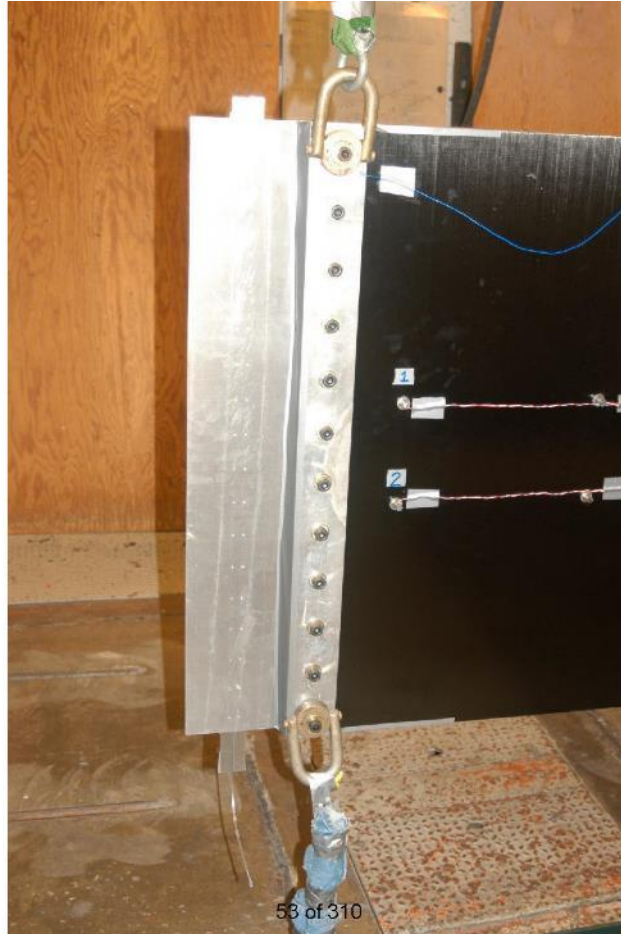
Document #:  
**NESC-RP-  
12-00783**


Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
56 of 832



	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 57 of 832</p>	



54 of 310



# NASA Engineering and Safety Center Technical Assessment Report

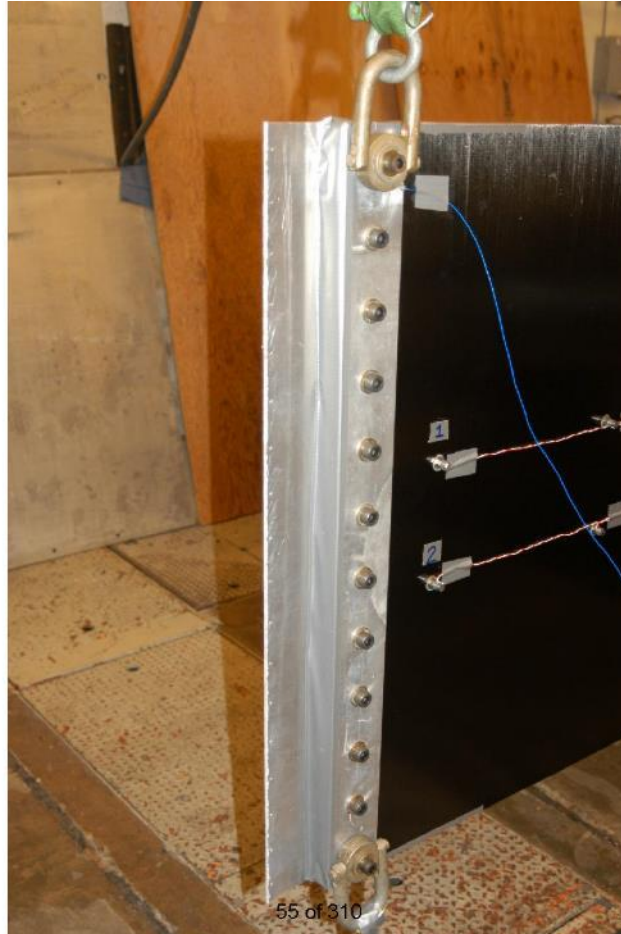
Document #:  
**NESC-RP-  
12-00783**


Version:  
**1.0**

Title:


**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

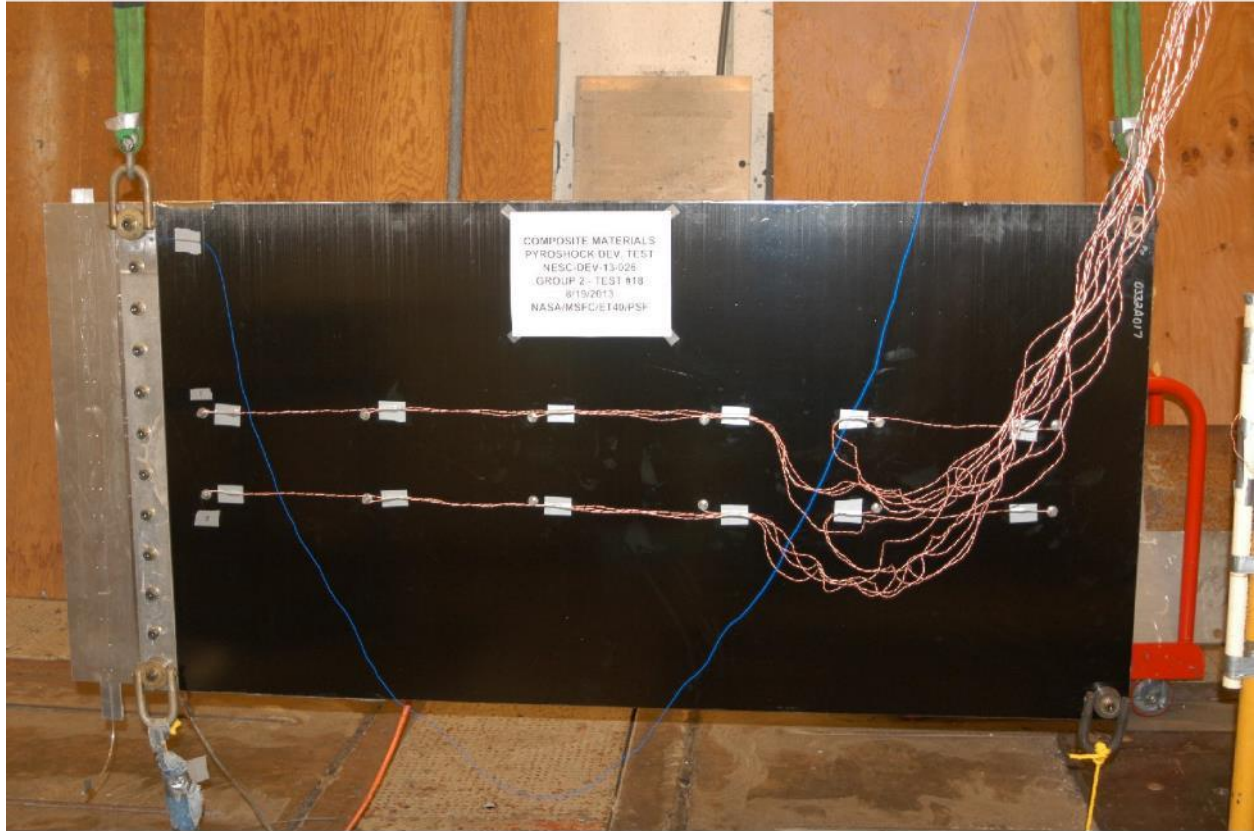
Page #:  
58 of 832



	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 59 of 832</p>	

**NESC-DEV-13-026**  
**Composite Materials**  
**Shock Test**  
  
**Test #8 Setup**

	<b>NASA Engineering and Safety Center          Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 60 of 832	



57 of 310





# NASA Engineering and Safety Center Technical Assessment Report

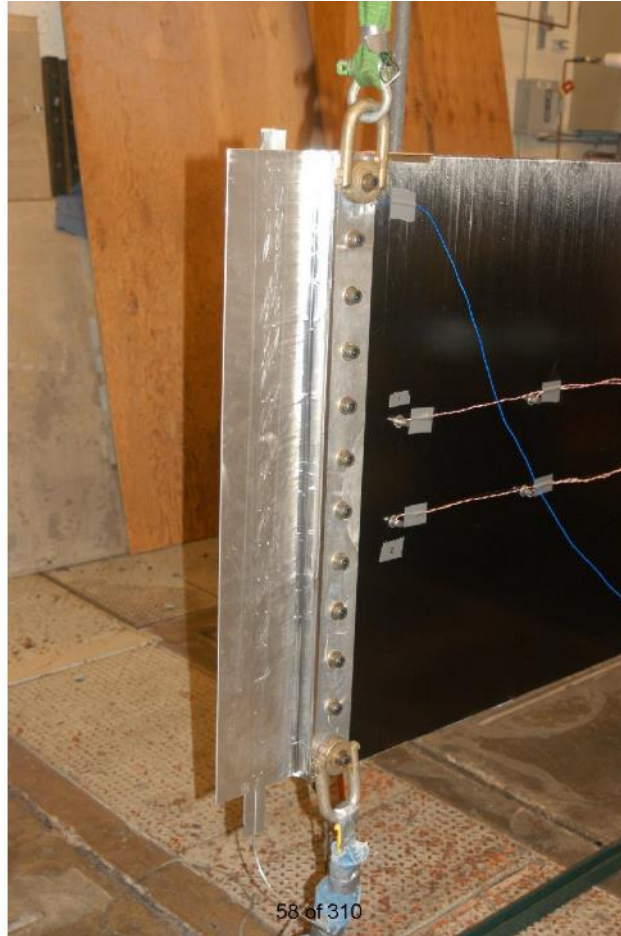
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
61 of 832





# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**


Version:  
**1.0**

Title:


**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
62 of 832



	<b>NASA Engineering and Safety Center          Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 63 of 832	



	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP- 12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 64 of 832	

**NESC-DEV-13-026  
Composite Materials  
Shock Test  
  
Test #1 Accelerometer Data  
Panel 0332A011**



# NASA Engineering and Safety Center Technical Assessment Report

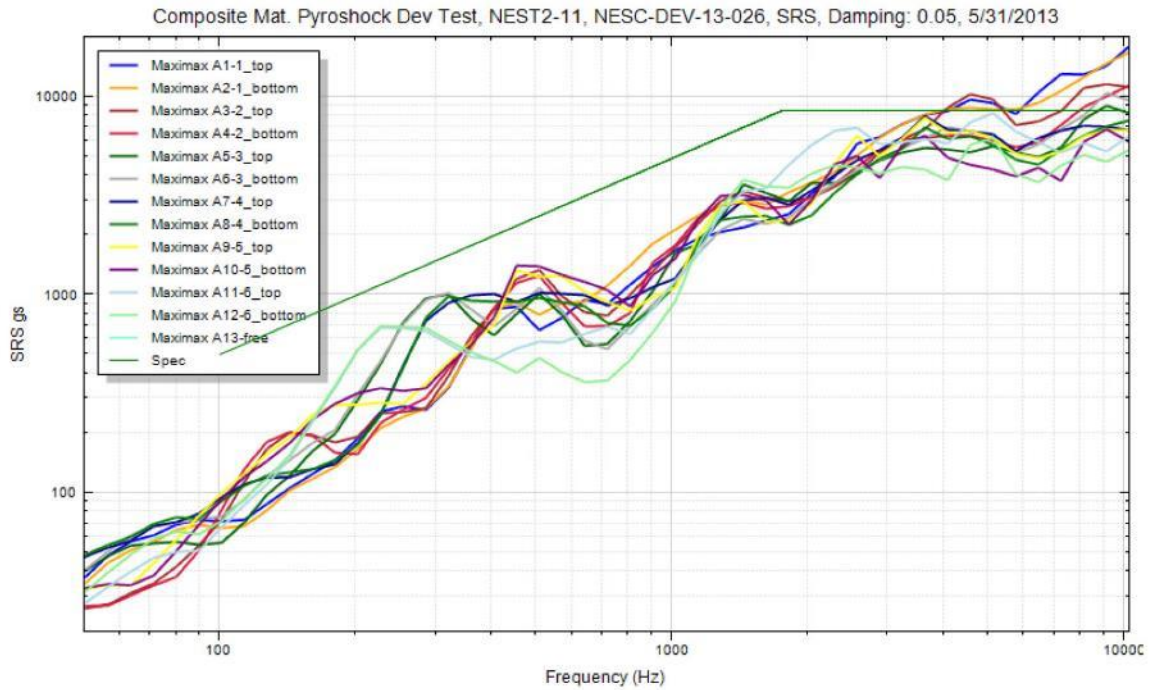
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
65 of 832





# NASA Engineering and Safety Center Technical Assessment Report

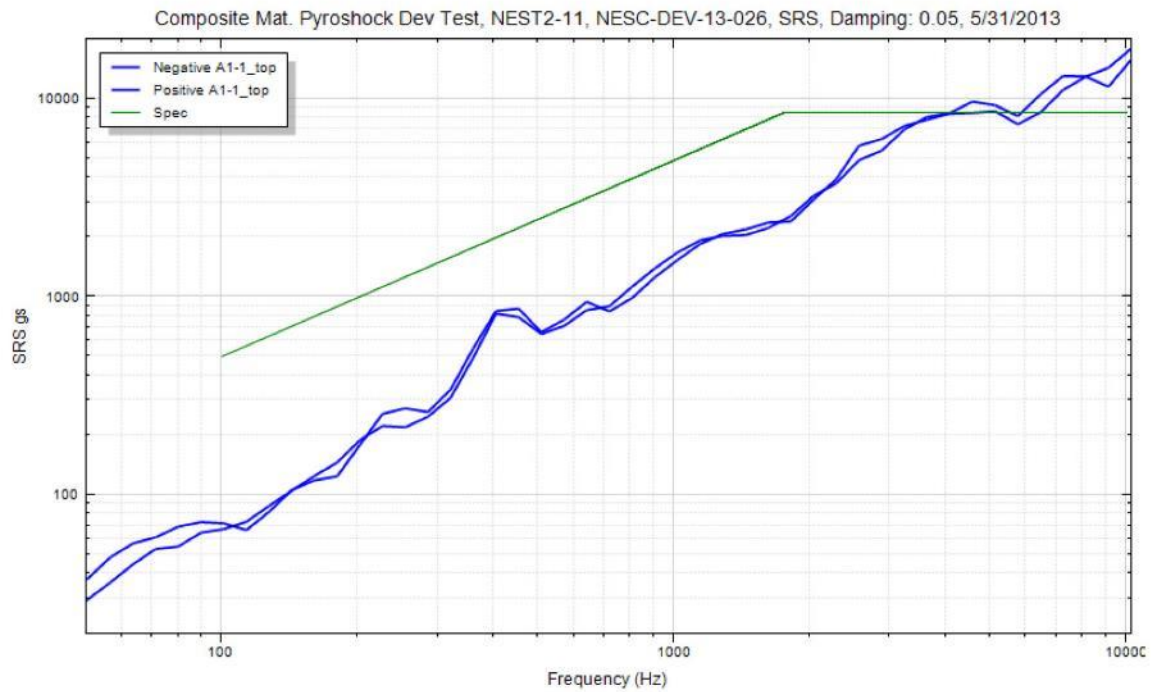
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
66 of 832





# NASA Engineering and Safety Center Technical Assessment Report

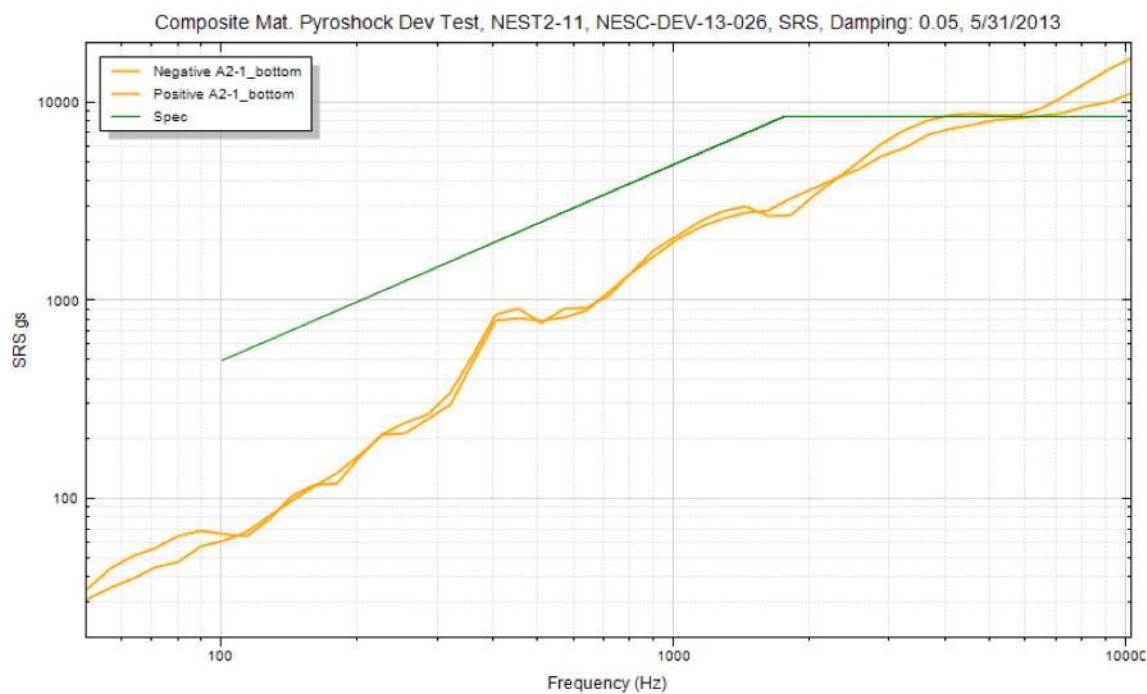
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
67 of 832





# NASA Engineering and Safety Center Technical Assessment Report

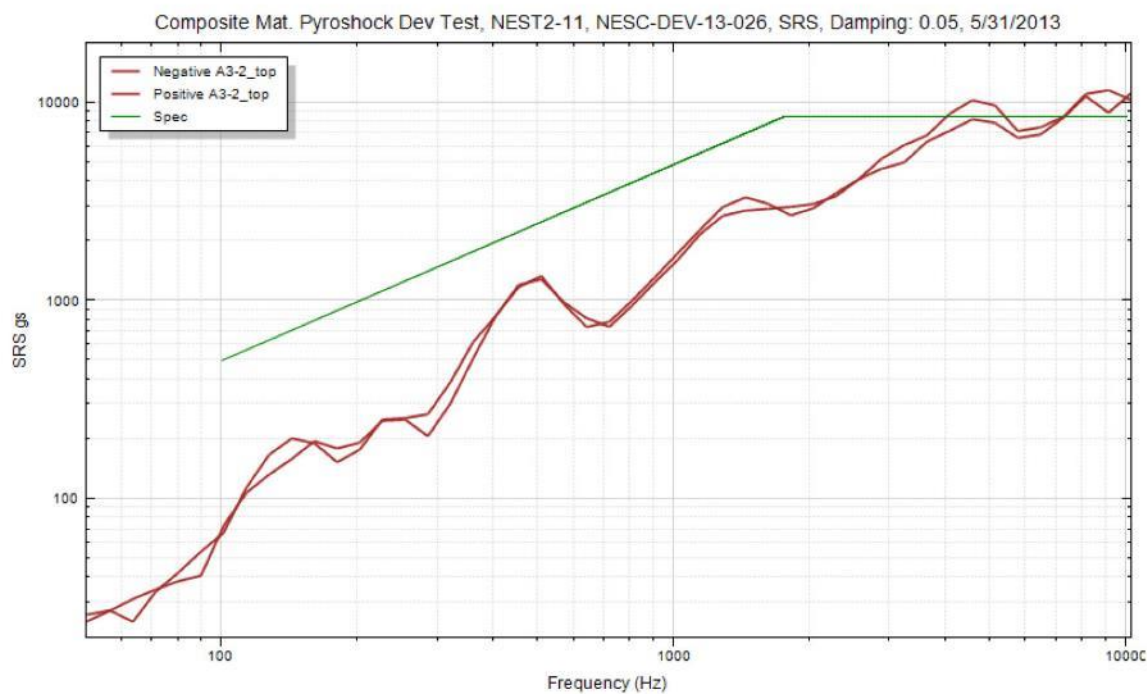
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
68 of 832







# NASA Engineering and Safety Center Technical Assessment Report

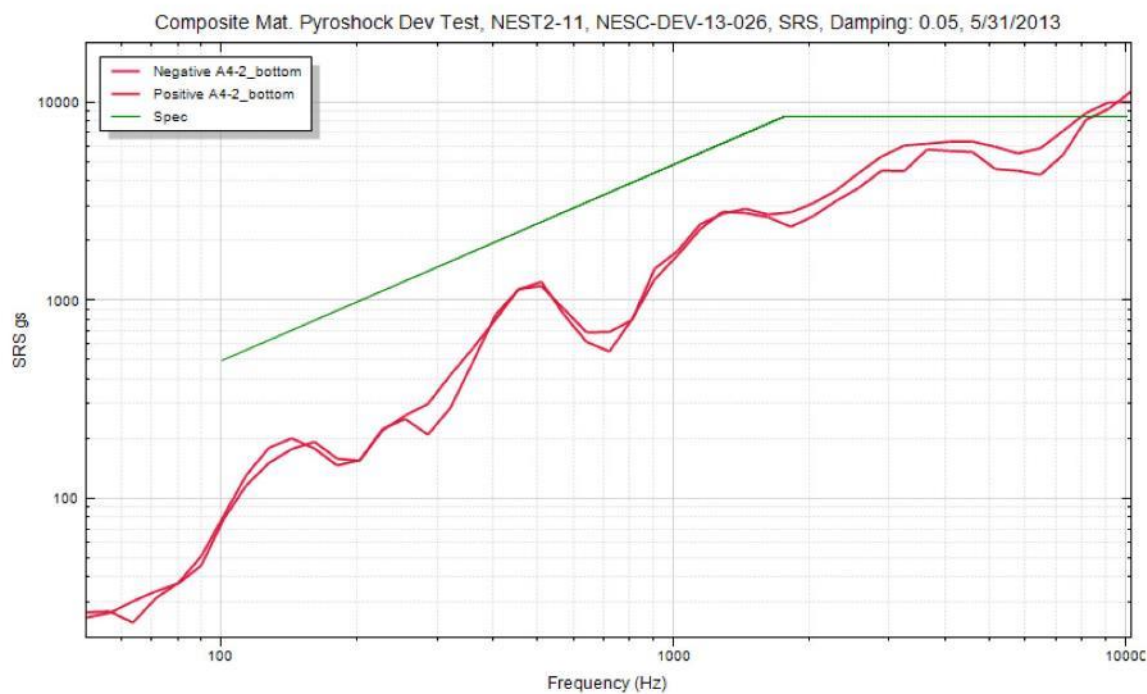
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
69 of 832





# NASA Engineering and Safety Center Technical Assessment Report

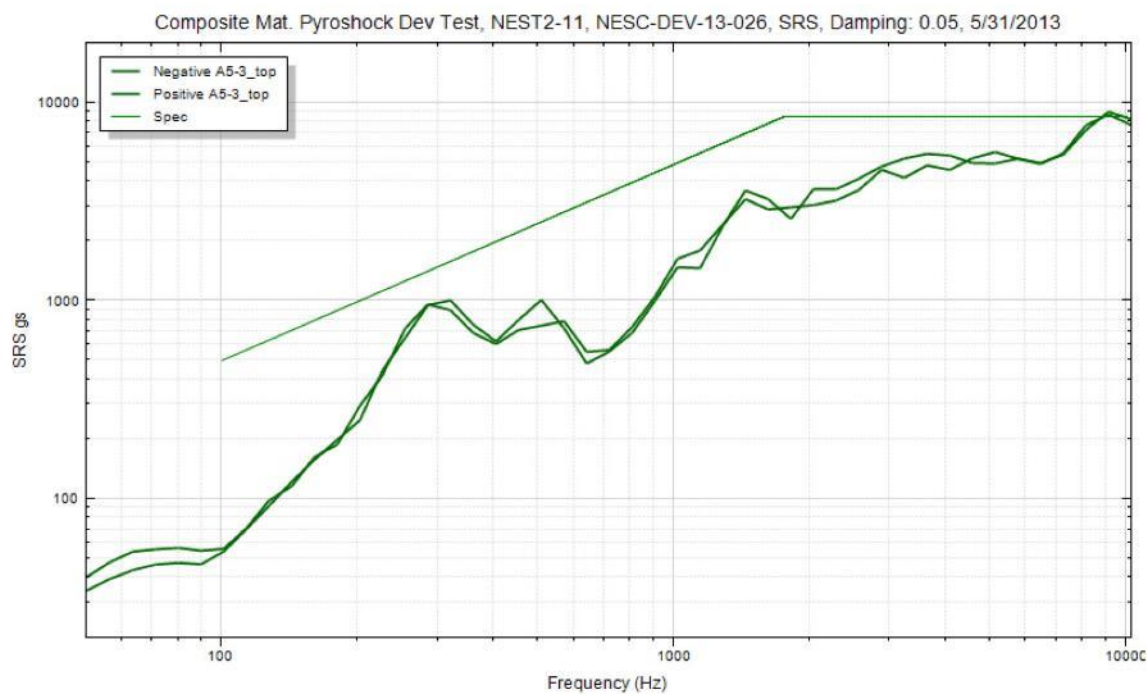
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
70 of 832





# NASA Engineering and Safety Center Technical Assessment Report

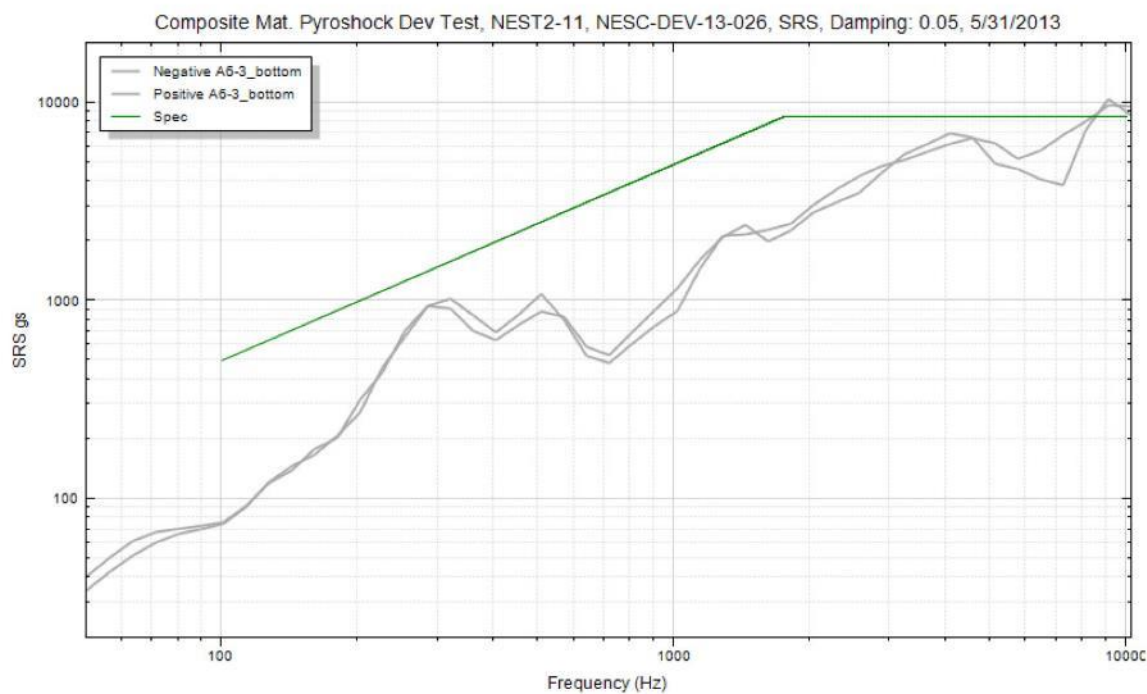
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
71 of 832





# NASA Engineering and Safety Center Technical Assessment Report

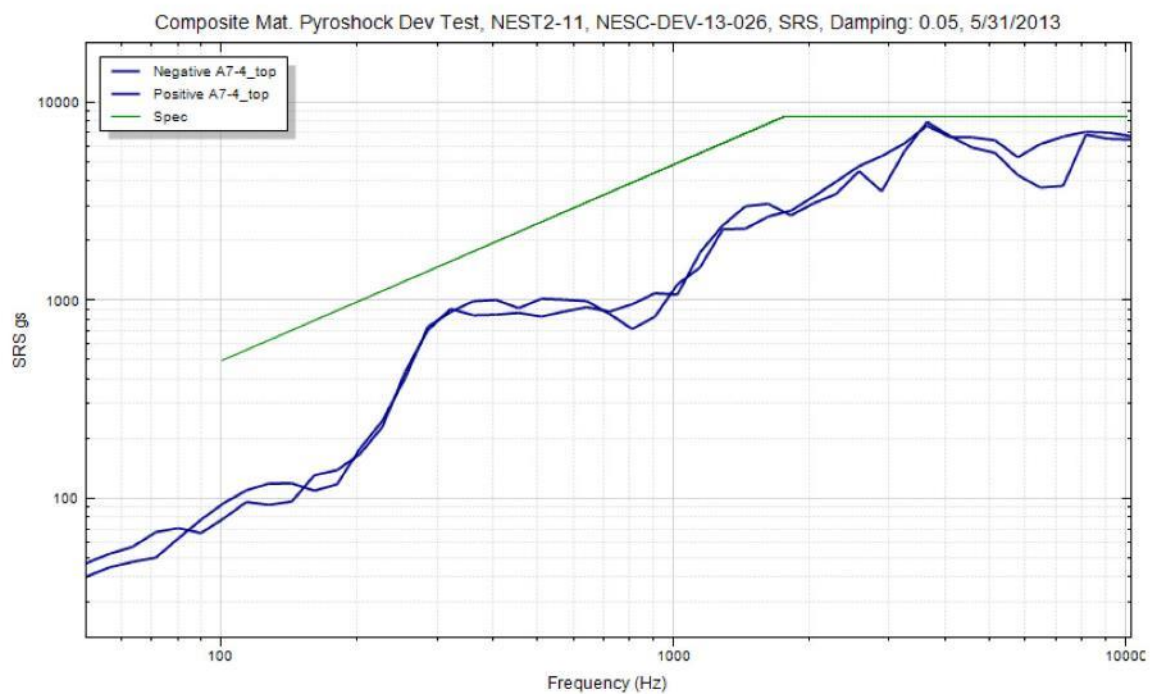
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
72 of 832





# NASA Engineering and Safety Center Technical Assessment Report

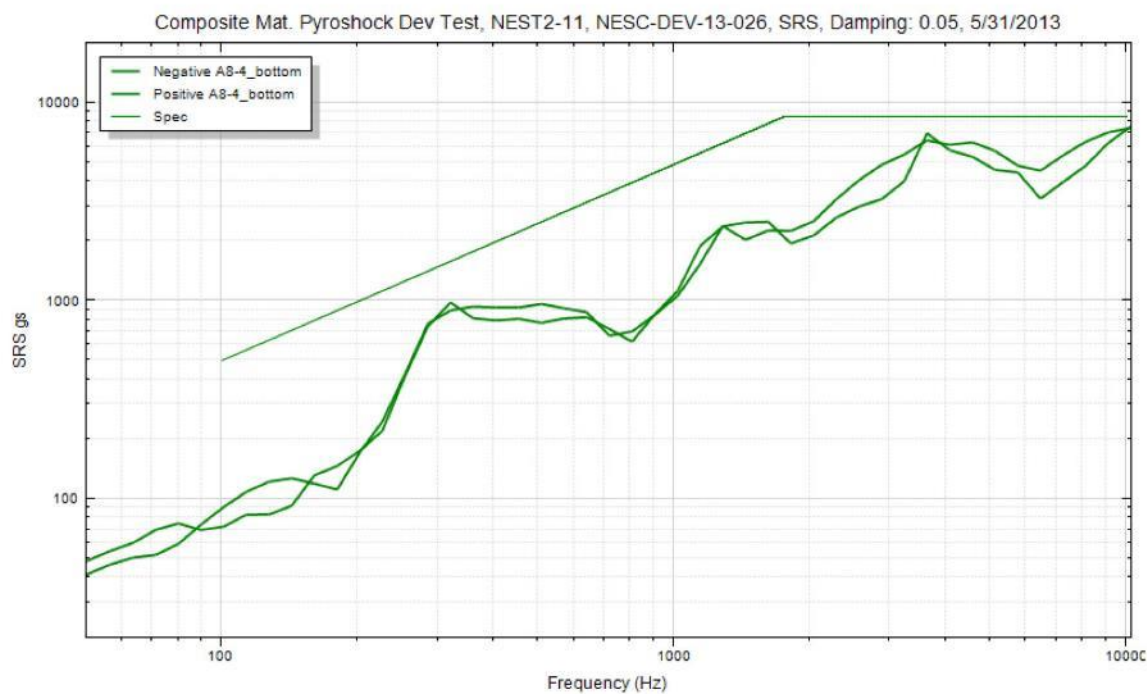
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
73 of 832





# NASA Engineering and Safety Center Technical Assessment Report

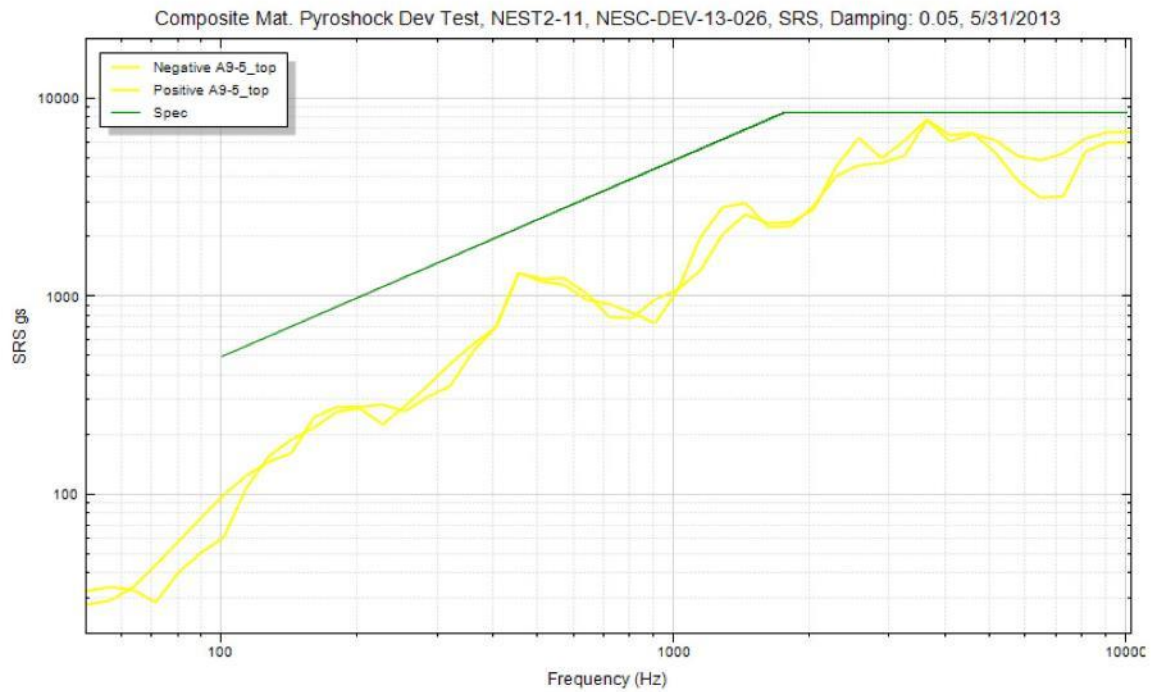
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
74 of 832





# NASA Engineering and Safety Center Technical Assessment Report

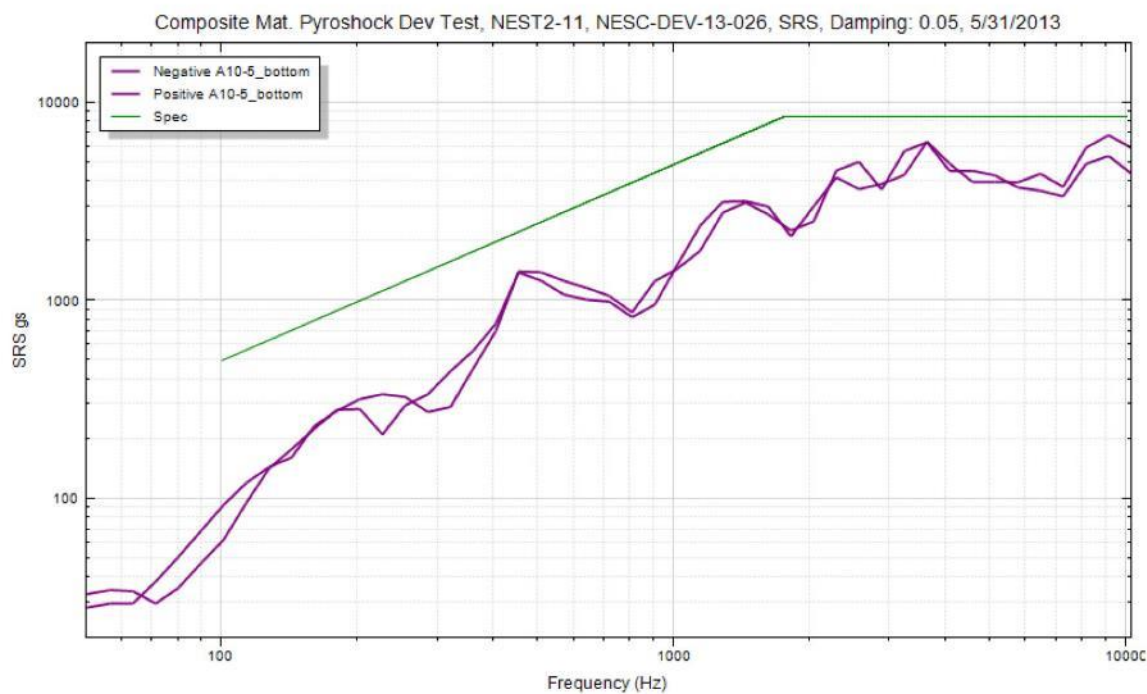
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
75 of 832





# NASA Engineering and Safety Center Technical Assessment Report

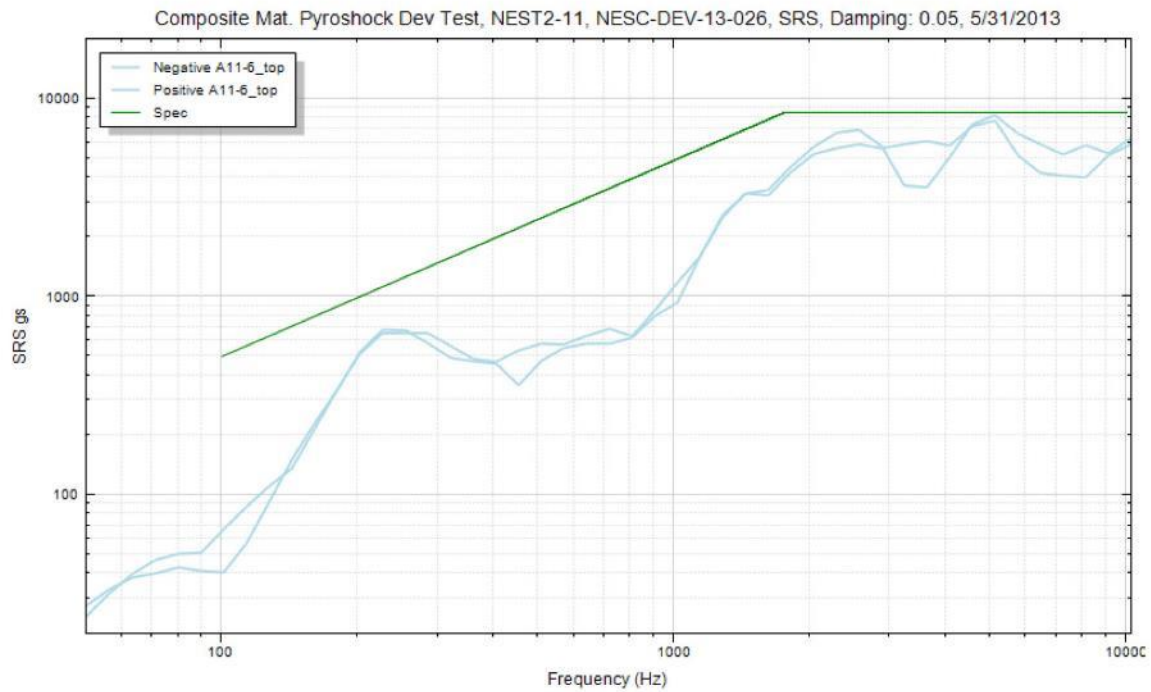
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
76 of 832







# NASA Engineering and Safety Center Technical Assessment Report

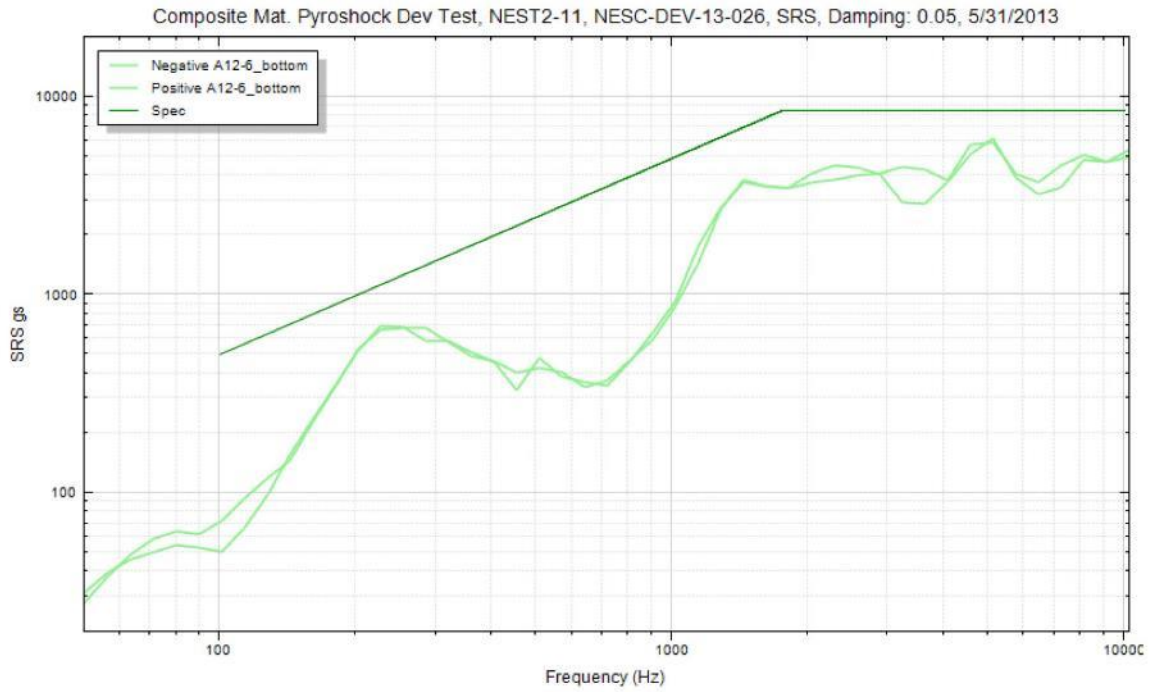
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
77 of 832





# NASA Engineering and Safety Center Technical Assessment Report

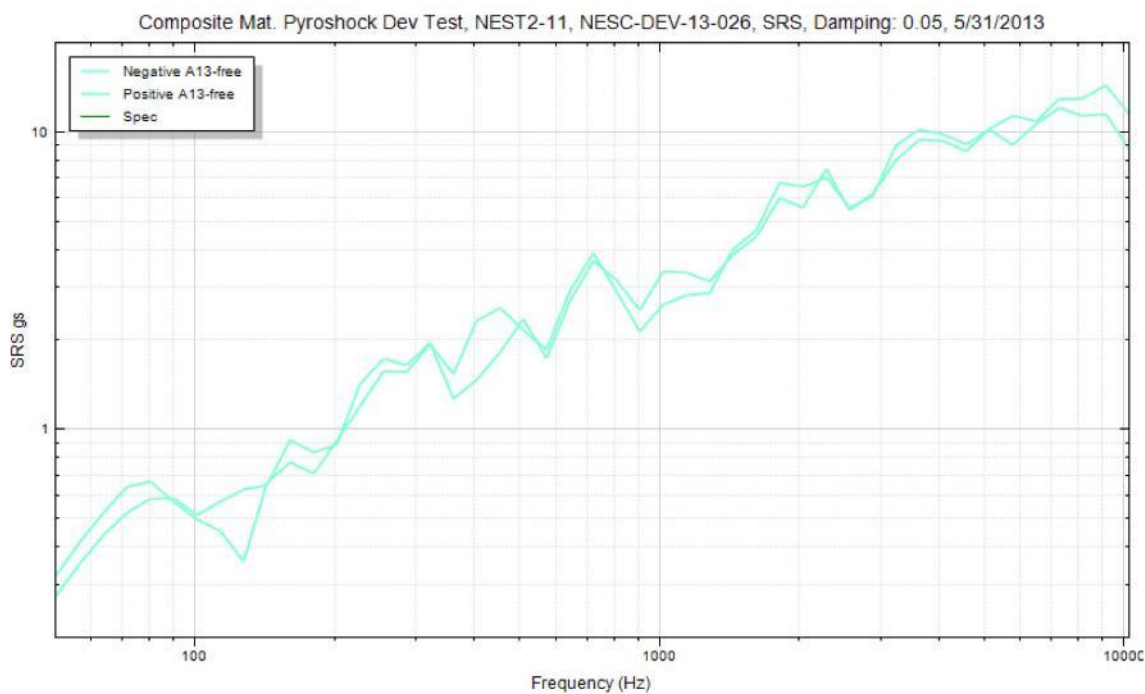
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
78 of 832





# NASA Engineering and Safety Center Technical Assessment Report

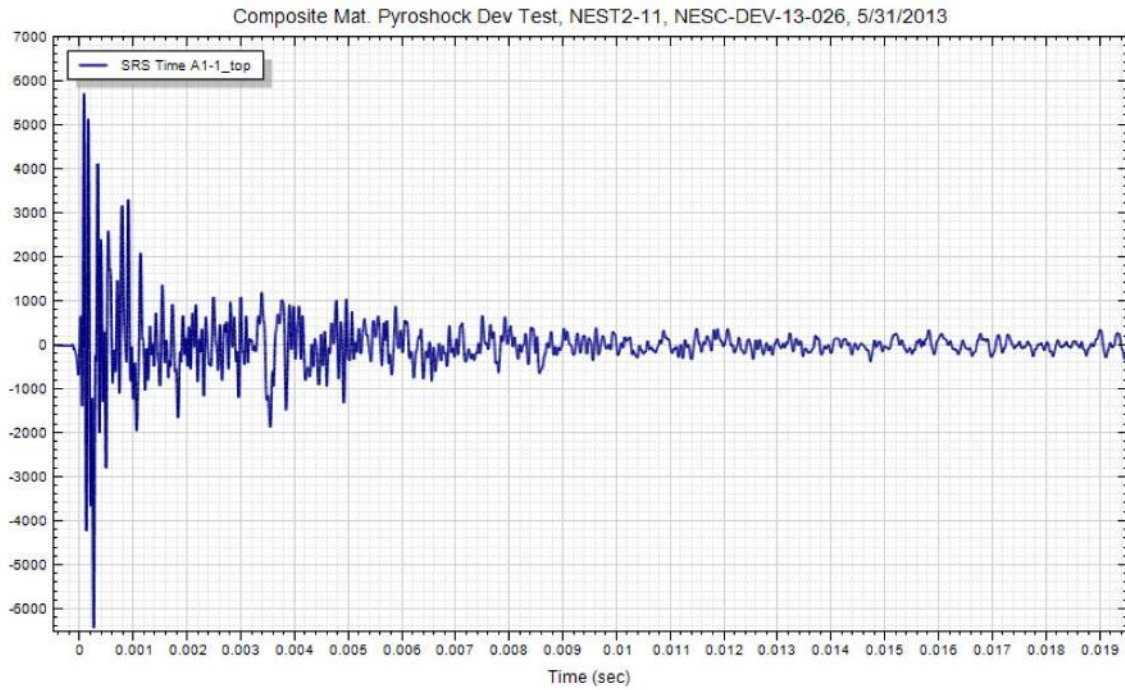
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
79 of 832





# NASA Engineering and Safety Center Technical Assessment Report

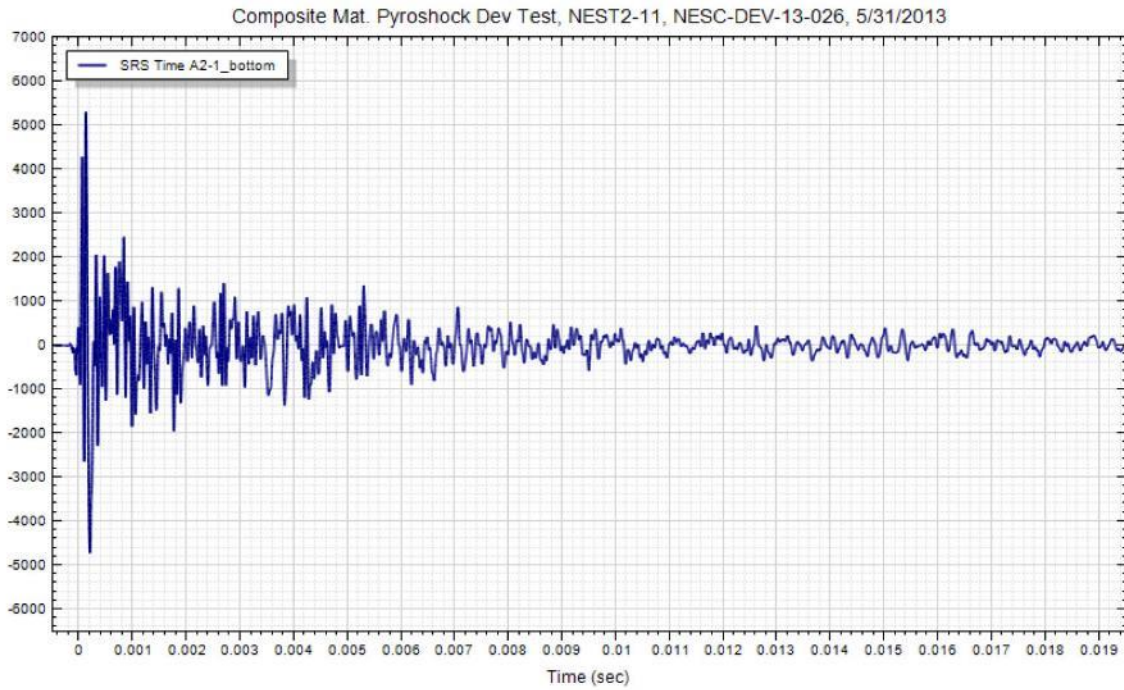
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
80 of 832





# NASA Engineering and Safety Center Technical Assessment Report

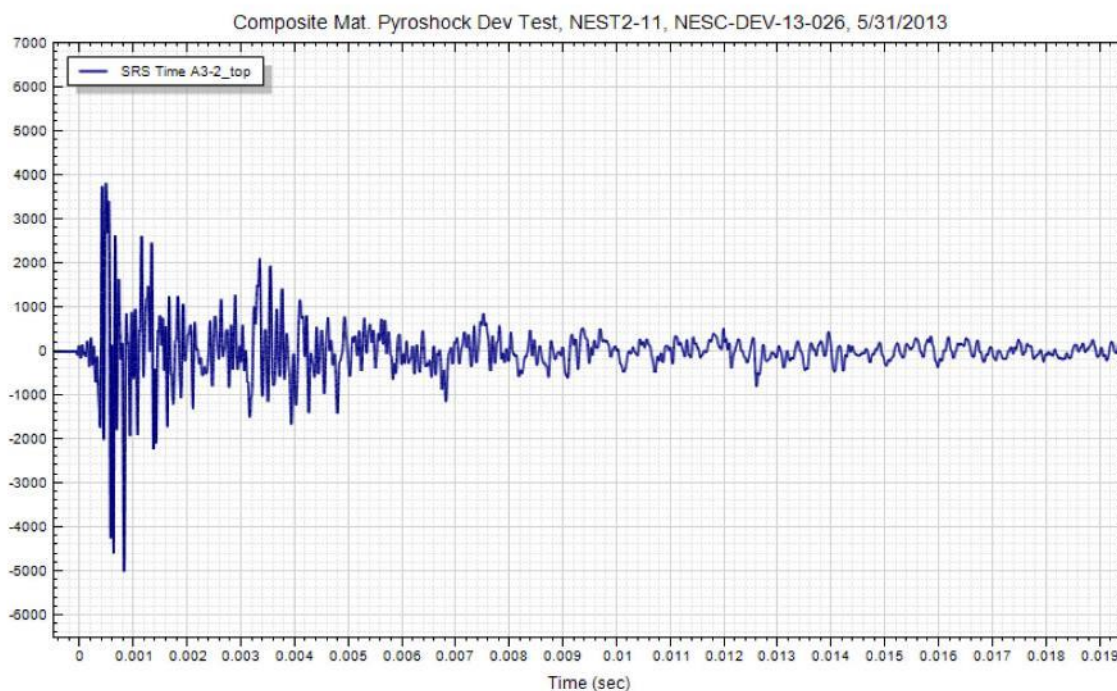
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
81 of 832





# NASA Engineering and Safety Center Technical Assessment Report

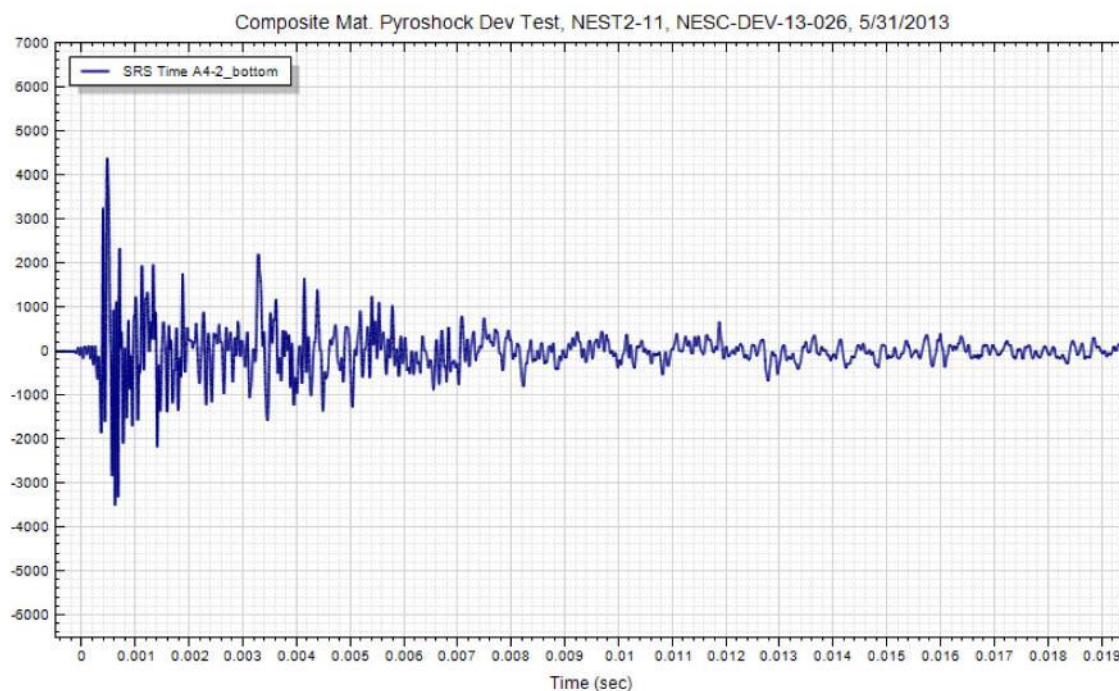
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
82 of 832





# NASA Engineering and Safety Center Technical Assessment Report

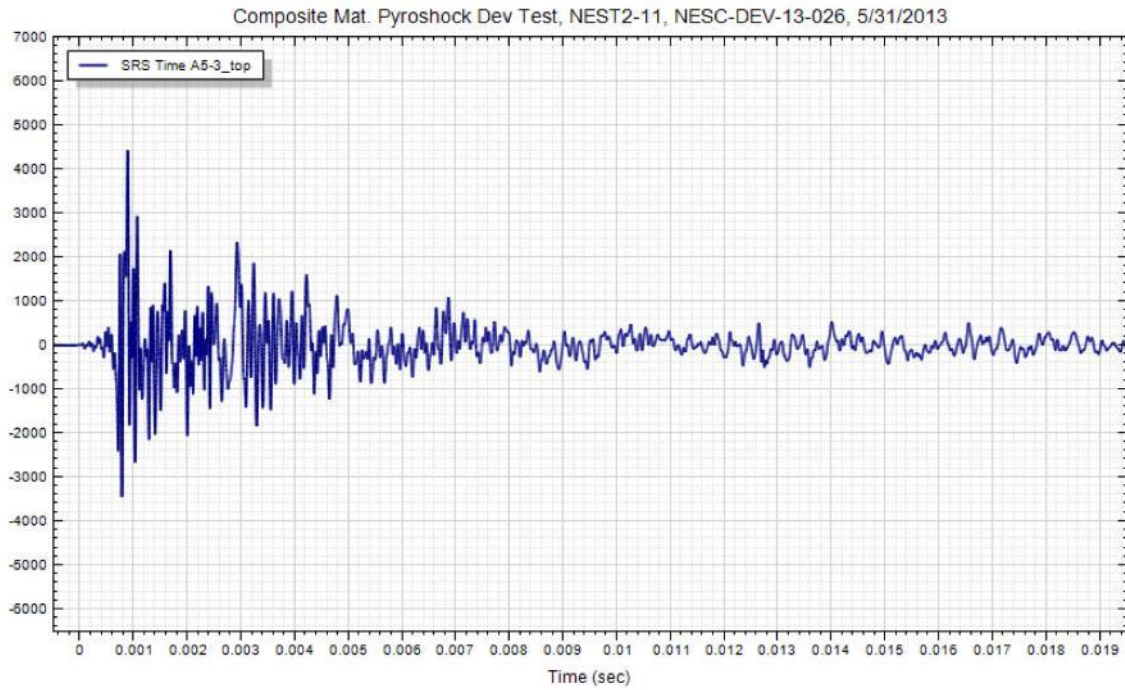
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
83 of 832





# NASA Engineering and Safety Center Technical Assessment Report

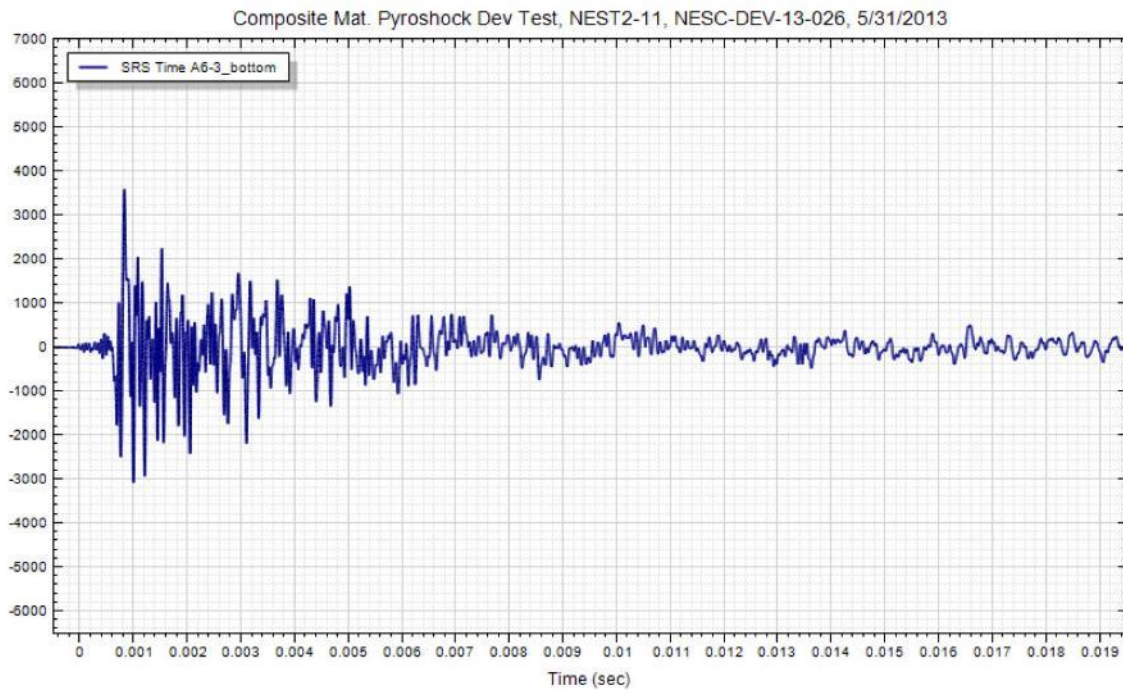
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
84 of 832







# NASA Engineering and Safety Center Technical Assessment Report

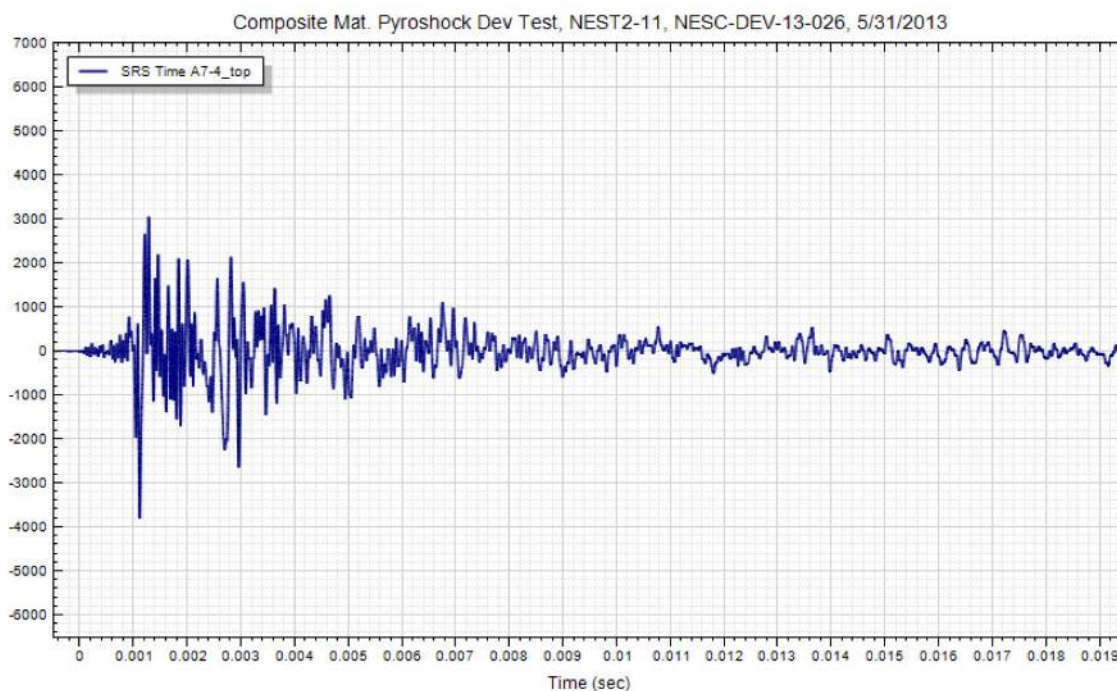
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
85 of 832





# NASA Engineering and Safety Center Technical Assessment Report

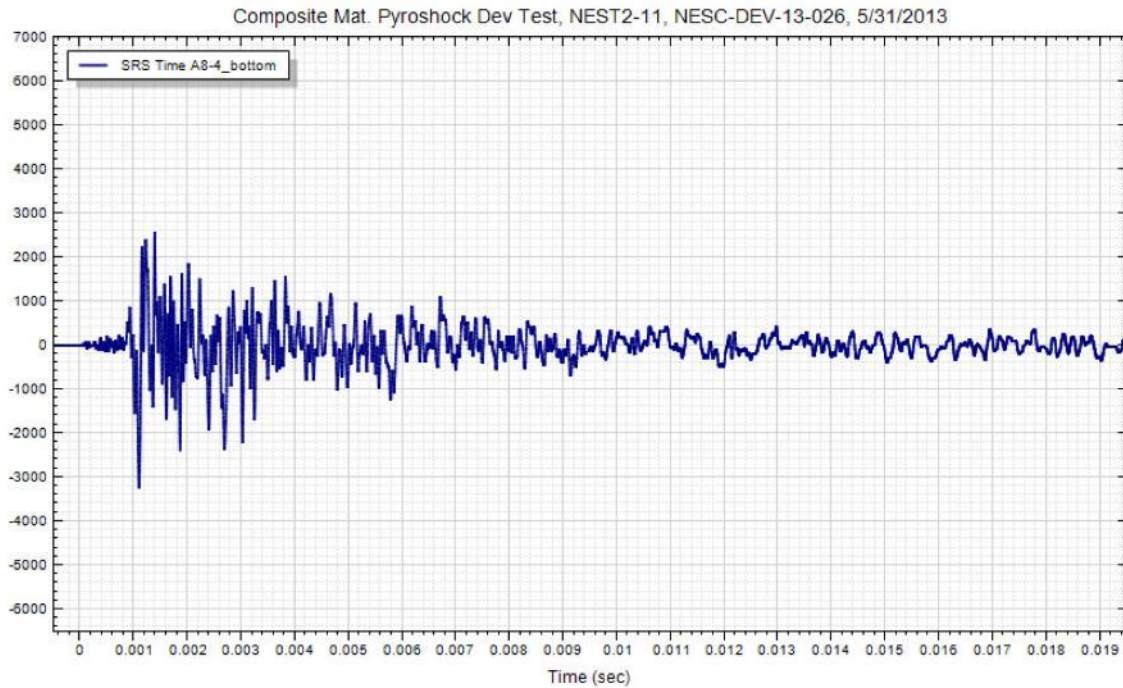
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
86 of 832





# NASA Engineering and Safety Center Technical Assessment Report

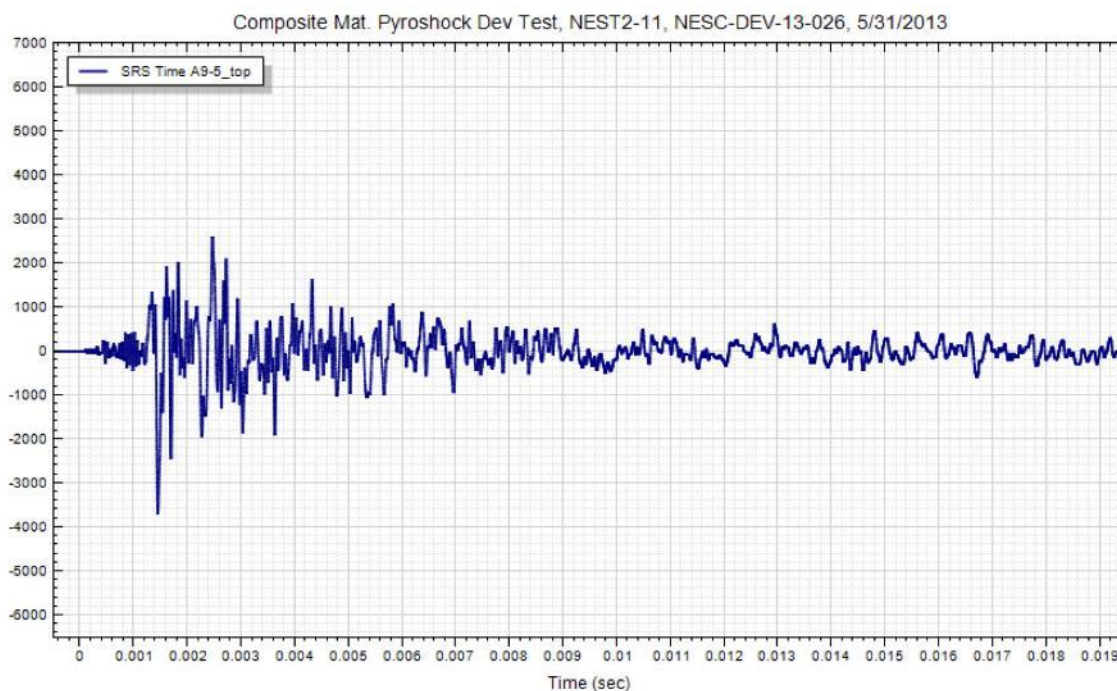
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
87 of 832





# NASA Engineering and Safety Center Technical Assessment Report

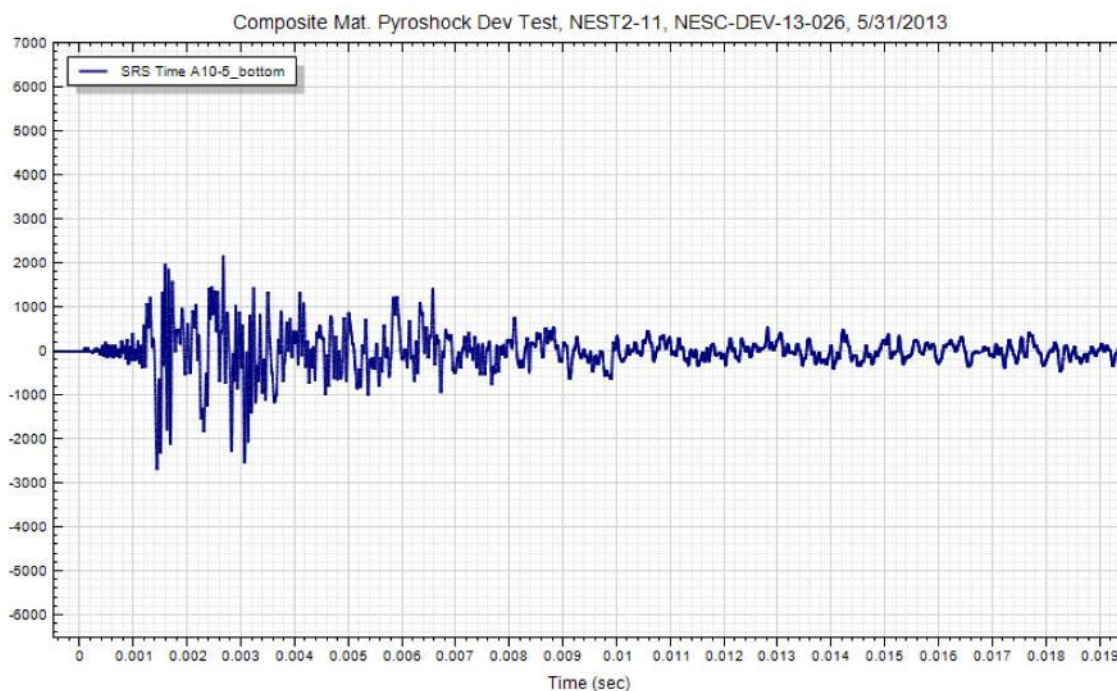
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
88 of 832





# NASA Engineering and Safety Center Technical Assessment Report

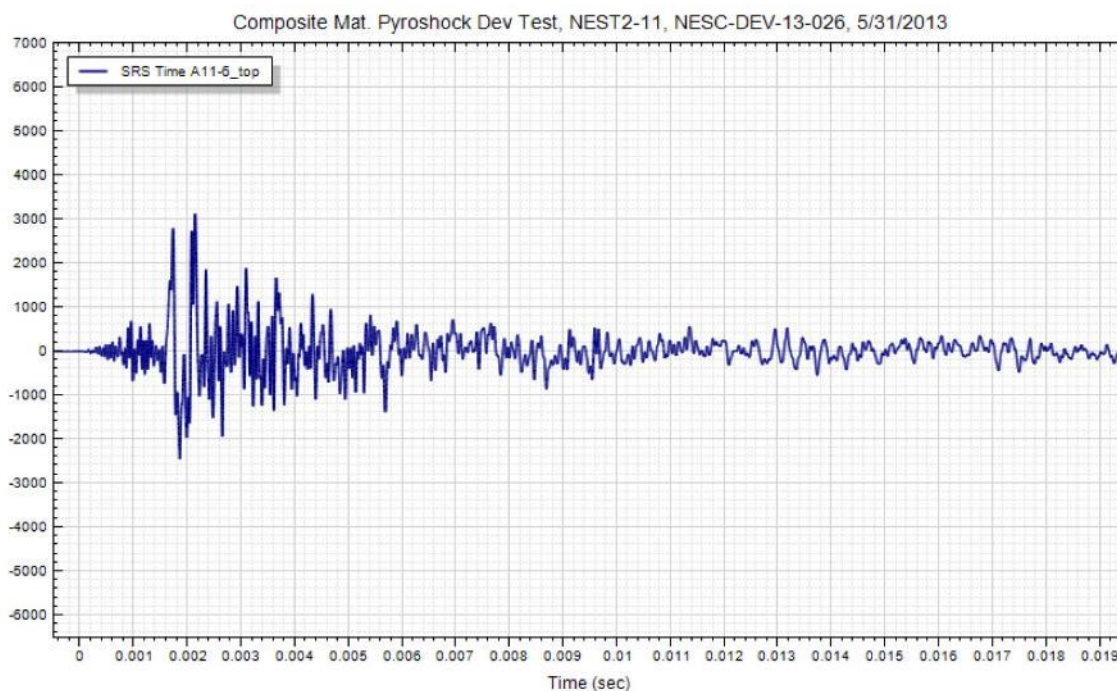
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
89 of 832





# NASA Engineering and Safety Center Technical Assessment Report

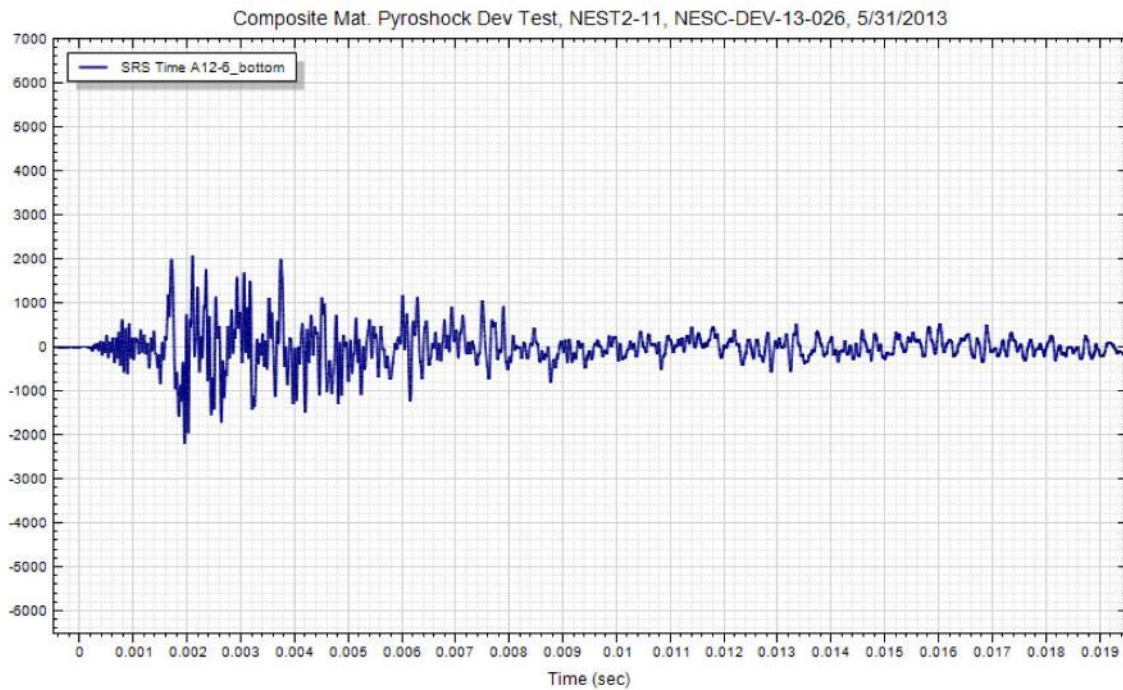
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
90 of 832





# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**

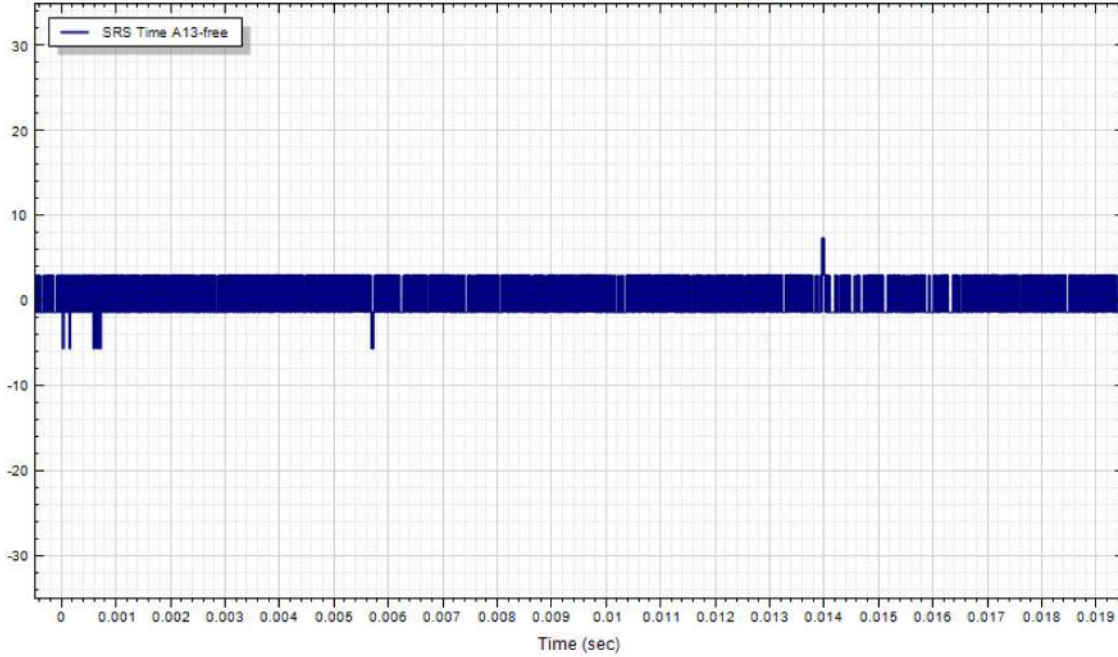
Version:  
**1.0**


Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
91 of 832

Composite Mat. Pyroshock Dev Test, NEST2-11, NESC-DEV-13-026, 5/31/2013



	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 92 of 832	

**NESC-DEV-13-026**  
**Composite Materials**  
**Shock Test**  
  
**Test #2 Accelerometer Data**  
**Panel 0332A014**





# NASA Engineering and Safety Center Technical Assessment Report

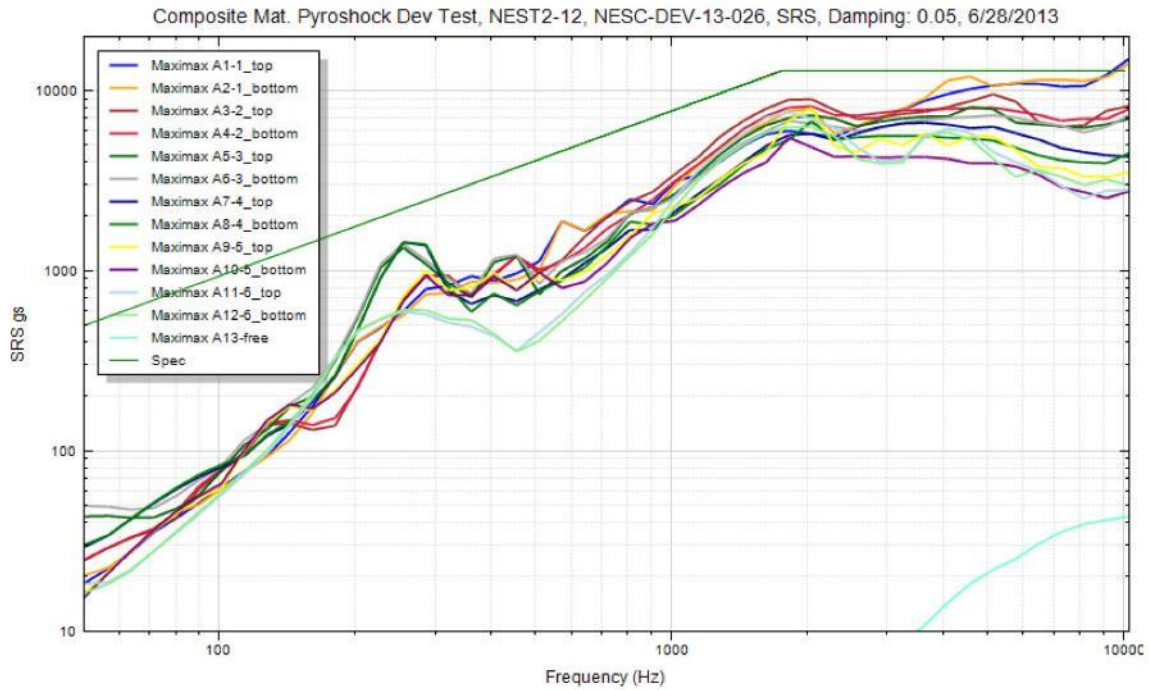
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
93 of 832





# NASA Engineering and Safety Center Technical Assessment Report

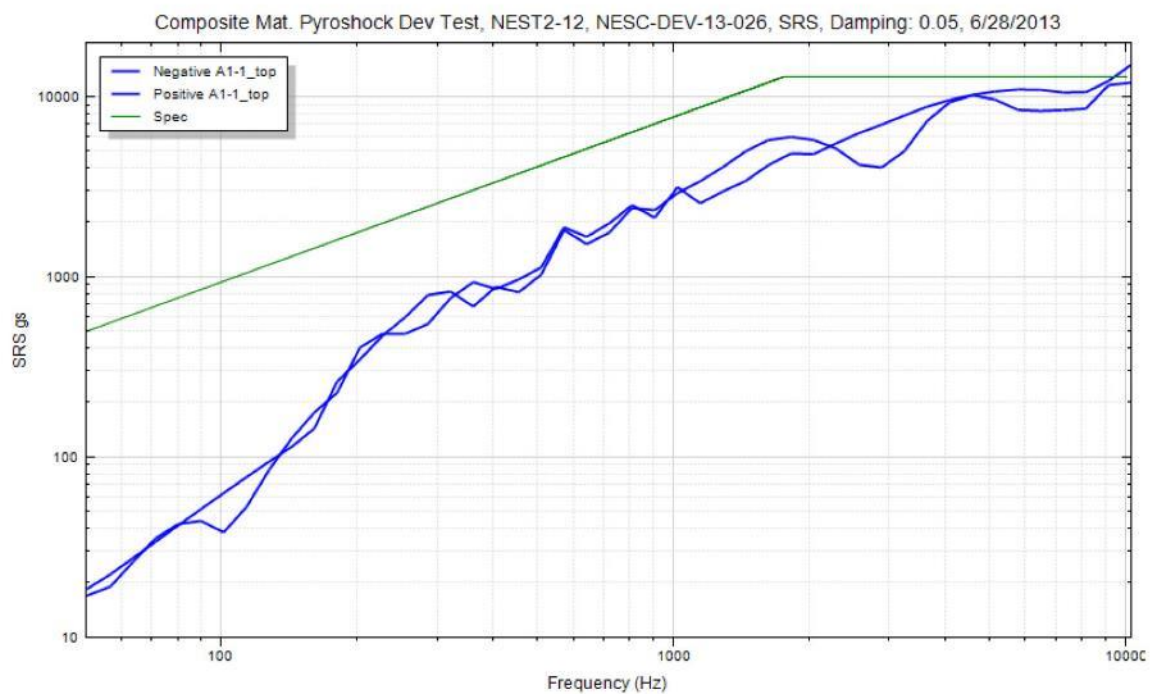
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
94 of 832





# NASA Engineering and Safety Center Technical Assessment Report

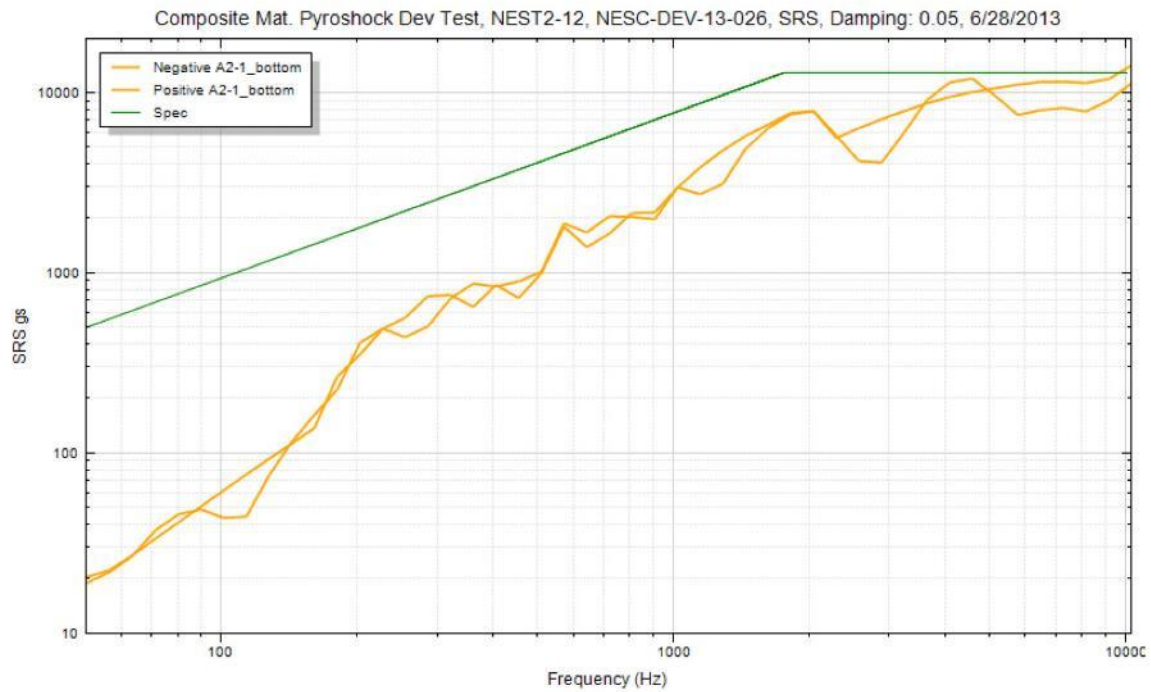
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
95 of 832





# NASA Engineering and Safety Center Technical Assessment Report

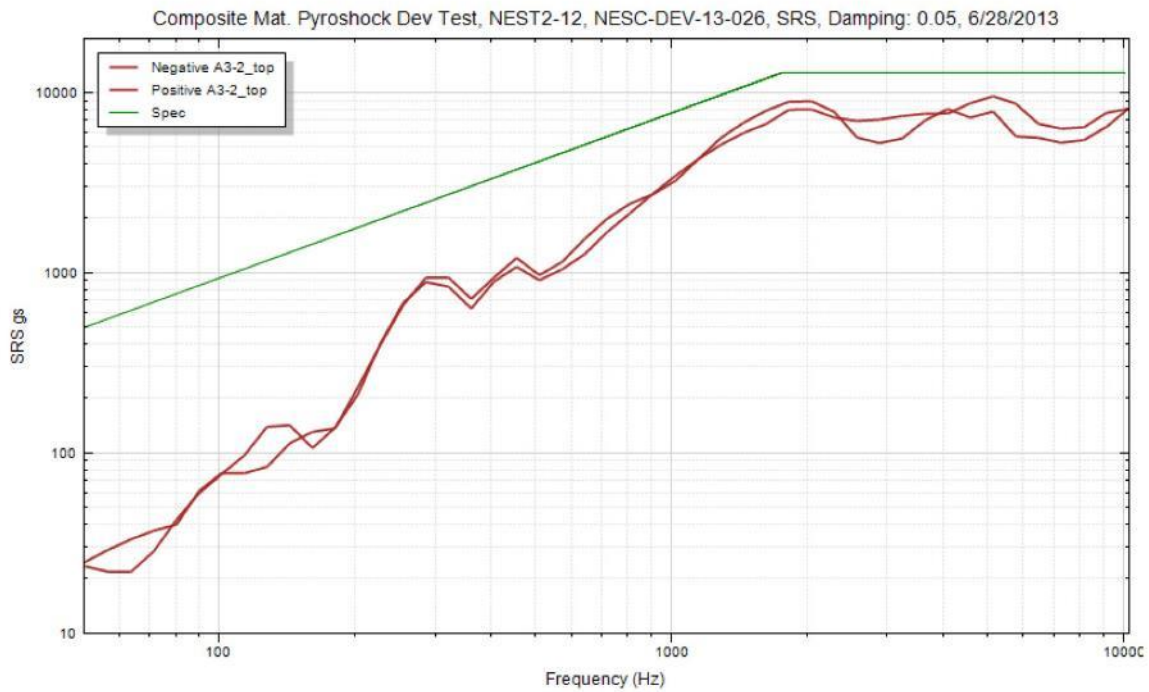
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
96 of 832





# NASA Engineering and Safety Center Technical Assessment Report

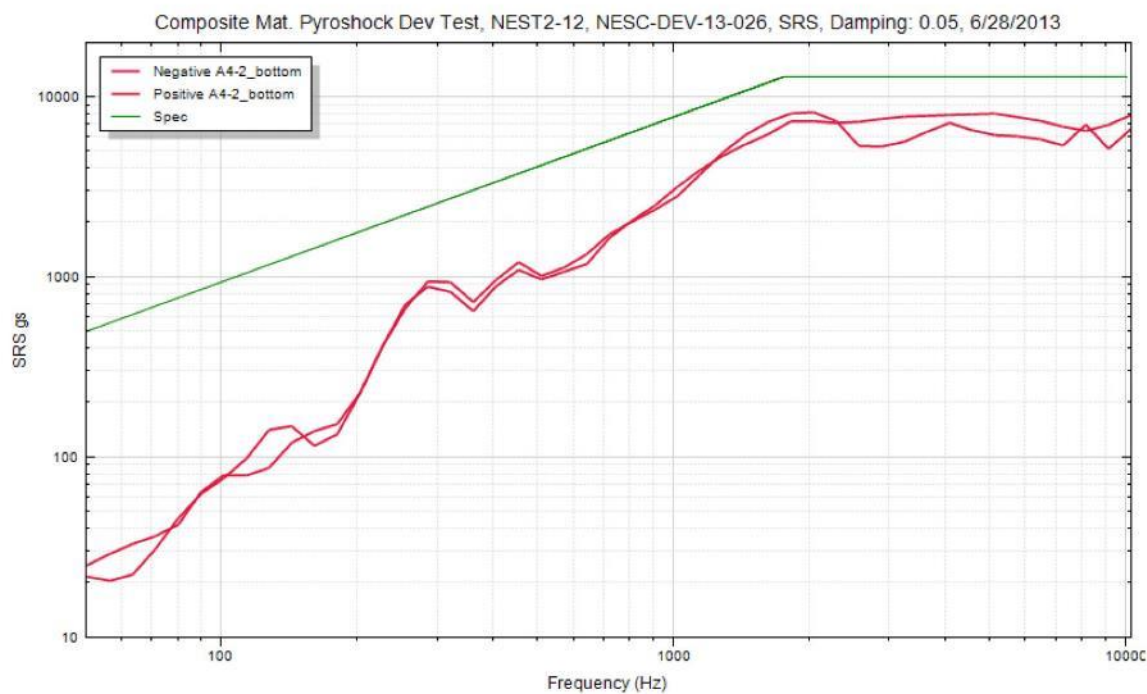
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
97 of 832





# NASA Engineering and Safety Center Technical Assessment Report

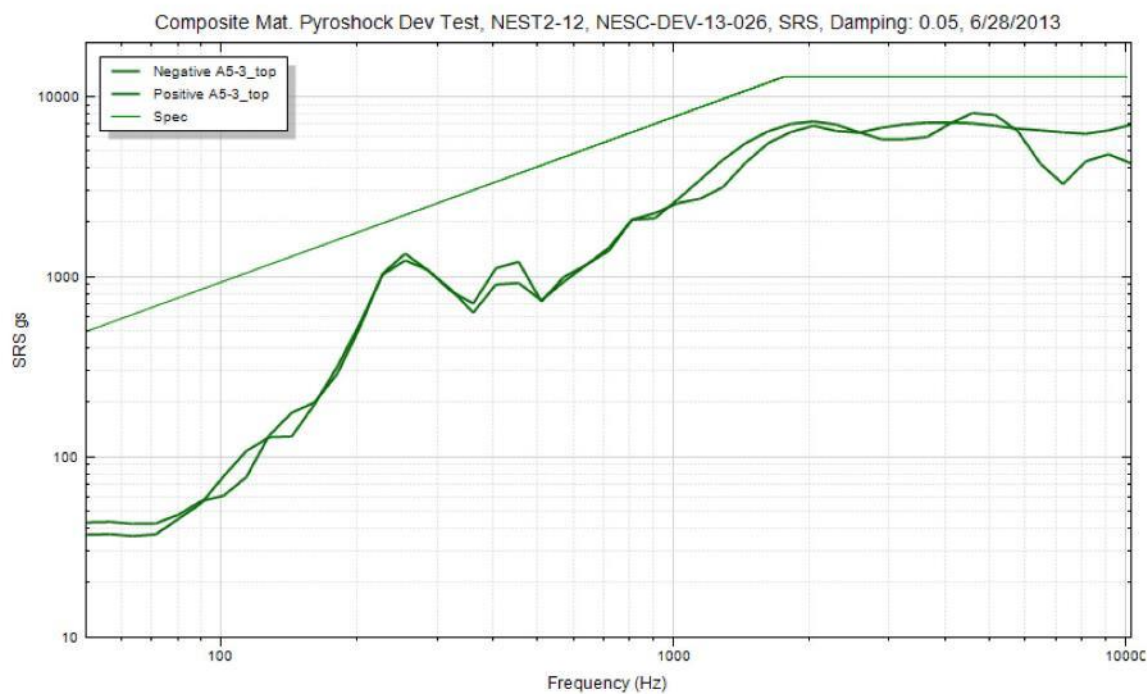
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
98 of 832





# NASA Engineering and Safety Center Technical Assessment Report

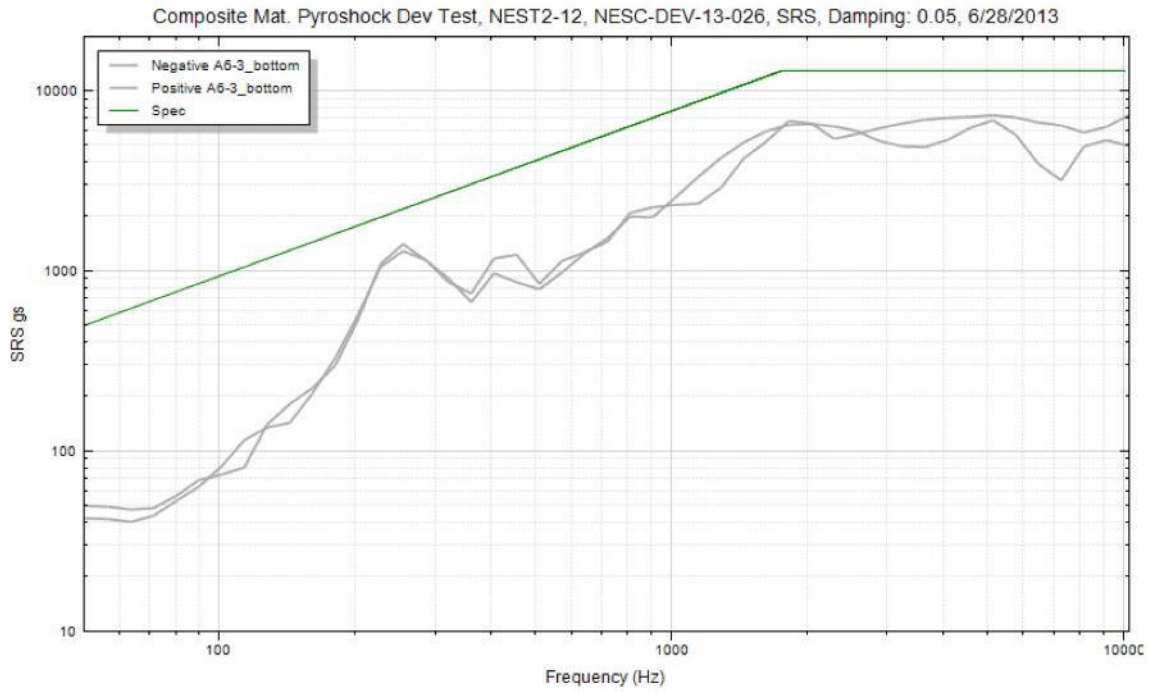
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
99 of 832





# NASA Engineering and Safety Center Technical Assessment Report

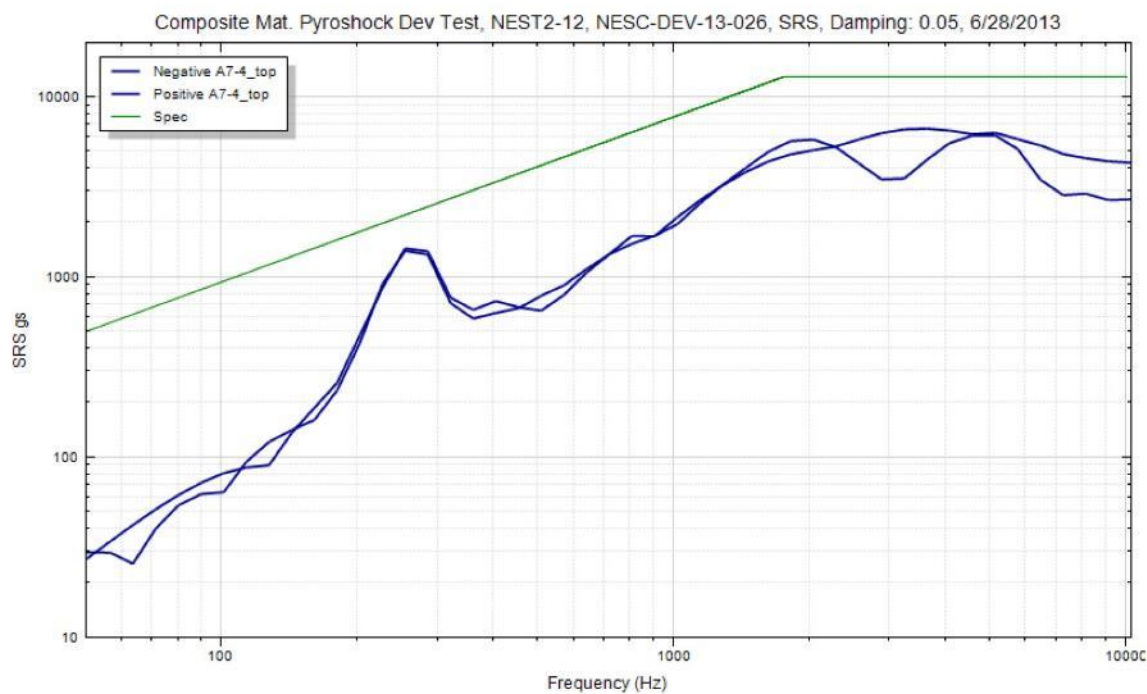
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
100 of 832







# NASA Engineering and Safety Center Technical Assessment Report

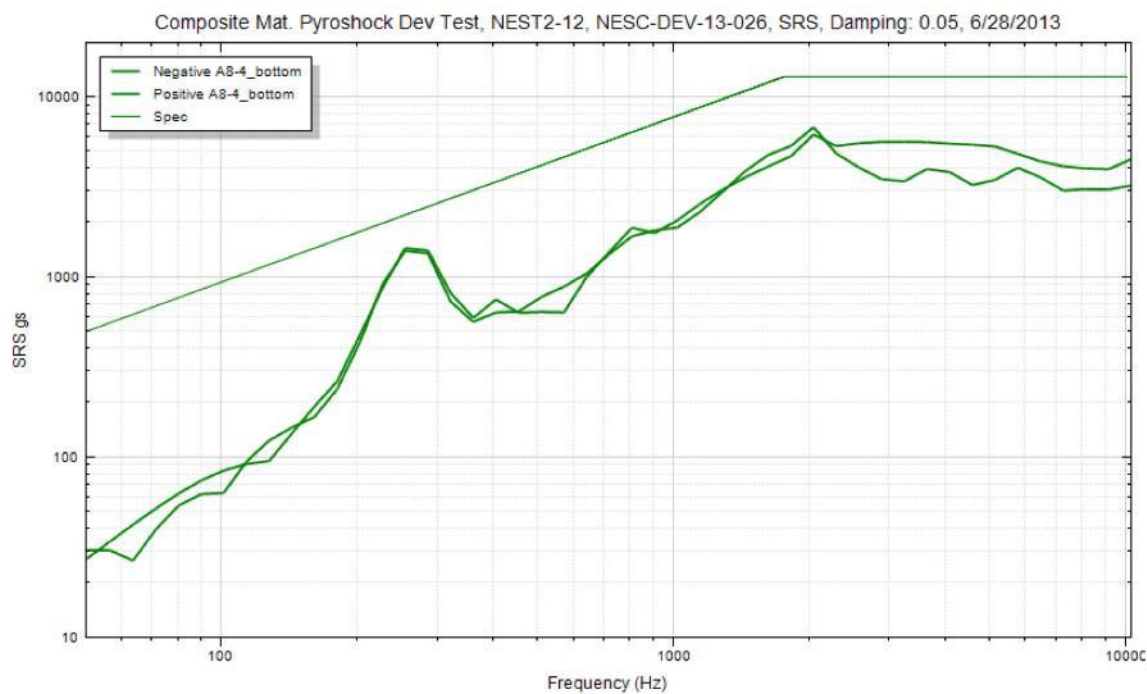
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
101 of 832





# NASA Engineering and Safety Center Technical Assessment Report

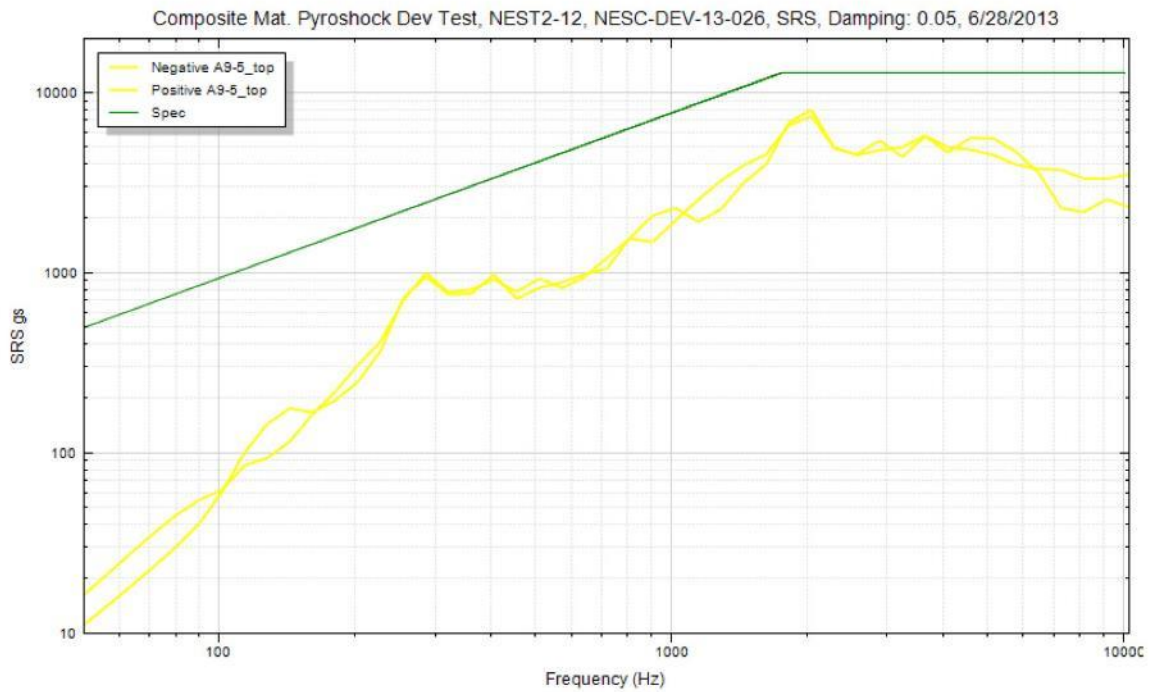
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
102 of 832





# NASA Engineering and Safety Center Technical Assessment Report

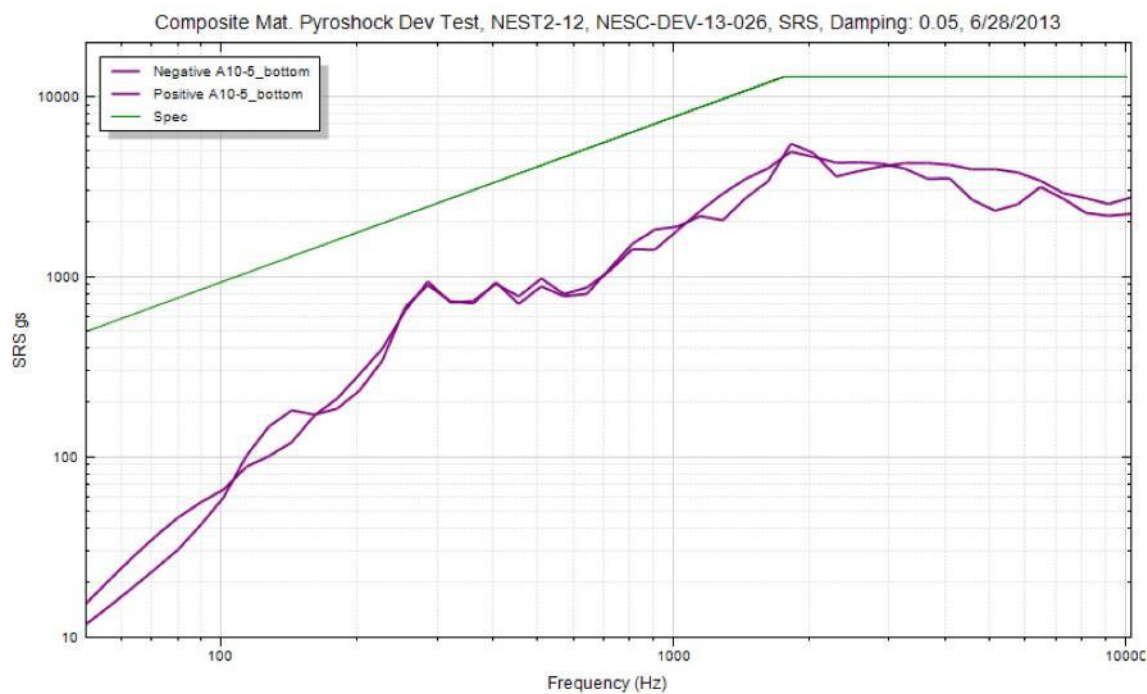
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
103 of 832





# NASA Engineering and Safety Center Technical Assessment Report

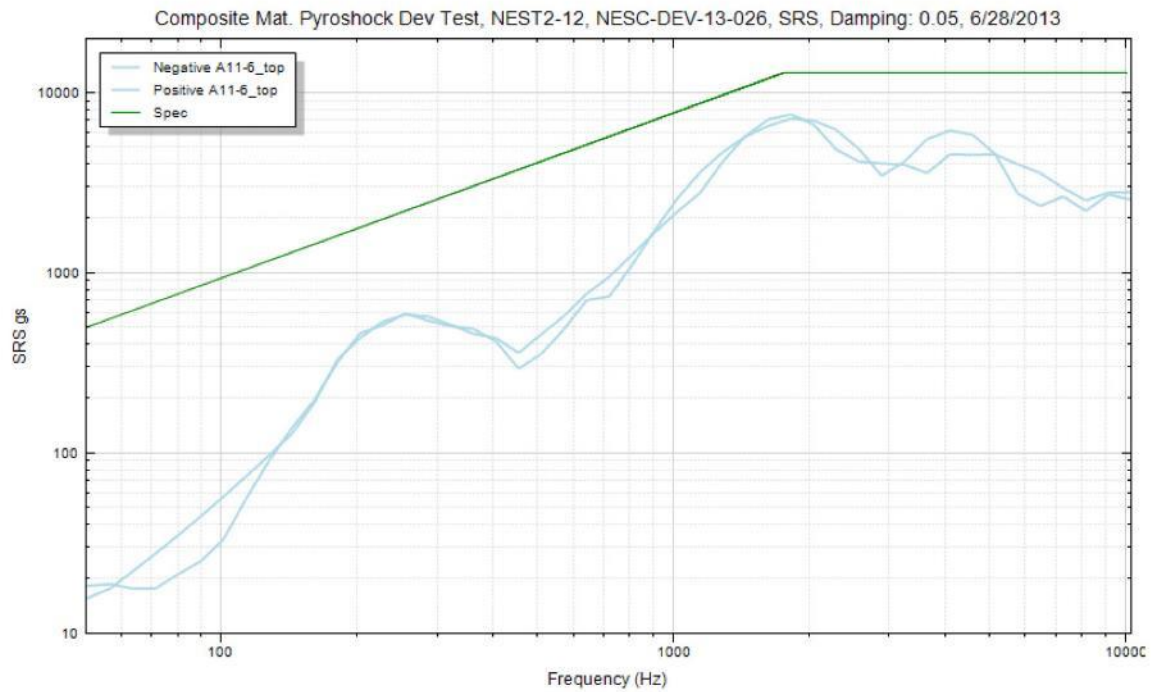
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
104 of 832





# NASA Engineering and Safety Center Technical Assessment Report

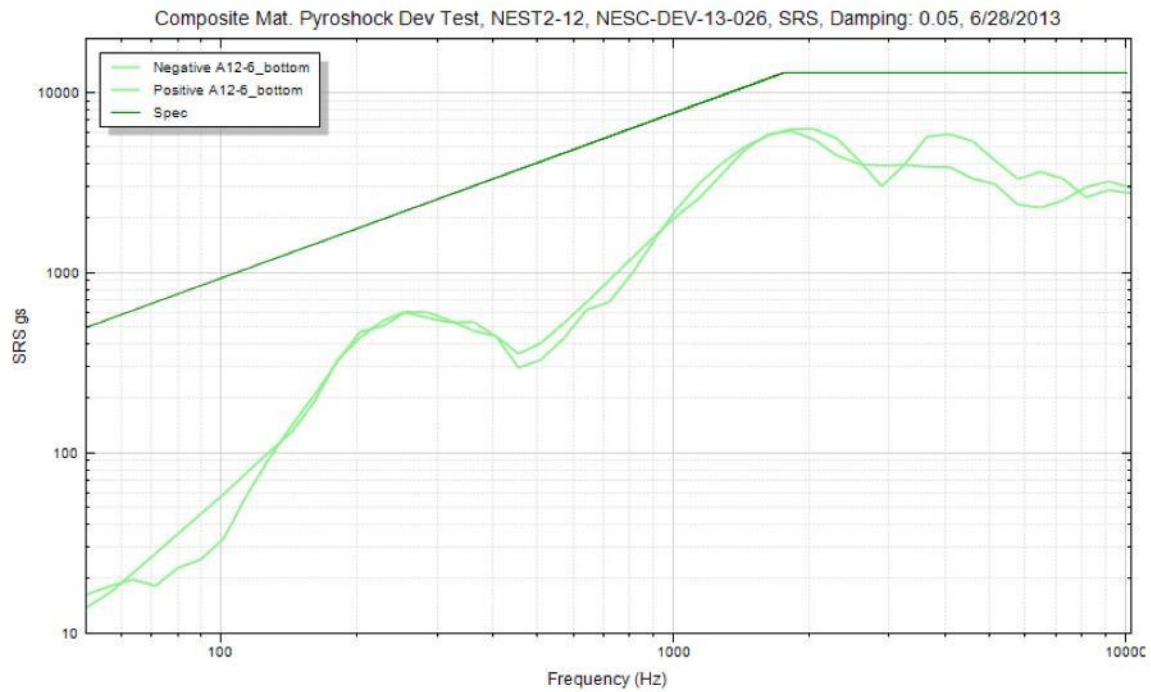
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
105 of 832





# NASA Engineering and Safety Center Technical Assessment Report

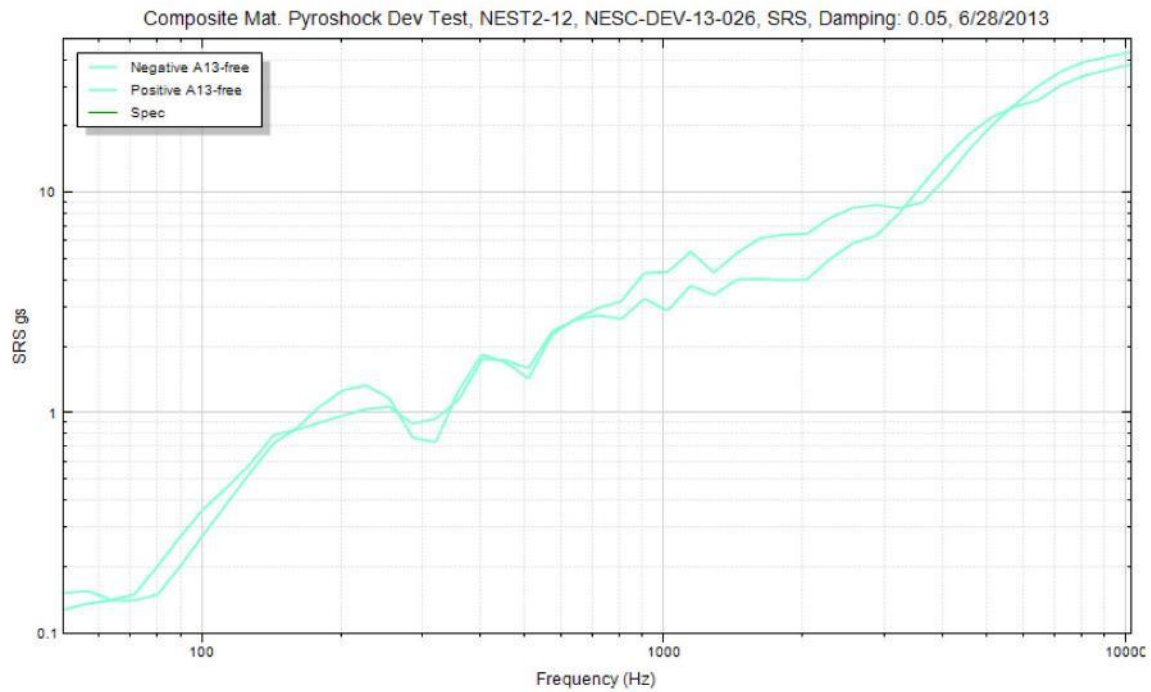
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
106 of 832



103 of 310



# NASA Engineering and Safety Center Technical Assessment Report

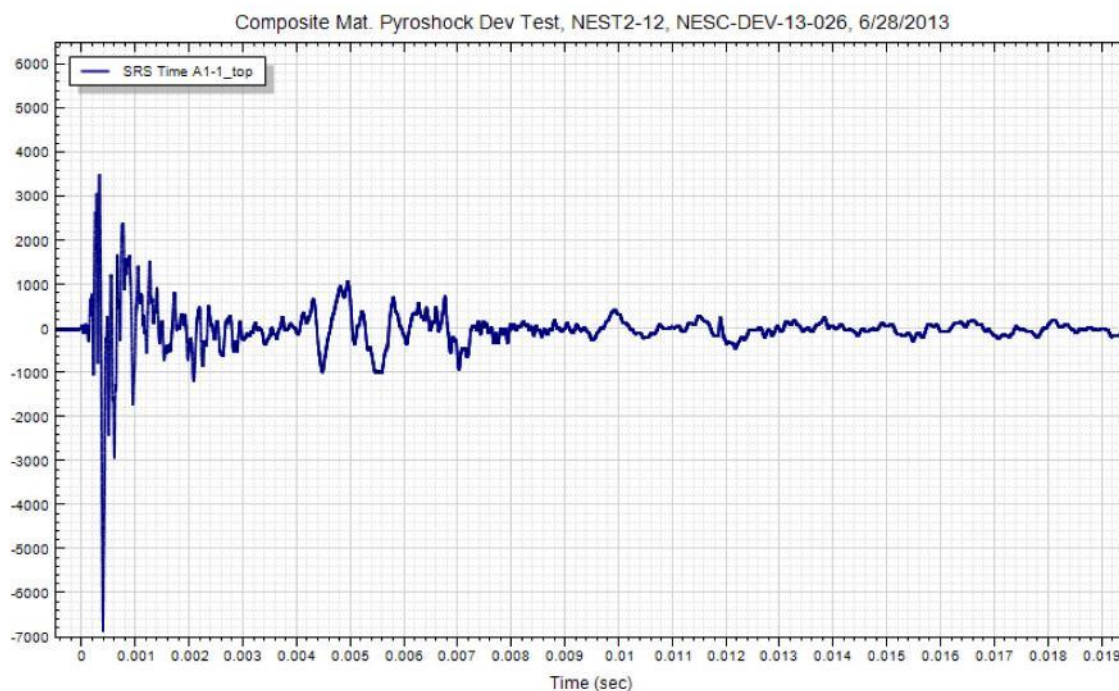
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
107 of 832





# NASA Engineering and Safety Center Technical Assessment Report

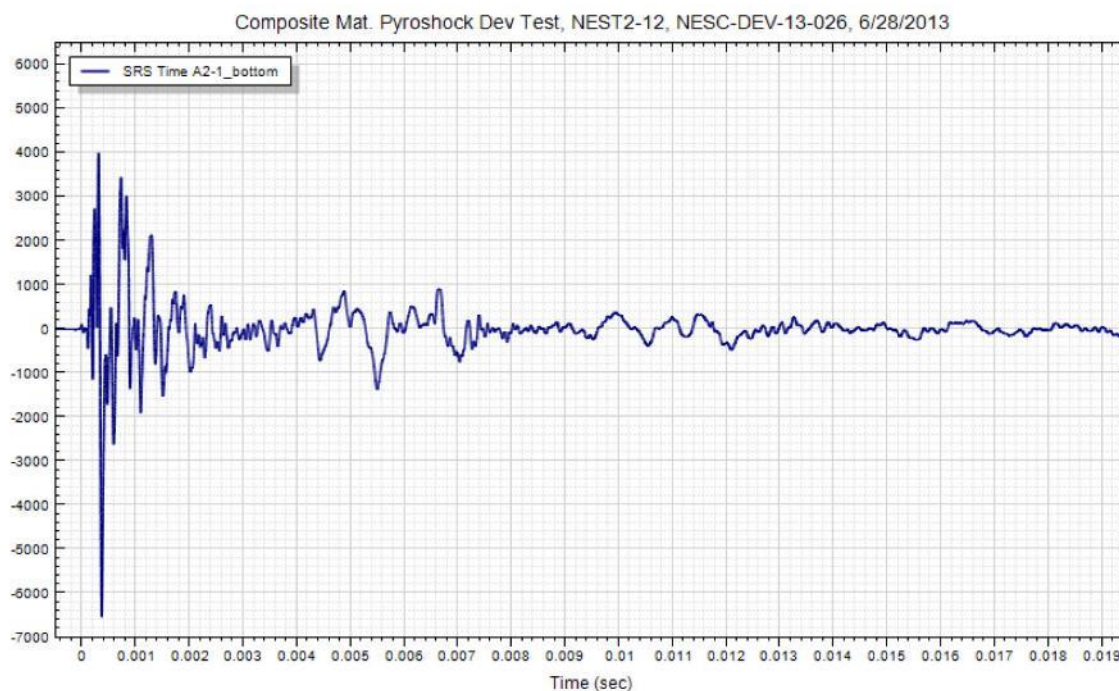
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
108 of 832







# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**

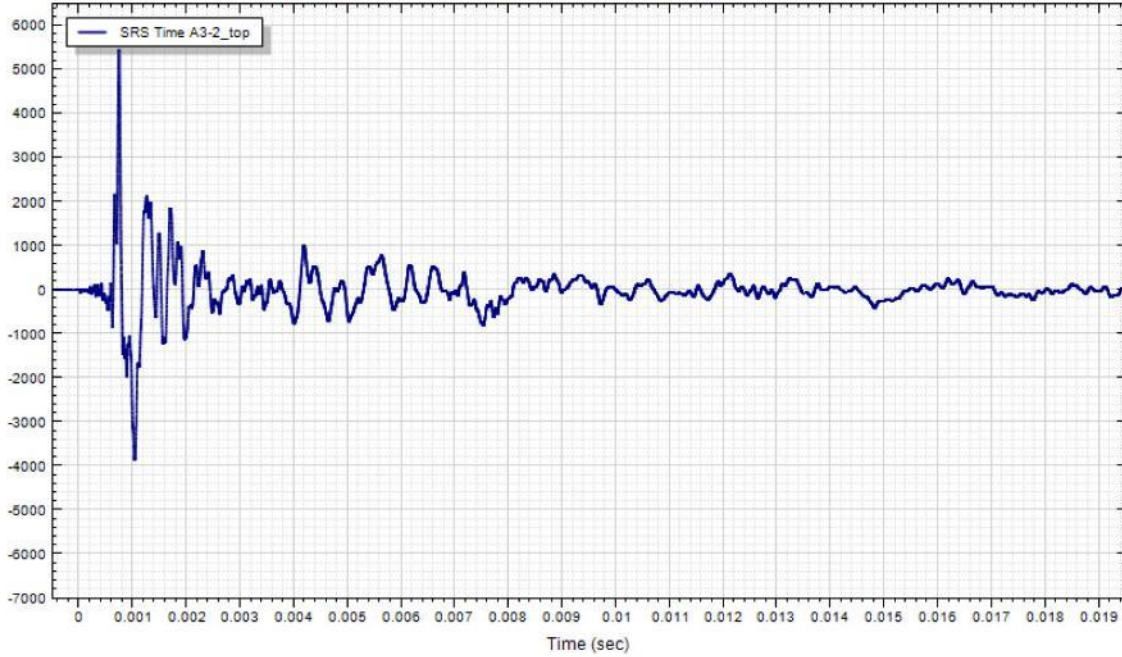
Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
109 of 832

Composite Mat. Pyroshock Dev Test, NEST2-12, NESC-DEV-13-026, 6/28/2013





# NASA Engineering and Safety Center Technical Assessment Report

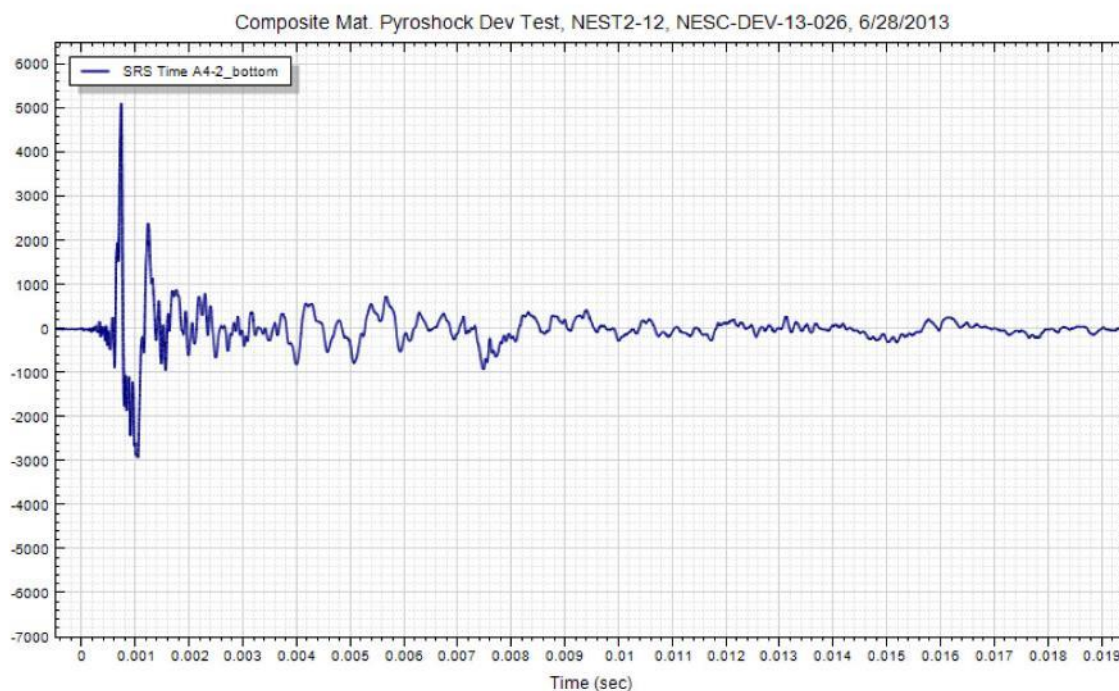
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
110 of 832





# NASA Engineering and Safety Center Technical Assessment Report

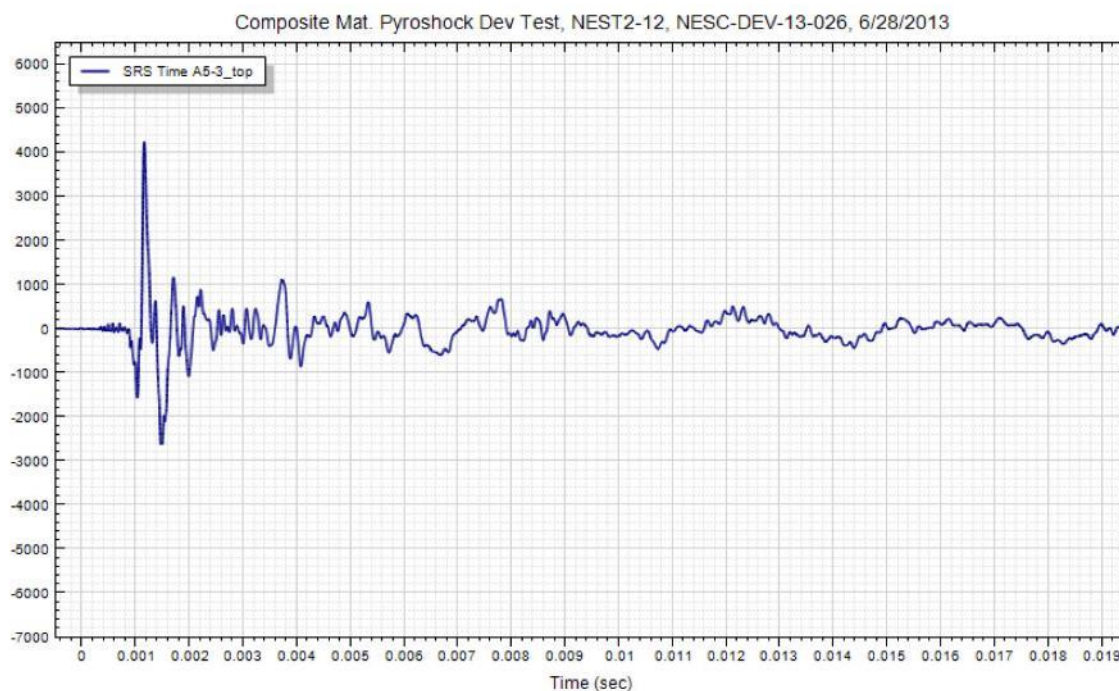
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
111 of 832





# NASA Engineering and Safety Center Technical Assessment Report

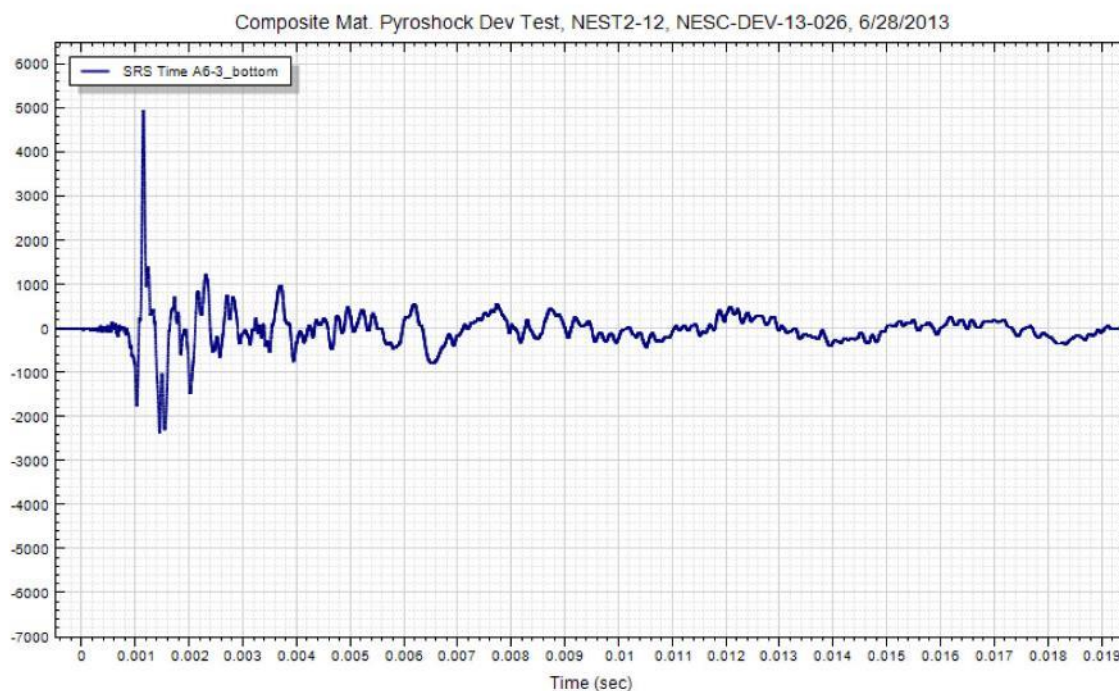
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
112 of 832





# NASA Engineering and Safety Center Technical Assessment Report

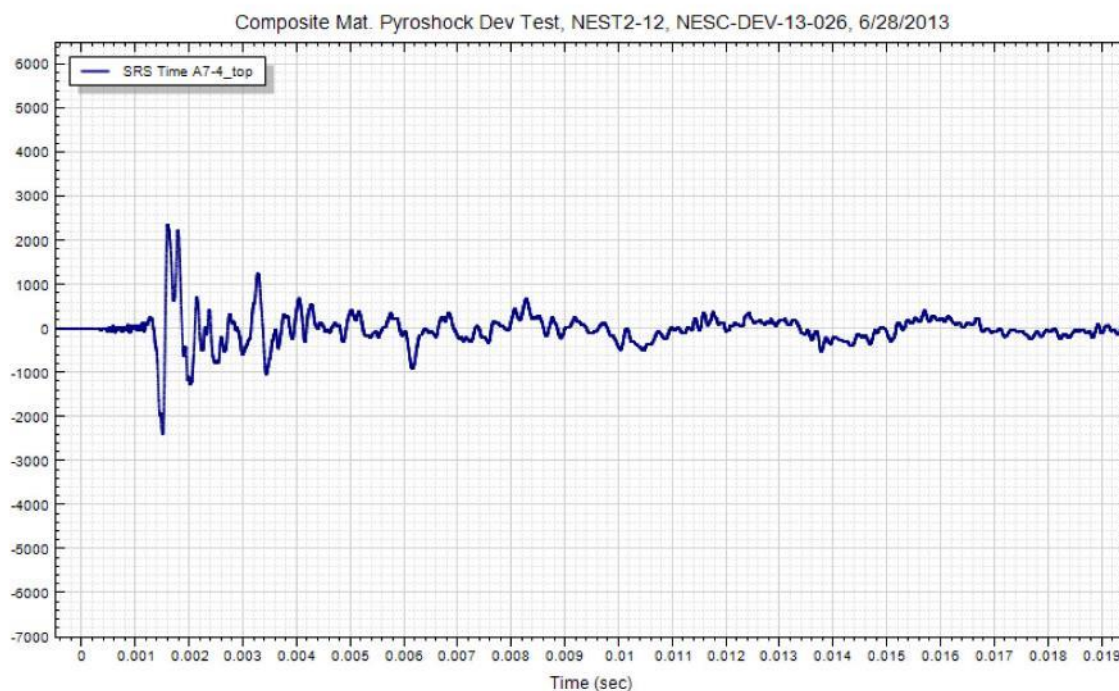
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
113 of 832





# NASA Engineering and Safety Center Technical Assessment Report

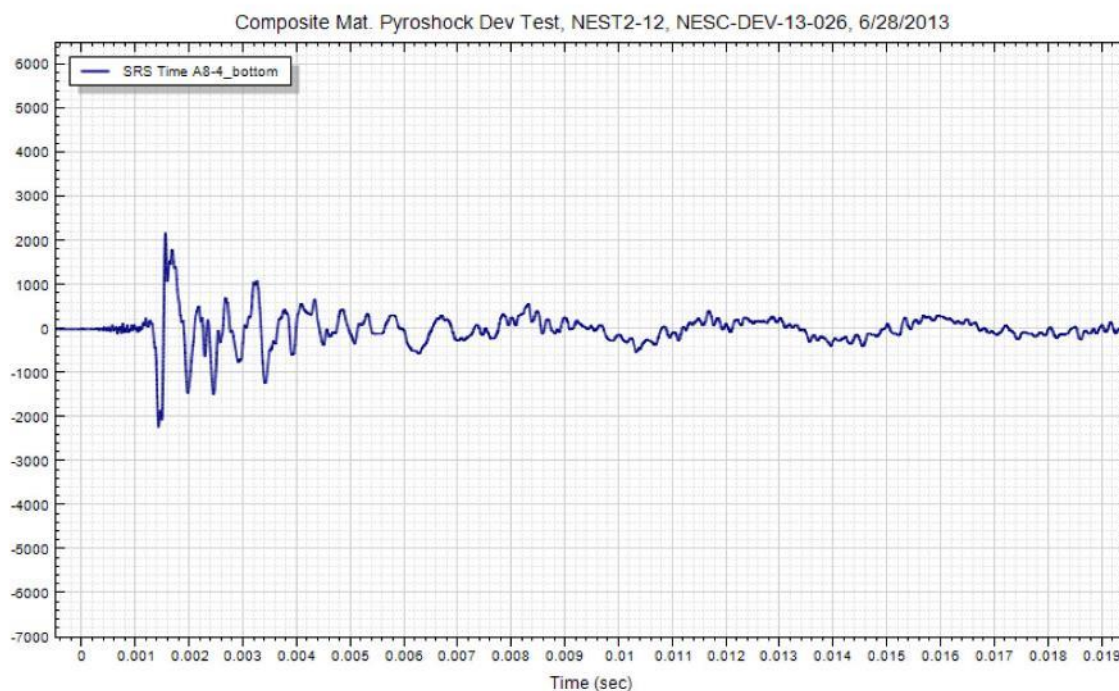
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
114 of 832





# NASA Engineering and Safety Center Technical Assessment Report

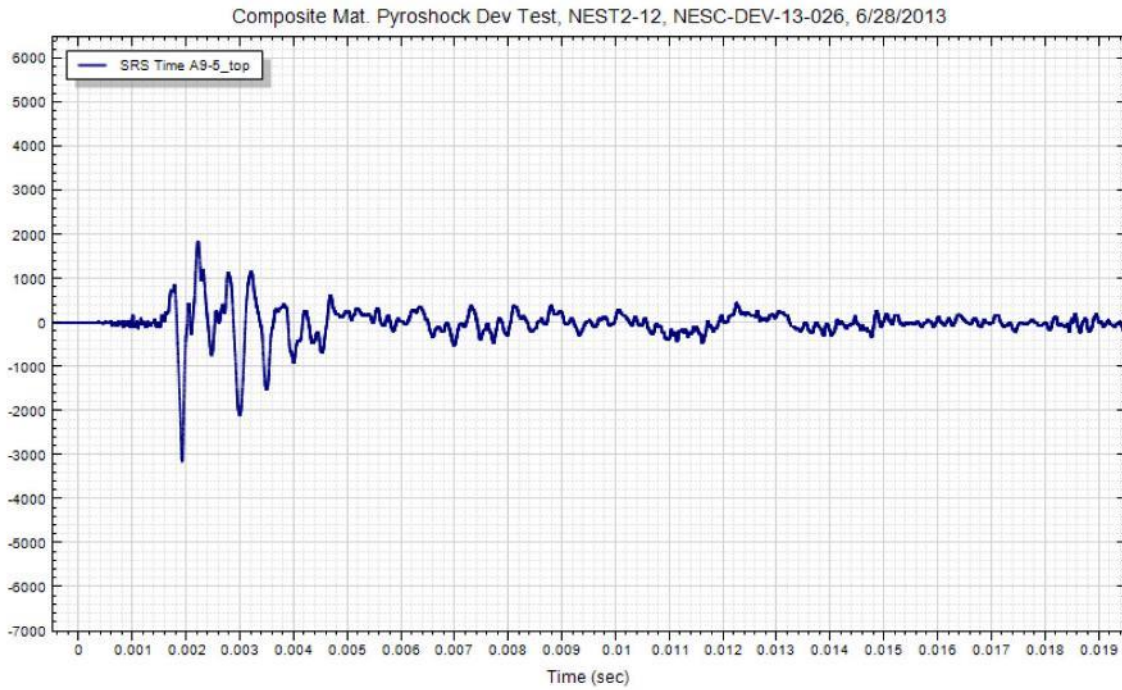
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
115 of 832





# NASA Engineering and Safety Center Technical Assessment Report

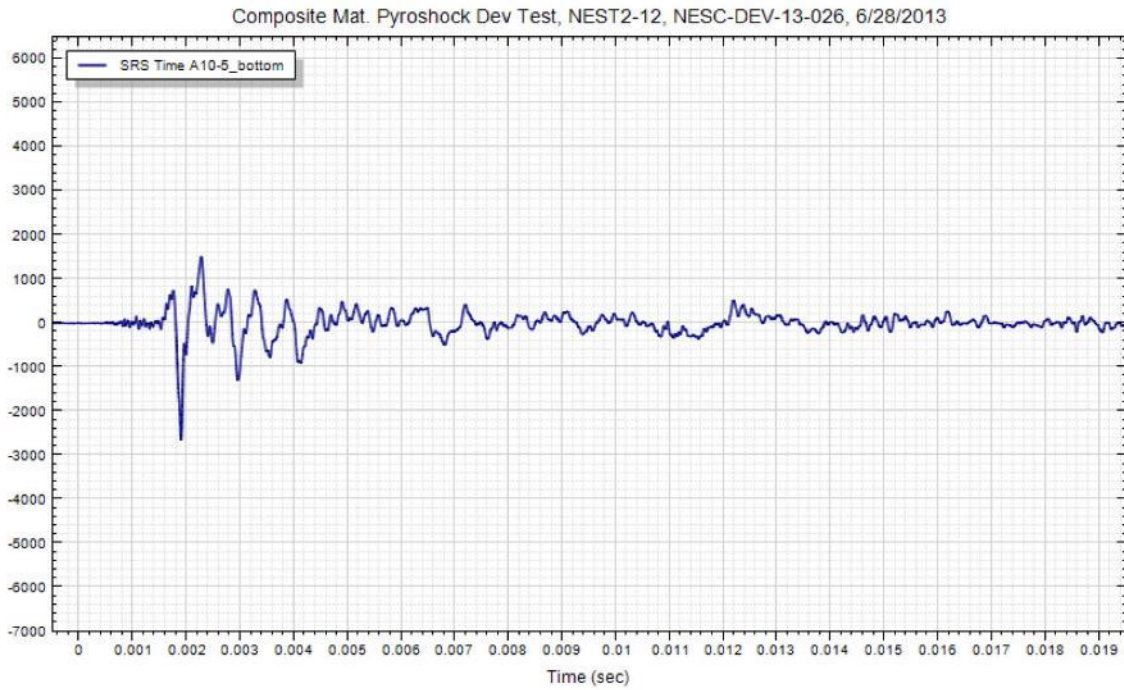
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
116 of 832







# NASA Engineering and Safety Center Technical Assessment Report

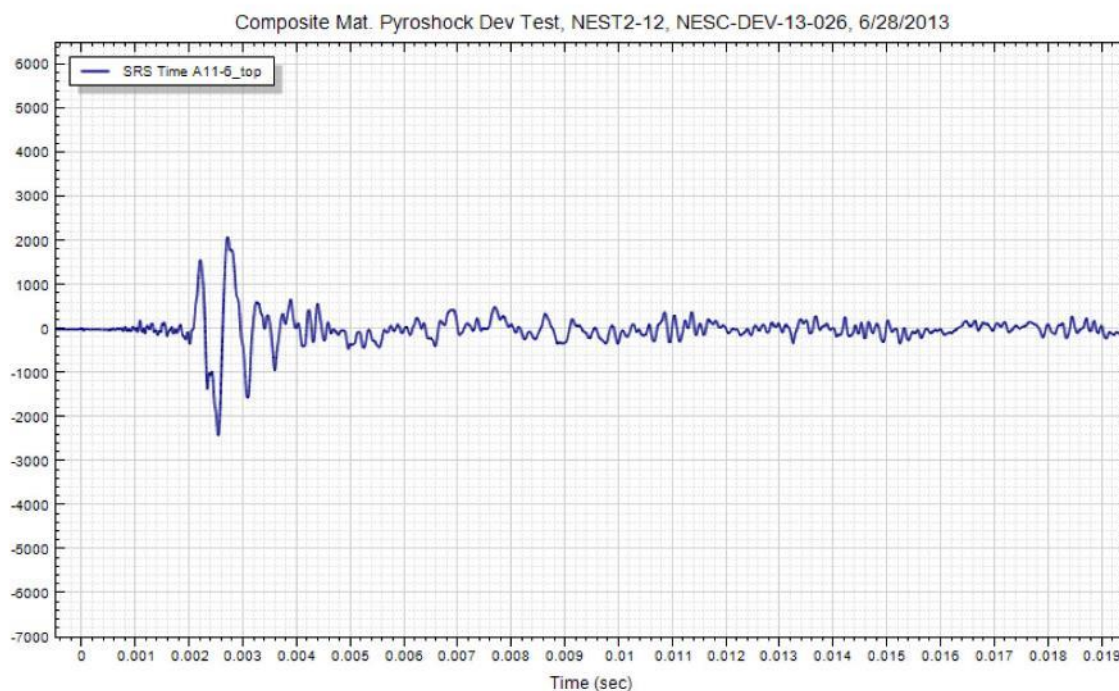
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
117 of 832





# NASA Engineering and Safety Center Technical Assessment Report

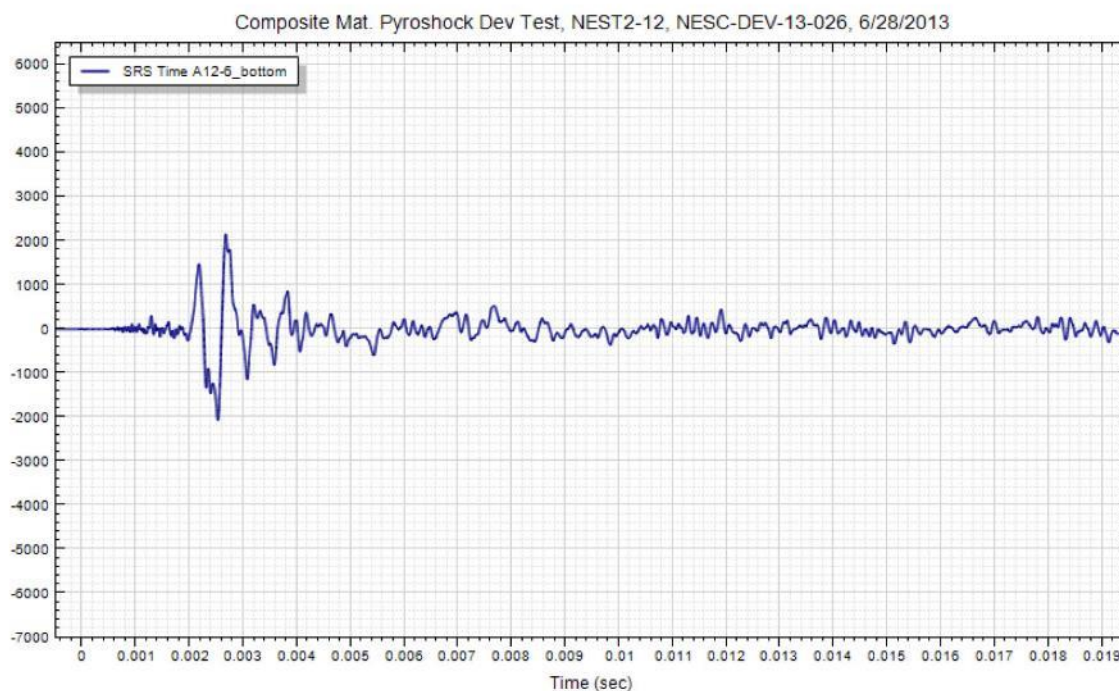
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
118 of 832





# NASA Engineering and Safety Center Technical Assessment Report

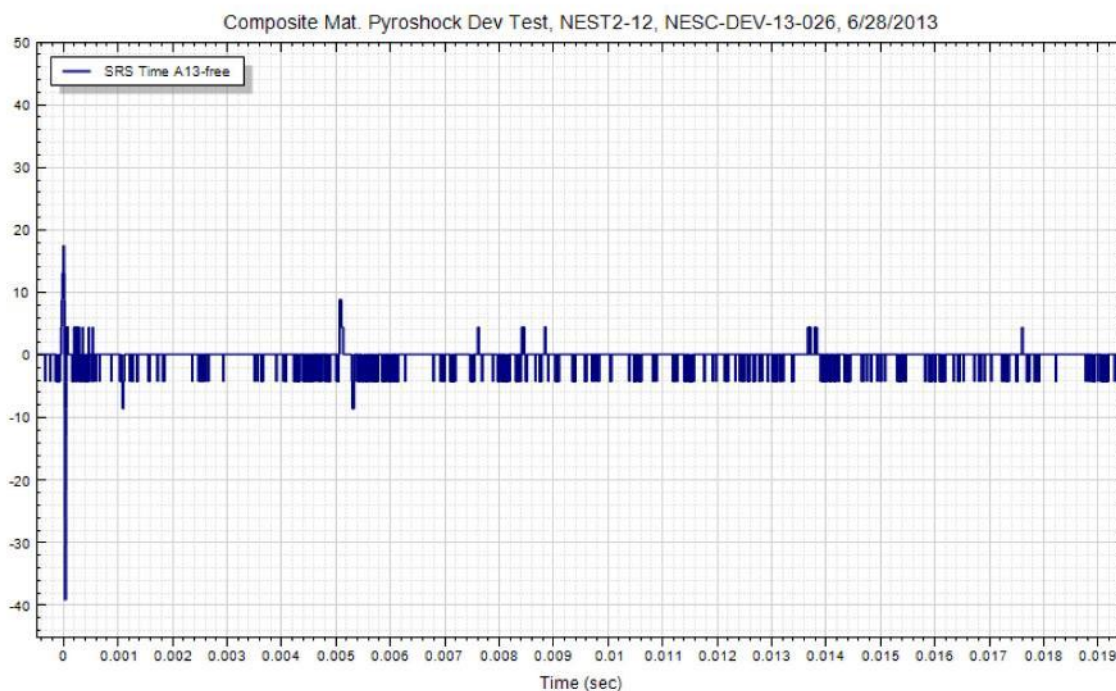
Document #:  
**NESC-RP-  
12-00783**


Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
119 of 832



	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 120 of 832	

**NESC-DEV-13-026**  
**Composite Materials**  
**Shock Test**  
  
**Test #3 Accelerometer Data**  
**Panel 0332A013**



# NASA Engineering and Safety Center Technical Assessment Report

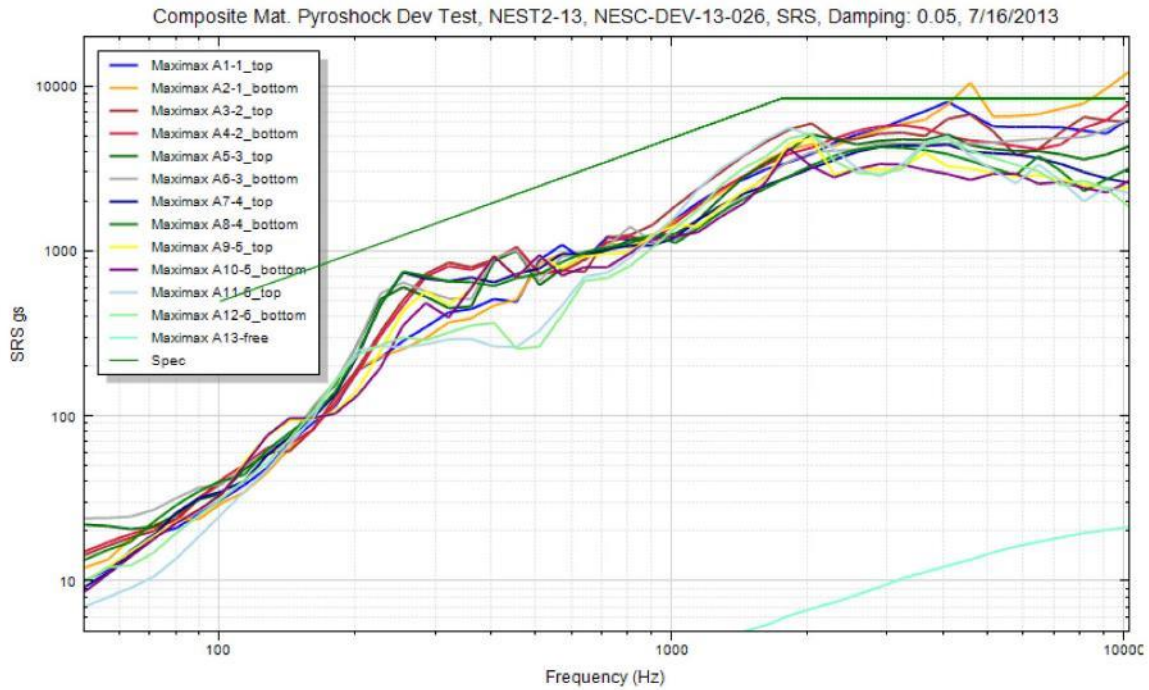
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
121 of 832





# NASA Engineering and Safety Center Technical Assessment Report

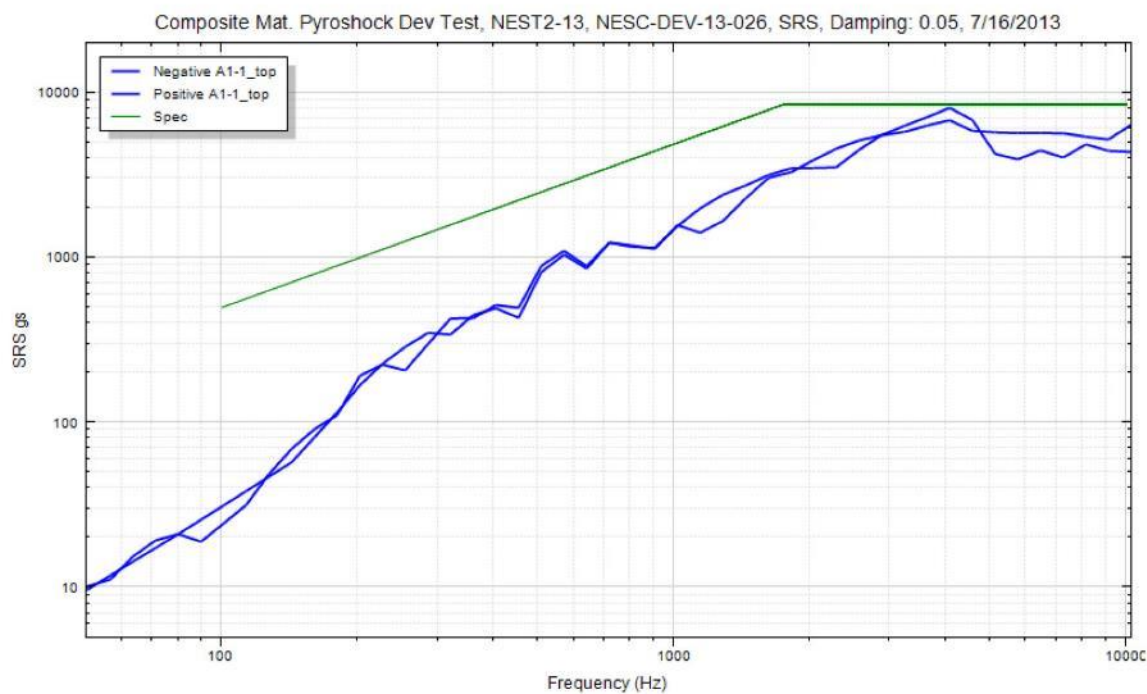
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
122 of 832





# NASA Engineering and Safety Center Technical Assessment Report

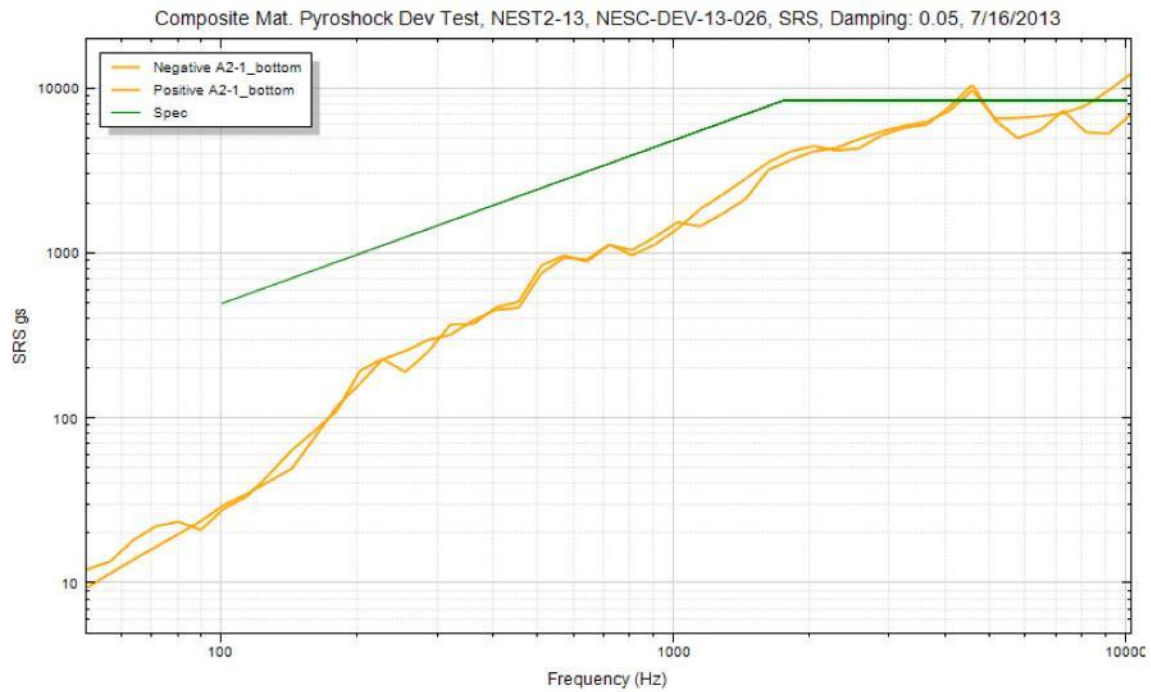
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
123 of 832





# NASA Engineering and Safety Center Technical Assessment Report

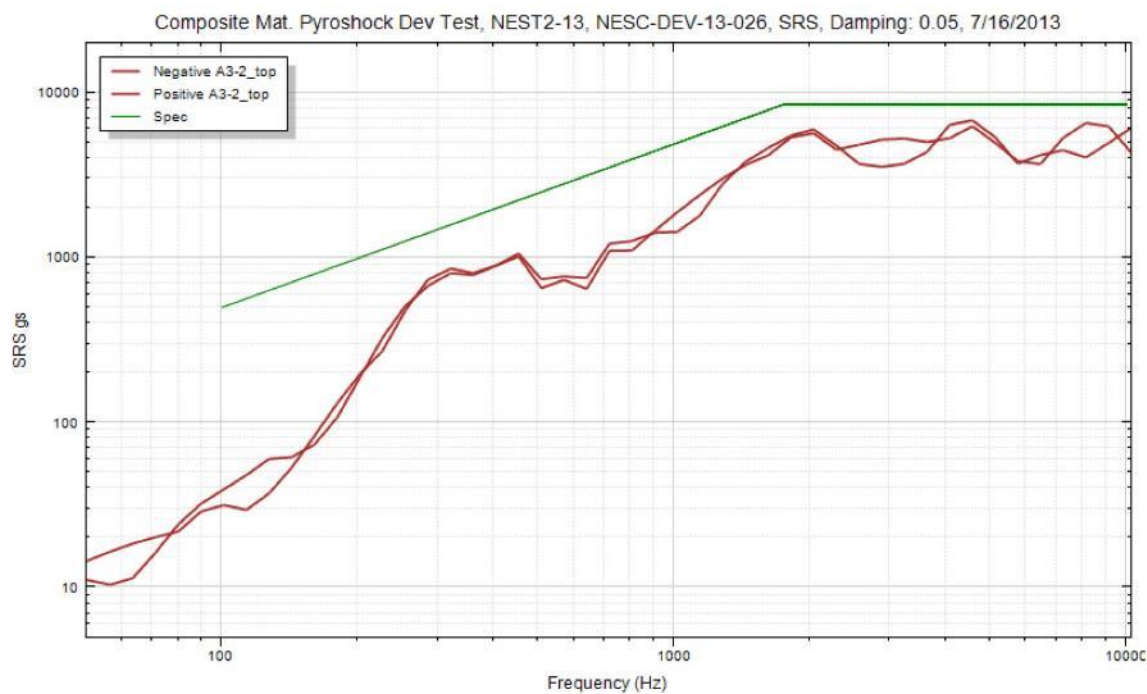
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
124 of 832







# NASA Engineering and Safety Center Technical Assessment Report

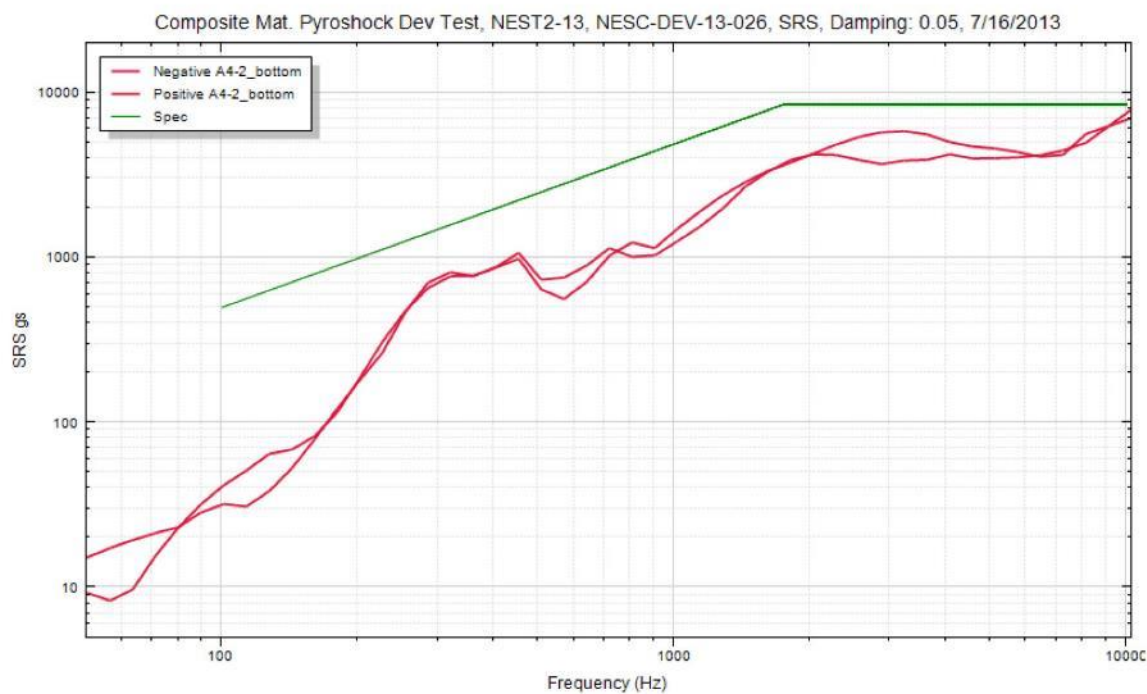
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
125 of 832





# NASA Engineering and Safety Center Technical Assessment Report

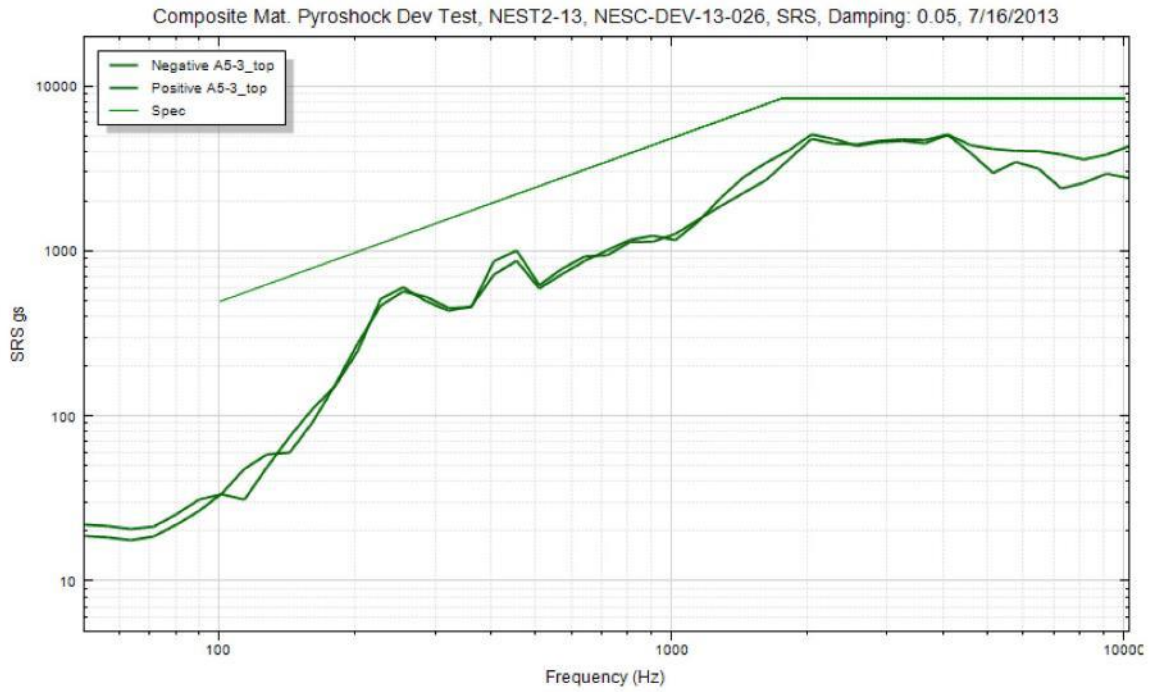
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
126 of 832





# NASA Engineering and Safety Center Technical Assessment Report

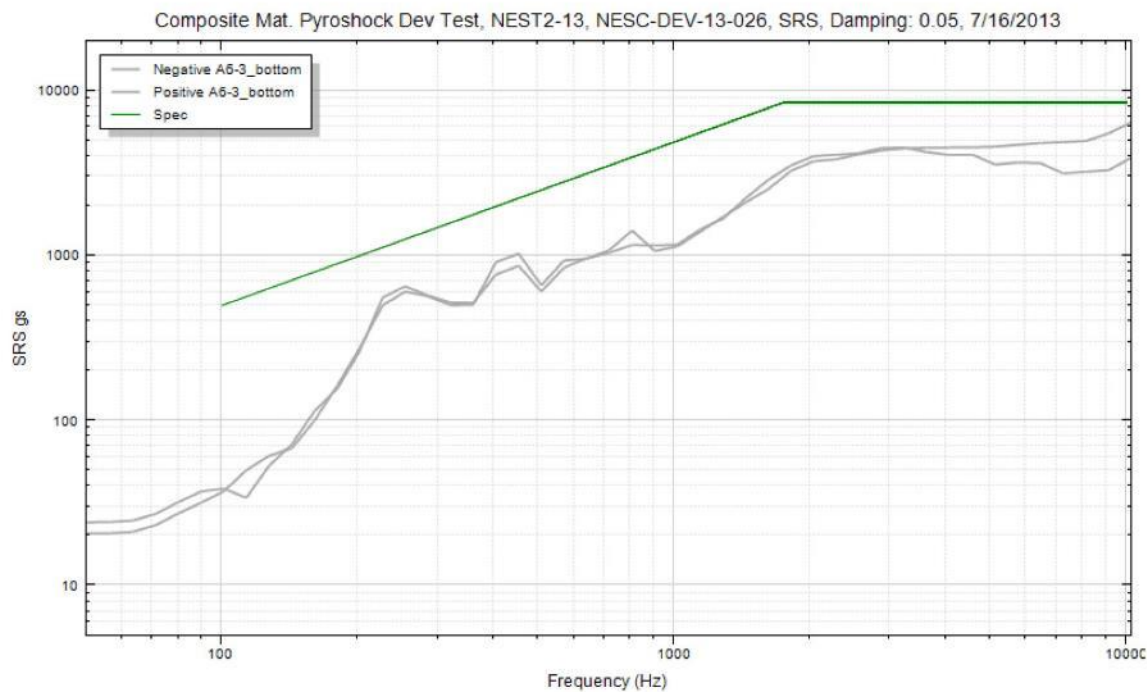
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
127 of 832





# NASA Engineering and Safety Center Technical Assessment Report

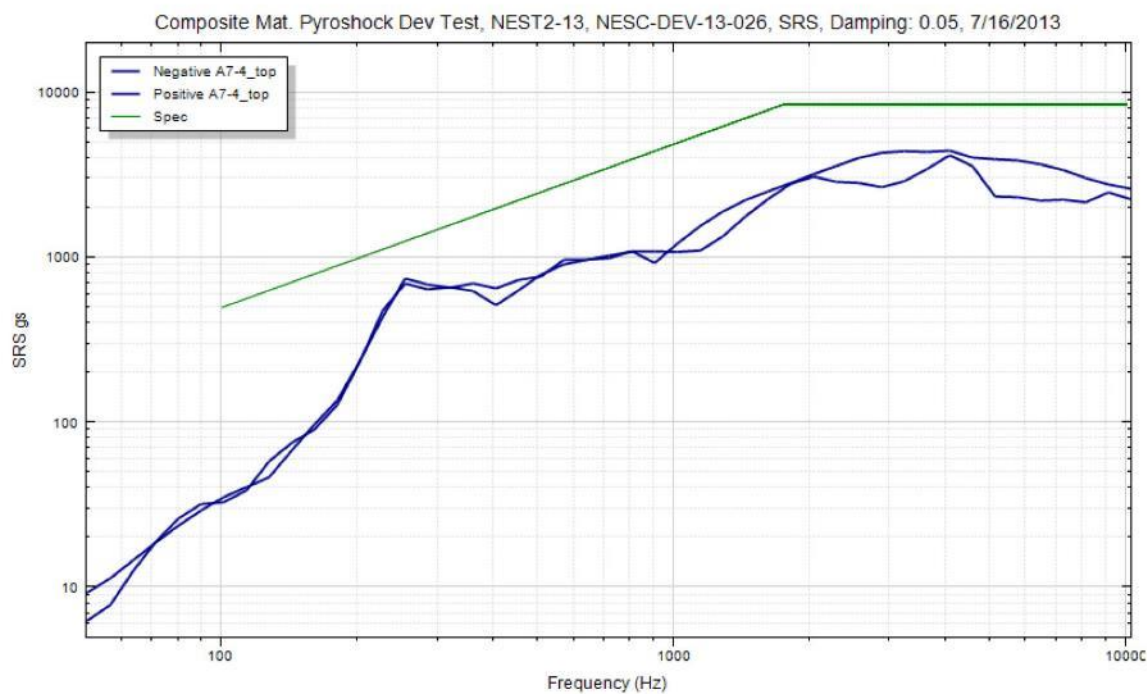
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
128 of 832





# NASA Engineering and Safety Center Technical Assessment Report

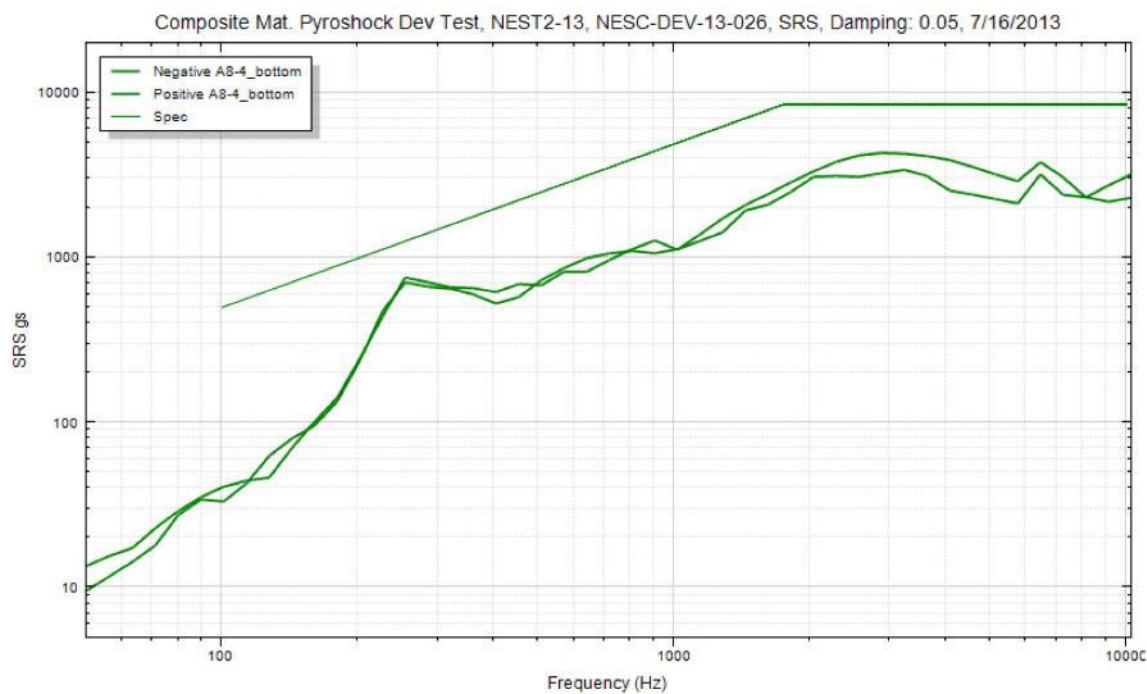
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
129 of 832





# NASA Engineering and Safety Center Technical Assessment Report

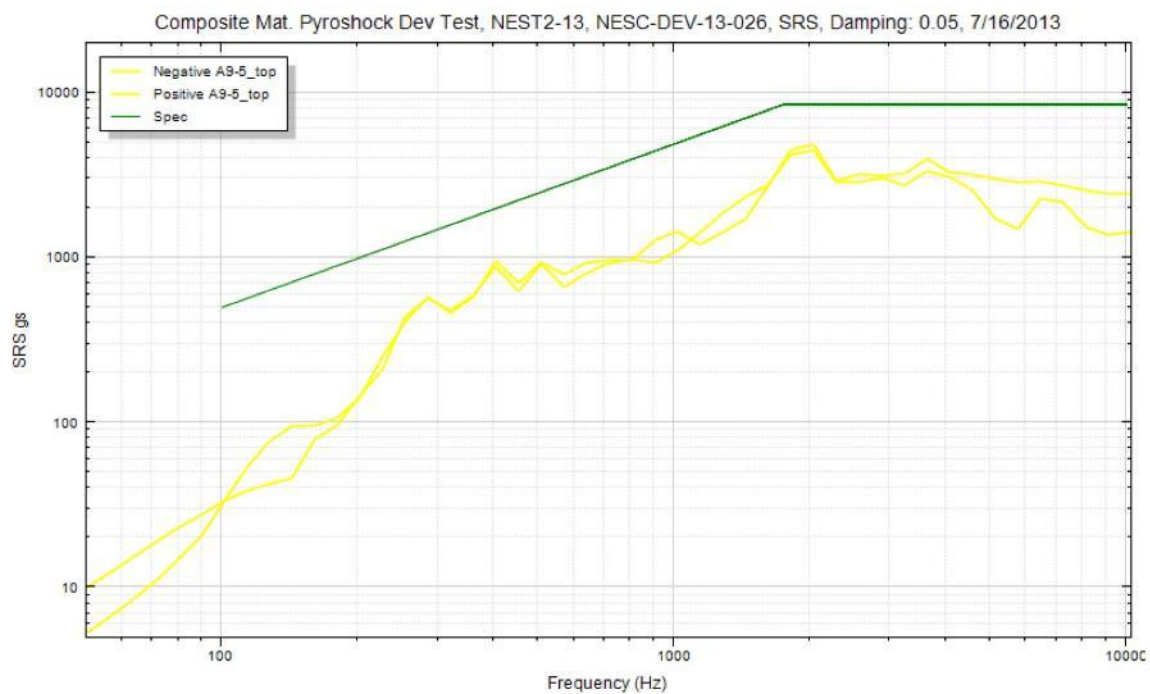
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
130 of 832





# NASA Engineering and Safety Center Technical Assessment Report

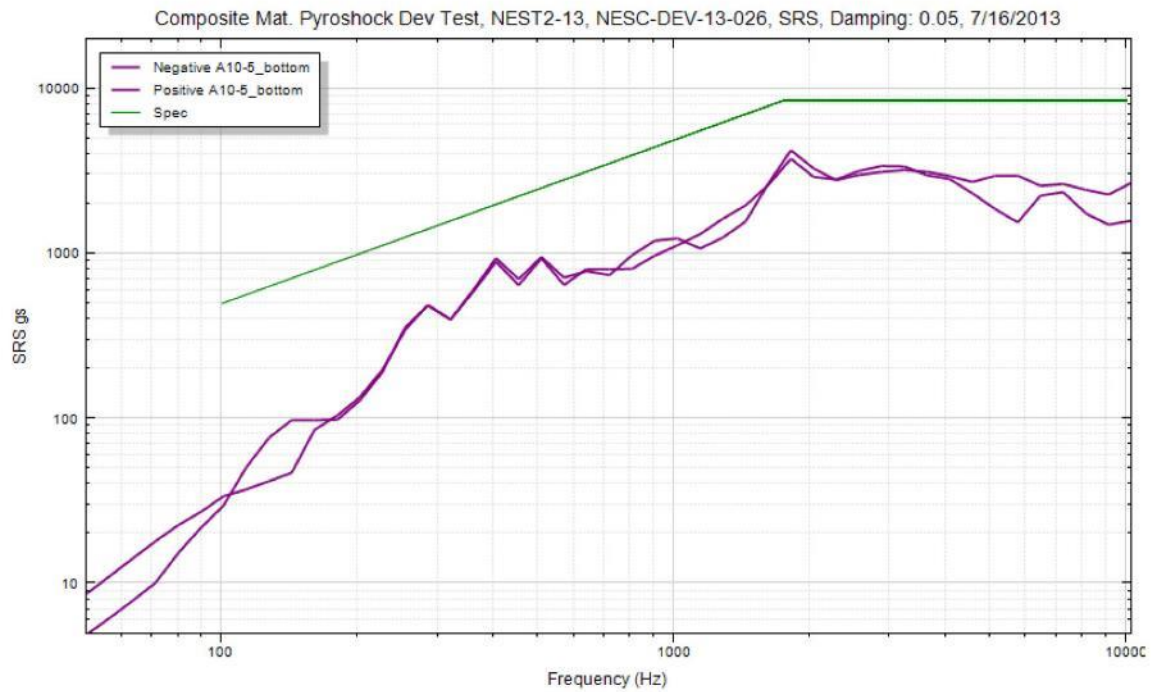
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
131 of 832





# NASA Engineering and Safety Center Technical Assessment Report

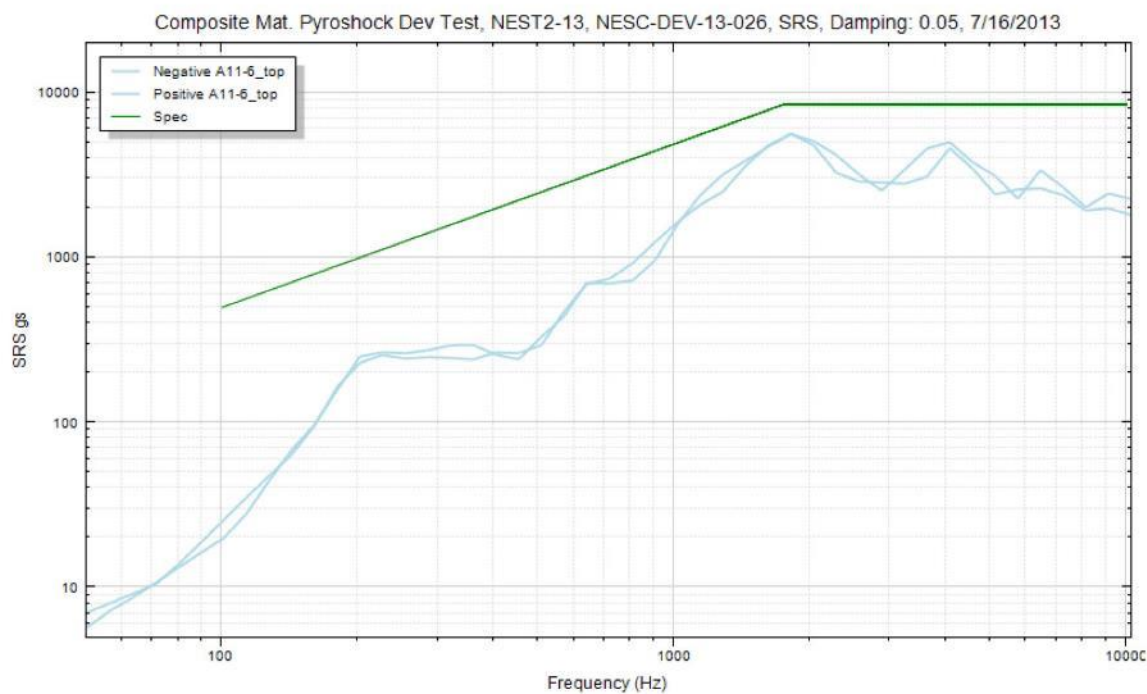
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
132 of 832







# NASA Engineering and Safety Center Technical Assessment Report

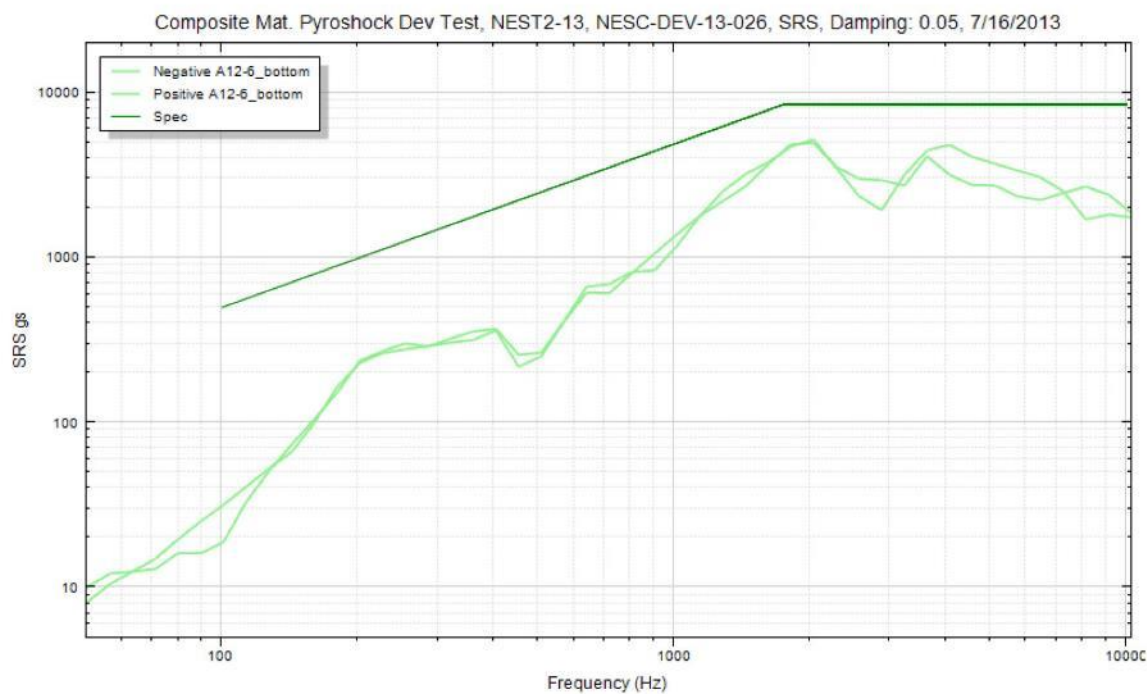
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
133 of 832





# NASA Engineering and Safety Center Technical Assessment Report

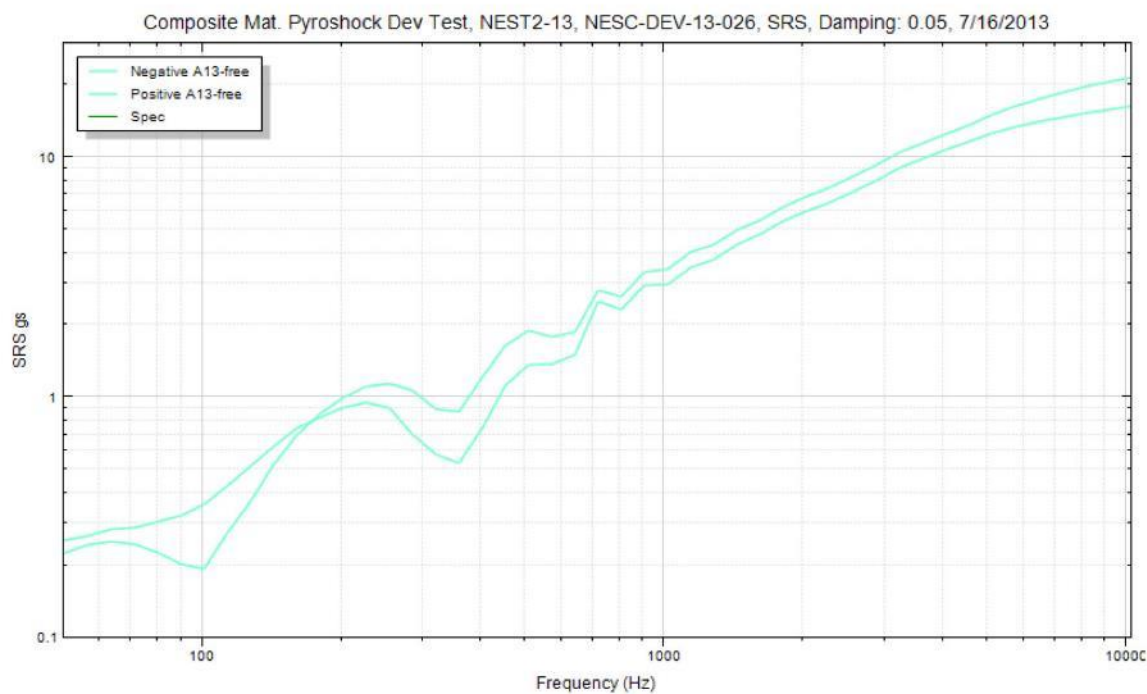
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
134 of 832





# NASA Engineering and Safety Center Technical Assessment Report

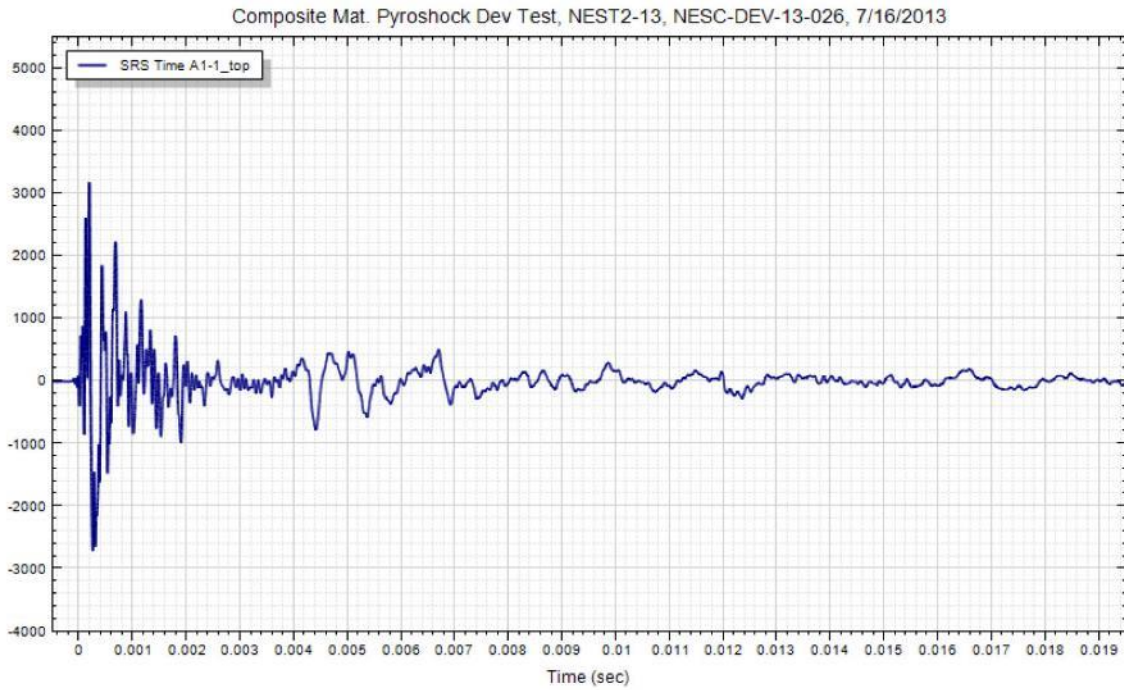
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
135 of 832





# NASA Engineering and Safety Center Technical Assessment Report

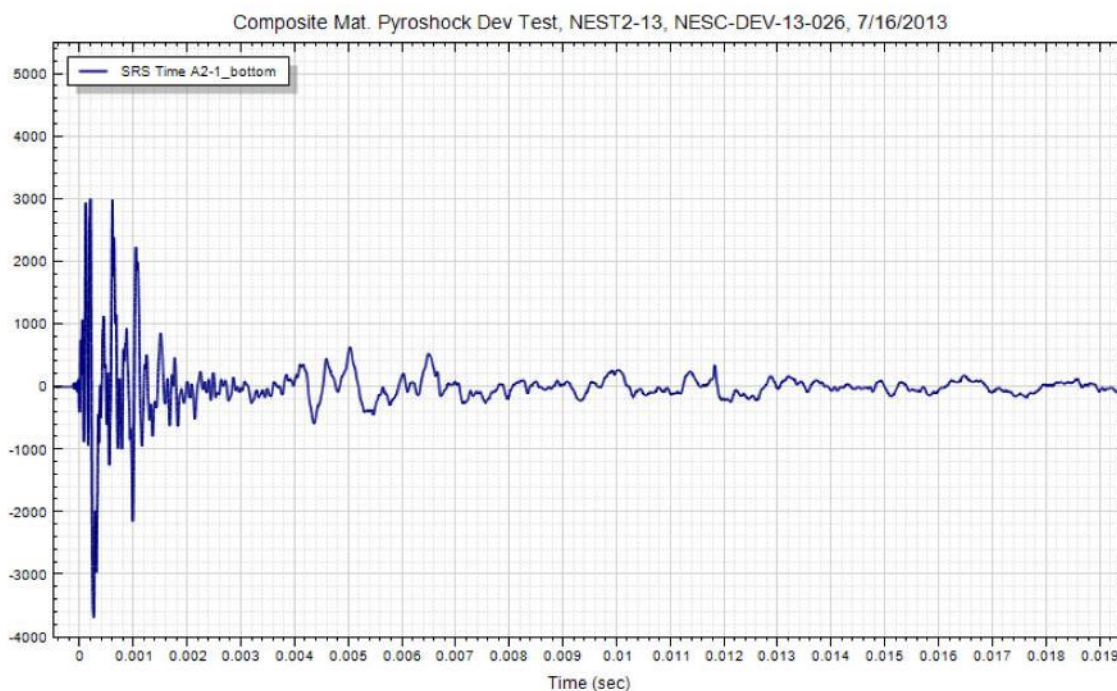
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
136 of 832





# NASA Engineering and Safety Center Technical Assessment Report

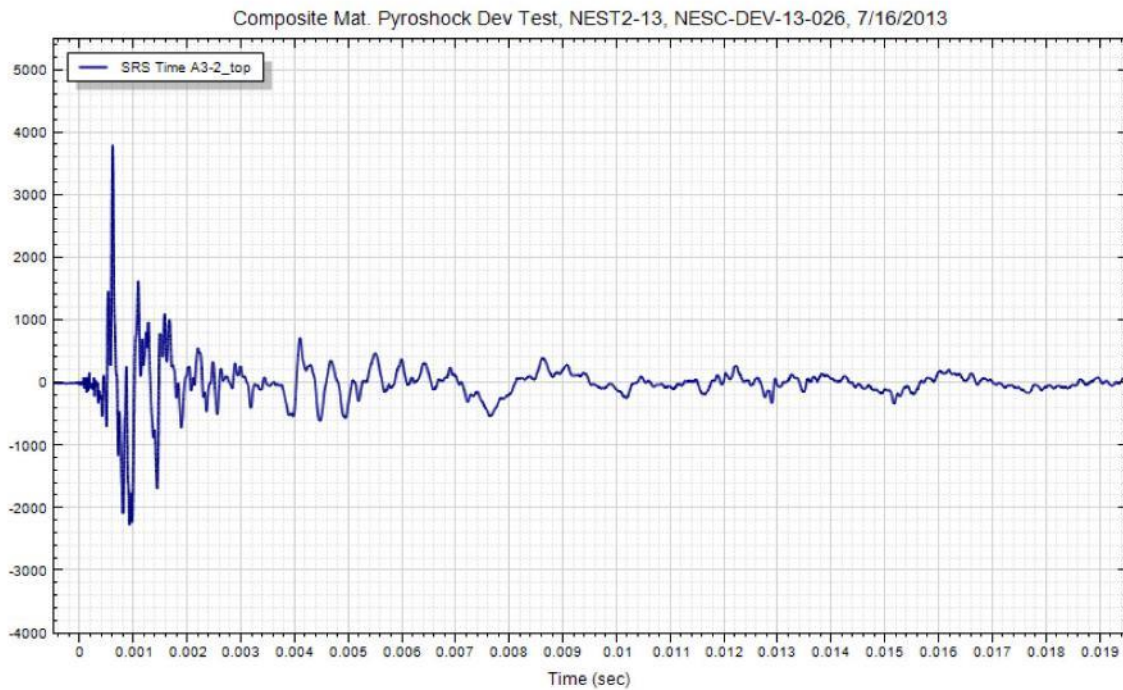
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
137 of 832





# NASA Engineering and Safety Center Technical Assessment Report

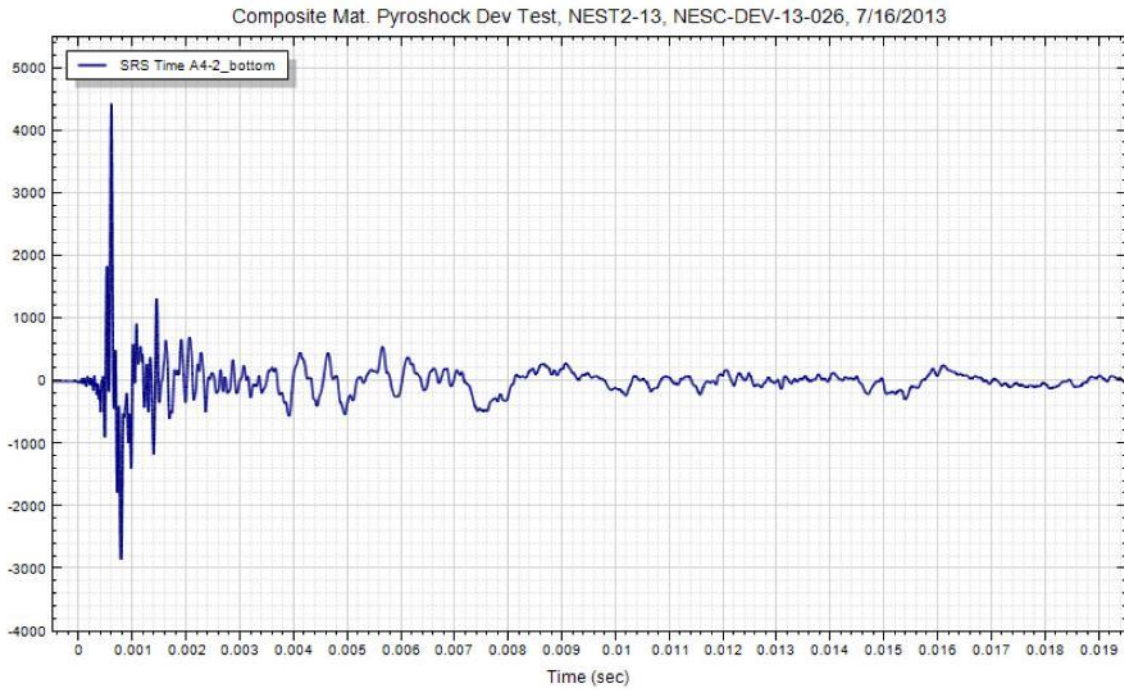
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
138 of 832





# NASA Engineering and Safety Center Technical Assessment Report

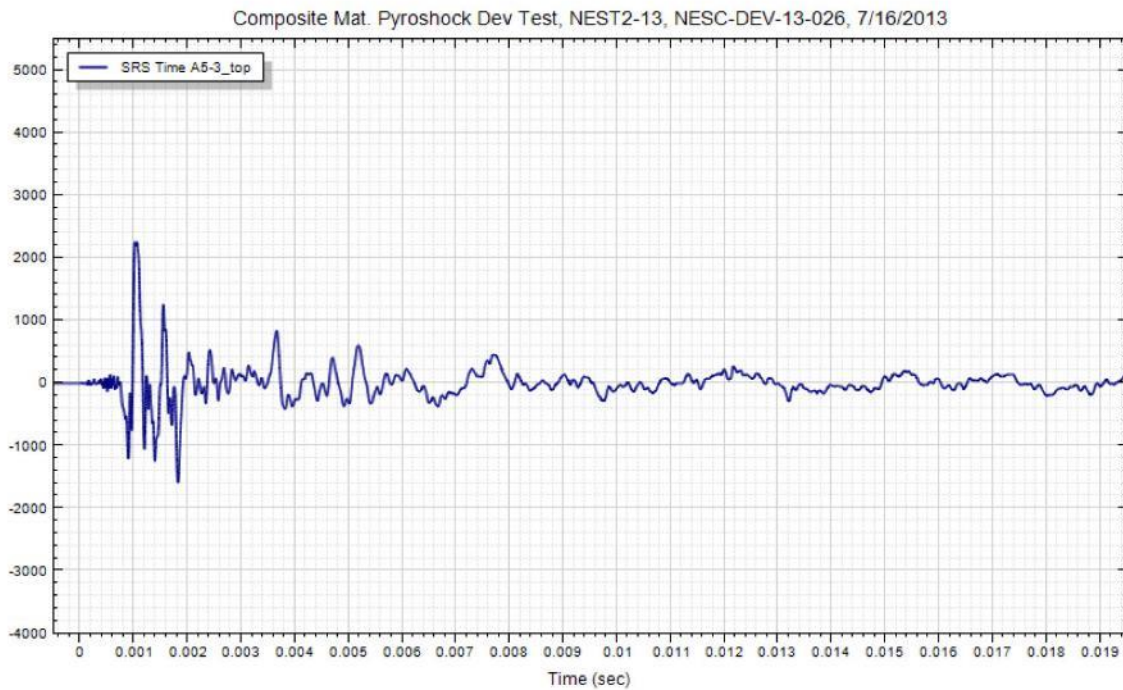
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
139 of 832





# NASA Engineering and Safety Center Technical Assessment Report

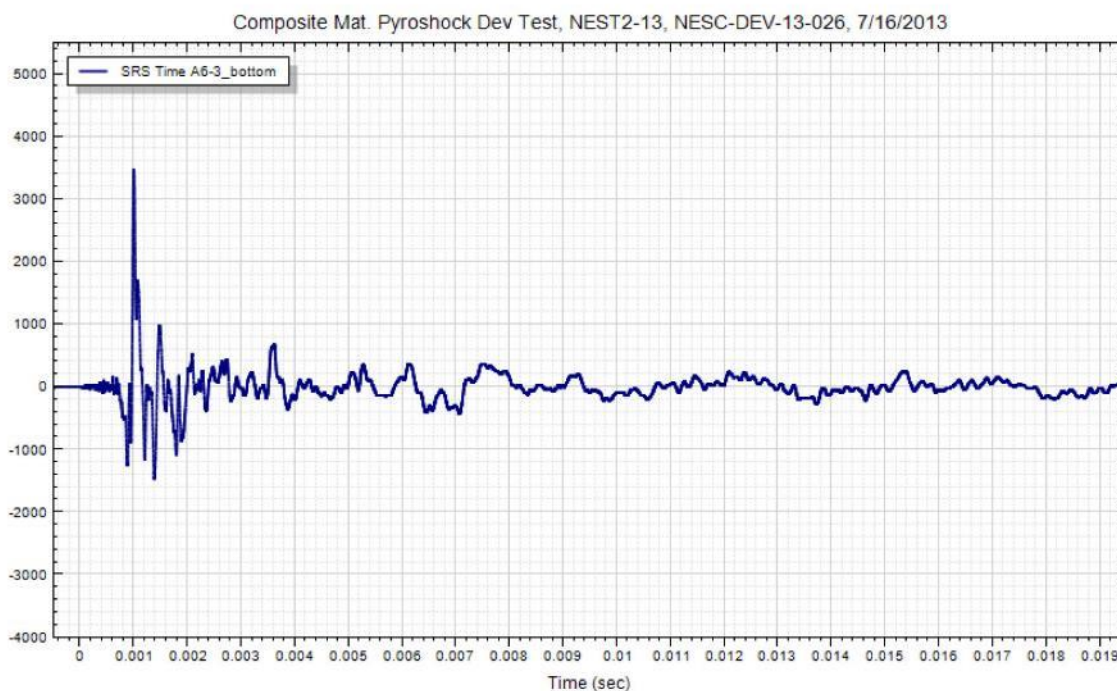
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
140 of 832







# NASA Engineering and Safety Center Technical Assessment Report

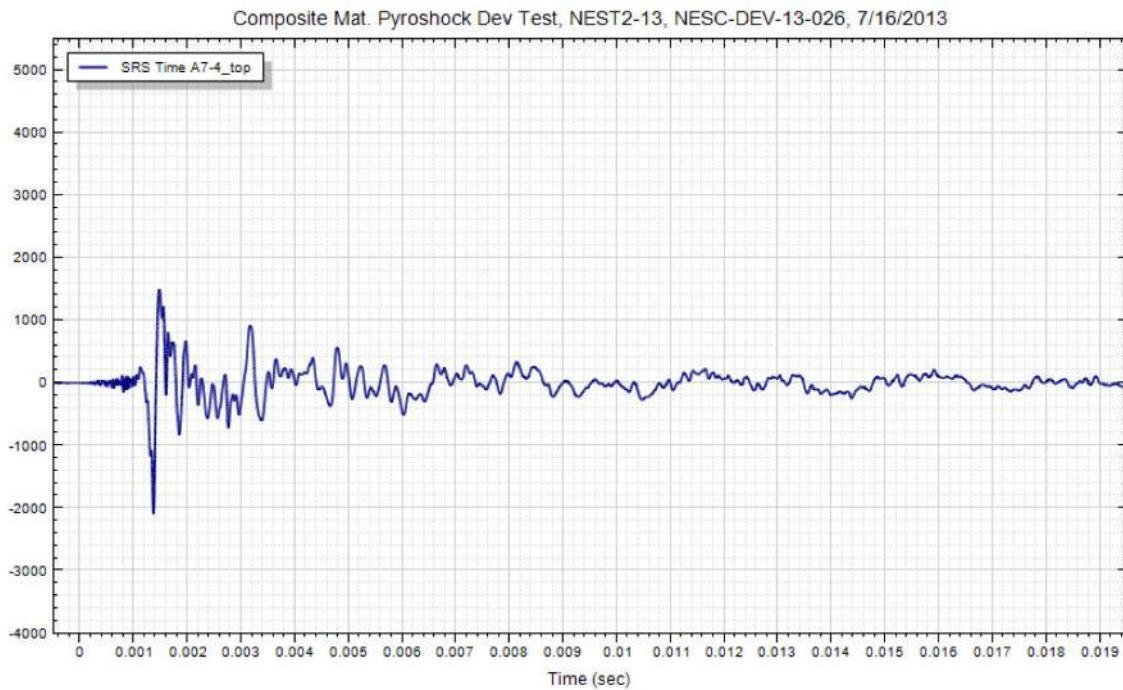
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
141 of 832





# NASA Engineering and Safety Center Technical Assessment Report

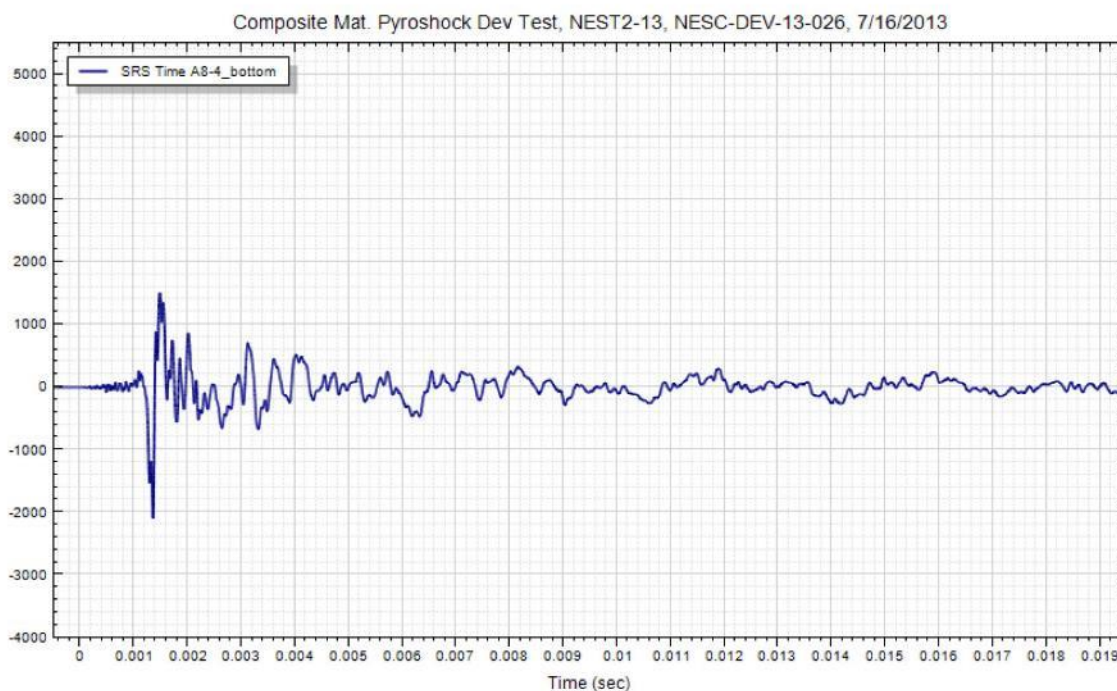
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
142 of 832





# NASA Engineering and Safety Center Technical Assessment Report

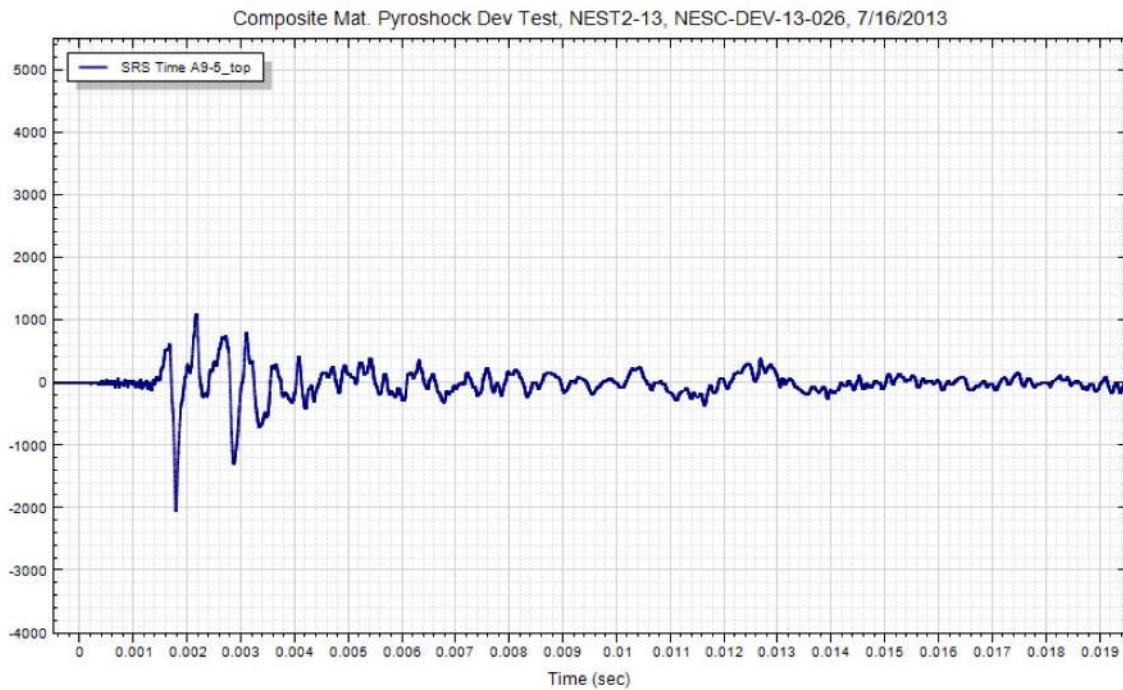
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
143 of 832





# NASA Engineering and Safety Center Technical Assessment Report

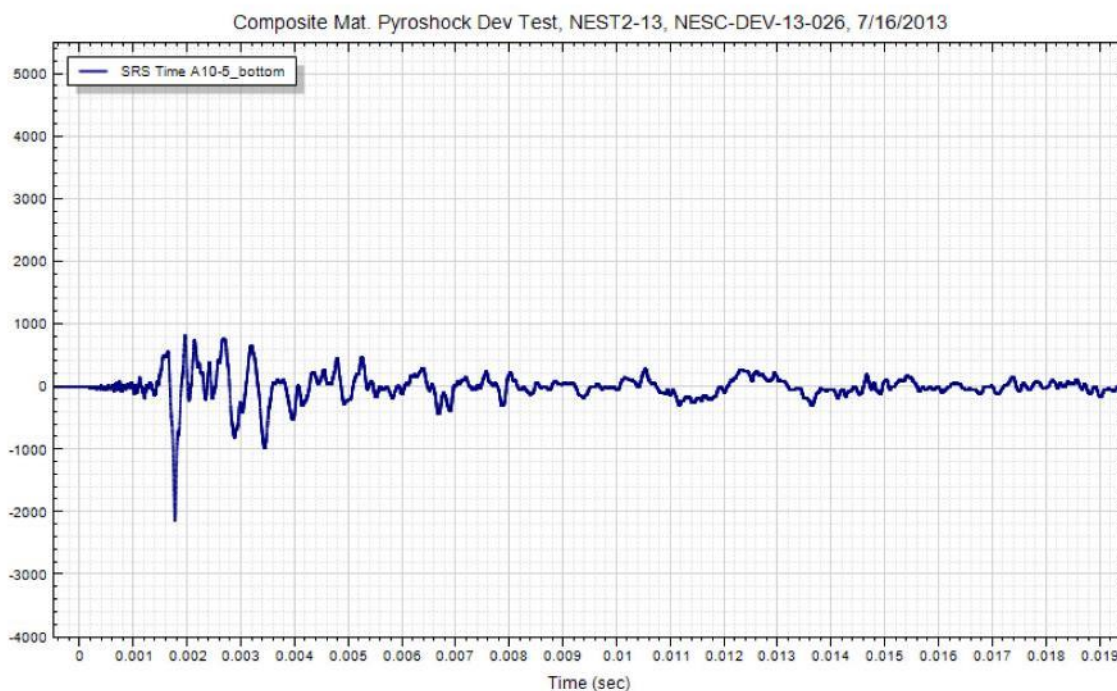
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
144 of 832





# NASA Engineering and Safety Center Technical Assessment Report

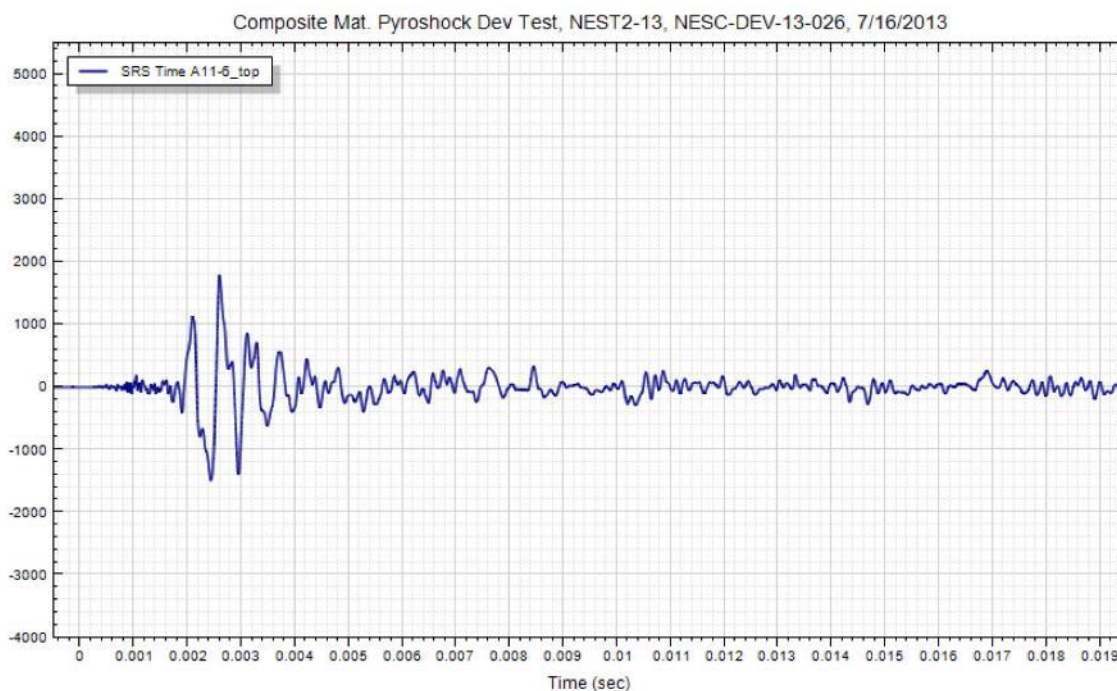
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
145 of 832





# NASA Engineering and Safety Center Technical Assessment Report

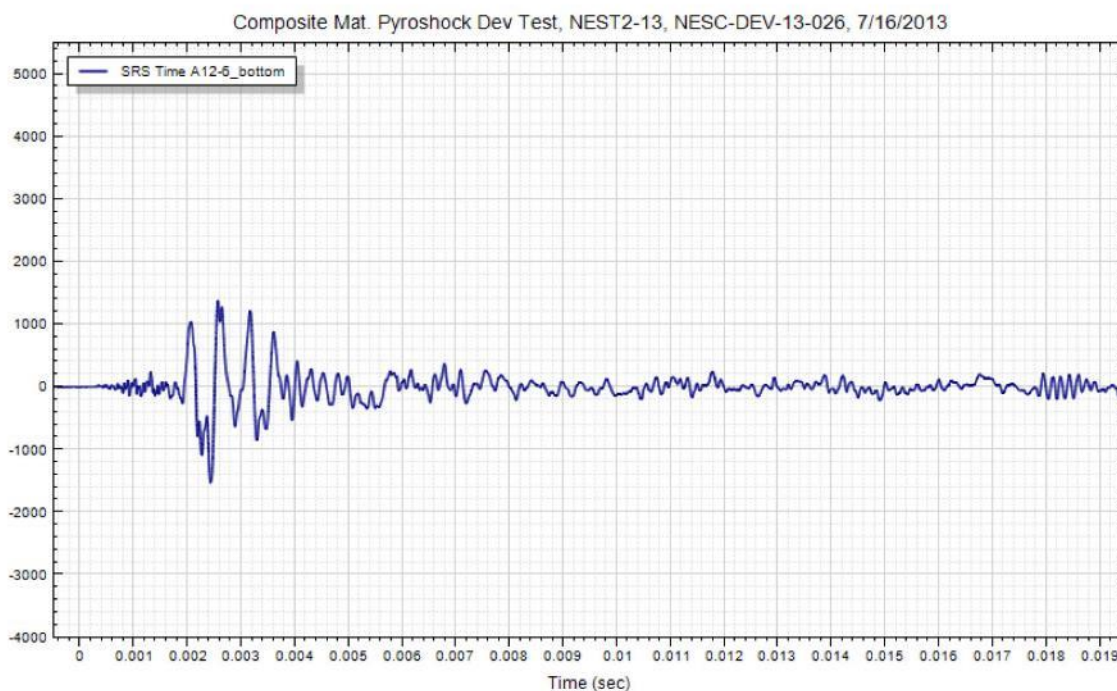
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
146 of 832





# NASA Engineering and Safety Center Technical Assessment Report

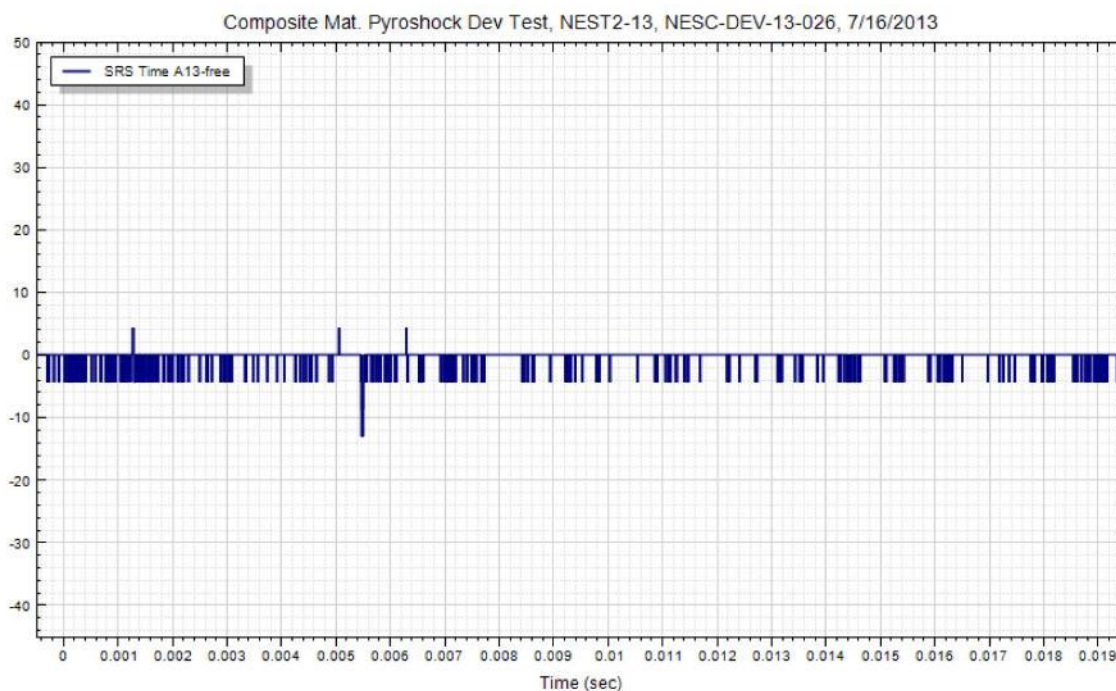
Document #:  
**NESC-RP-  
12-00783**


Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
147 of 832



	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 148 of 832</p>	

**NESC-DEV-13-026**  
**Composite Materials**  
**Shock Test**  
  
**Test #4 Accelerometer Data**  
**Panel 0332A012**





# NASA Engineering and Safety Center Technical Assessment Report

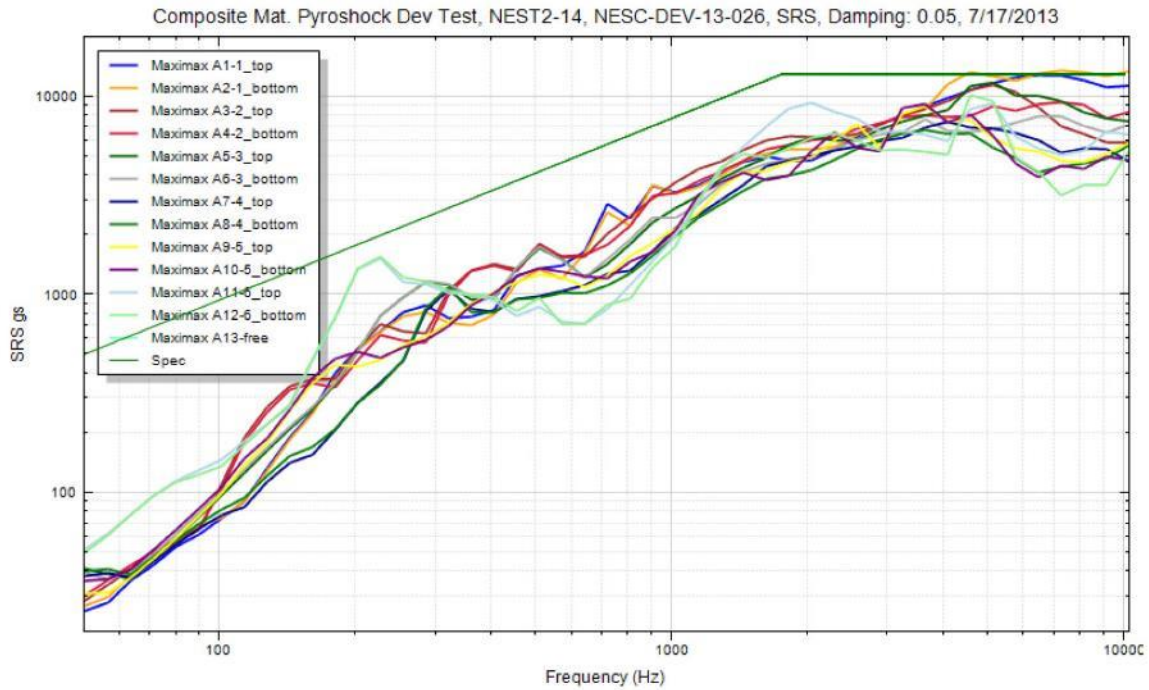
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
149 of 832





# NASA Engineering and Safety Center Technical Assessment Report

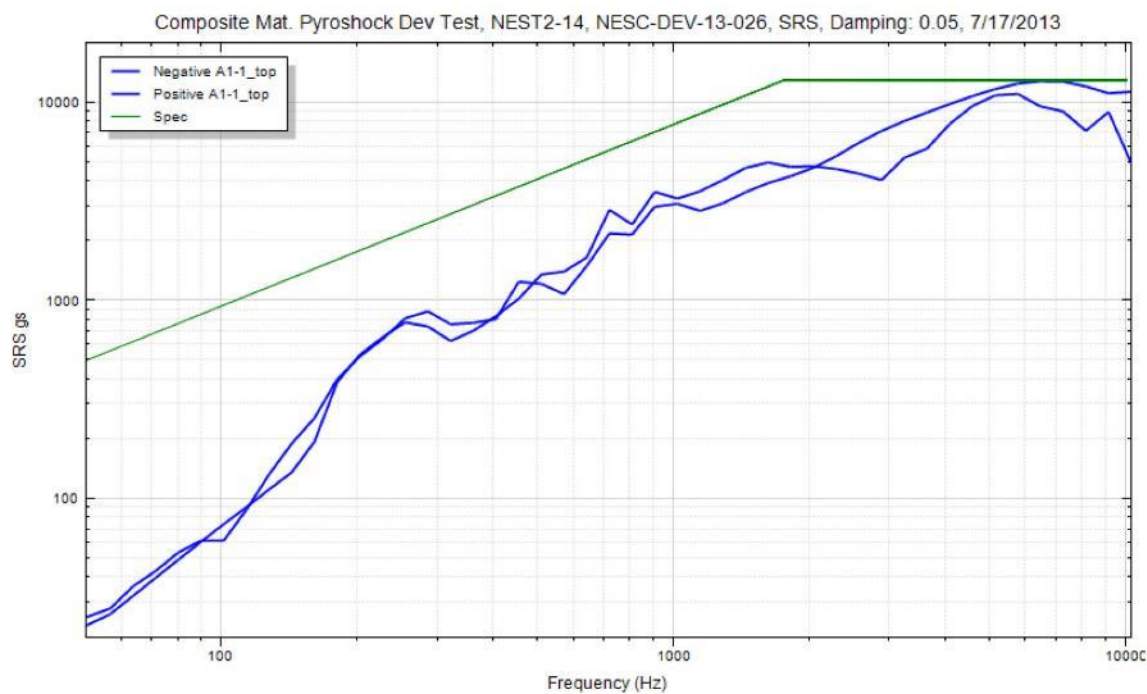
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
150 of 832





# NASA Engineering and Safety Center Technical Assessment Report

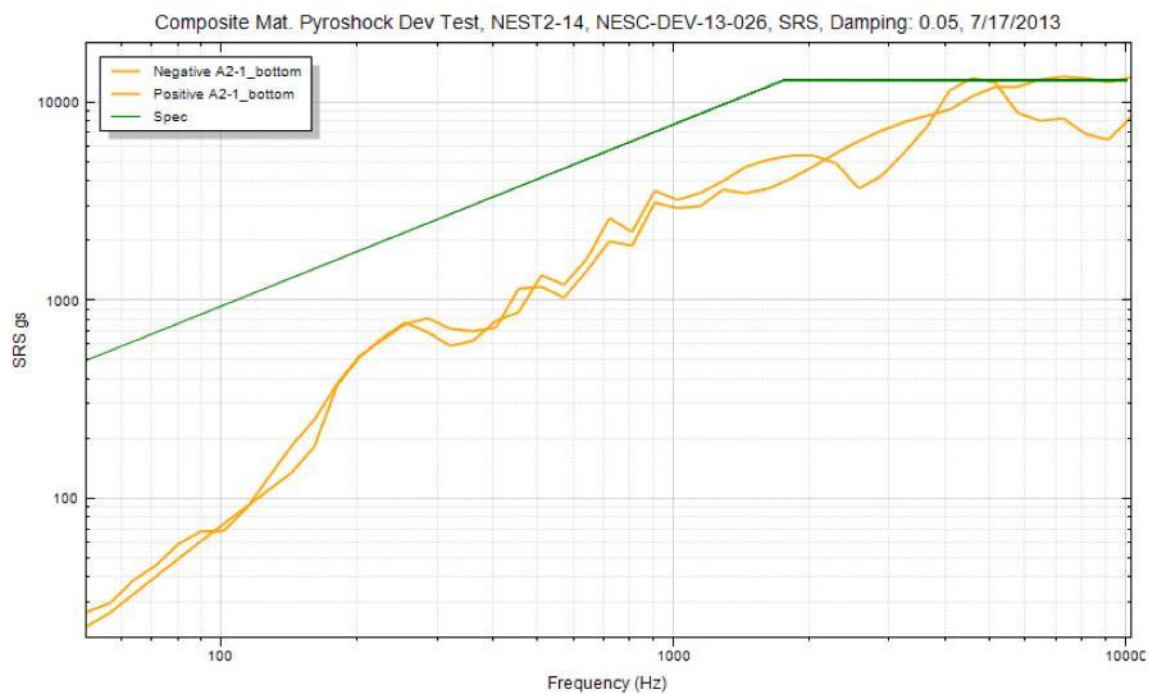
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
151 of 832





# NASA Engineering and Safety Center Technical Assessment Report

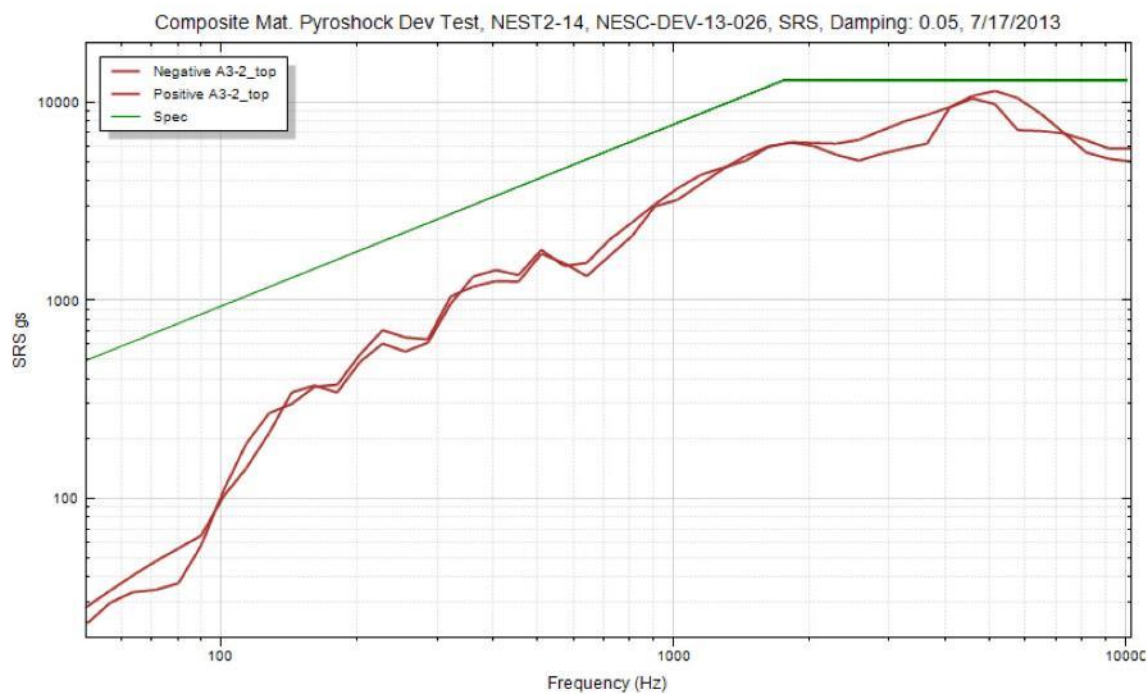
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
152 of 832





# NASA Engineering and Safety Center Technical Assessment Report

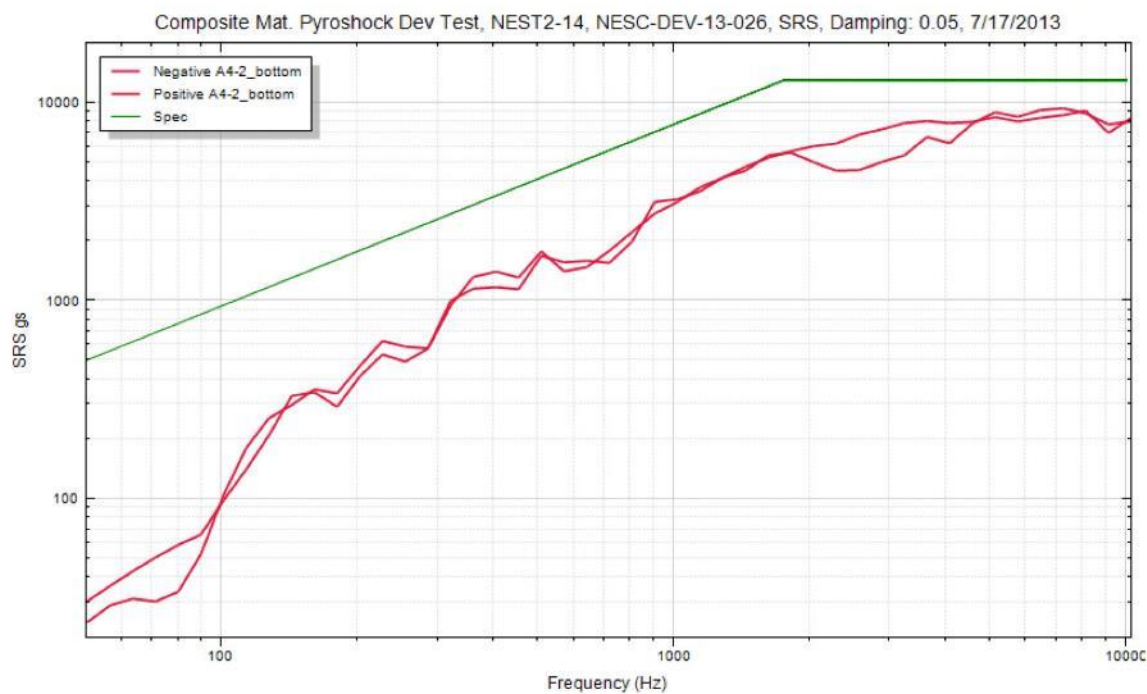
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
153 of 832





# NASA Engineering and Safety Center Technical Assessment Report

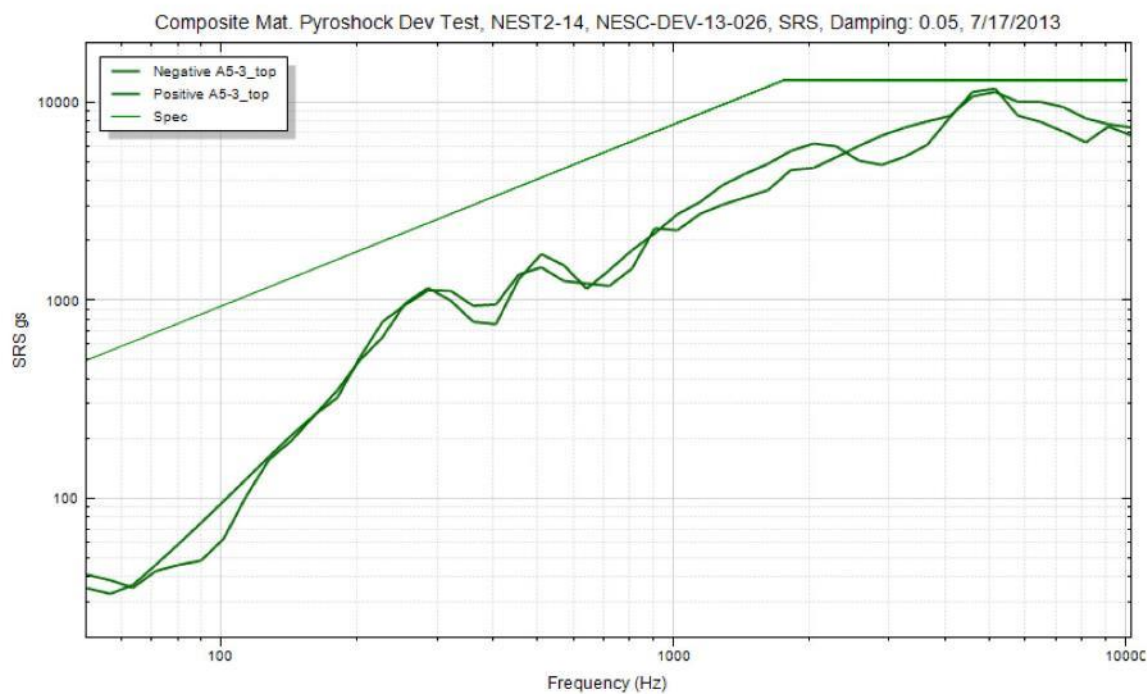
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
154 of 832





# NASA Engineering and Safety Center Technical Assessment Report

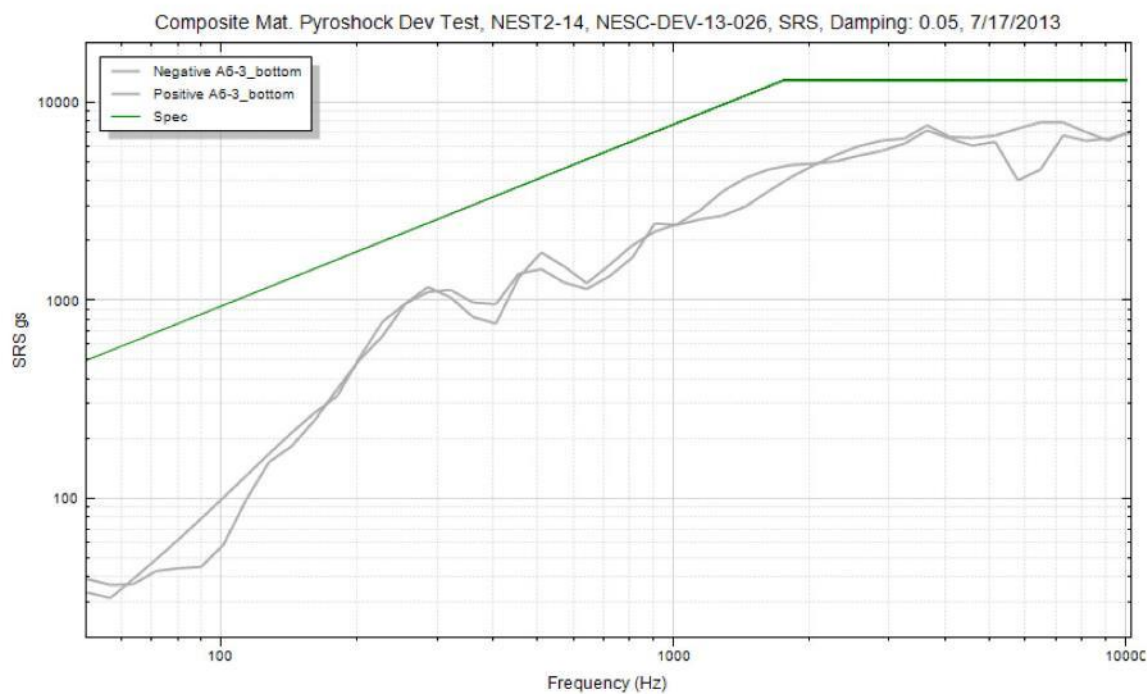
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
155 of 832





# NASA Engineering and Safety Center Technical Assessment Report

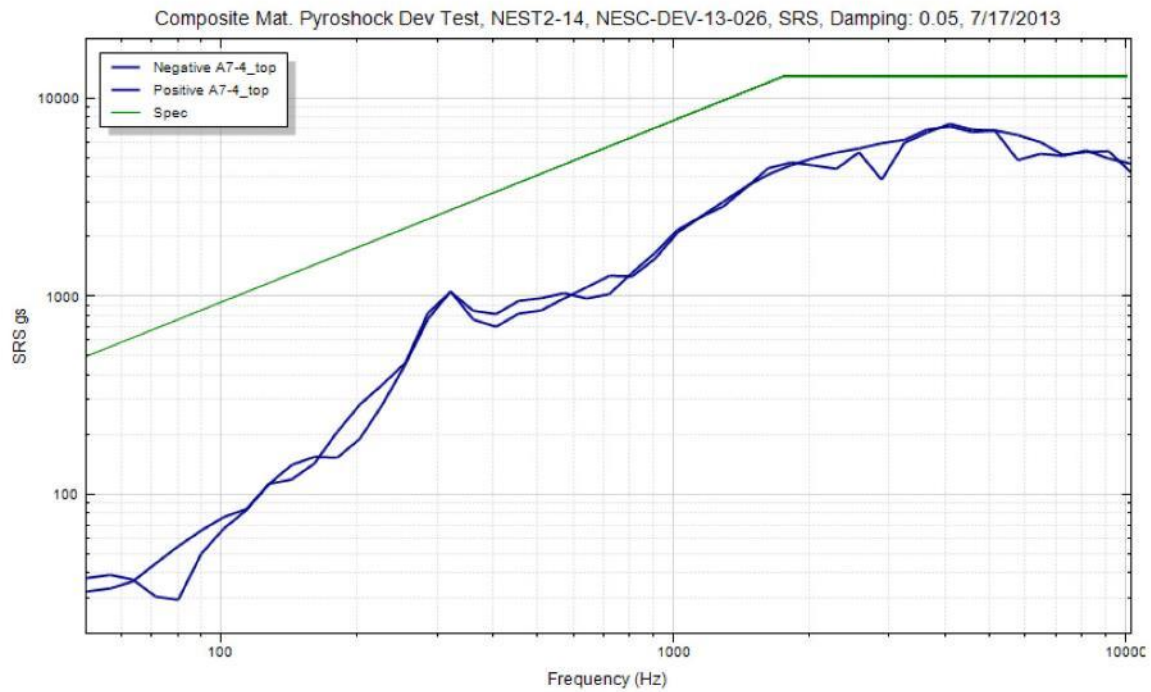
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
156 of 832







# NASA Engineering and Safety Center Technical Assessment Report

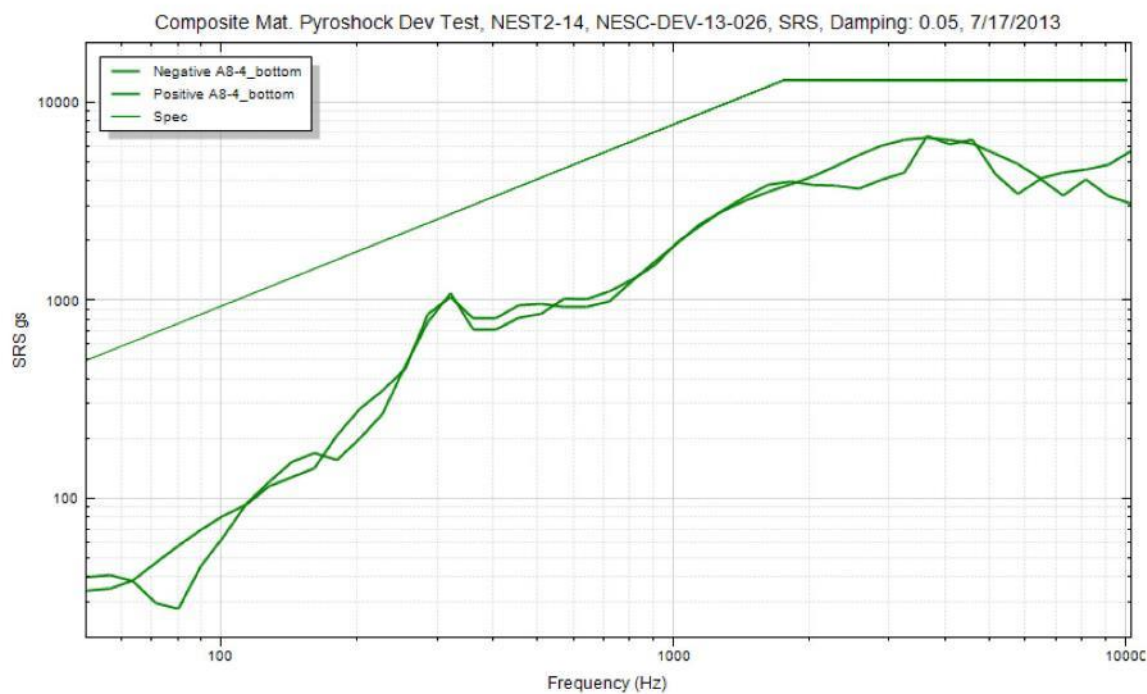
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
157 of 832





# NASA Engineering and Safety Center Technical Assessment Report

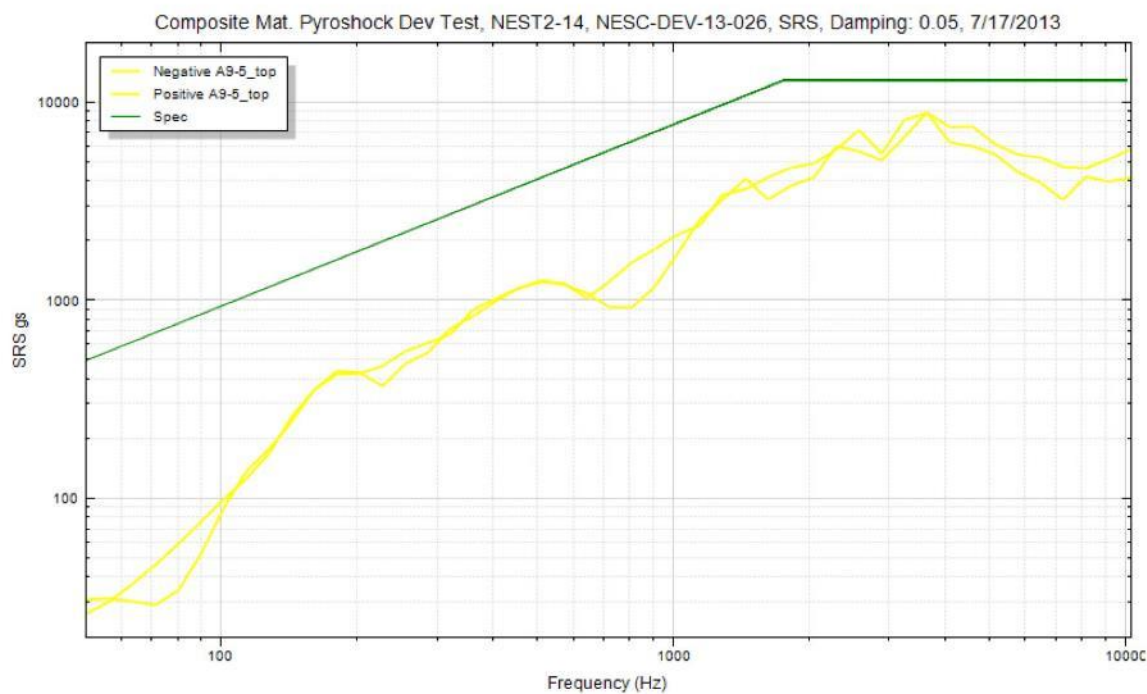
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
158 of 832





# NASA Engineering and Safety Center Technical Assessment Report

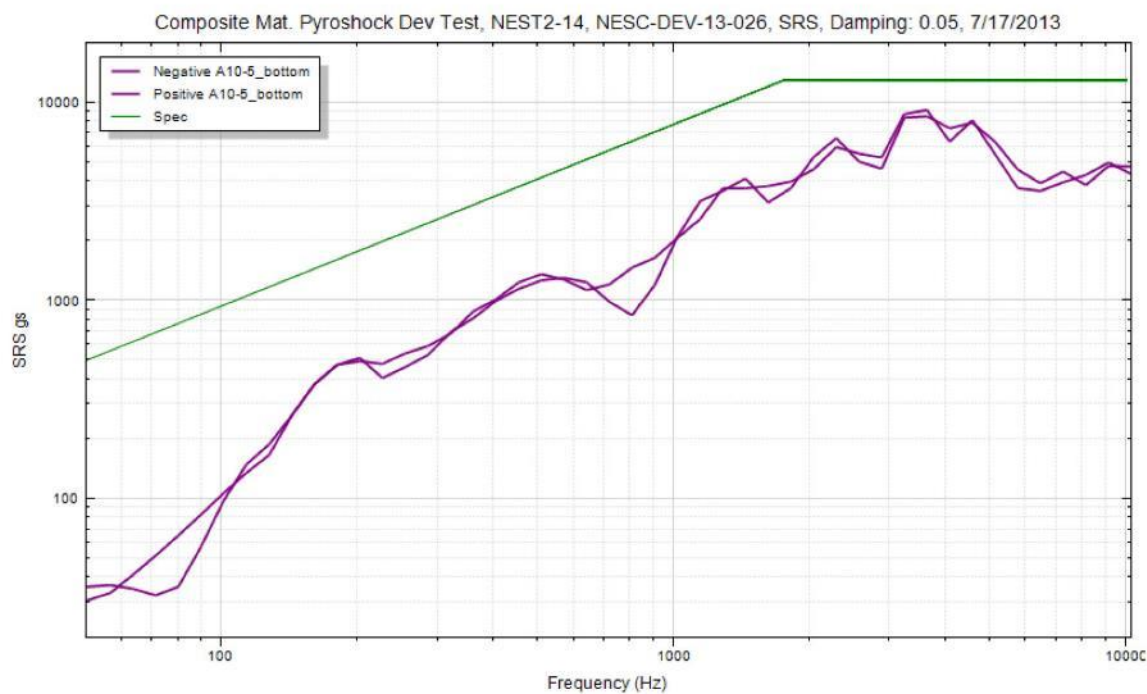
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
159 of 832





# NASA Engineering and Safety Center Technical Assessment Report

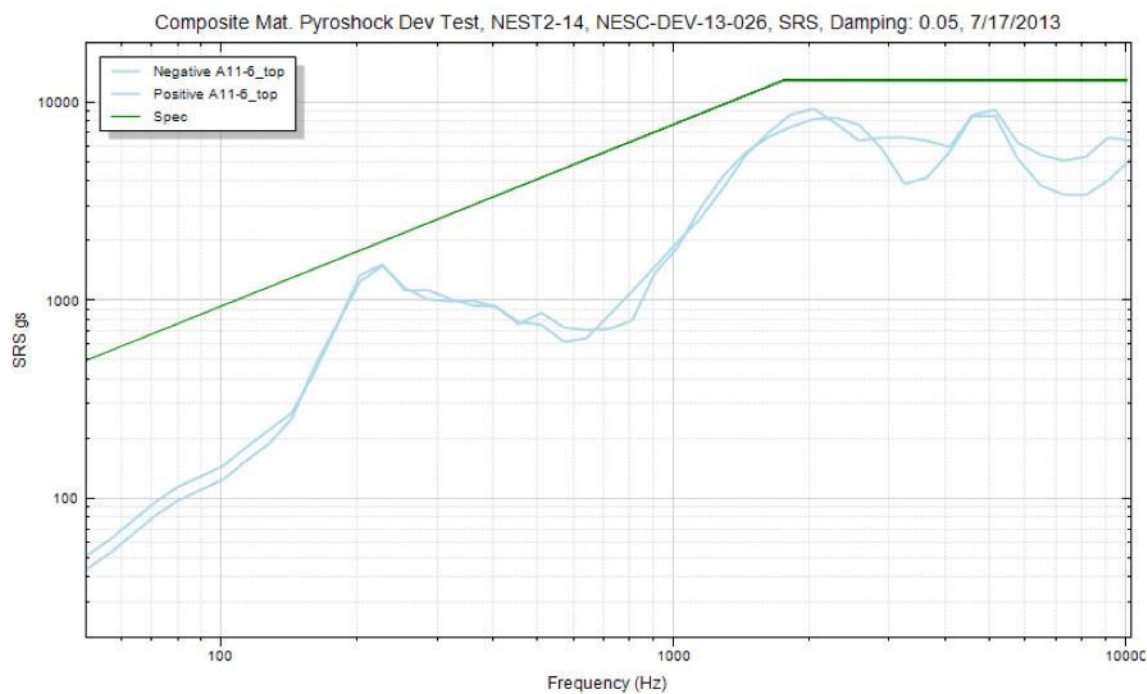
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
160 of 832





# NASA Engineering and Safety Center Technical Assessment Report

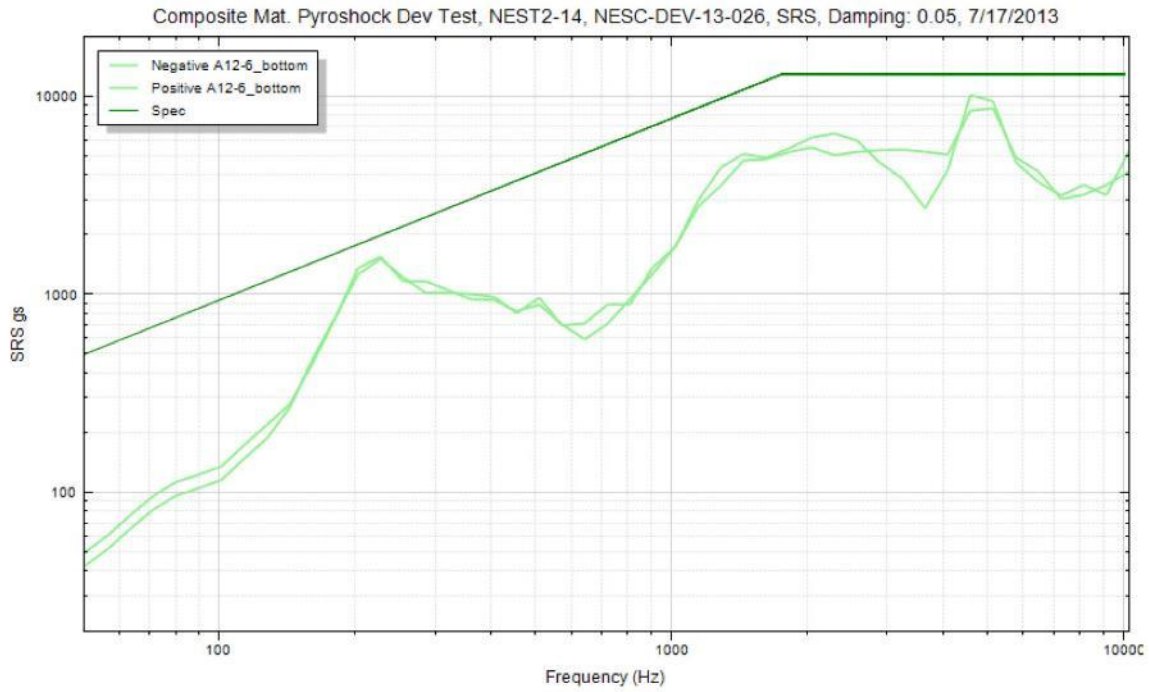
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
161 of 832





# NASA Engineering and Safety Center Technical Assessment Report

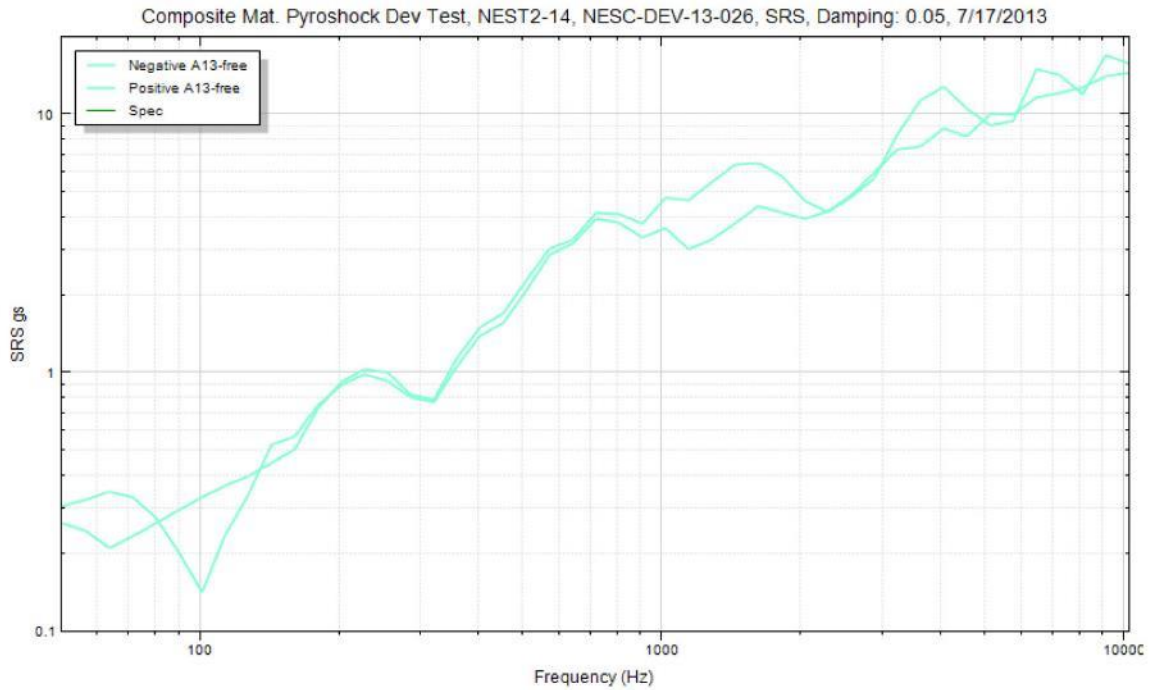
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
162 of 832





# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**

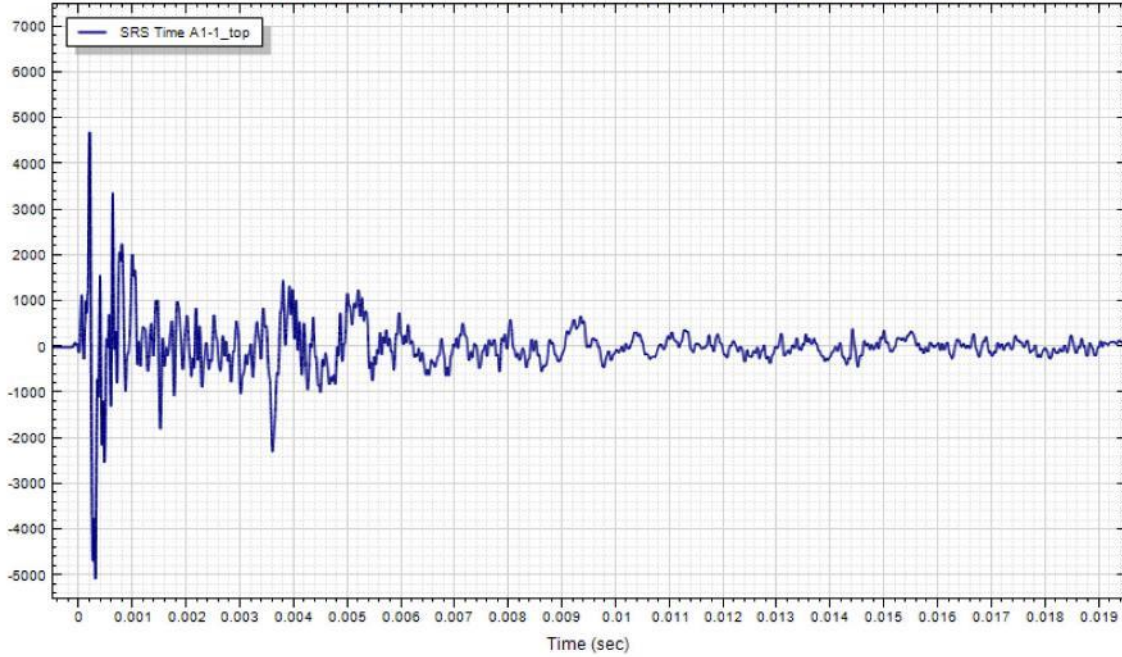
Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
163 of 832

Composite Mat. Pyroshock Dev Test, NEST2-14, NESC-DEV-13-026, 7/17/2013





# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**

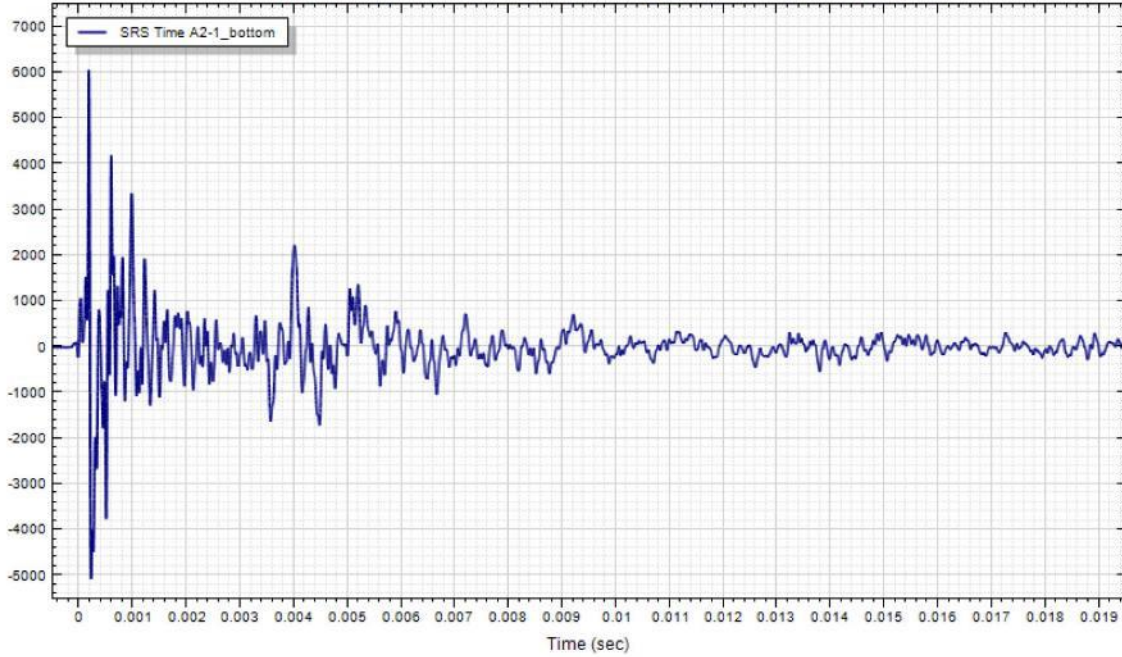
Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
164 of 832

Composite Mat. Pyroshock Dev Test, NEST2-14, NESC-DEV-13-026, 7/17/2013







# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**

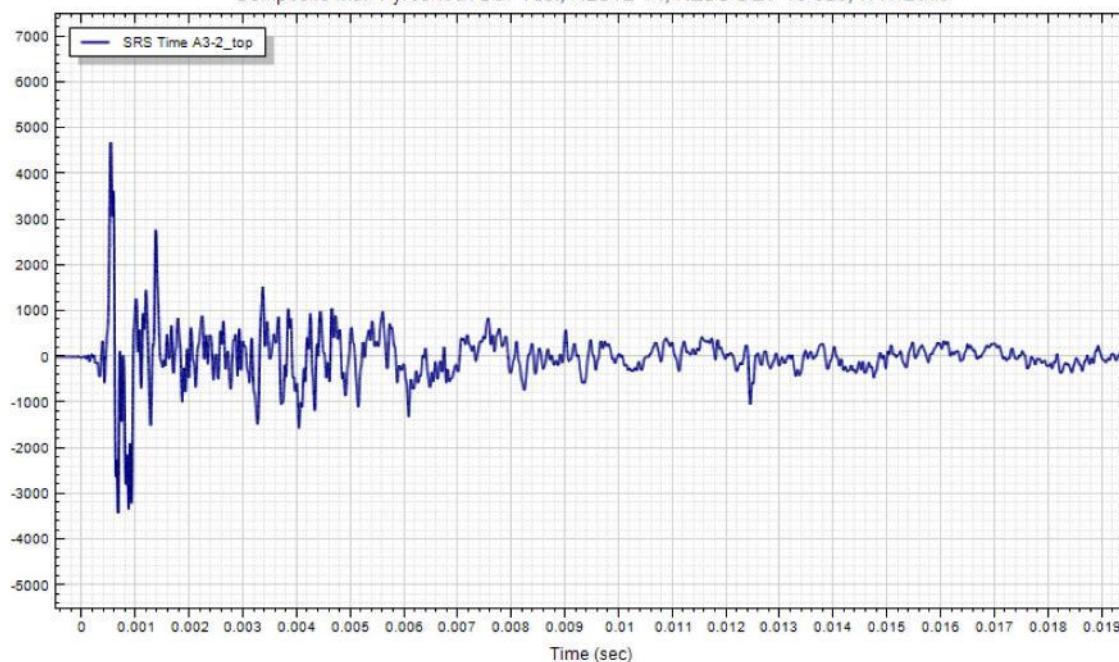
Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
165 of 832

Composite Mat. Pyroshock Dev Test, NEST2-14, NESC-DEV-13-026, 7/17/2013





# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**

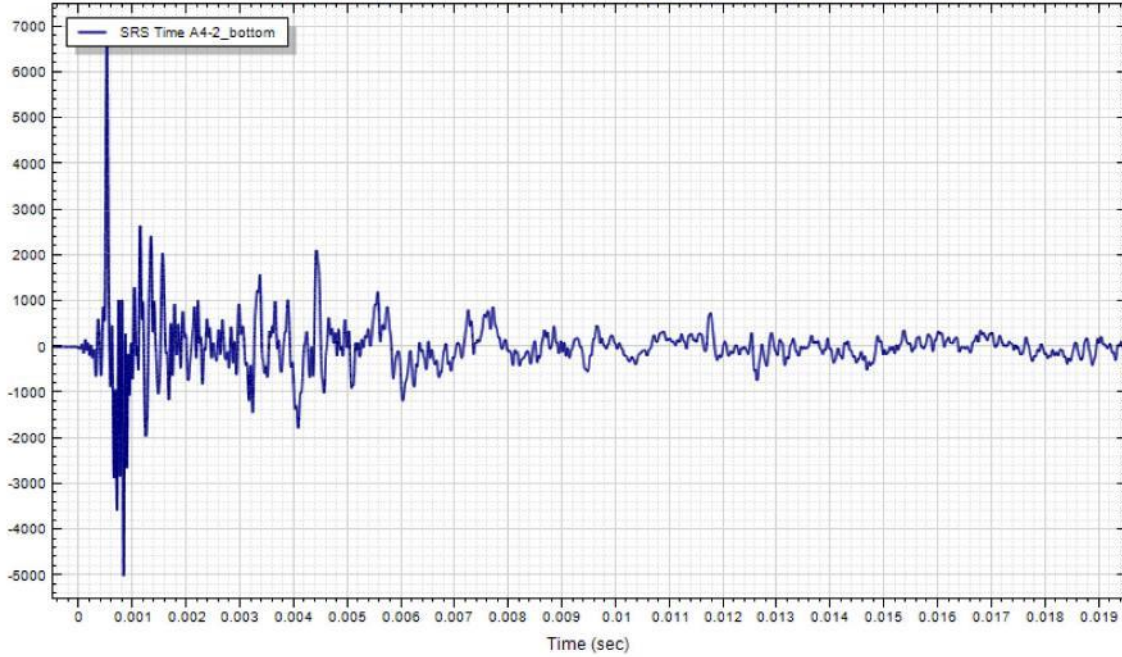
Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
166 of 832

Composite Mat. Pyroshock Dev Test, NEST2-14, NESC-DEV-13-026, 7/17/2013





# NASA Engineering and Safety Center Technical Assessment Report

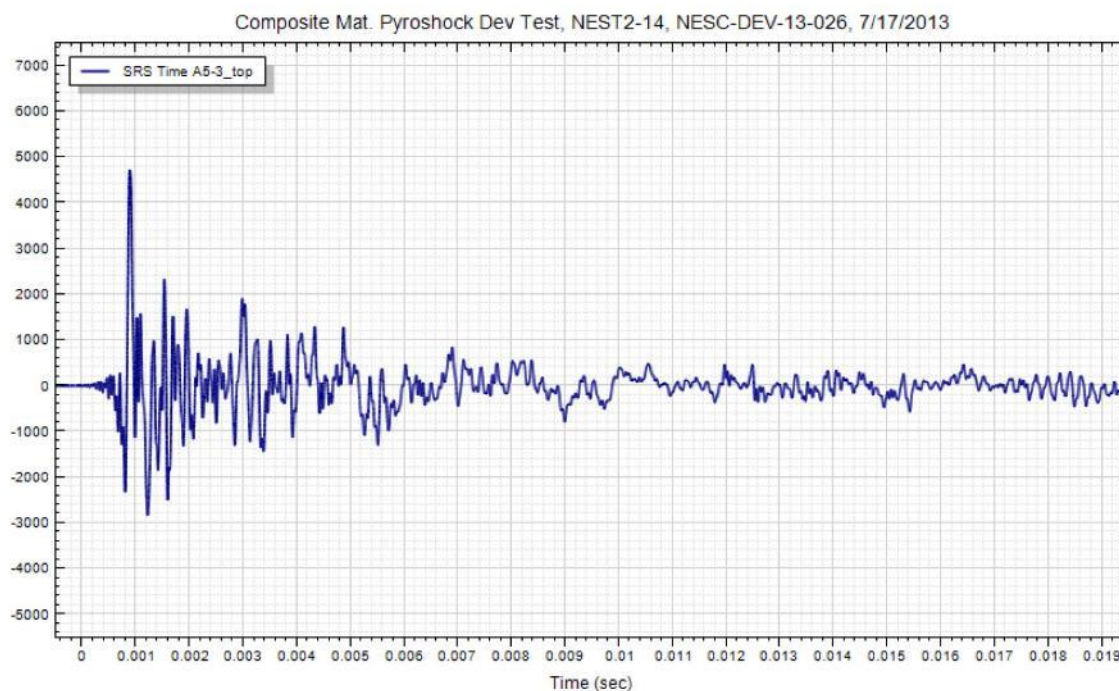
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
167 of 832





# NASA Engineering and Safety Center Technical Assessment Report

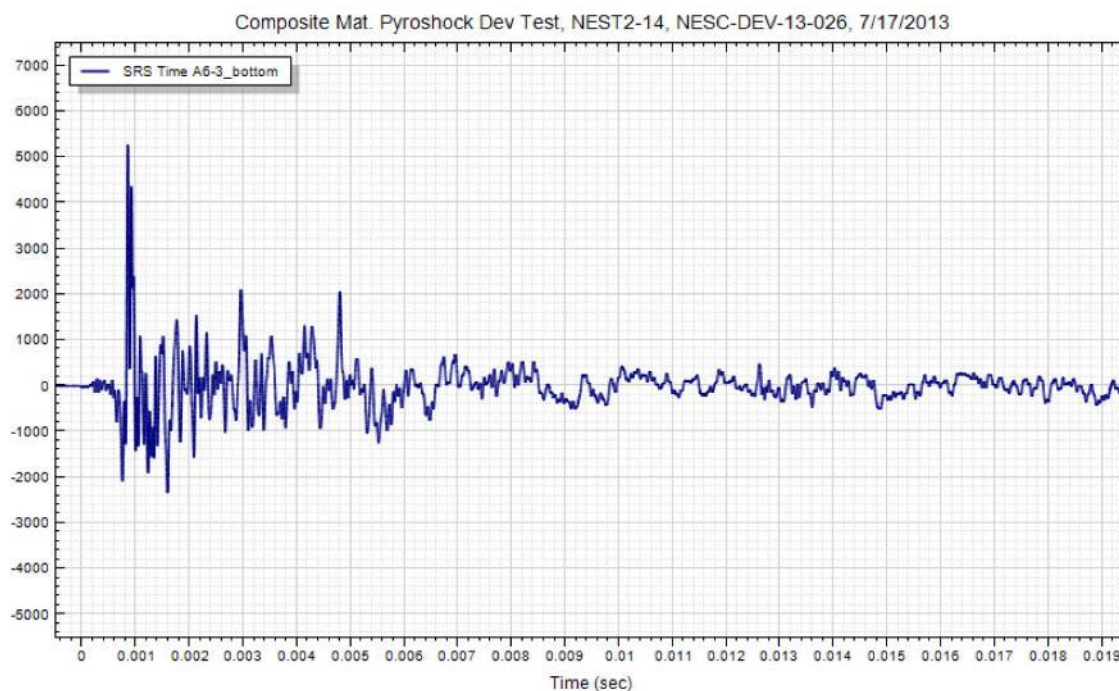
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
168 of 832





# NASA Engineering and Safety Center Technical Assessment Report

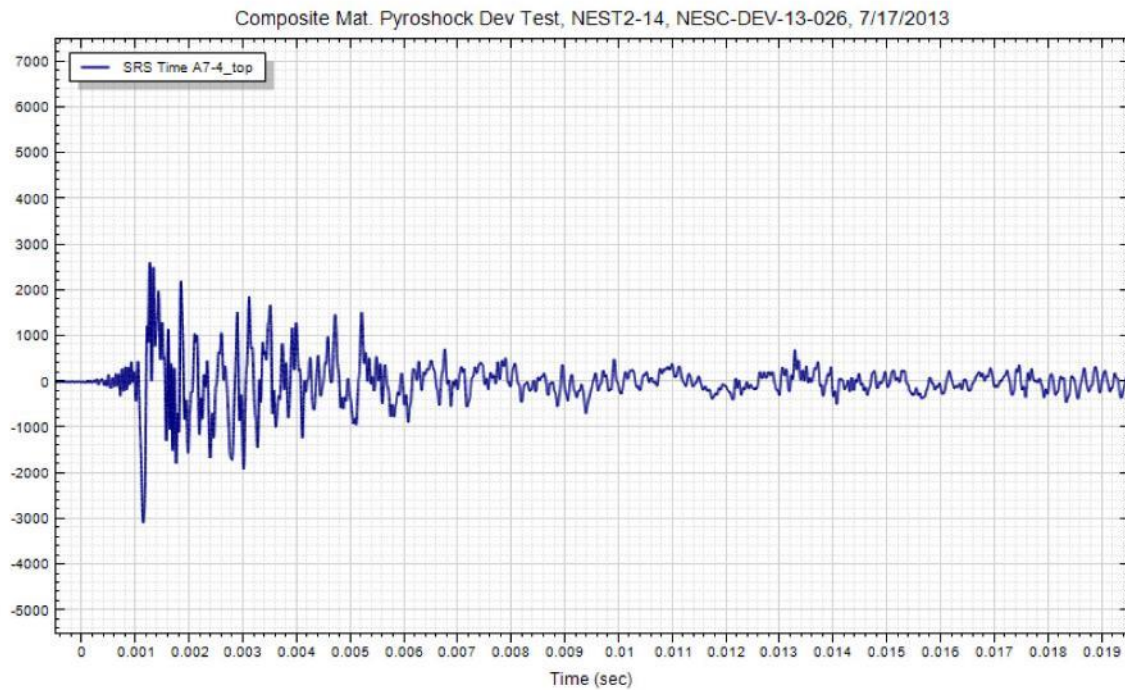
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
169 of 832





# NASA Engineering and Safety Center Technical Assessment Report

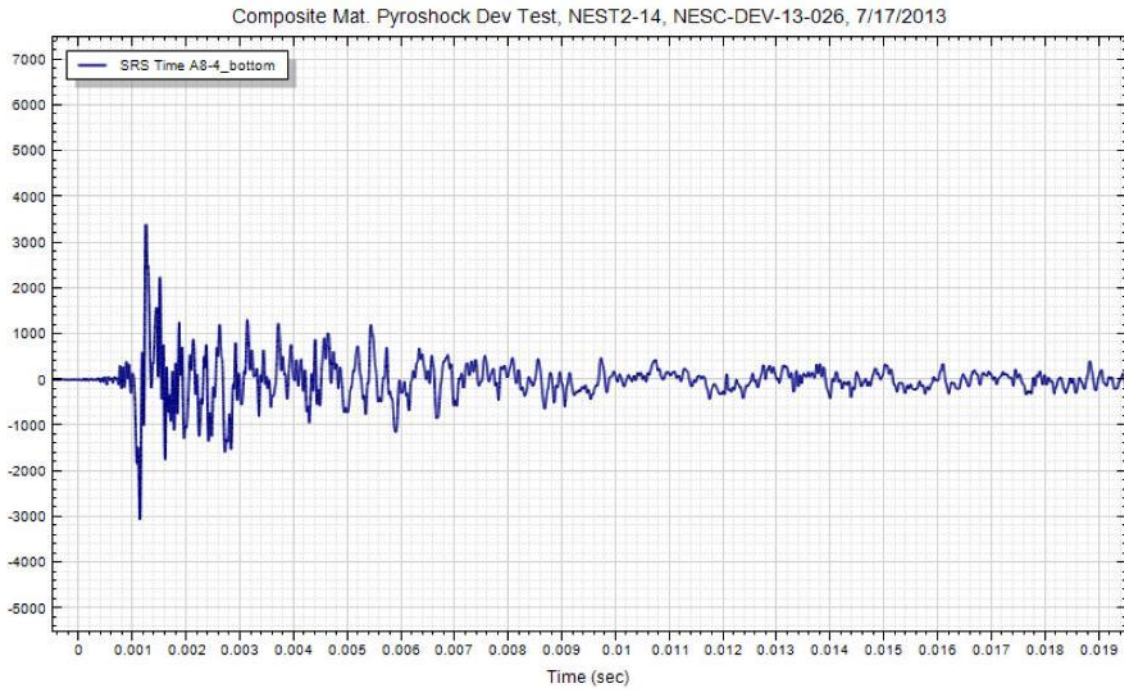
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
170 of 832





# NASA Engineering and Safety Center Technical Assessment Report

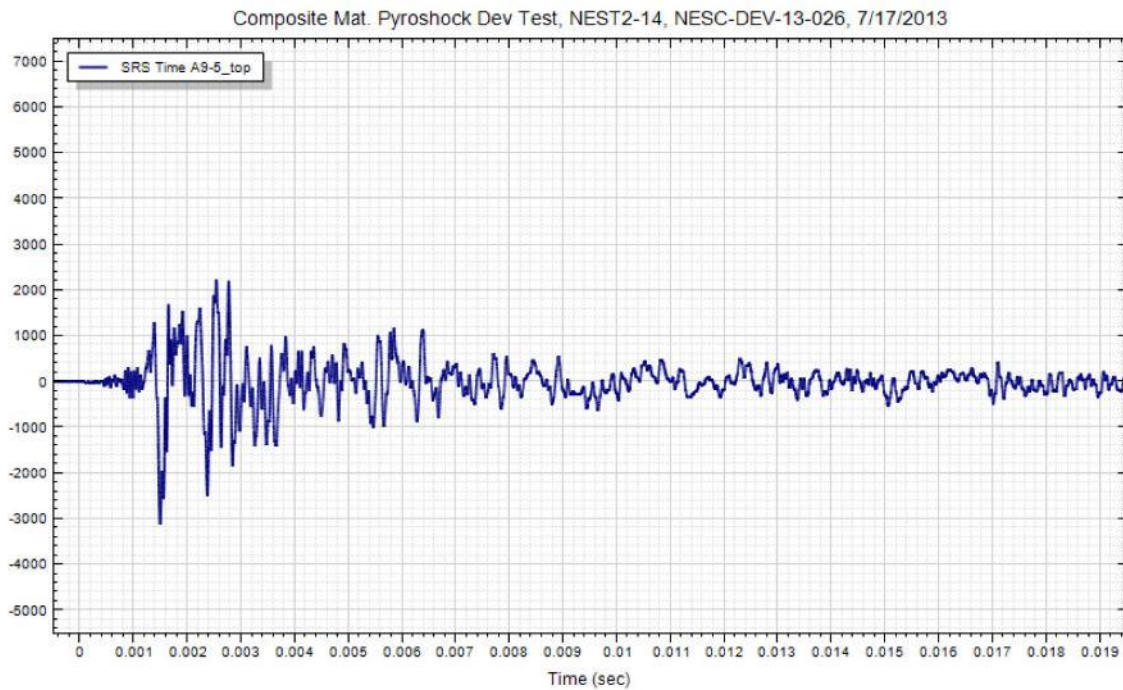
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
171 of 832





# NASA Engineering and Safety Center Technical Assessment Report

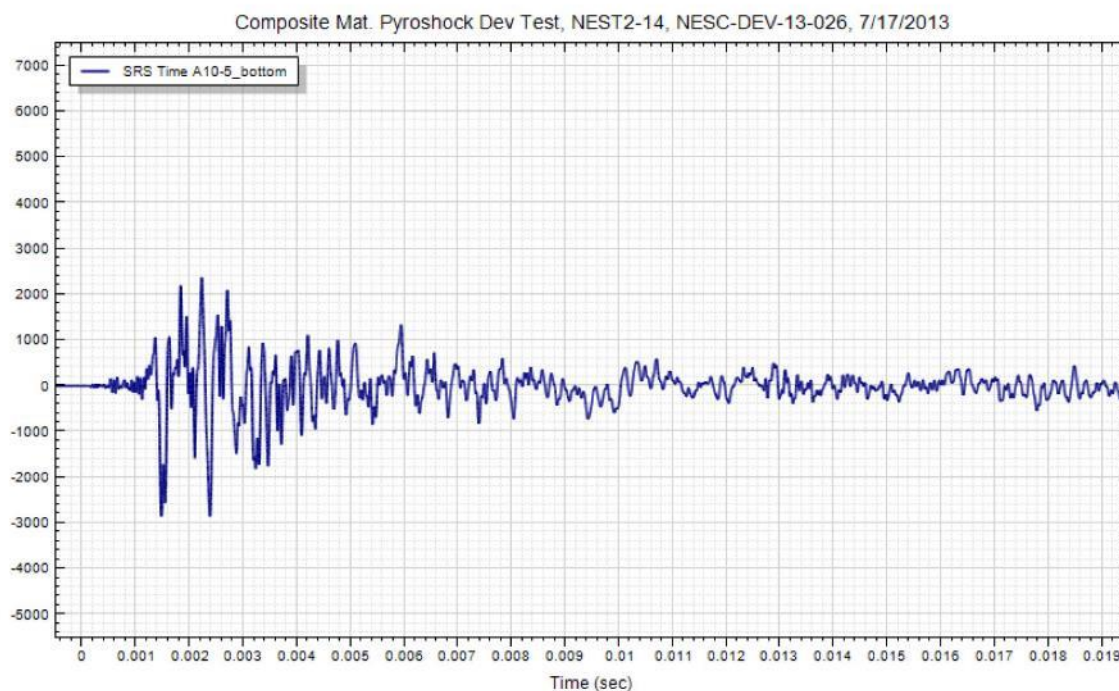
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
172 of 832







# NASA Engineering and Safety Center Technical Assessment Report

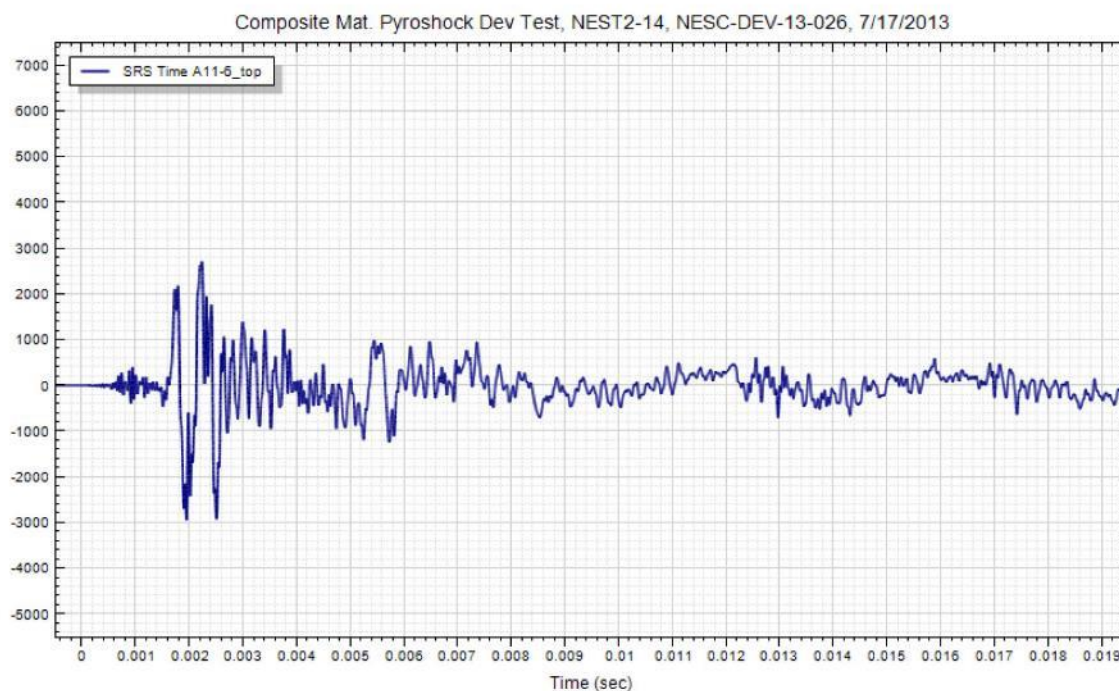
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
173 of 832





# NASA Engineering and Safety Center Technical Assessment Report

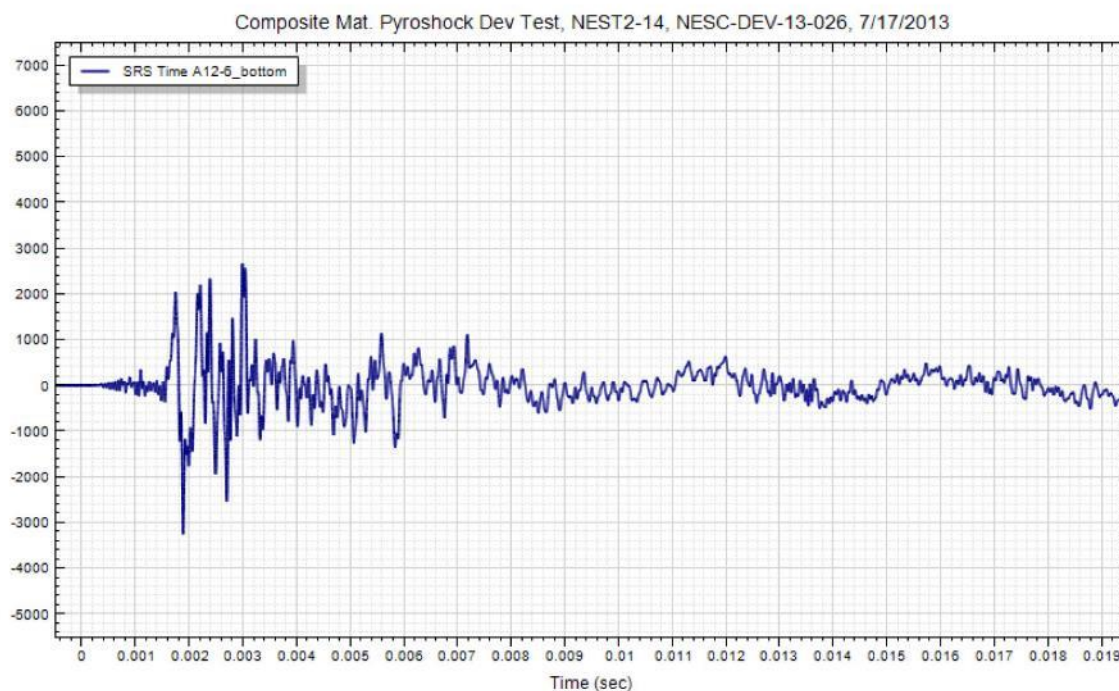
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
174 of 832





# NASA Engineering and Safety Center Technical Assessment Report

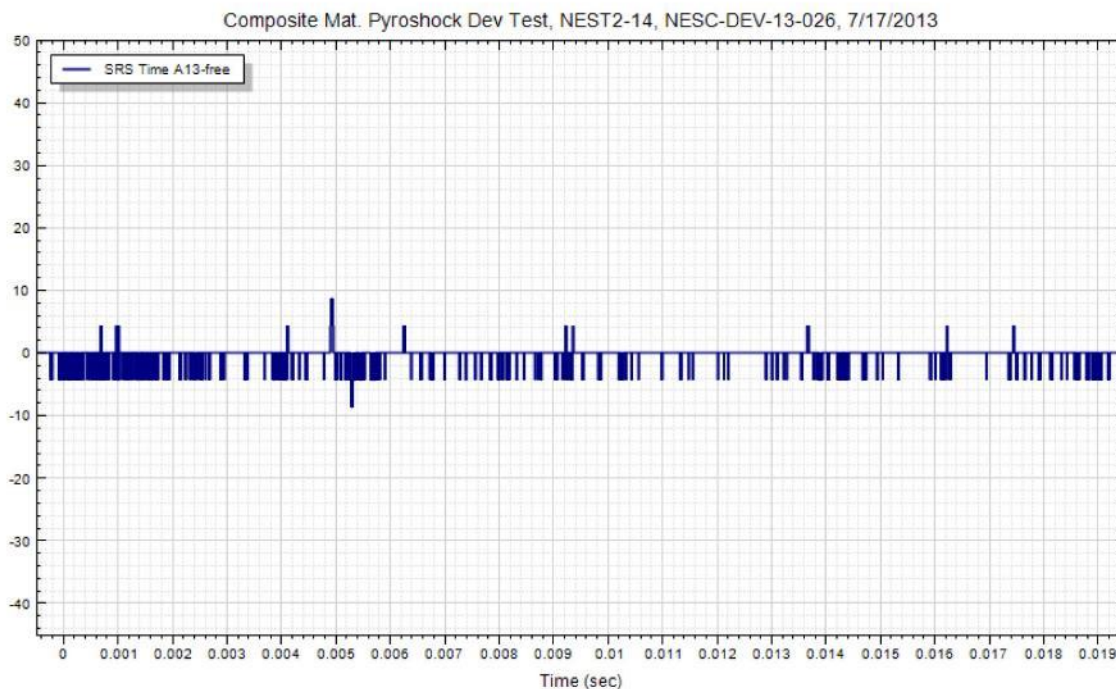
Document #:  
**NESC-RP-  
12-00783**


Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
175 of 832



	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 176 of 832	

**NESC-DEV-13-026**  
**Composite Materials**  
**Shock Test**  
  
**Test #5 Accelerometer Data**  
**Panel 0332A016**



# NASA Engineering and Safety Center Technical Assessment Report

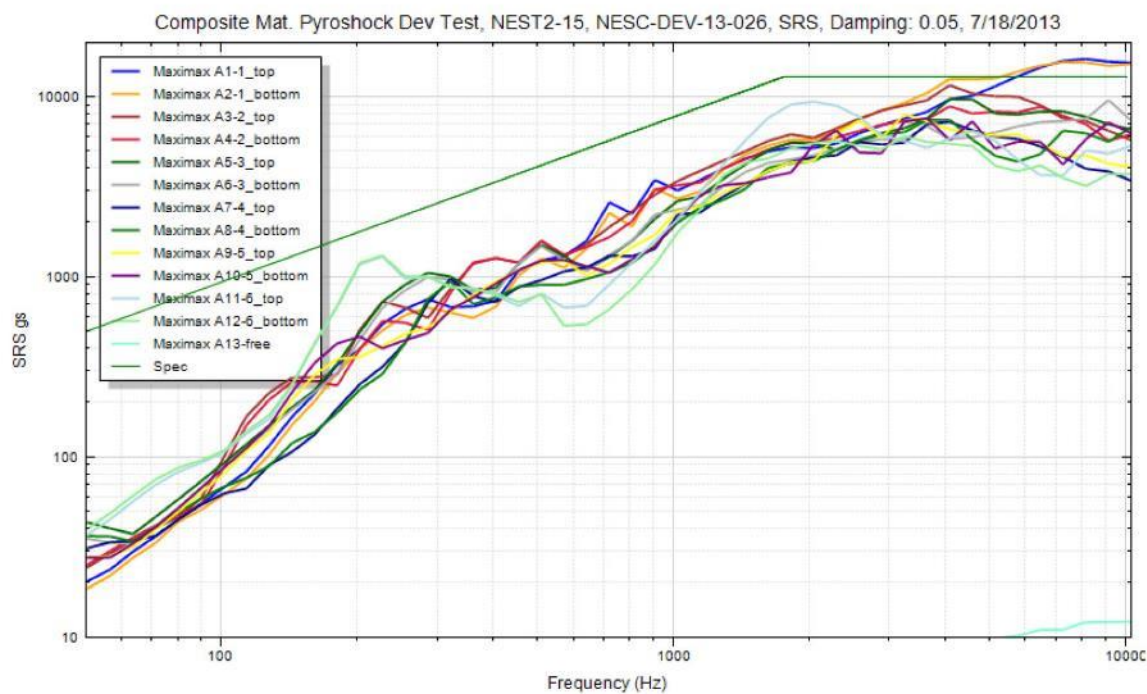
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
177 of 832





# NASA Engineering and Safety Center Technical Assessment Report

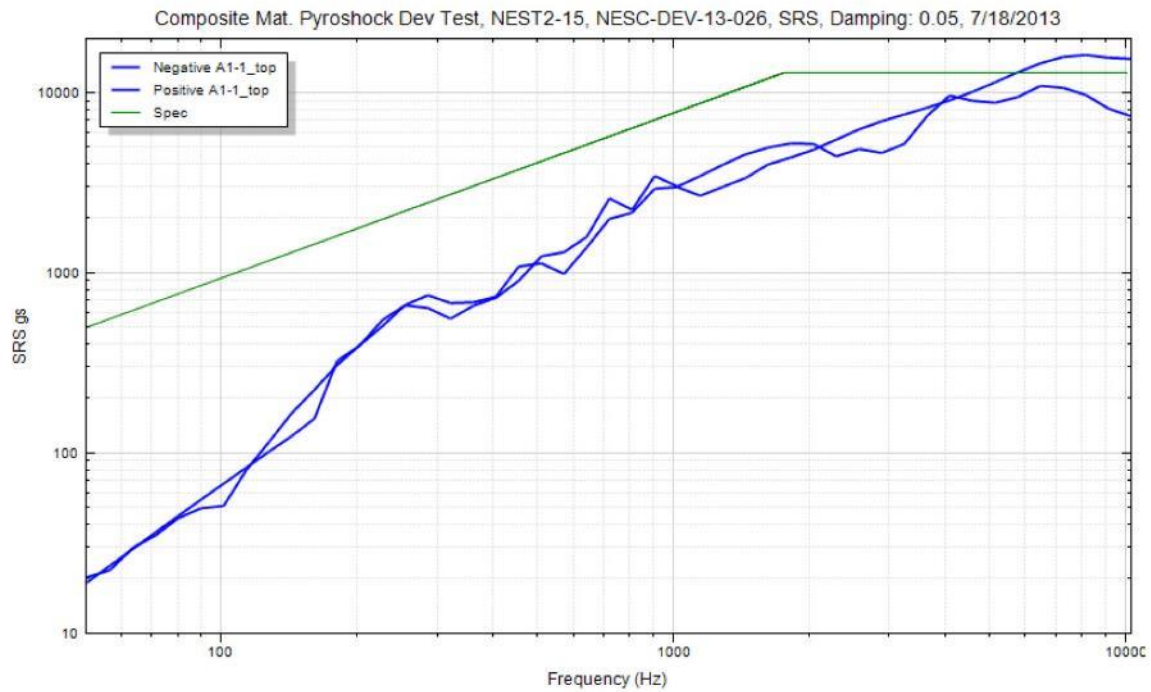
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
178 of 832





# NASA Engineering and Safety Center Technical Assessment Report

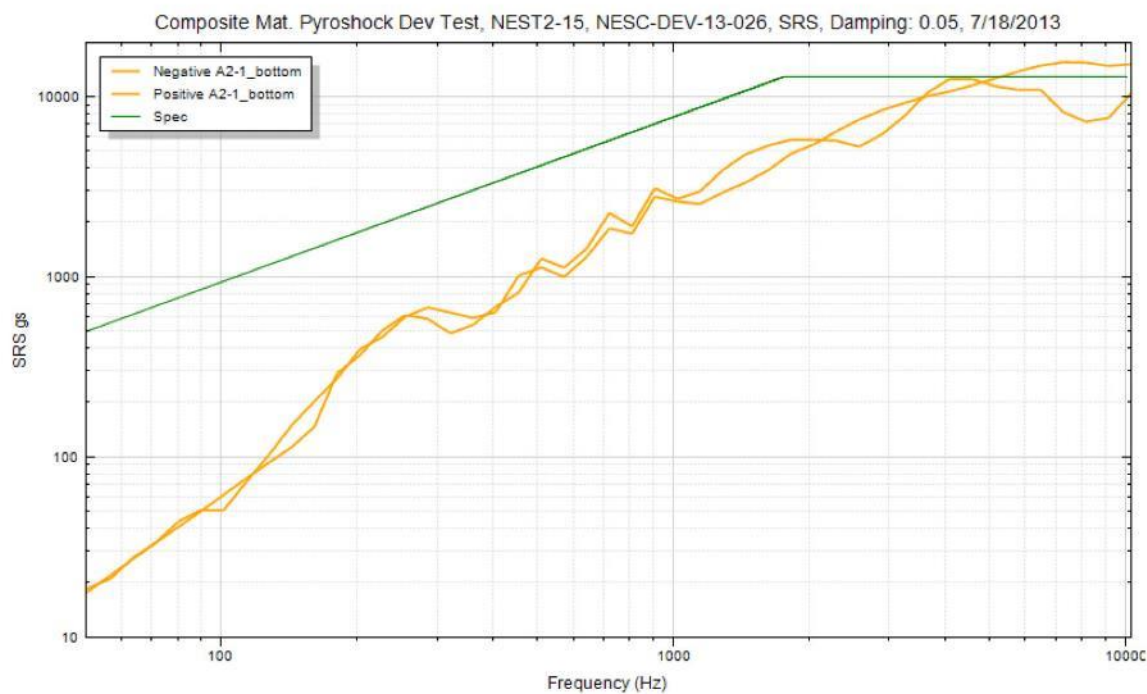
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
179 of 832





# NASA Engineering and Safety Center Technical Assessment Report

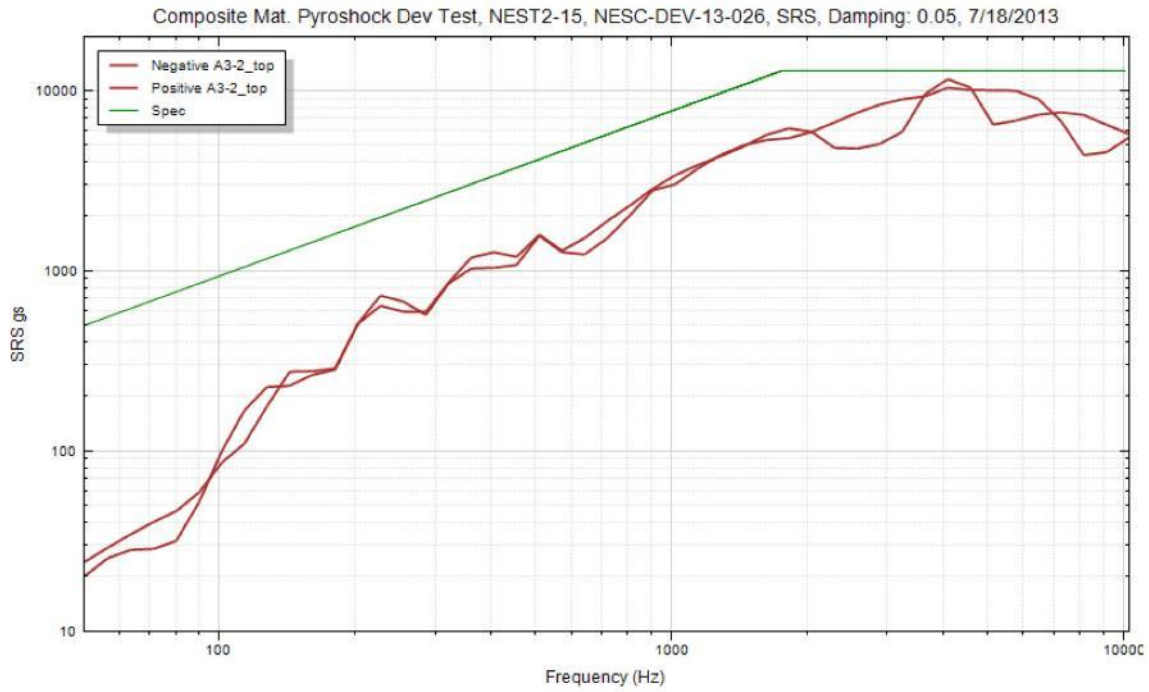
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
180 of 832







# NASA Engineering and Safety Center Technical Assessment Report

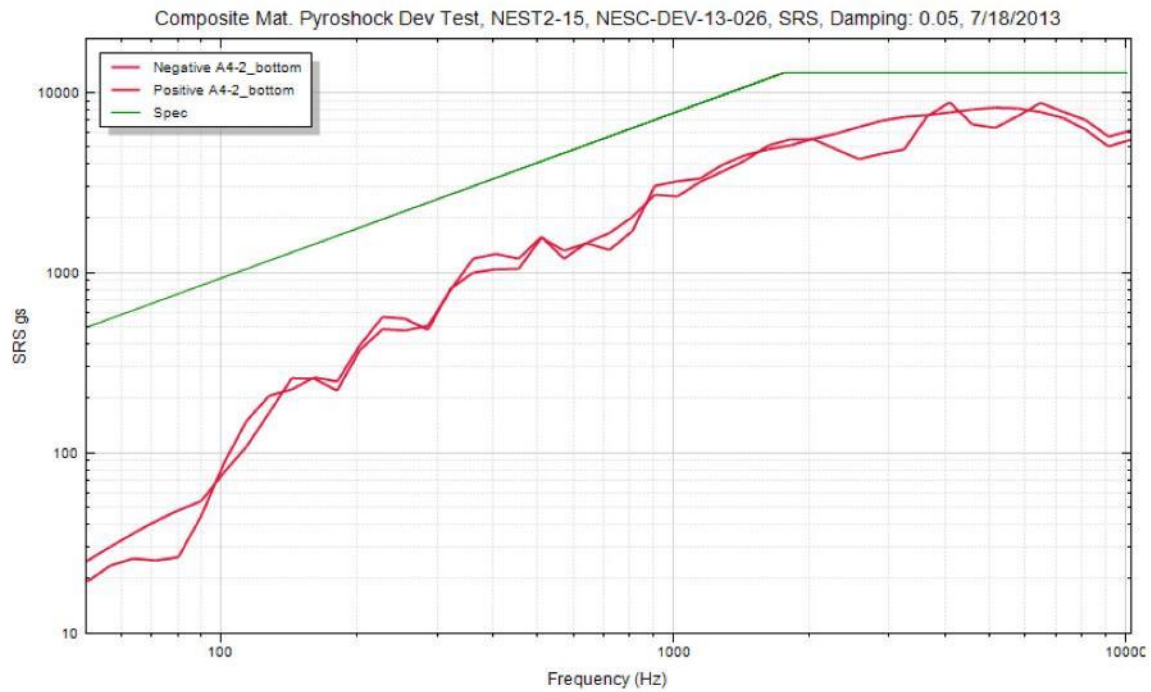
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
181 of 832





# NASA Engineering and Safety Center Technical Assessment Report

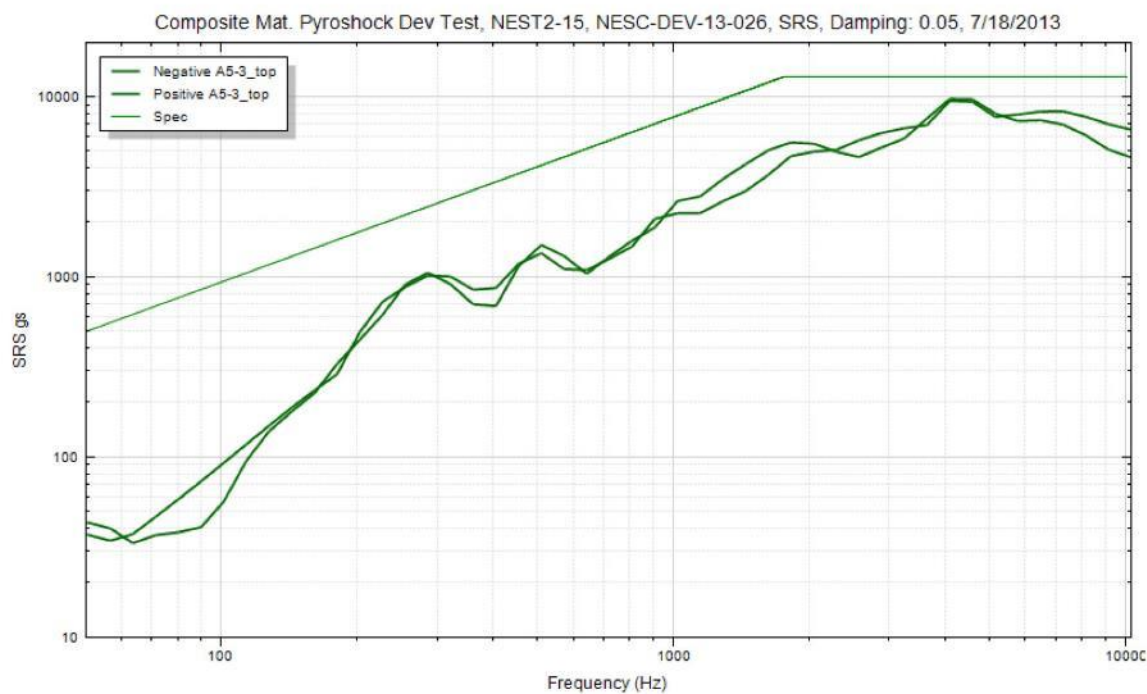
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
182 of 832





# NASA Engineering and Safety Center Technical Assessment Report

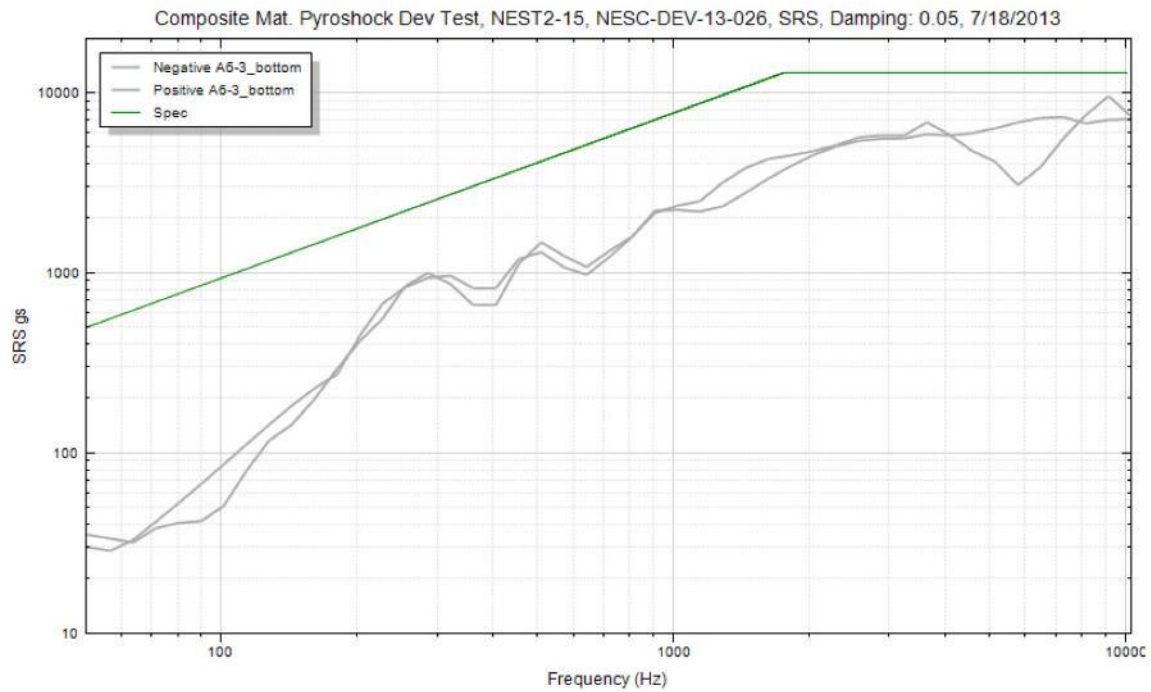
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
183 of 832





# NASA Engineering and Safety Center Technical Assessment Report

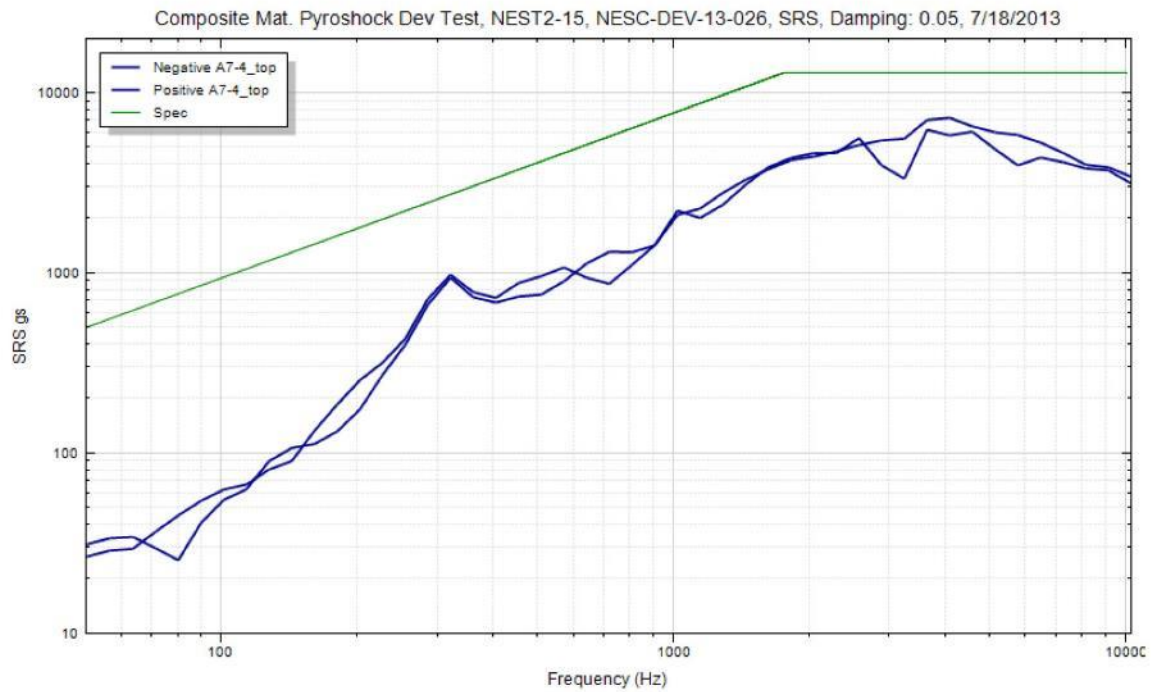
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
184 of 832





# NASA Engineering and Safety Center Technical Assessment Report

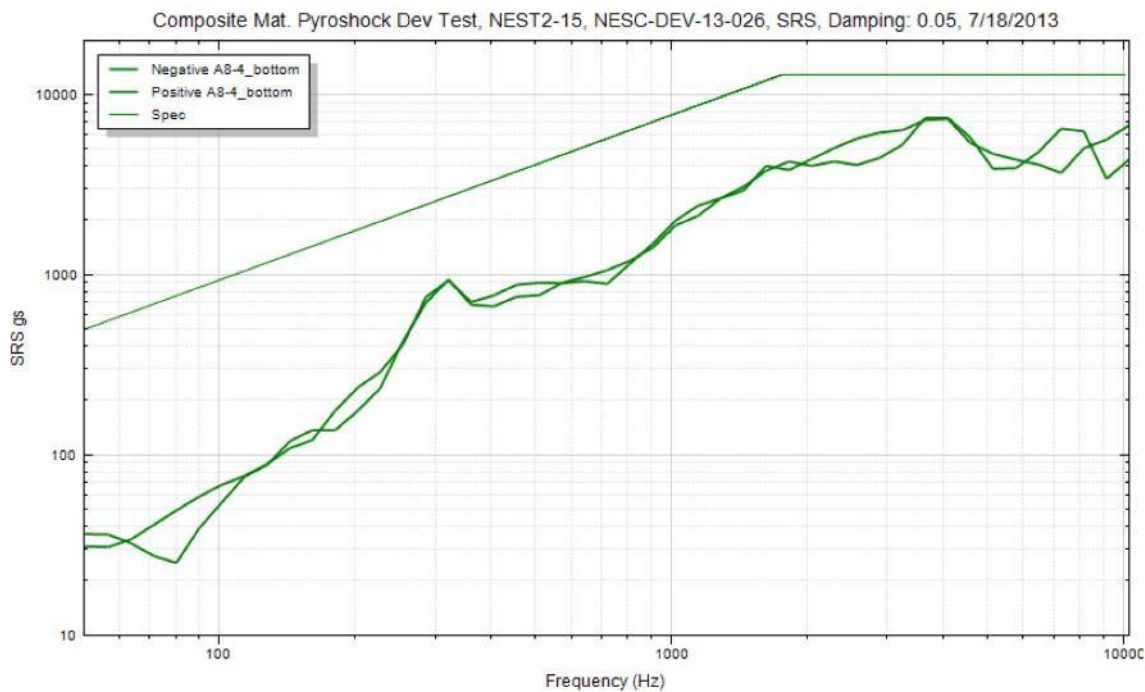
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
185 of 832





# NASA Engineering and Safety Center Technical Assessment Report

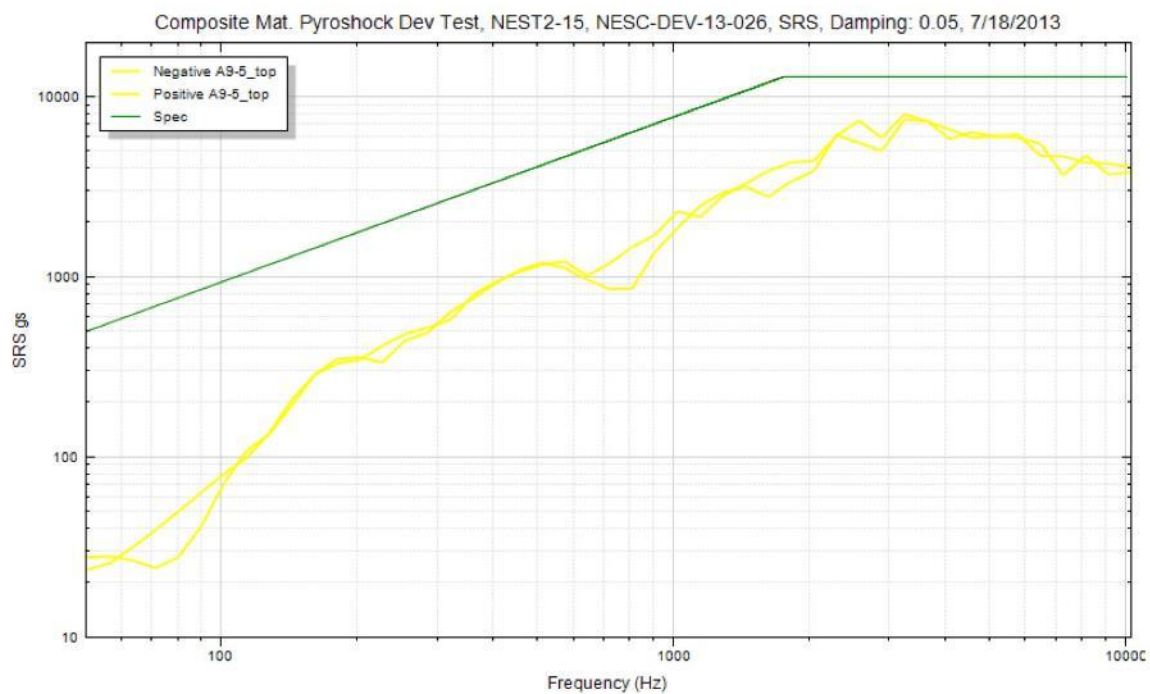
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
186 of 832





# NASA Engineering and Safety Center Technical Assessment Report

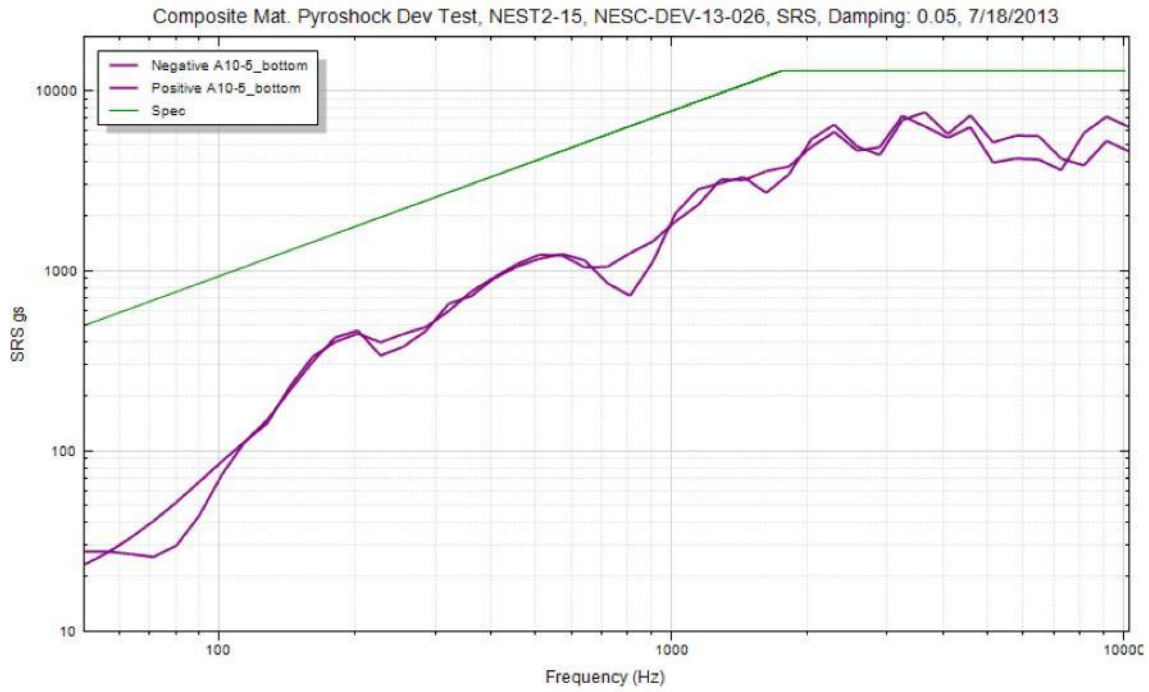
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
187 of 832





# NASA Engineering and Safety Center Technical Assessment Report

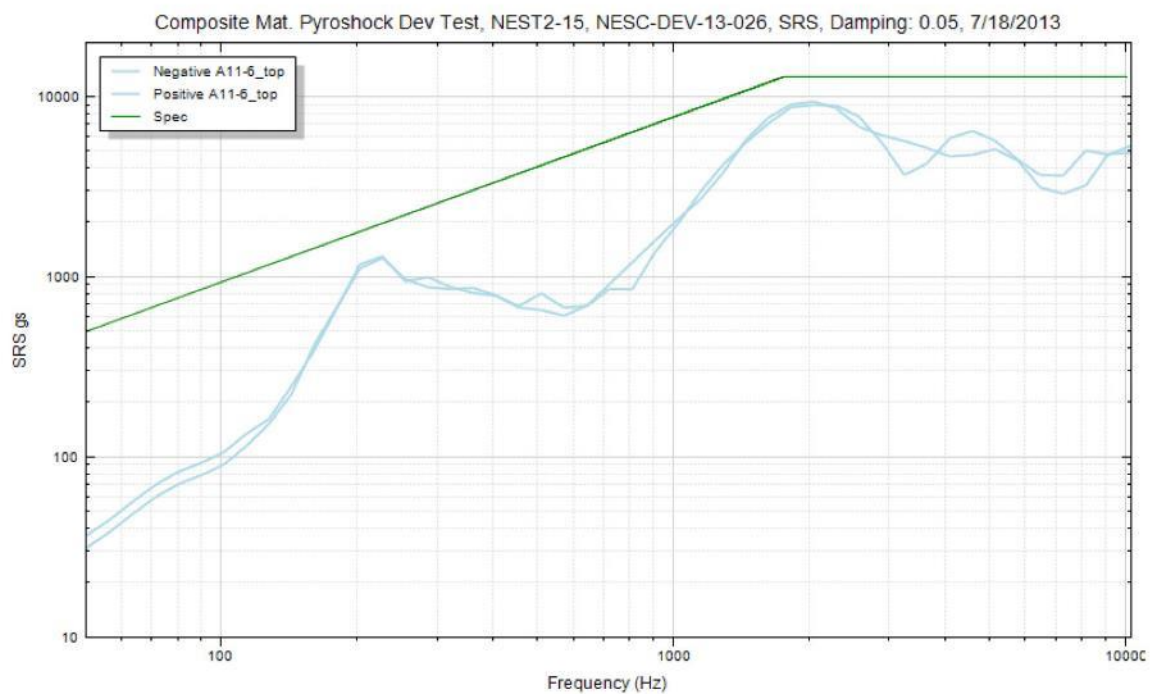
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
188 of 832







# NASA Engineering and Safety Center Technical Assessment Report

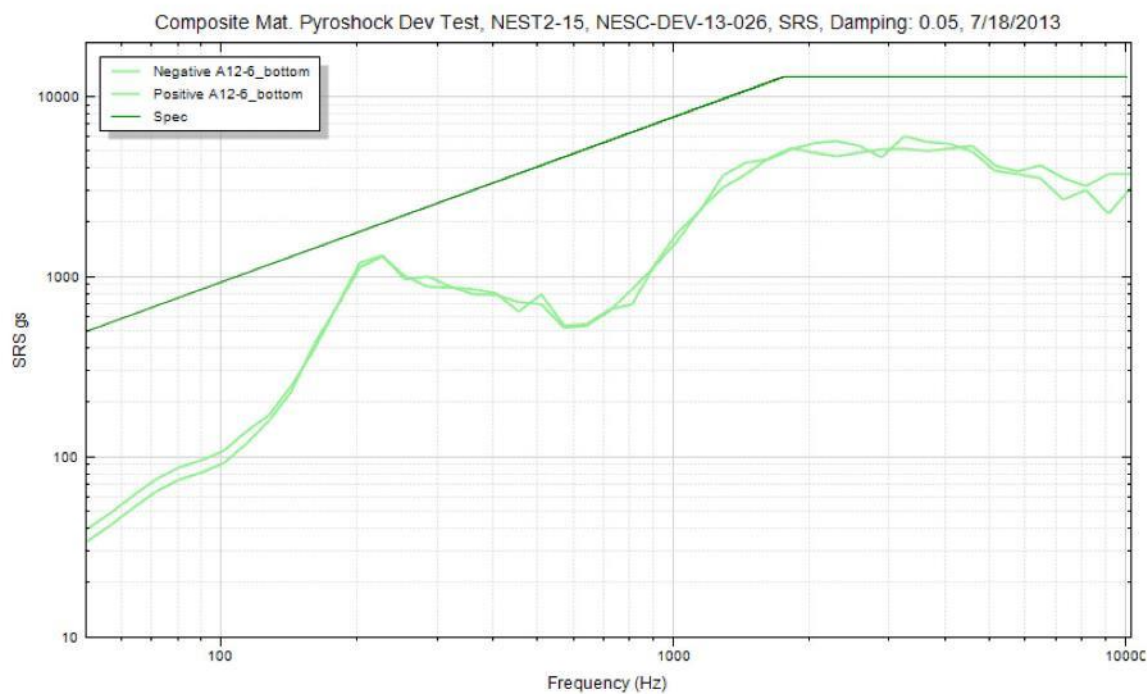
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
189 of 832





# NASA Engineering and Safety Center Technical Assessment Report

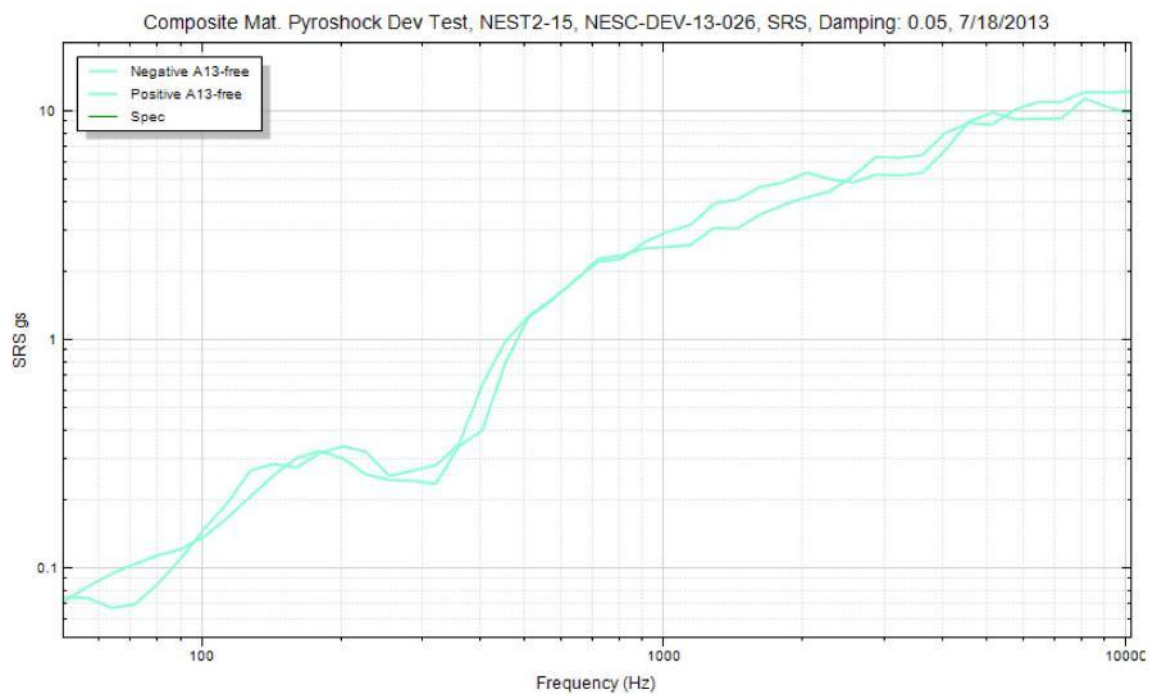
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
190 of 832





# NASA Engineering and Safety Center Technical Assessment Report

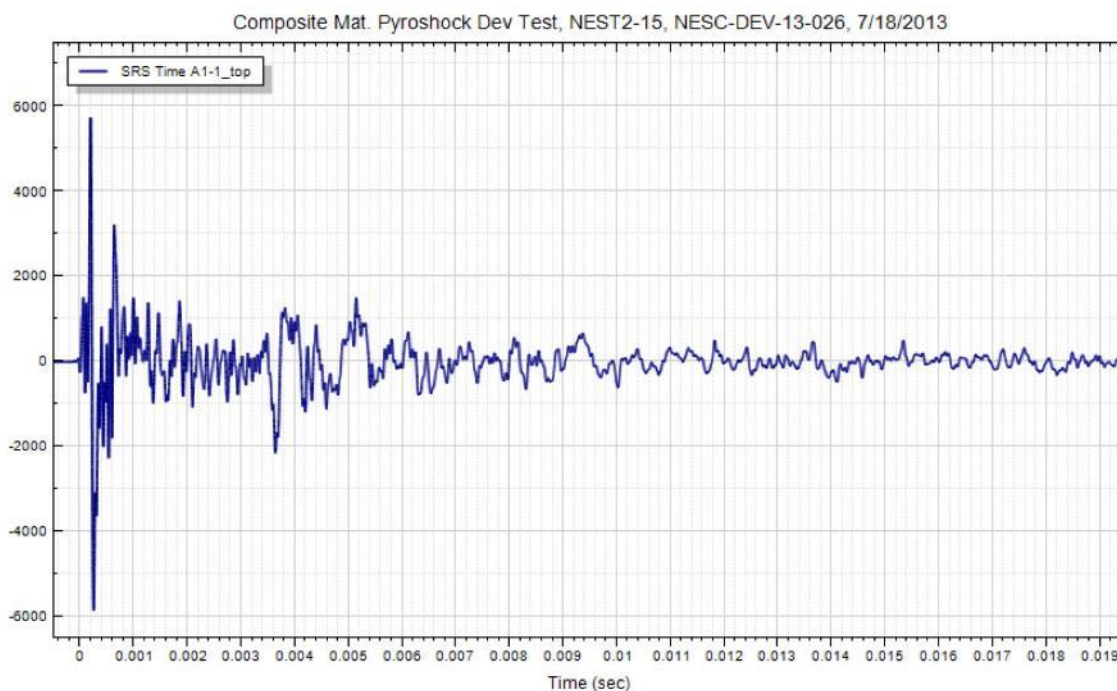
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
191 of 832





# NASA Engineering and Safety Center Technical Assessment Report

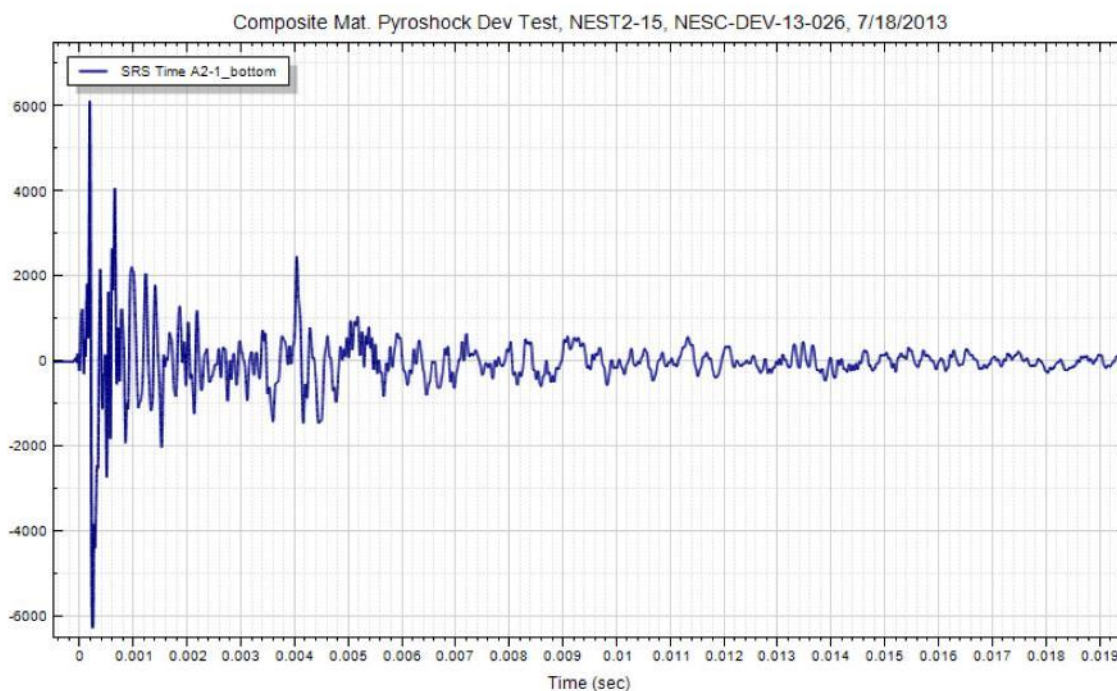
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
192 of 832





# NASA Engineering and Safety Center Technical Assessment Report

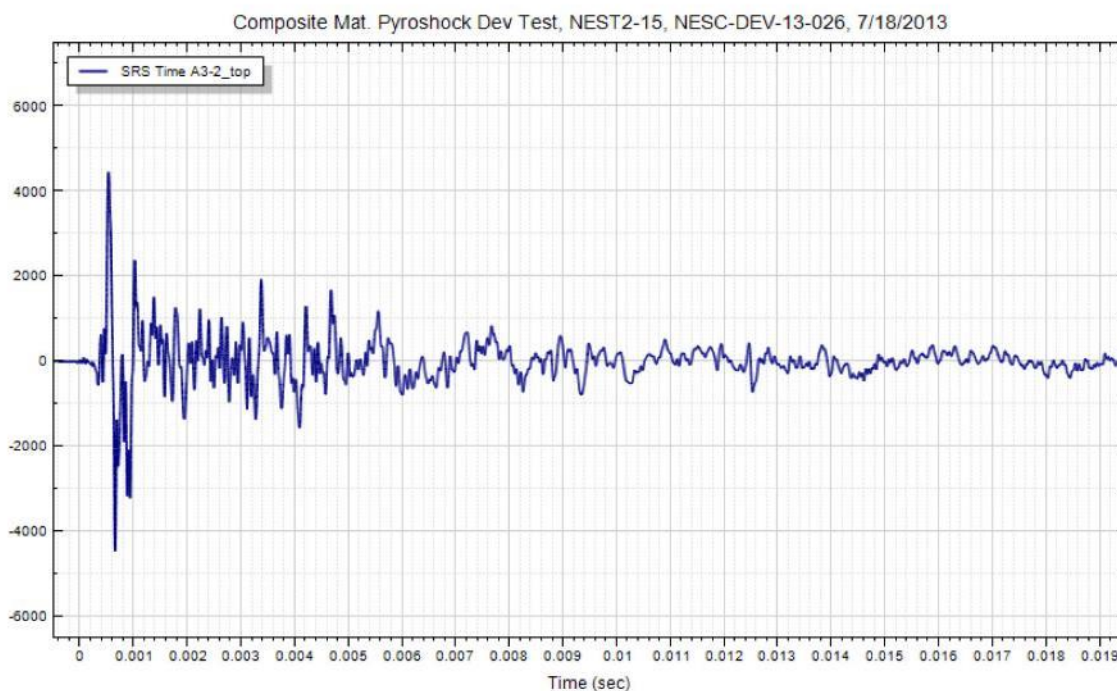
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
193 of 832





# NASA Engineering and Safety Center Technical Assessment Report

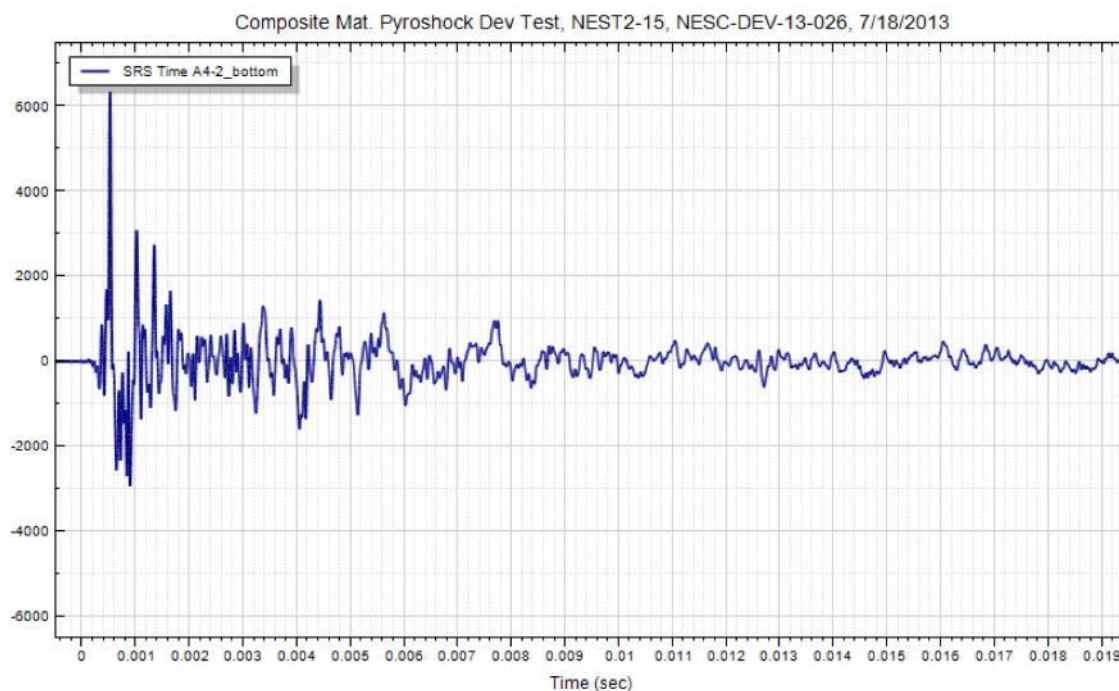
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
194 of 832





# NASA Engineering and Safety Center Technical Assessment Report

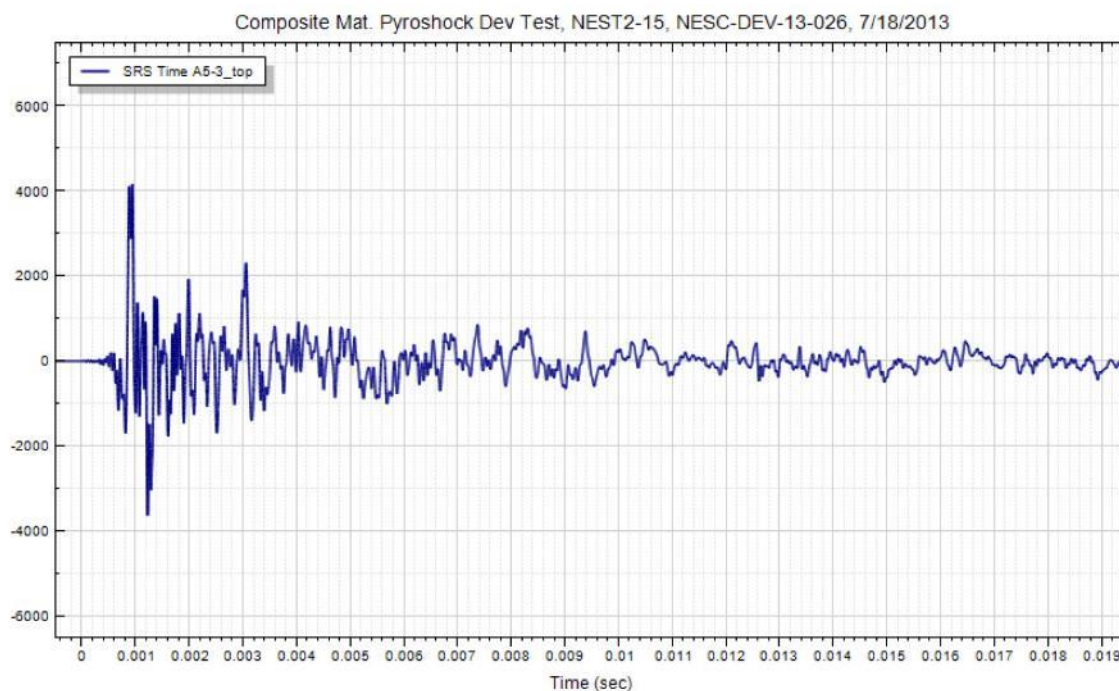
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
195 of 832





# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**

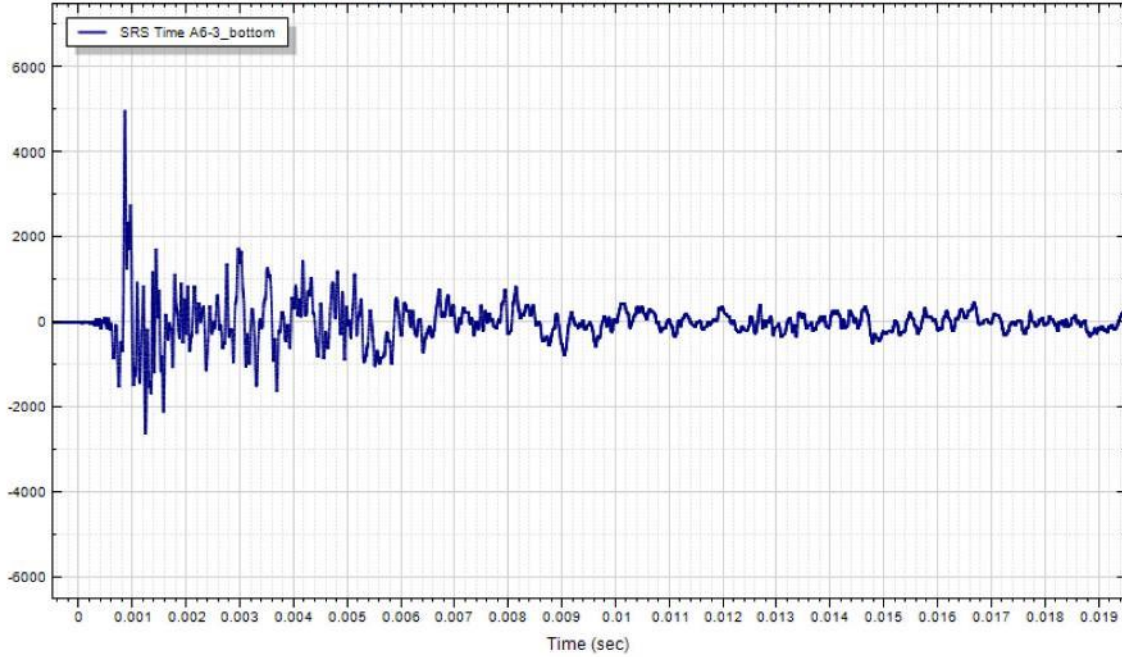
Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
196 of 832

Composite Mat. Pyroshock Dev Test, NEST2-15, NESC-DEV-13-026, 7/18/2013







# NASA Engineering and Safety Center Technical Assessment Report

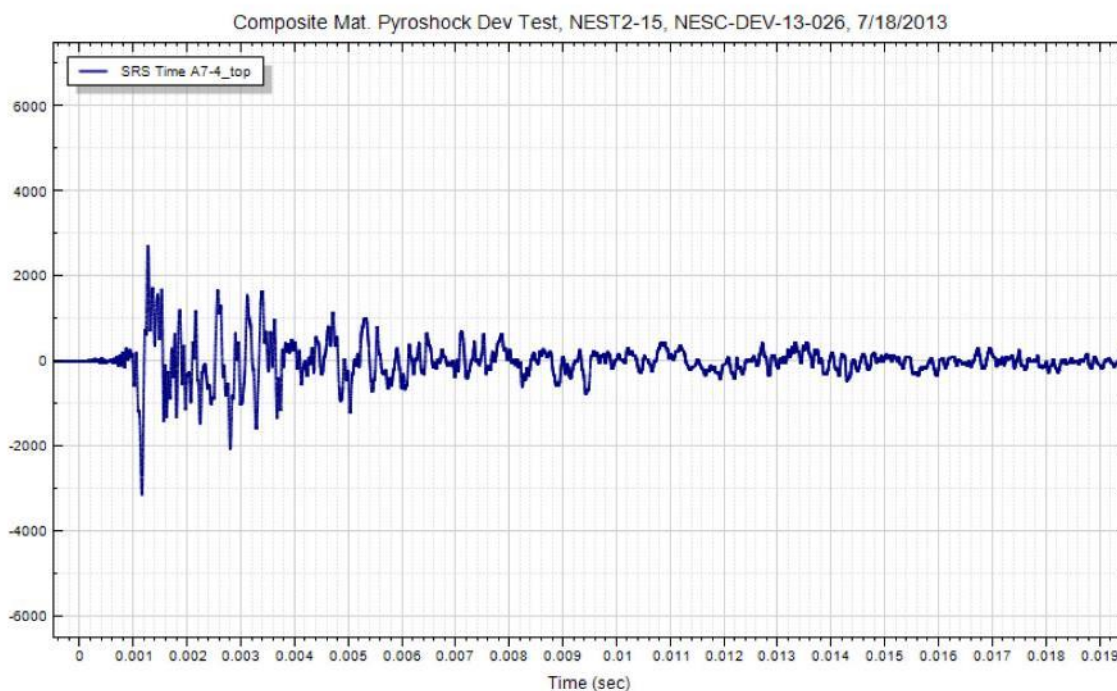
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
197 of 832





# NASA Engineering and Safety Center Technical Assessment Report

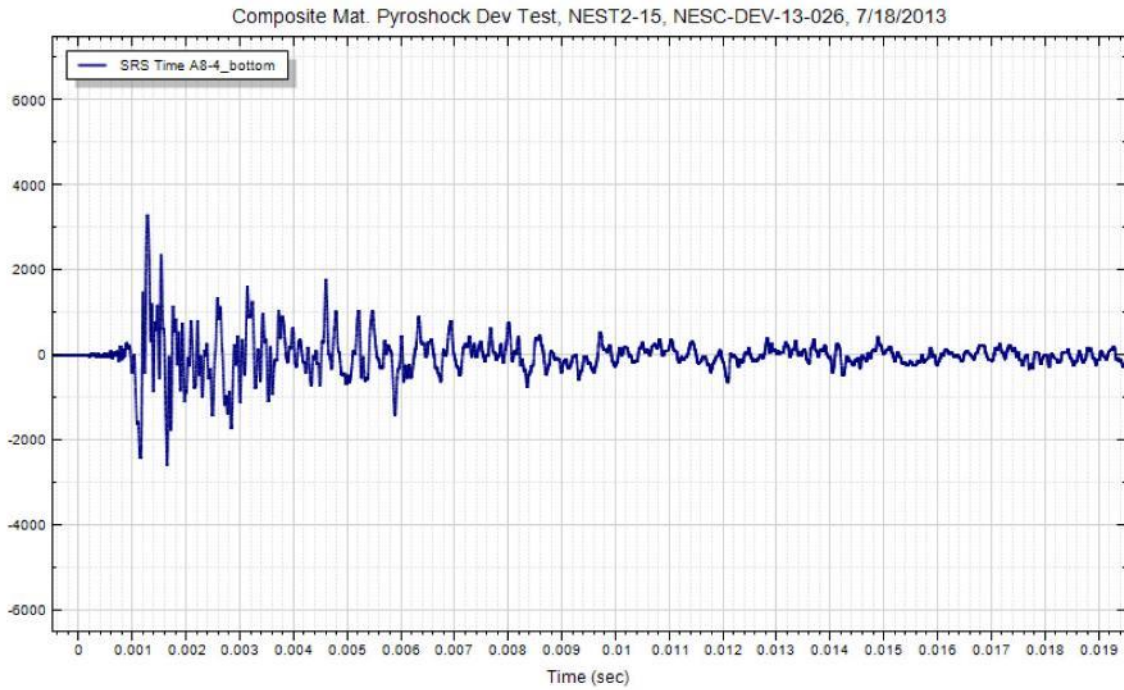
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
198 of 832





# NASA Engineering and Safety Center Technical Assessment Report

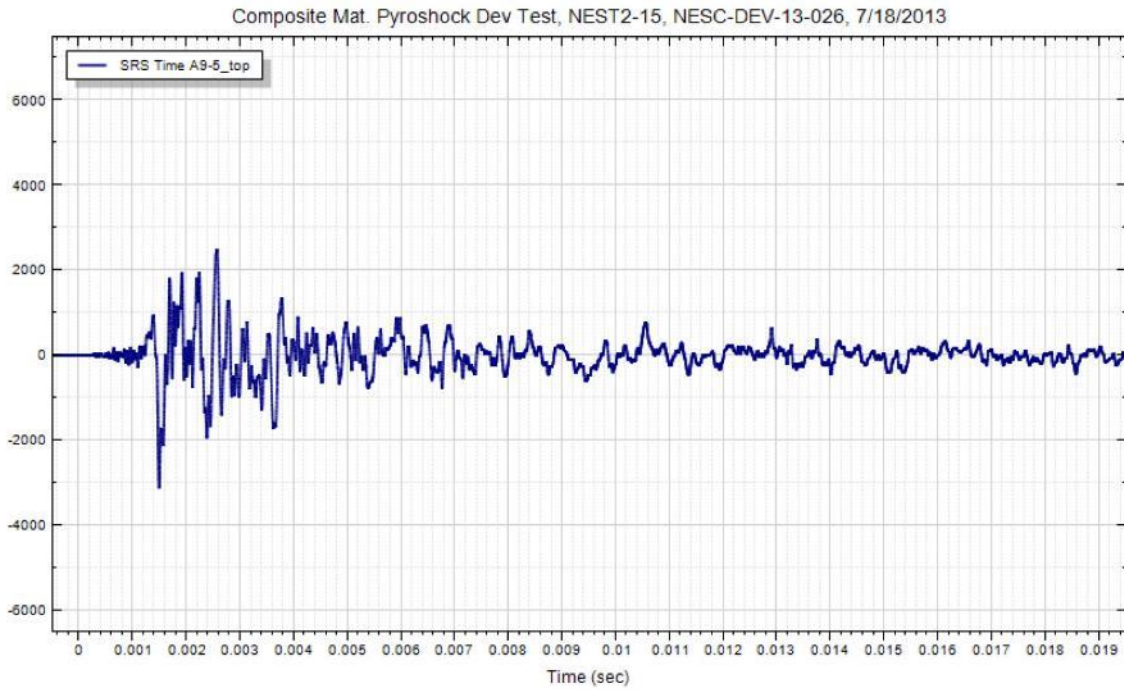
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
199 of 832





# NASA Engineering and Safety Center Technical Assessment Report

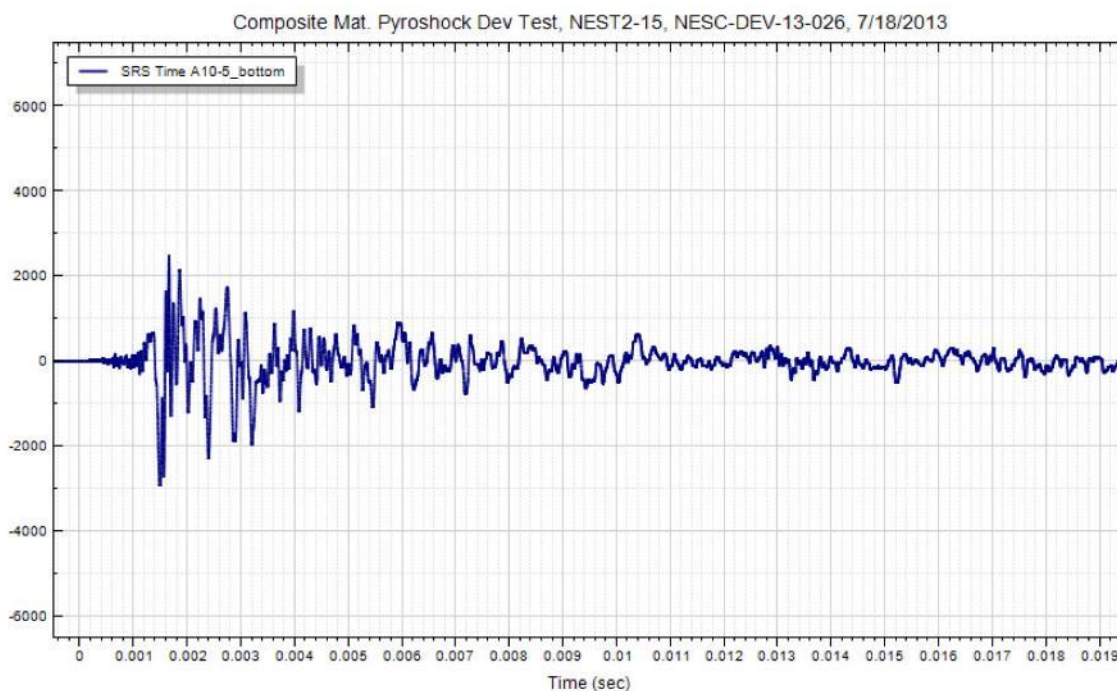
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
200 of 832





# NASA Engineering and Safety Center Technical Assessment Report

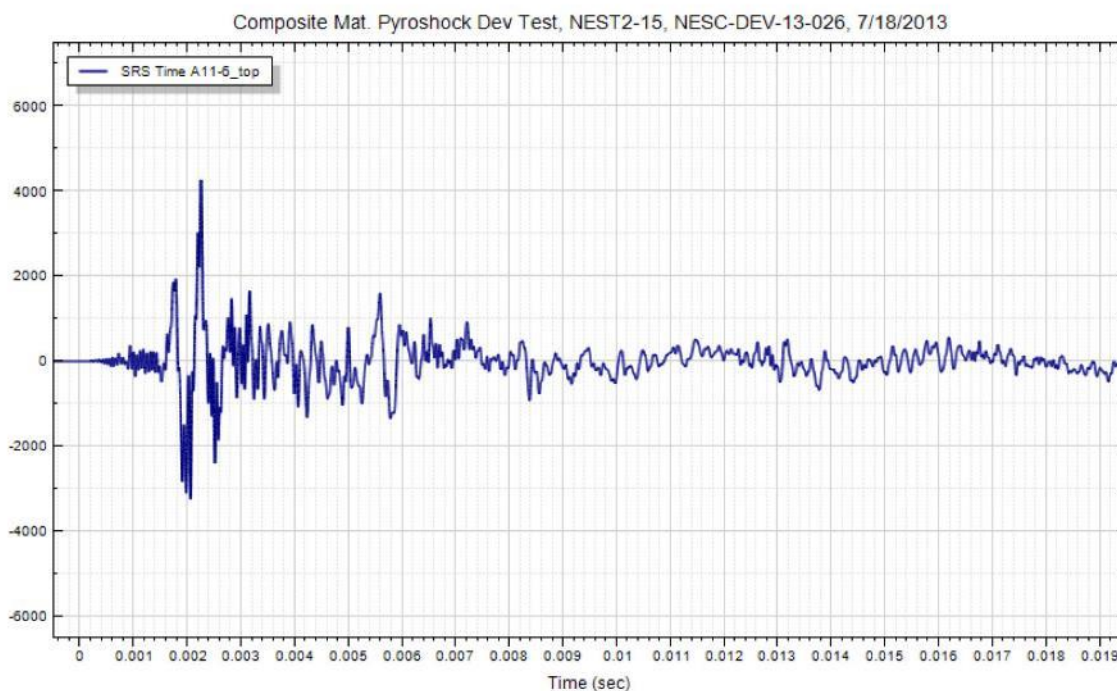
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
201 of 832





# NASA Engineering and Safety Center Technical Assessment Report

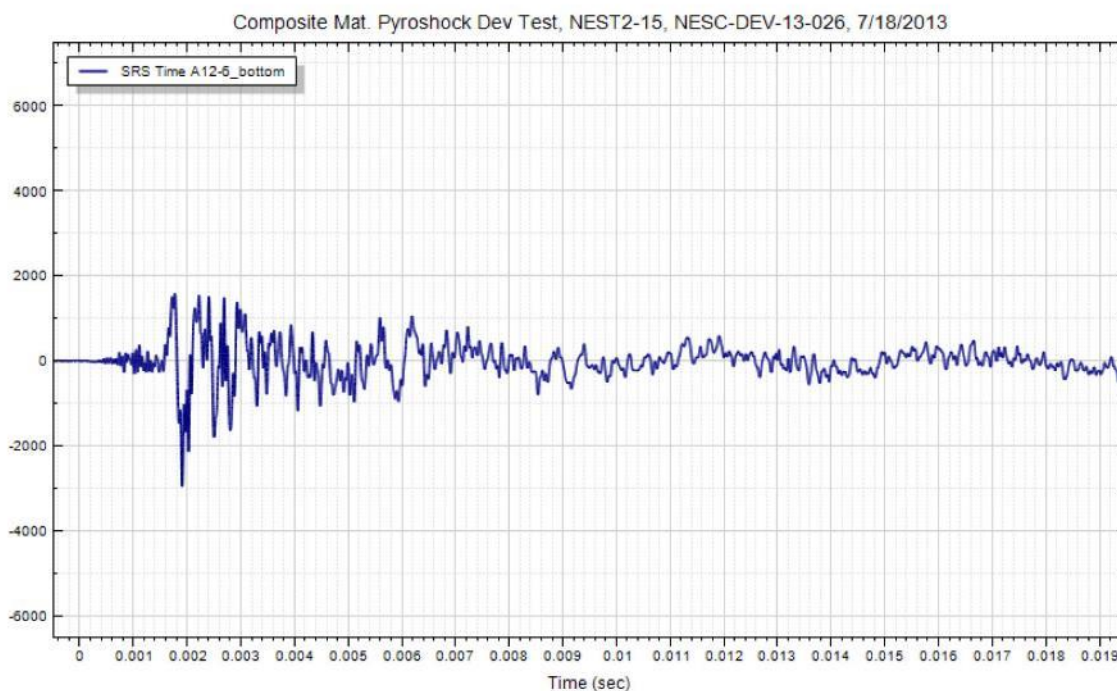
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
202 of 832





# NASA Engineering and Safety Center Technical Assessment Report

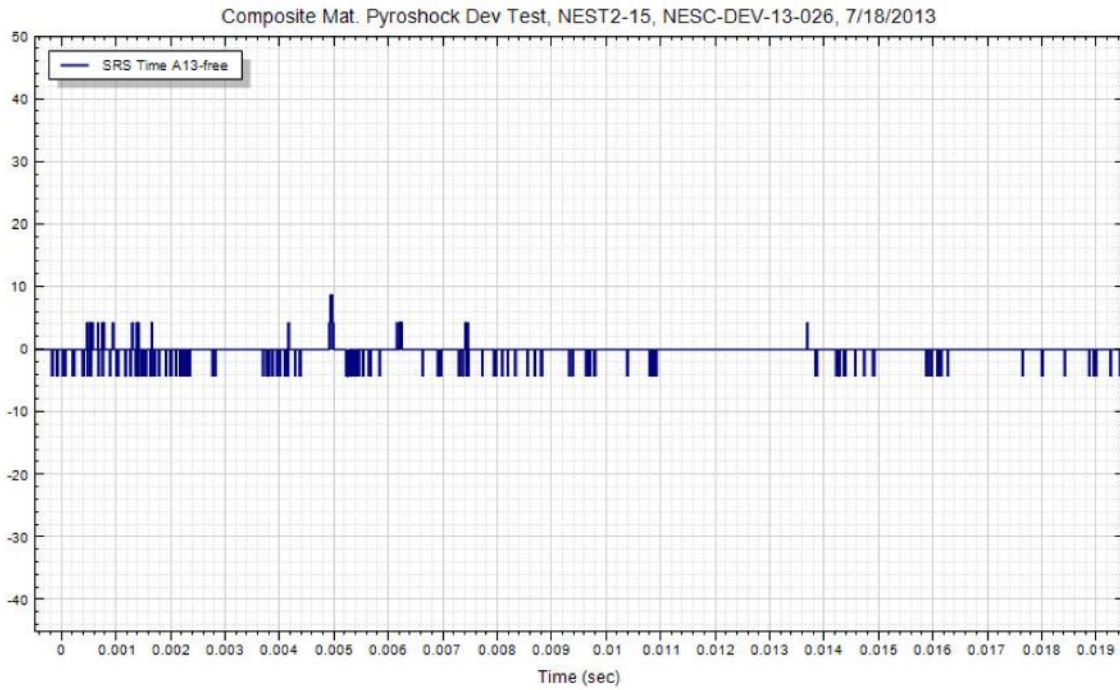
Document #:  
**NESC-RP-  
12-00783**


Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
203 of 832



	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 204 of 832	

**NESC-DEV-13-026**  
**Composite Materials**  
**Shock Test**  
  
**Test #6 Accelerometer Data**  
**Panel 0332A018**





# NASA Engineering and Safety Center Technical Assessment Report

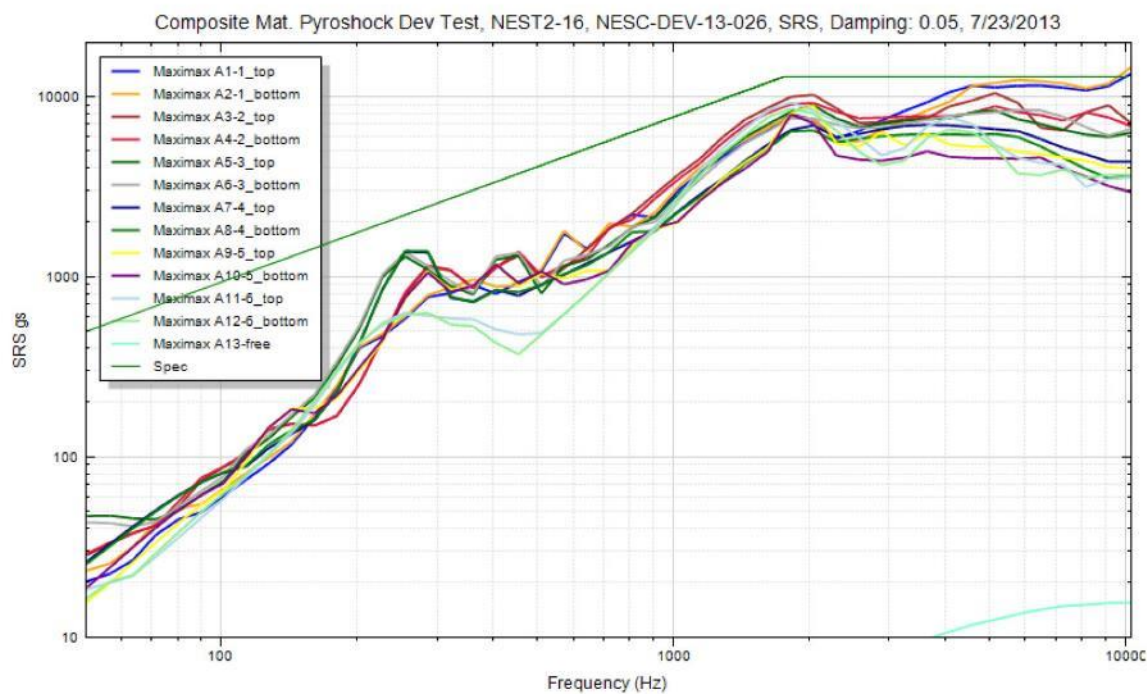
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
205 of 832





# NASA Engineering and Safety Center Technical Assessment Report

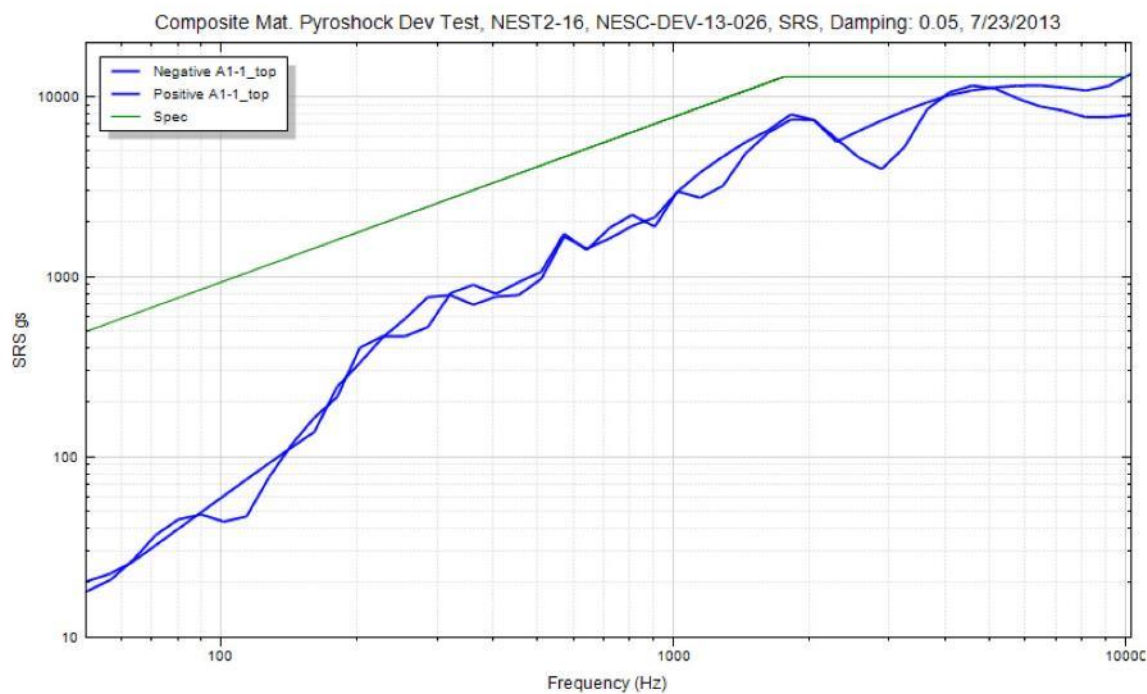
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
206 of 832





# NASA Engineering and Safety Center Technical Assessment Report

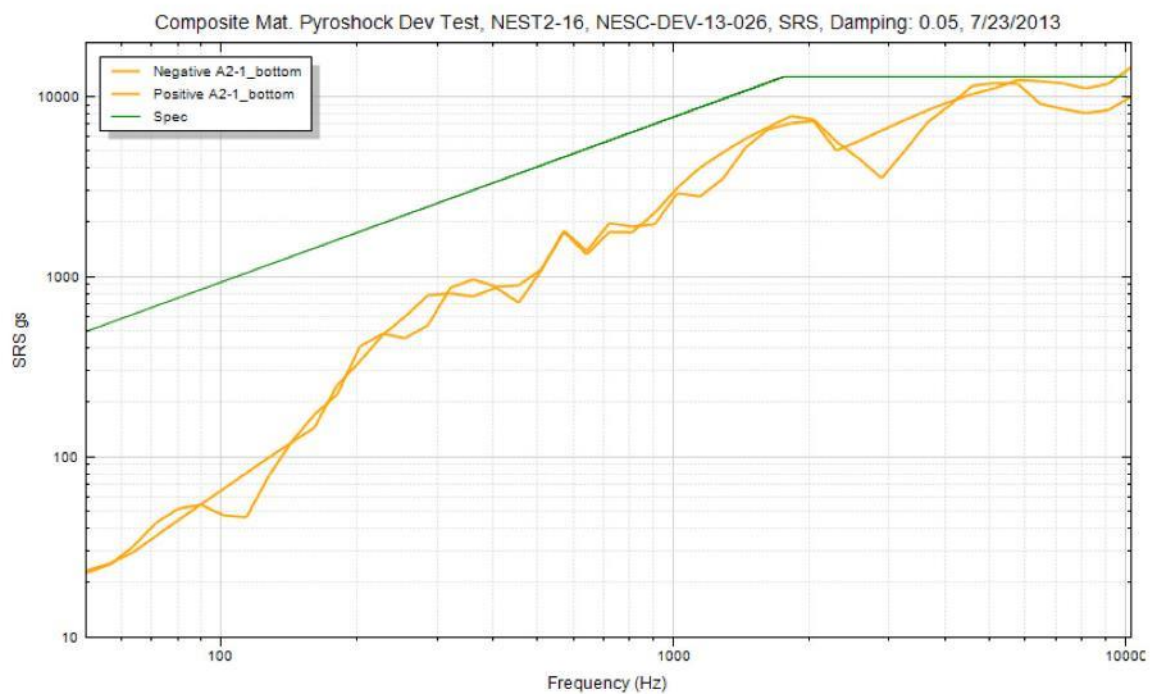
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
207 of 832





# NASA Engineering and Safety Center Technical Assessment Report

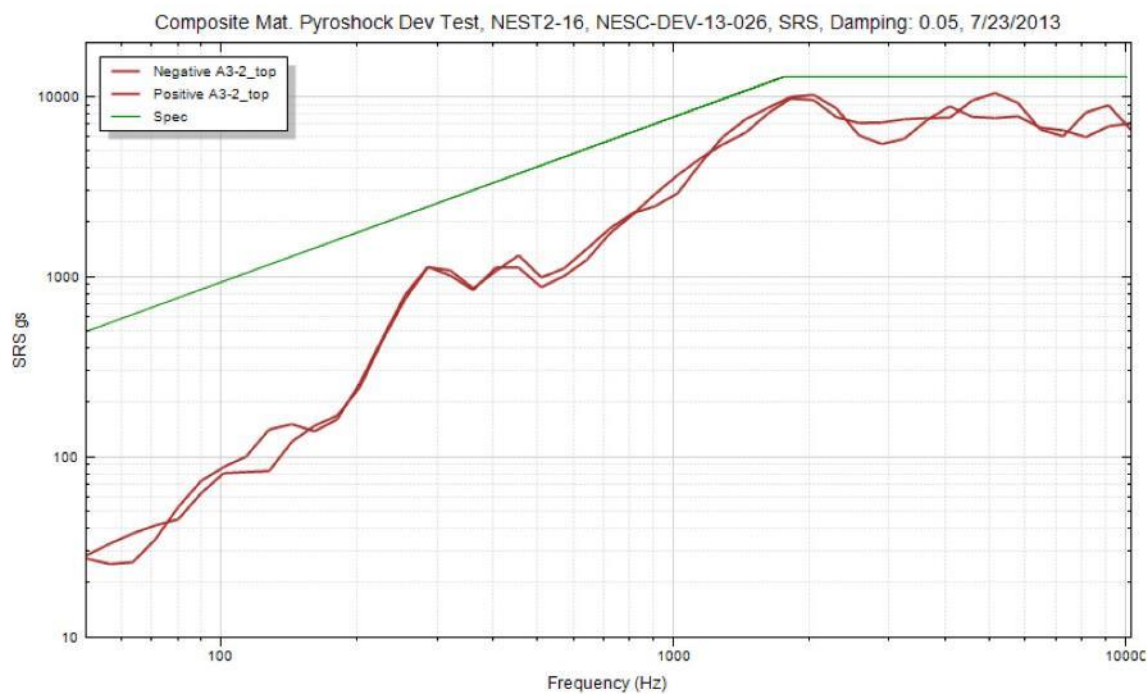
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
208 of 832





# NASA Engineering and Safety Center Technical Assessment Report

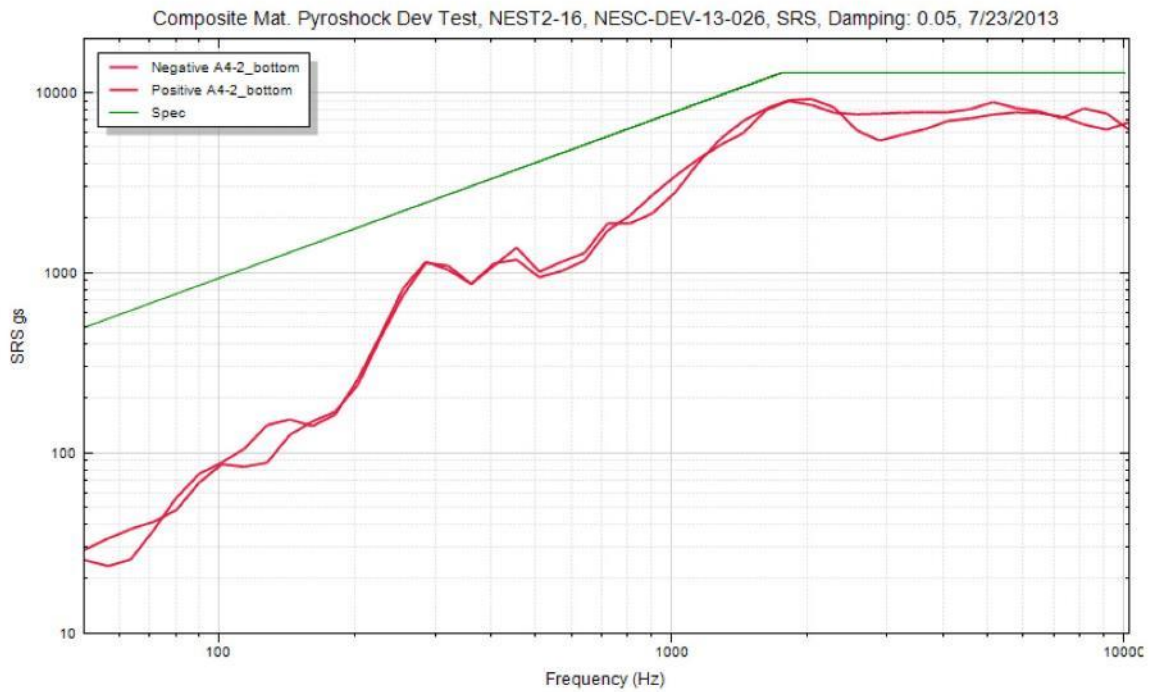
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
209 of 832





# NASA Engineering and Safety Center Technical Assessment Report

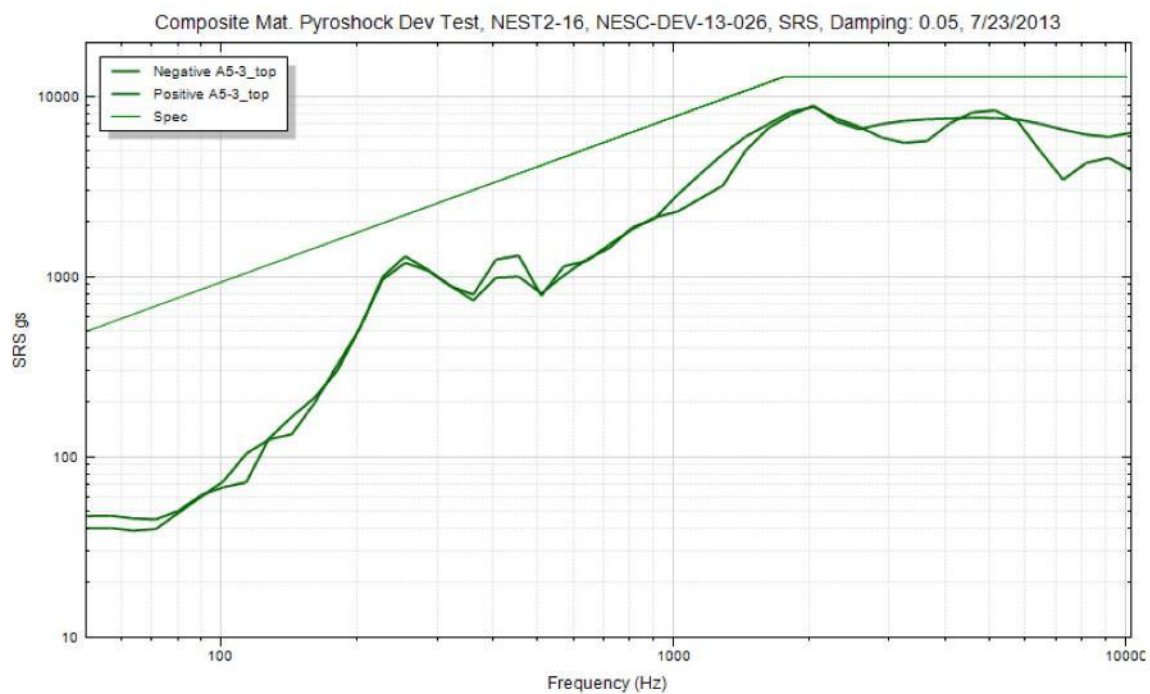
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
210 of 832





# NASA Engineering and Safety Center Technical Assessment Report

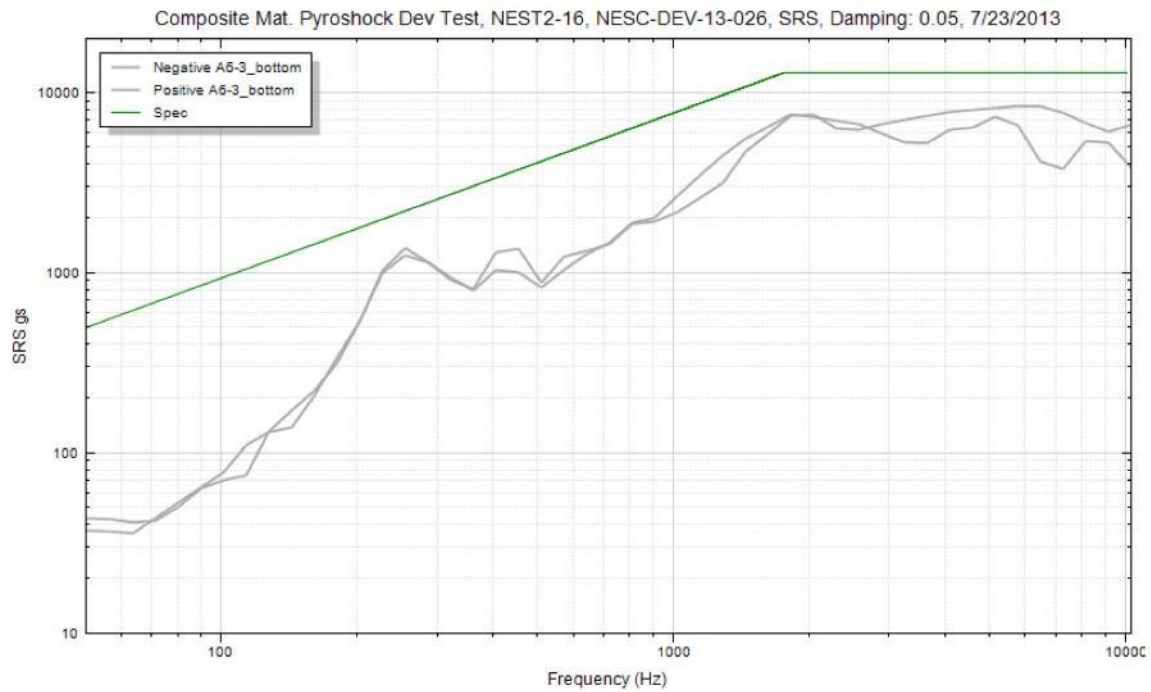
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
211 of 832





# NASA Engineering and Safety Center Technical Assessment Report

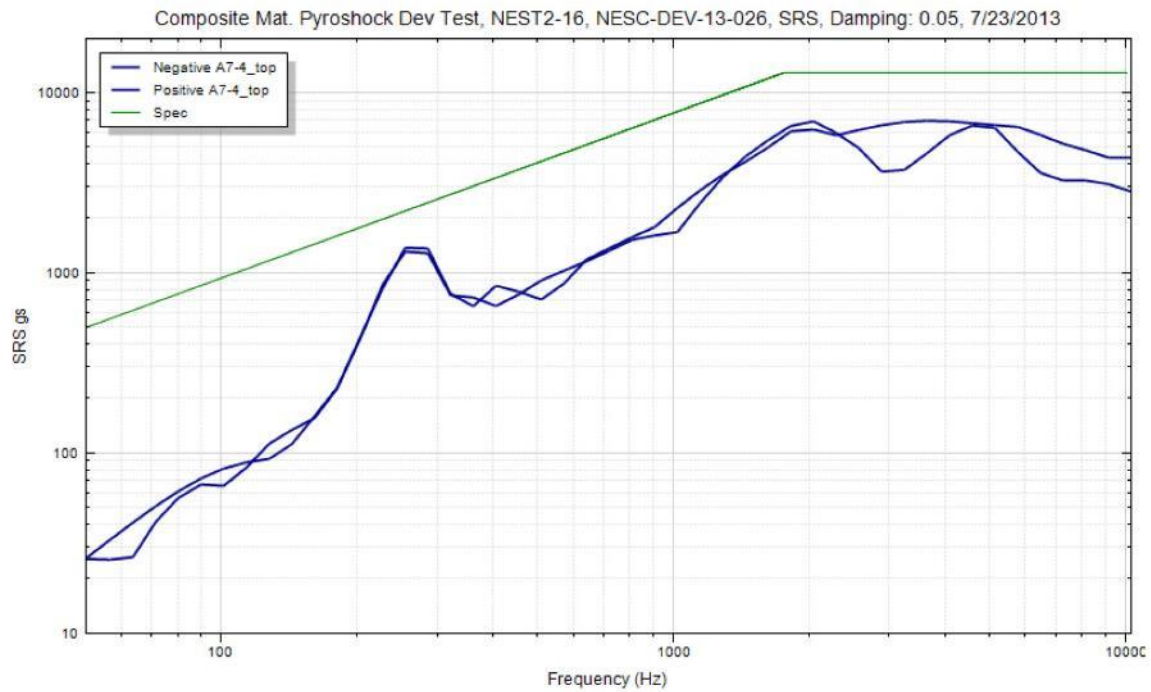
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
212 of 832







# NASA Engineering and Safety Center Technical Assessment Report

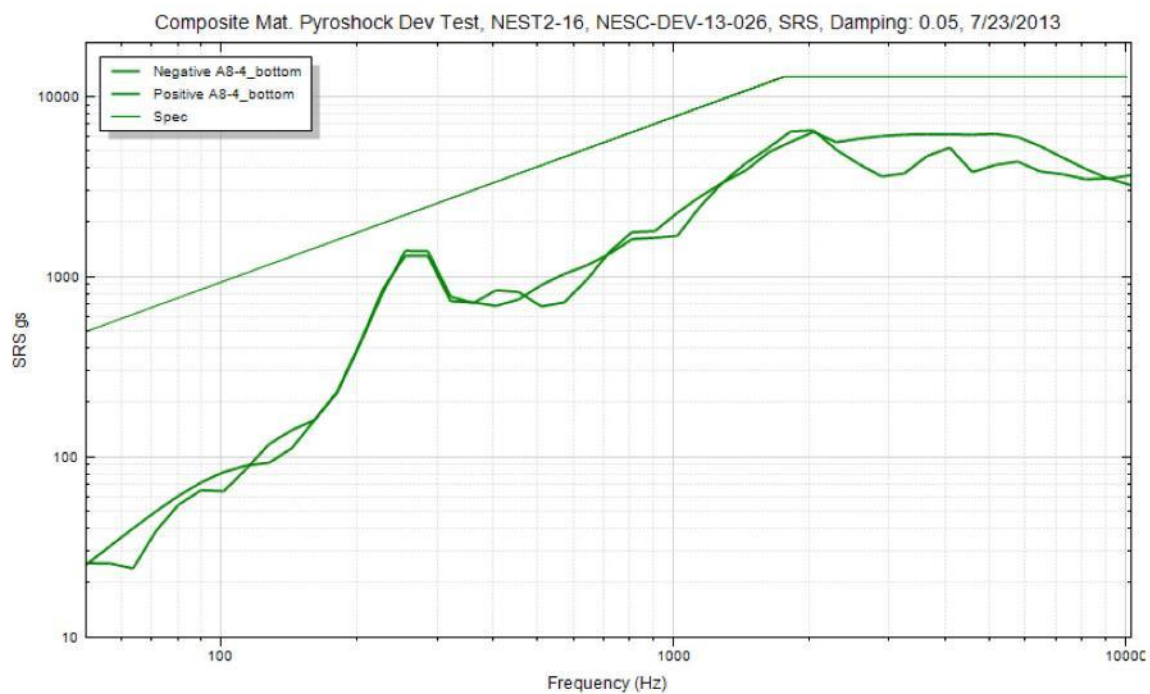
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
213 of 832





# NASA Engineering and Safety Center Technical Assessment Report

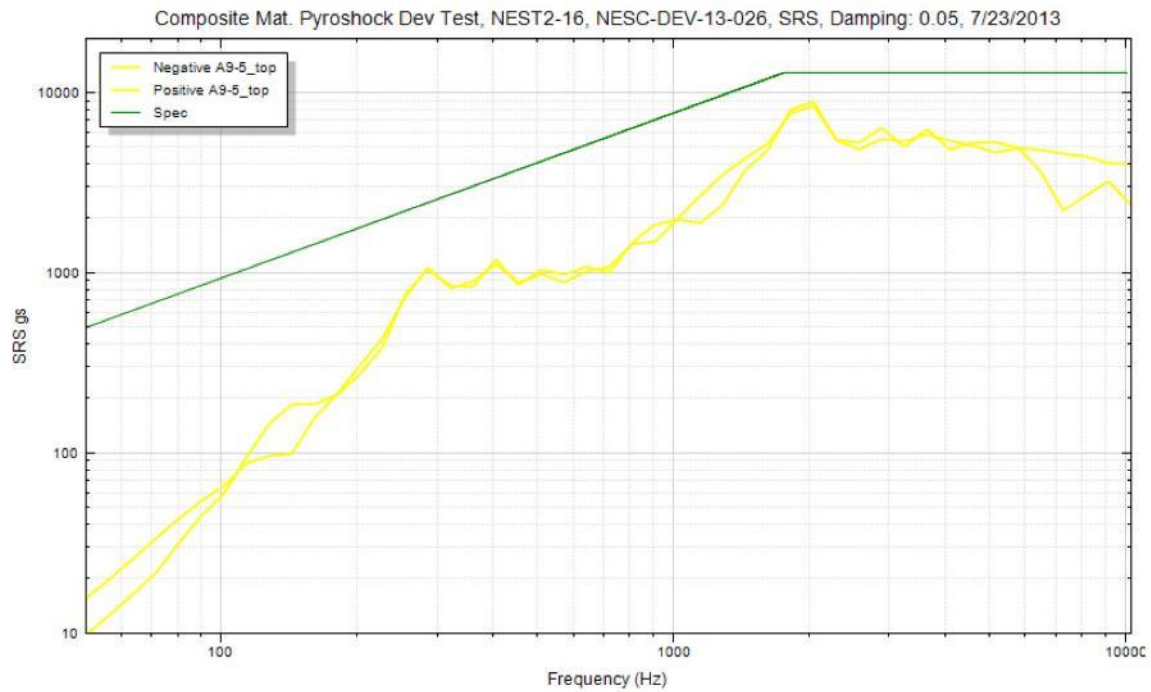
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
214 of 832





# NASA Engineering and Safety Center Technical Assessment Report

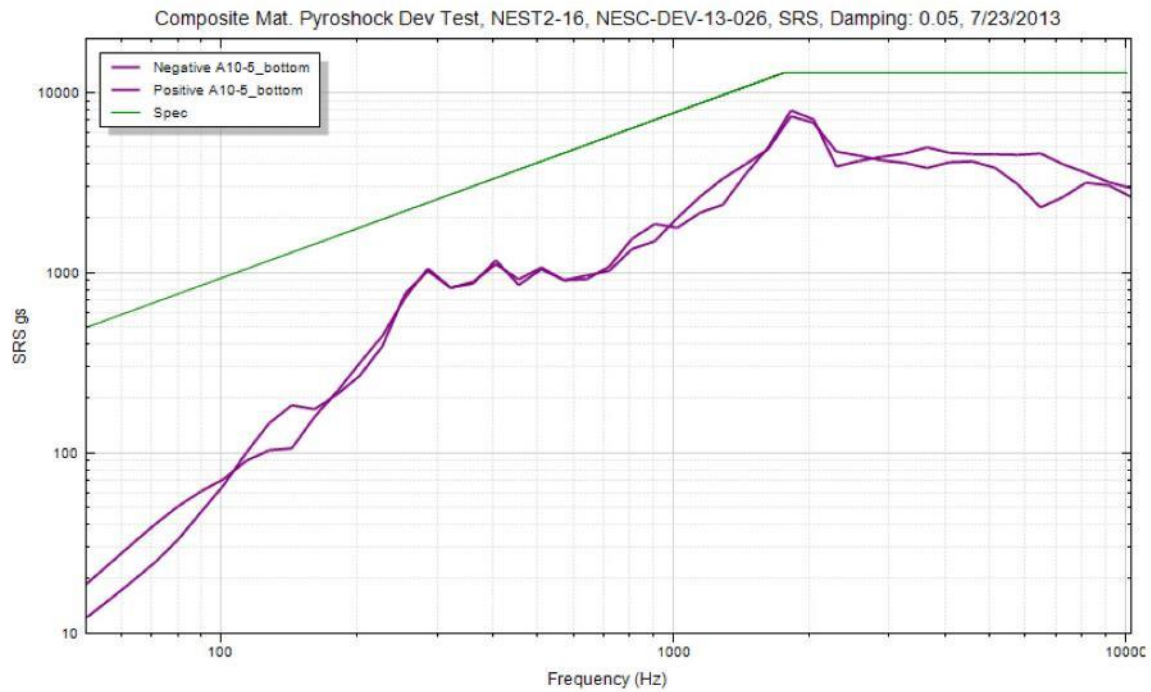
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
215 of 832





# NASA Engineering and Safety Center Technical Assessment Report

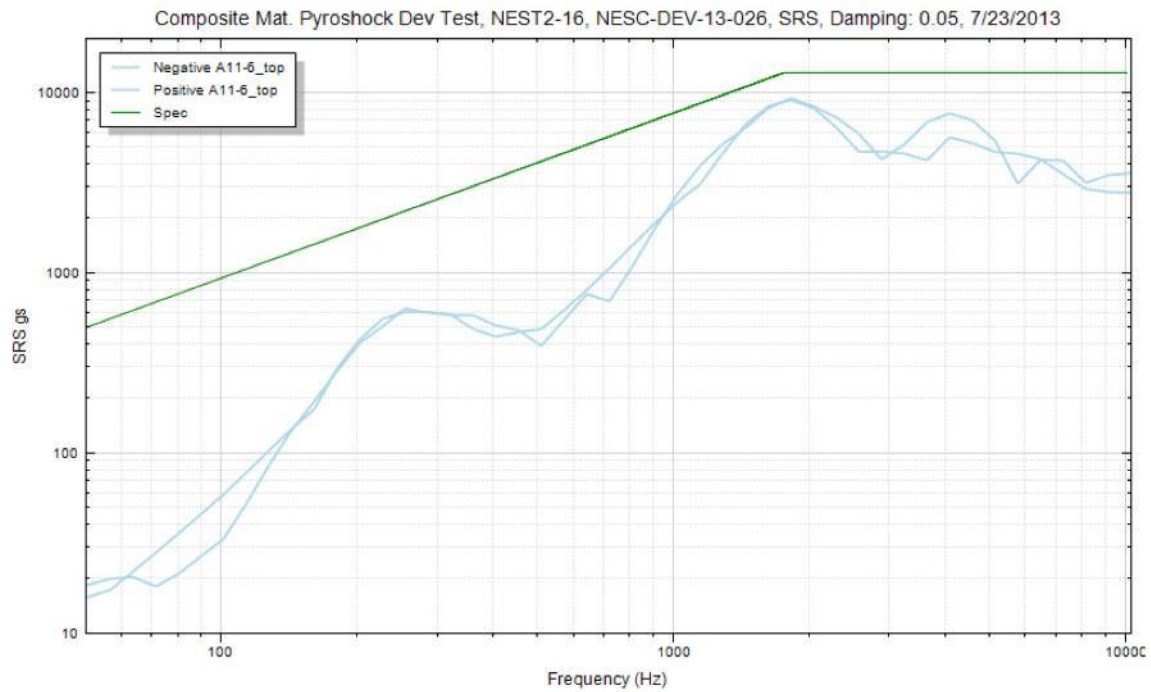
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
216 of 832





# NASA Engineering and Safety Center Technical Assessment Report

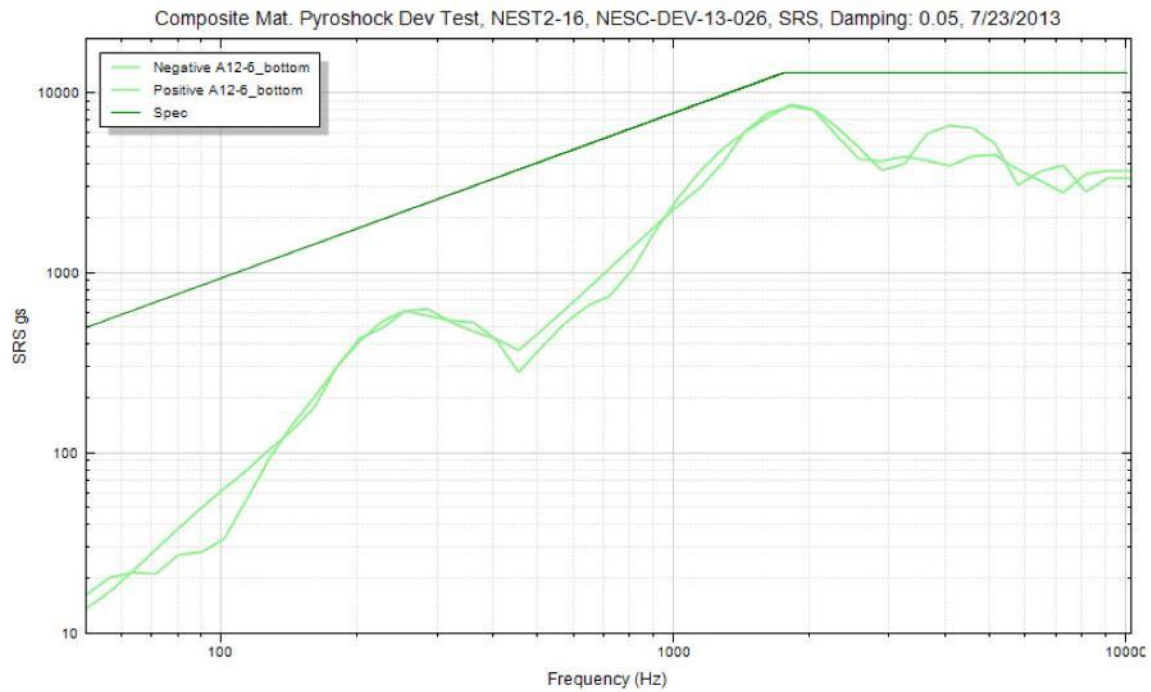
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
217 of 832





# NASA Engineering and Safety Center Technical Assessment Report

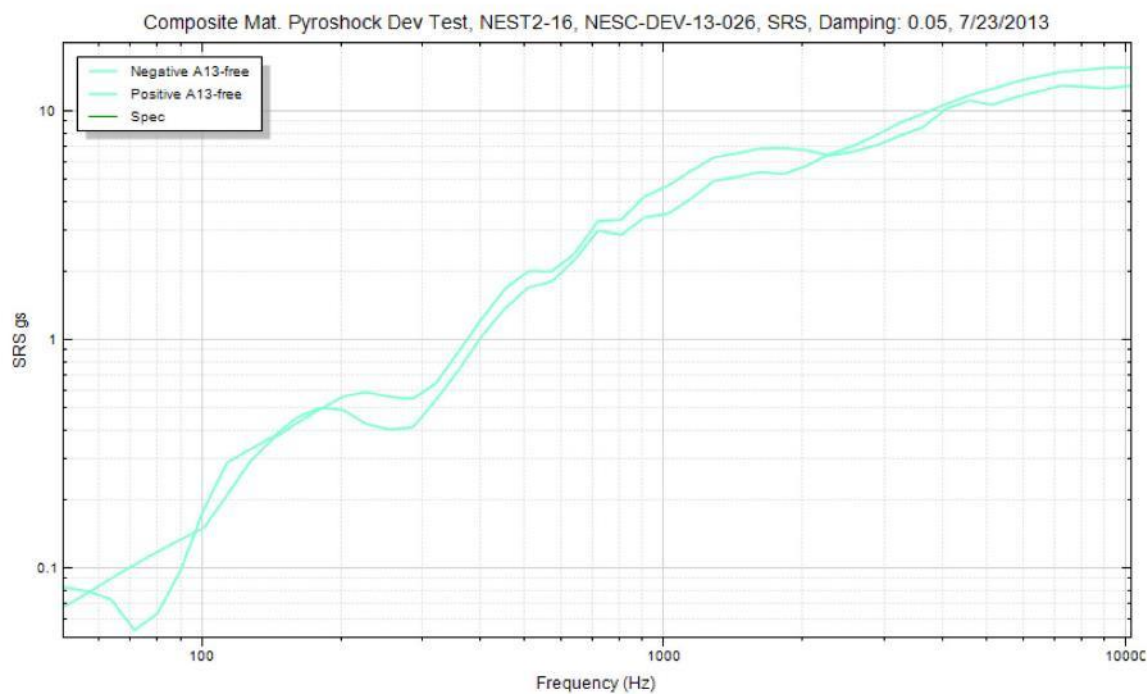
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
218 of 832





# NASA Engineering and Safety Center Technical Assessment Report

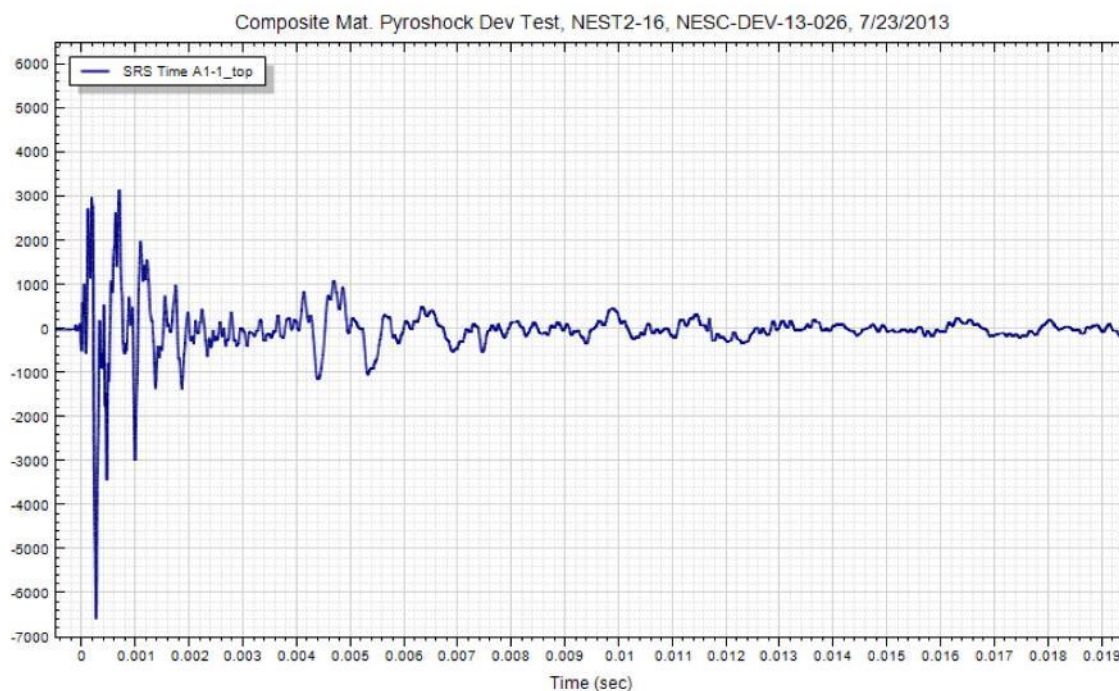
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
219 of 832





# NASA Engineering and Safety Center Technical Assessment Report

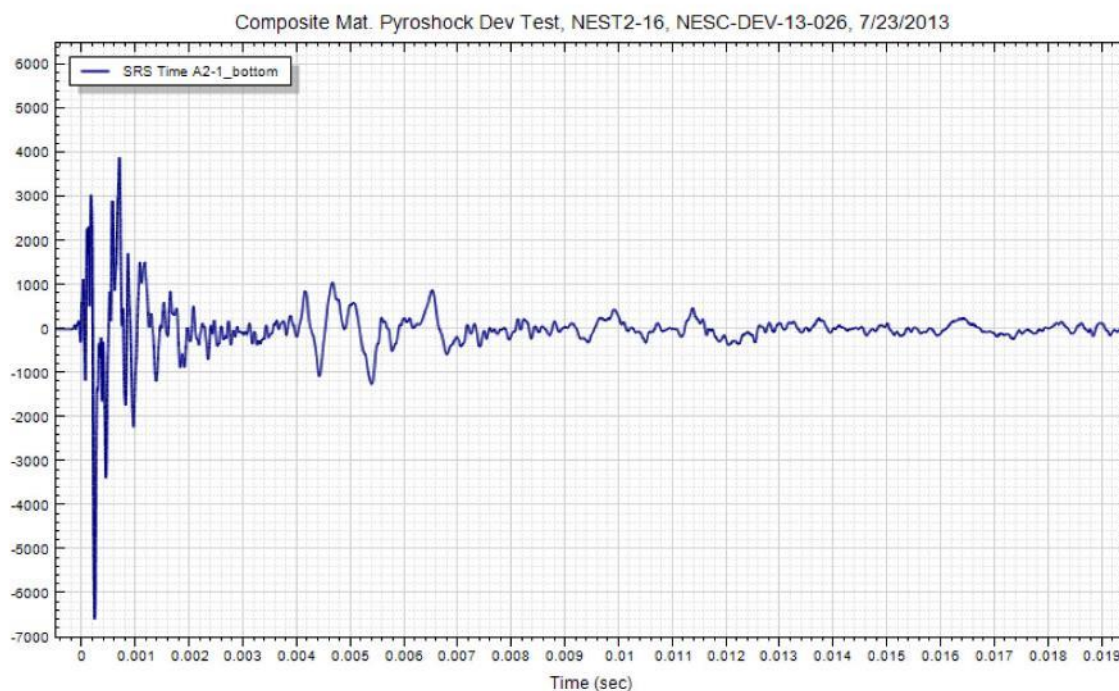
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
220 of 832







# NASA Engineering and Safety Center Technical Assessment Report

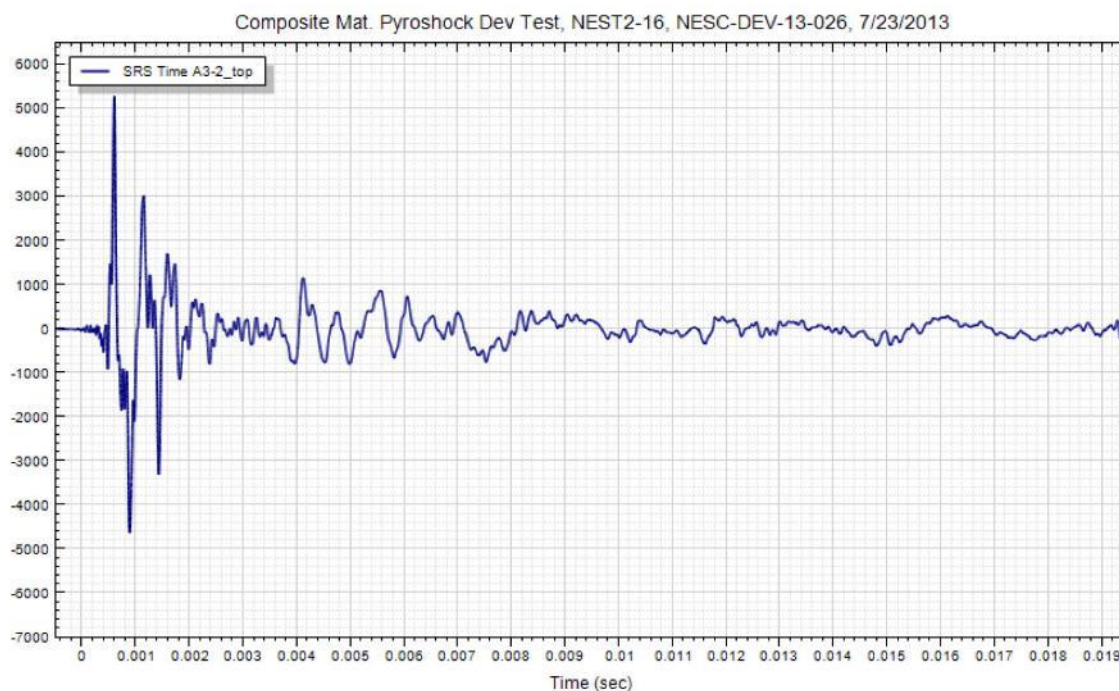
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
221 of 832





# NASA Engineering and Safety Center Technical Assessment Report

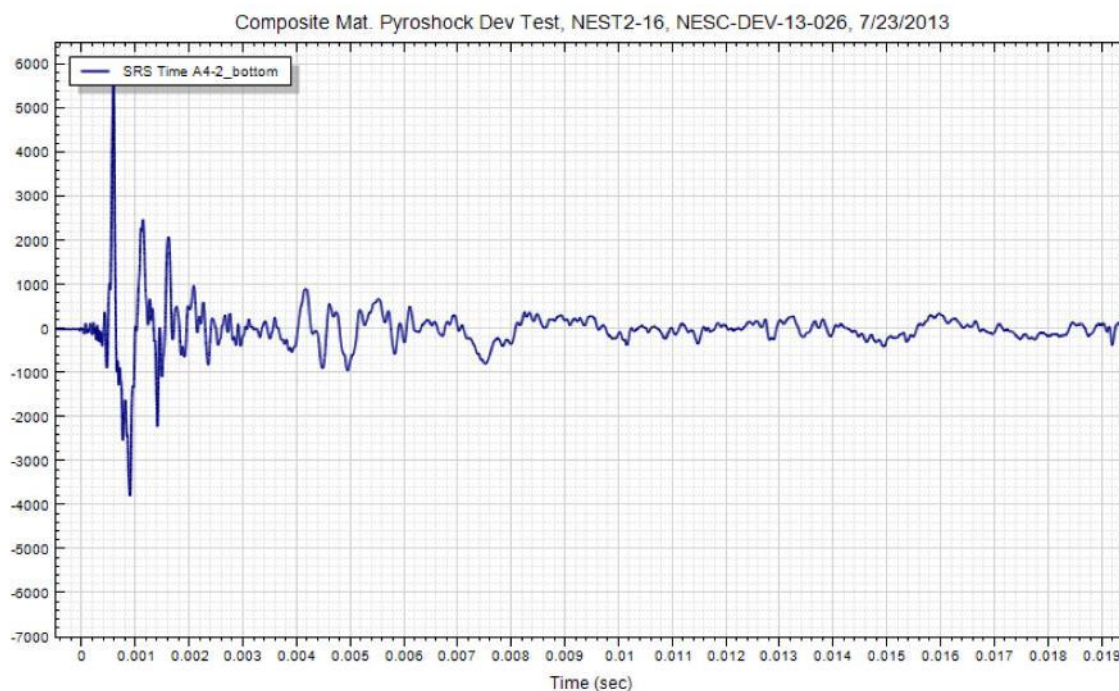
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
222 of 832





# NASA Engineering and Safety Center Technical Assessment Report

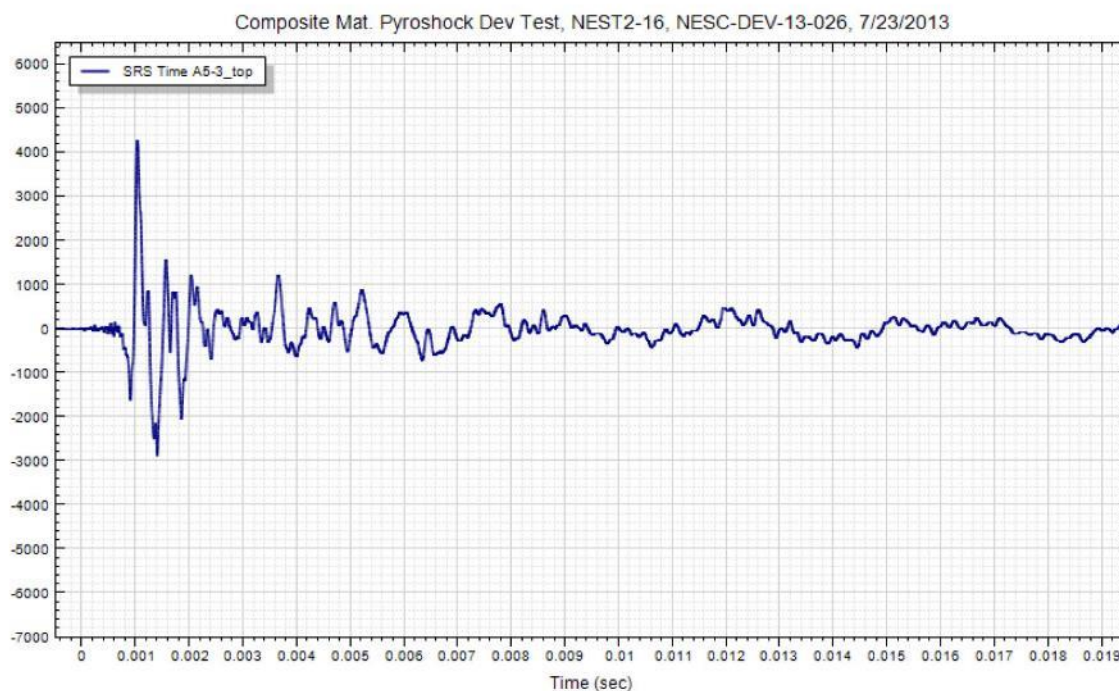
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
223 of 832





# NASA Engineering and Safety Center Technical Assessment Report

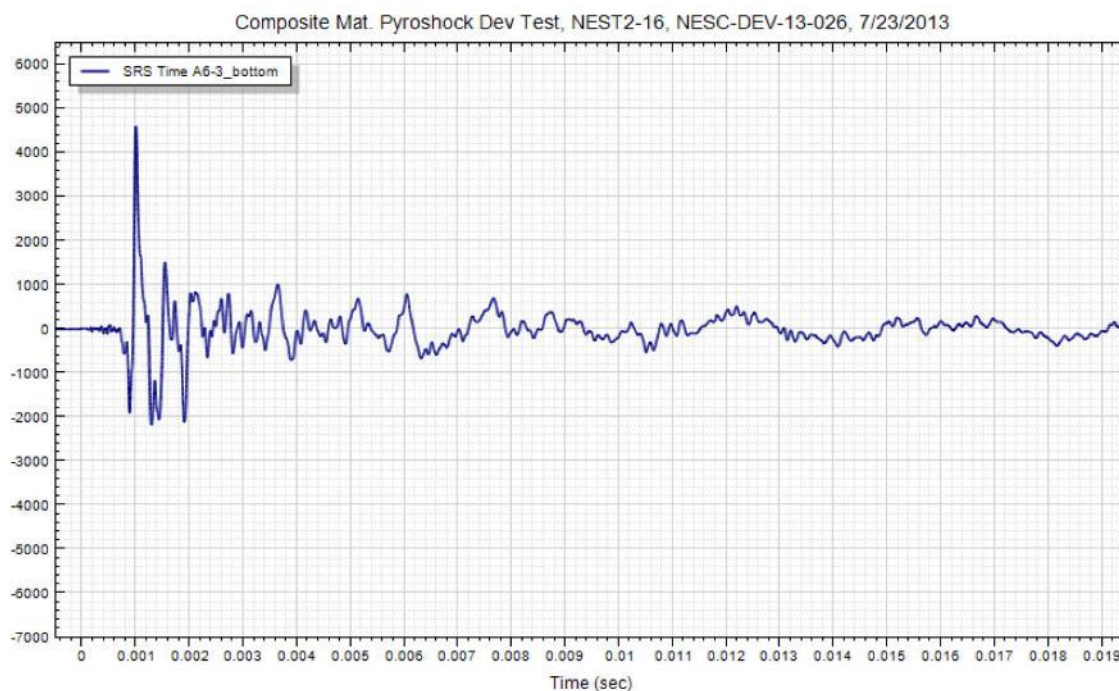
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
224 of 832





# NASA Engineering and Safety Center Technical Assessment Report

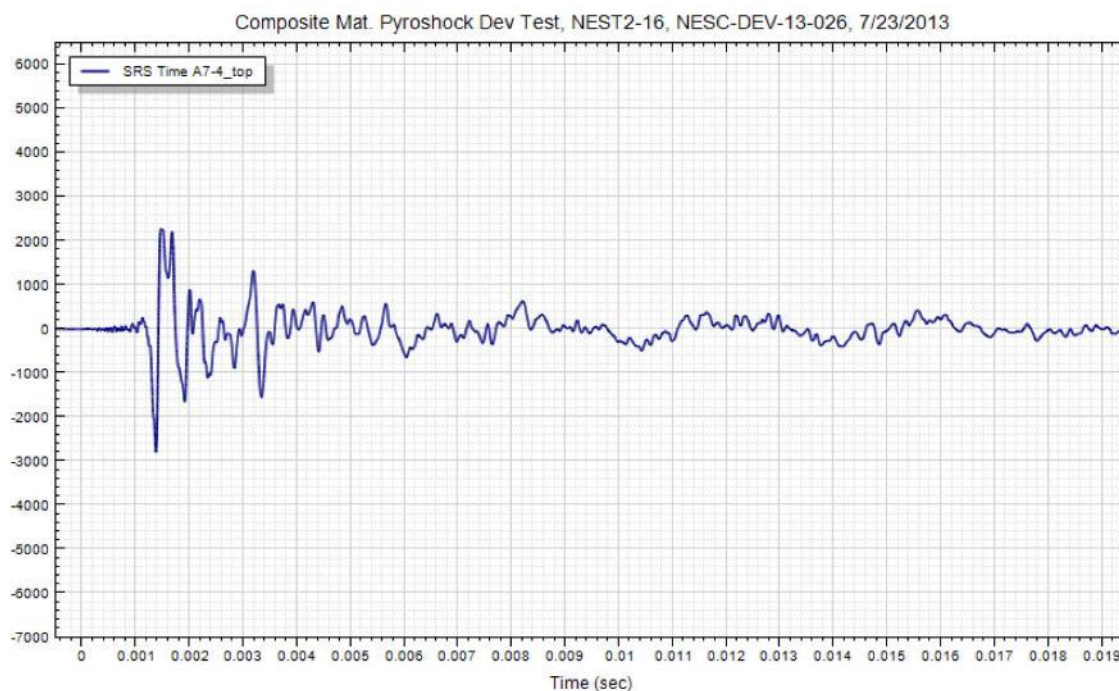
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
225 of 832





# NASA Engineering and Safety Center Technical Assessment Report

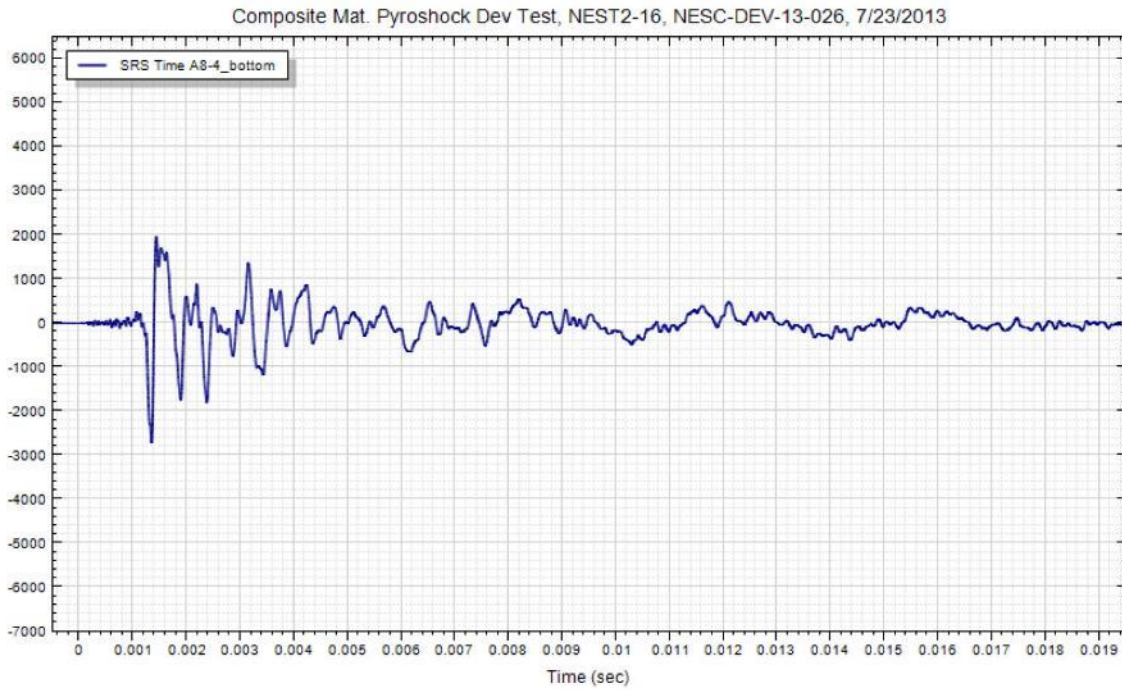
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
226 of 832





# NASA Engineering and Safety Center Technical Assessment Report

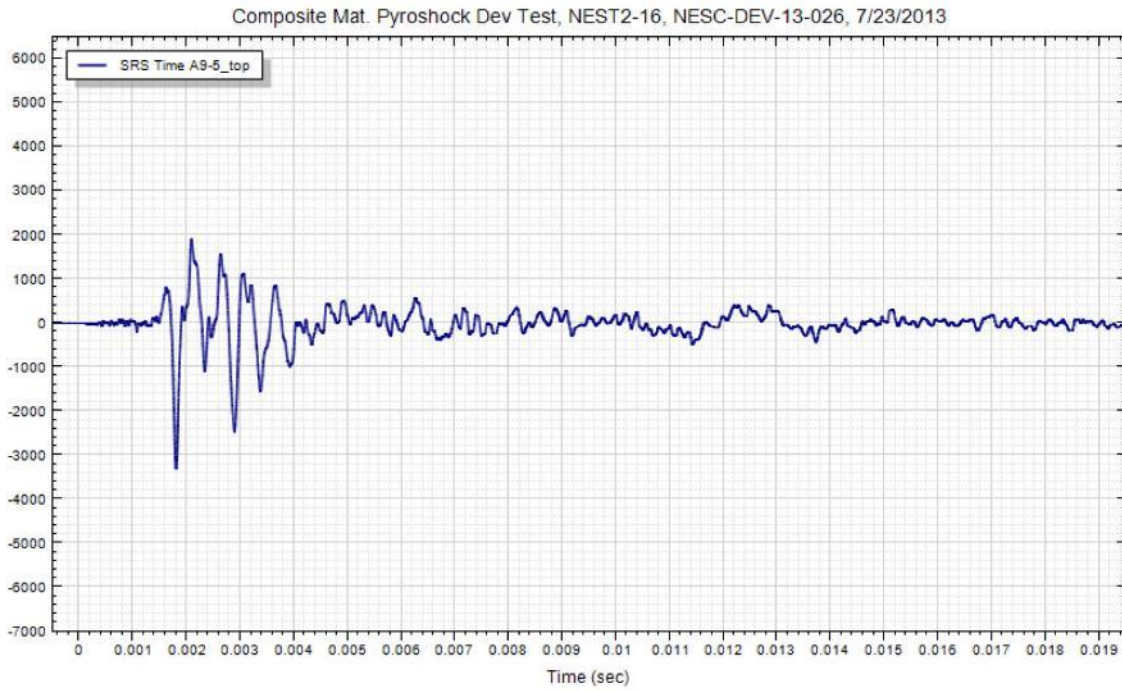
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
227 of 832





# NASA Engineering and Safety Center Technical Assessment Report

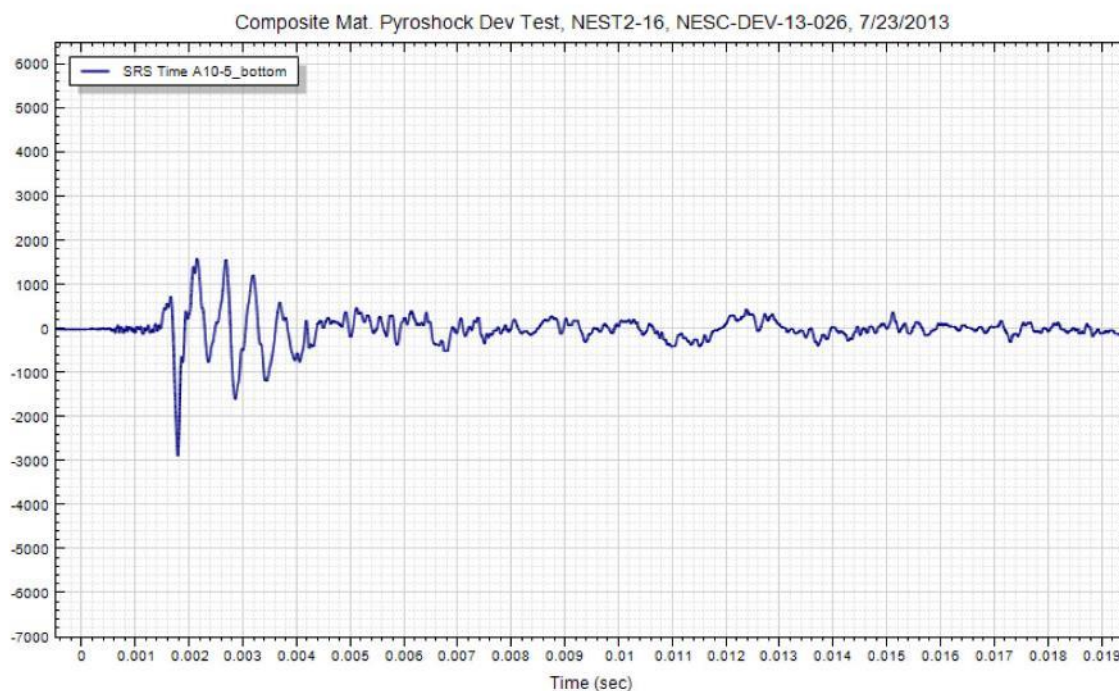
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
228 of 832







# NASA Engineering and Safety Center Technical Assessment Report

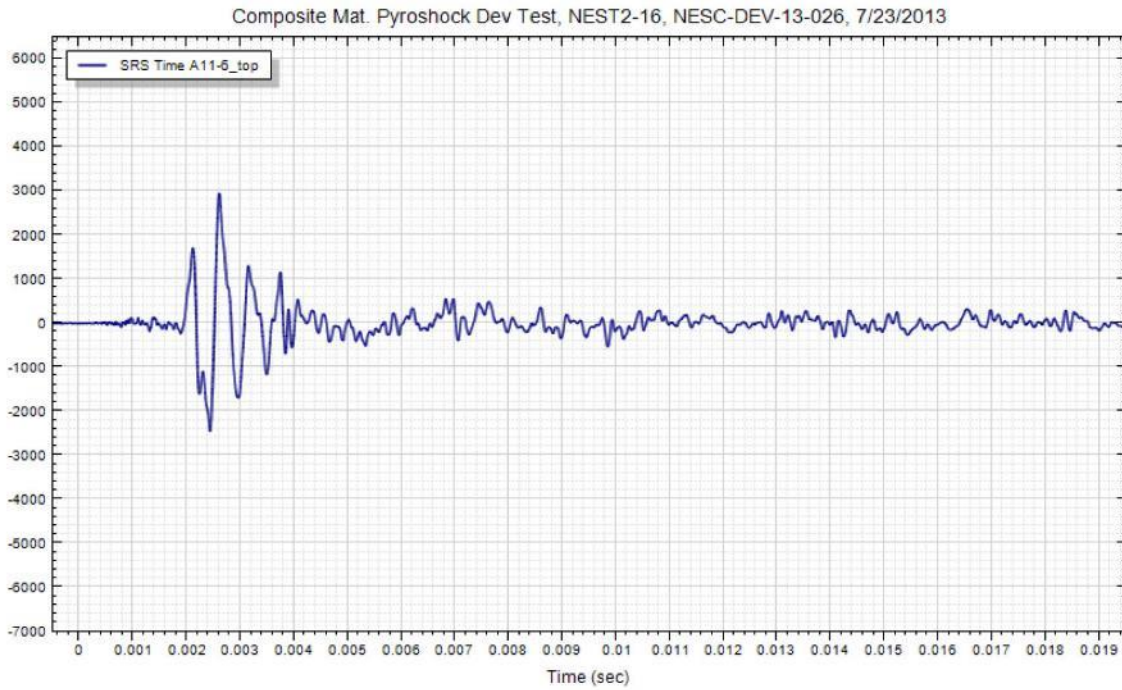
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
229 of 832





# NASA Engineering and Safety Center Technical Assessment Report

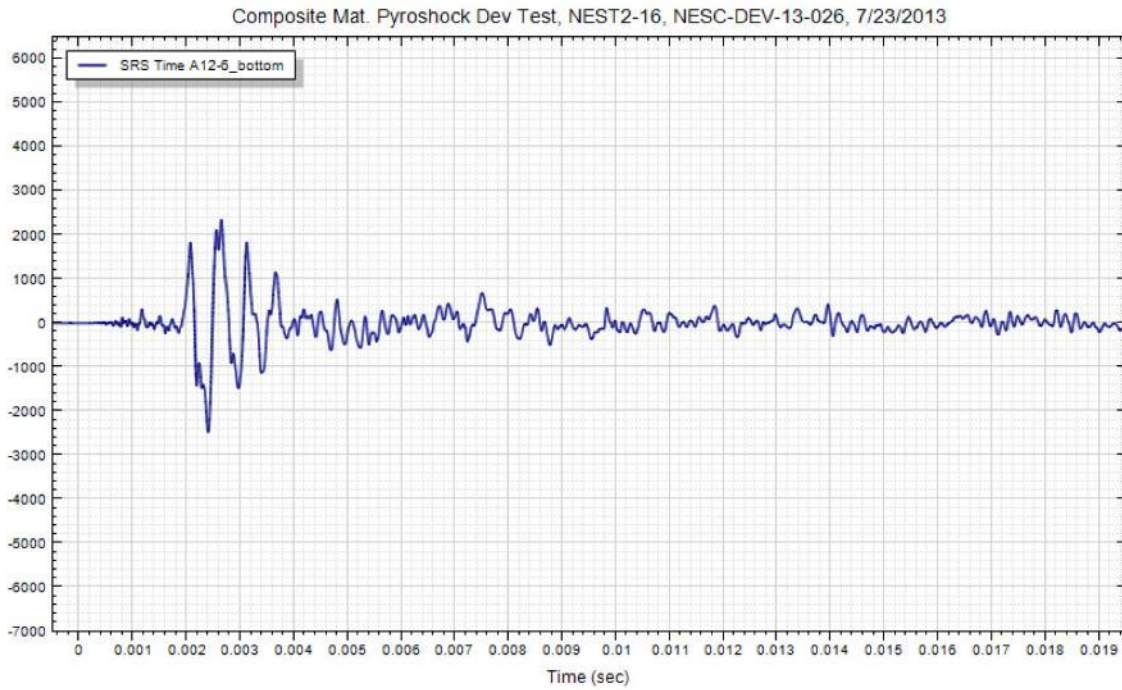
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
230 of 832





# NASA Engineering and Safety Center Technical Assessment Report

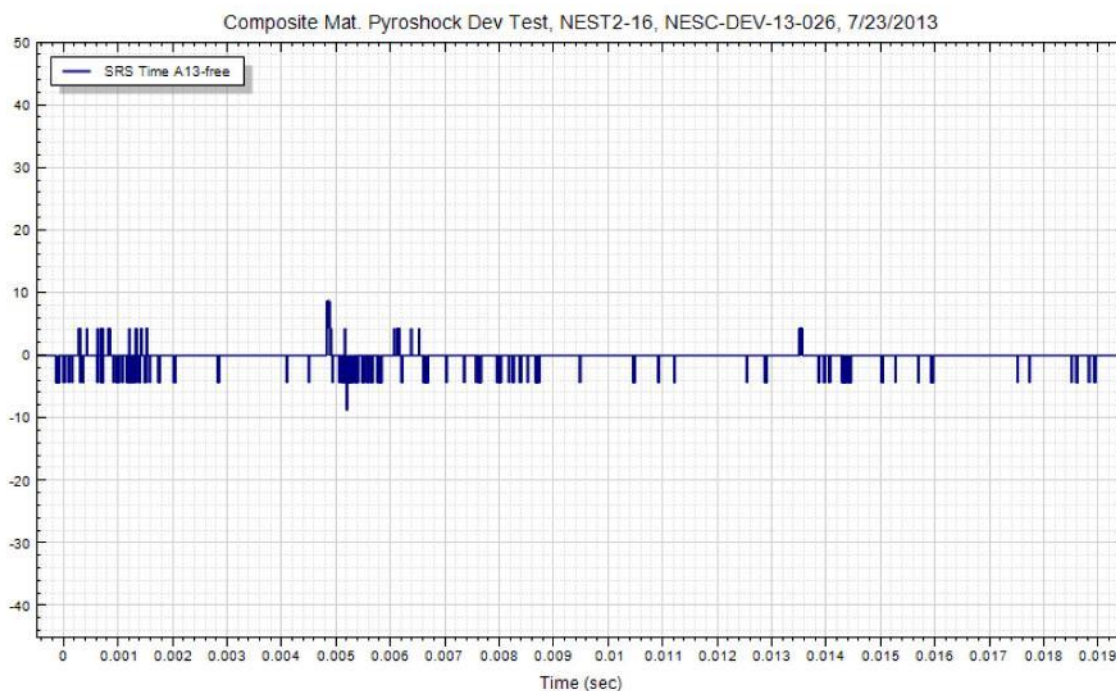
Document #:  
**NESC-RP-  
12-00783**


Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
231 of 832



	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 232 of 832	

**NESC-DEV-13-026**  
**Composite Materials**  
**Shock Test**  
  
**Test #7 Accelerometer Data**  
**Panel 0332A015**



# NASA Engineering and Safety Center Technical Assessment Report

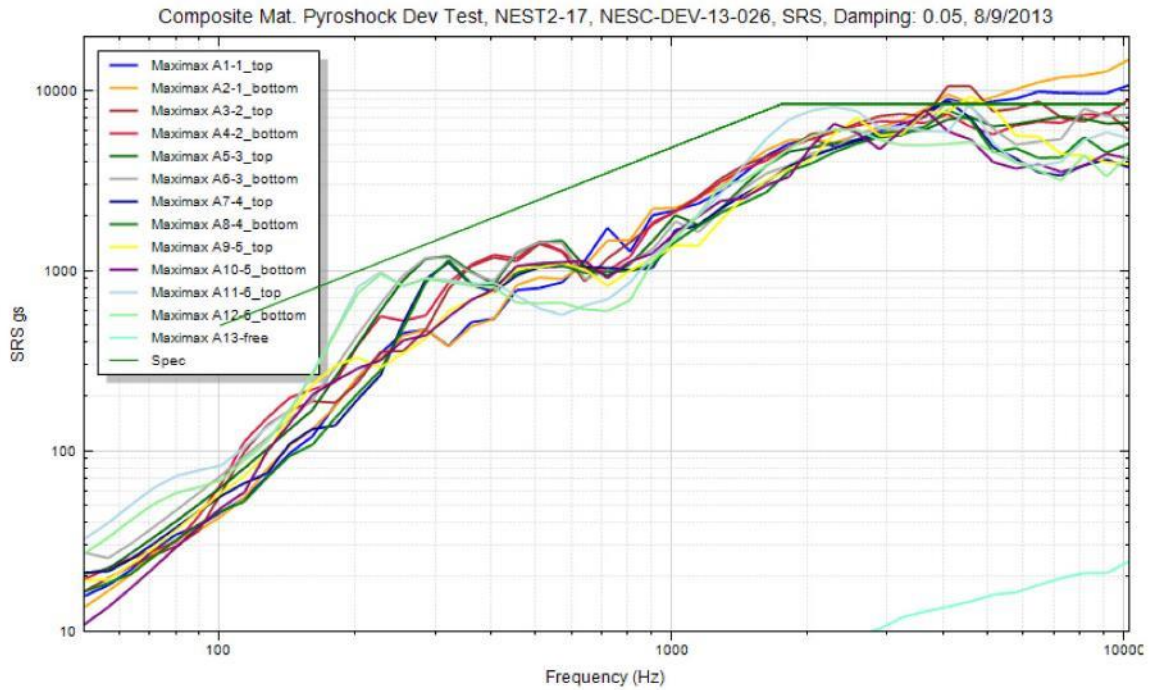
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
233 of 832





# NASA Engineering and Safety Center Technical Assessment Report

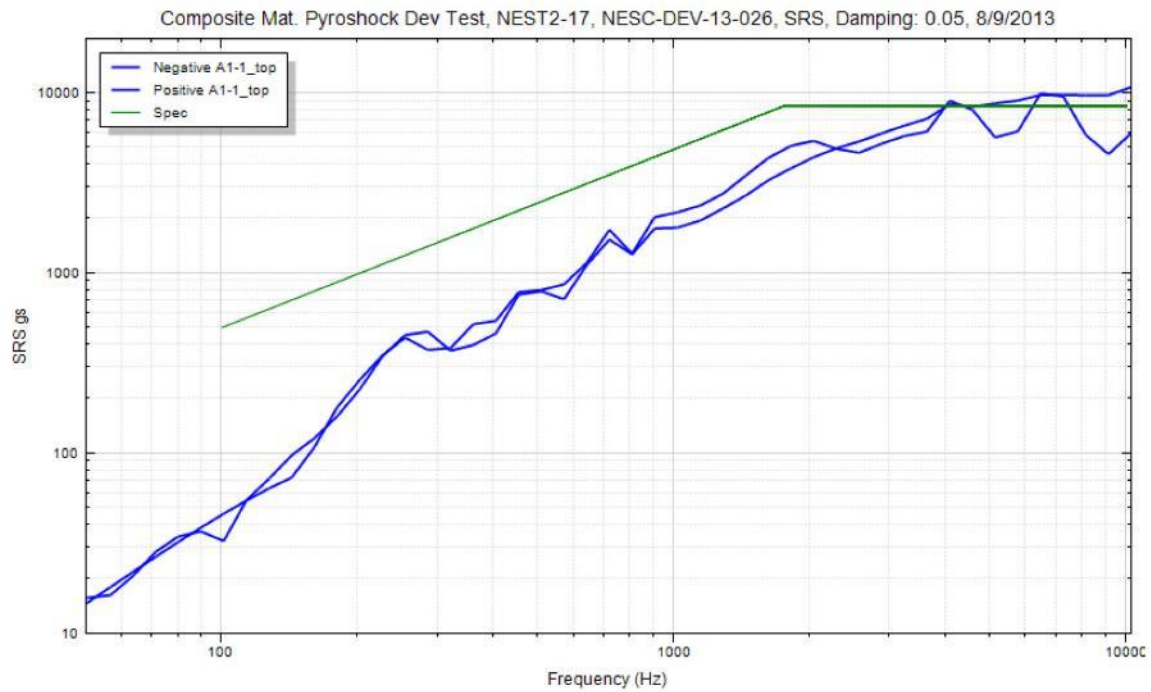
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
234 of 832





# NASA Engineering and Safety Center Technical Assessment Report

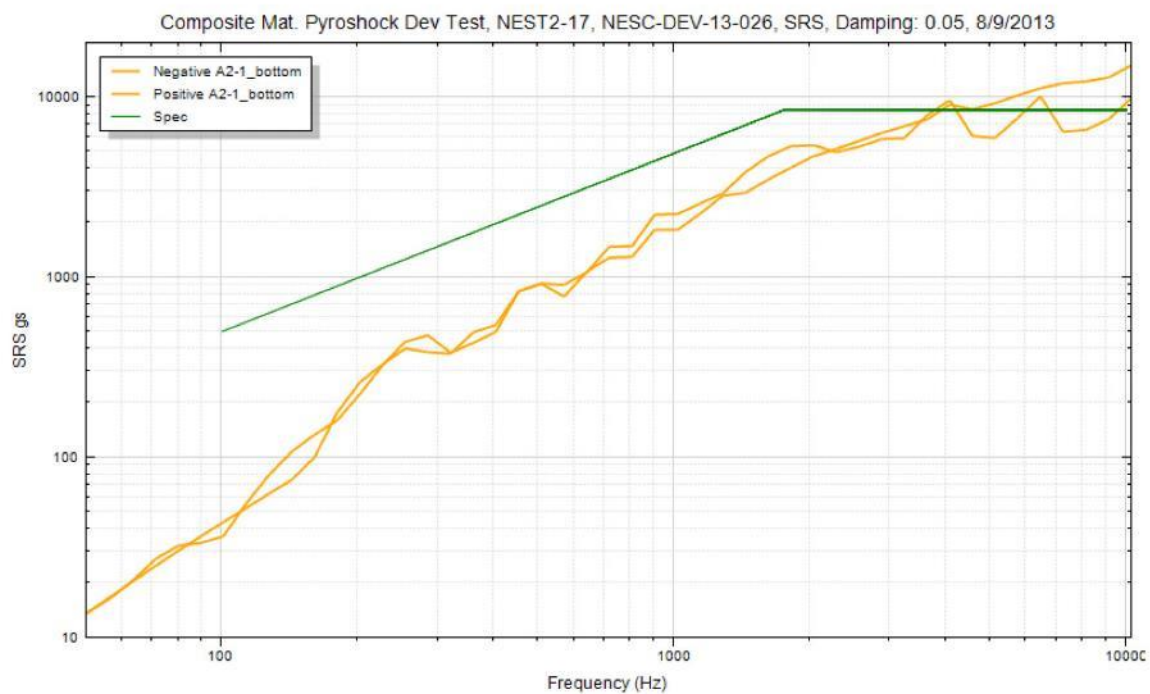
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
235 of 832





# NASA Engineering and Safety Center Technical Assessment Report

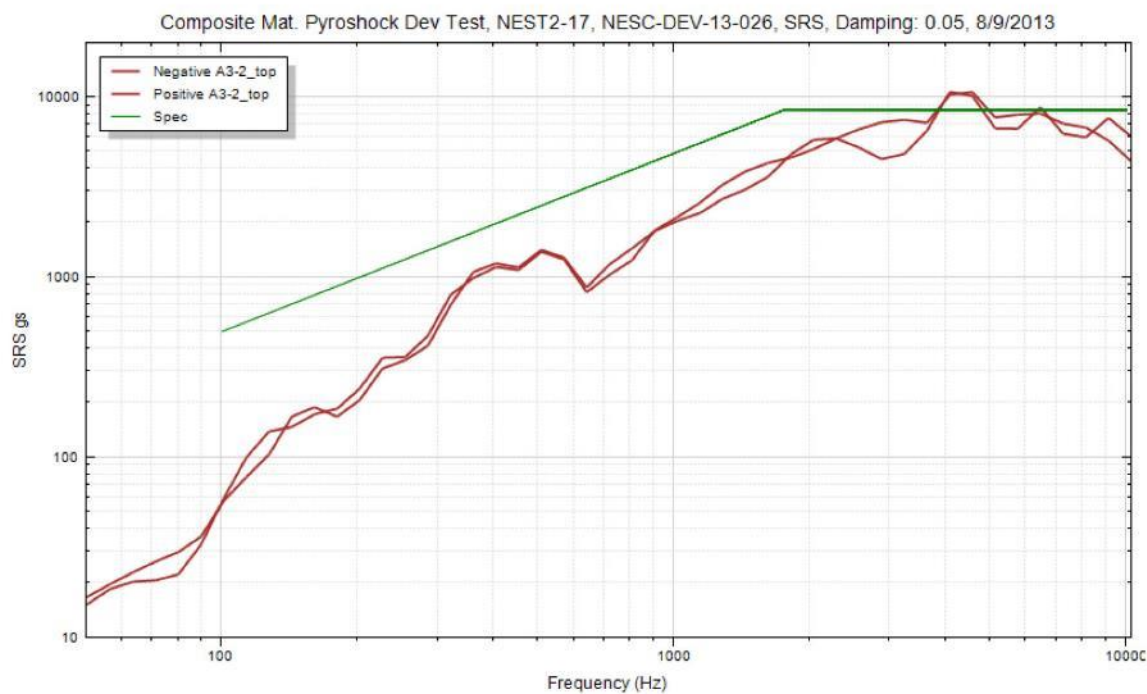
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
236 of 832







# NASA Engineering and Safety Center Technical Assessment Report

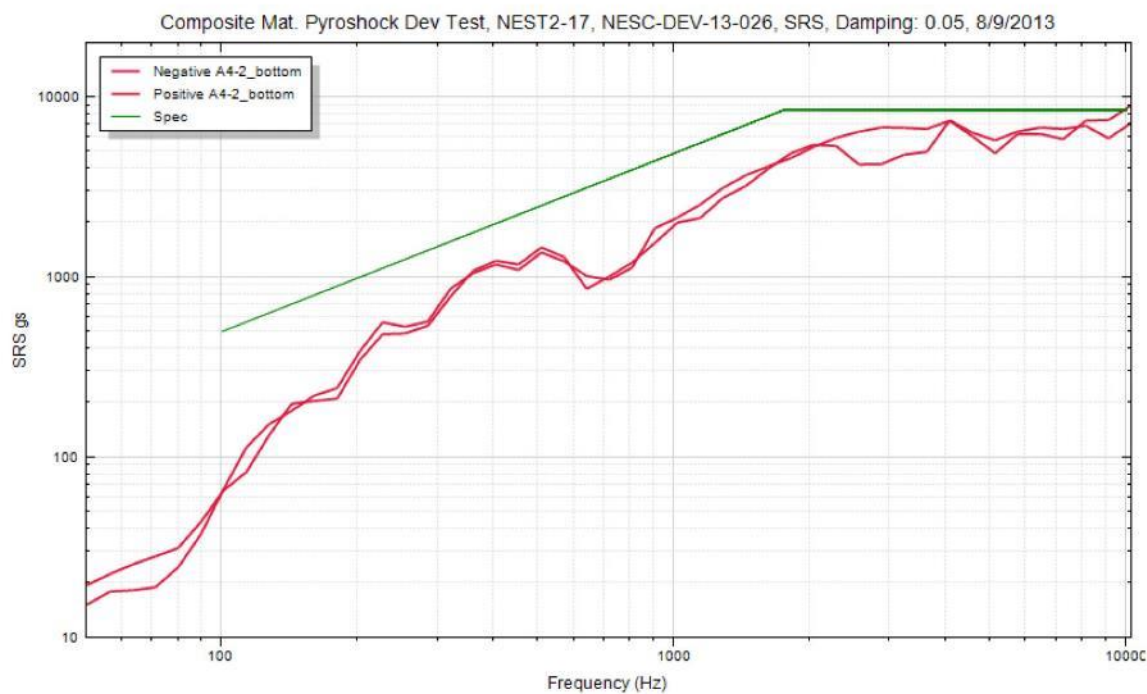
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
237 of 832





# NASA Engineering and Safety Center Technical Assessment Report

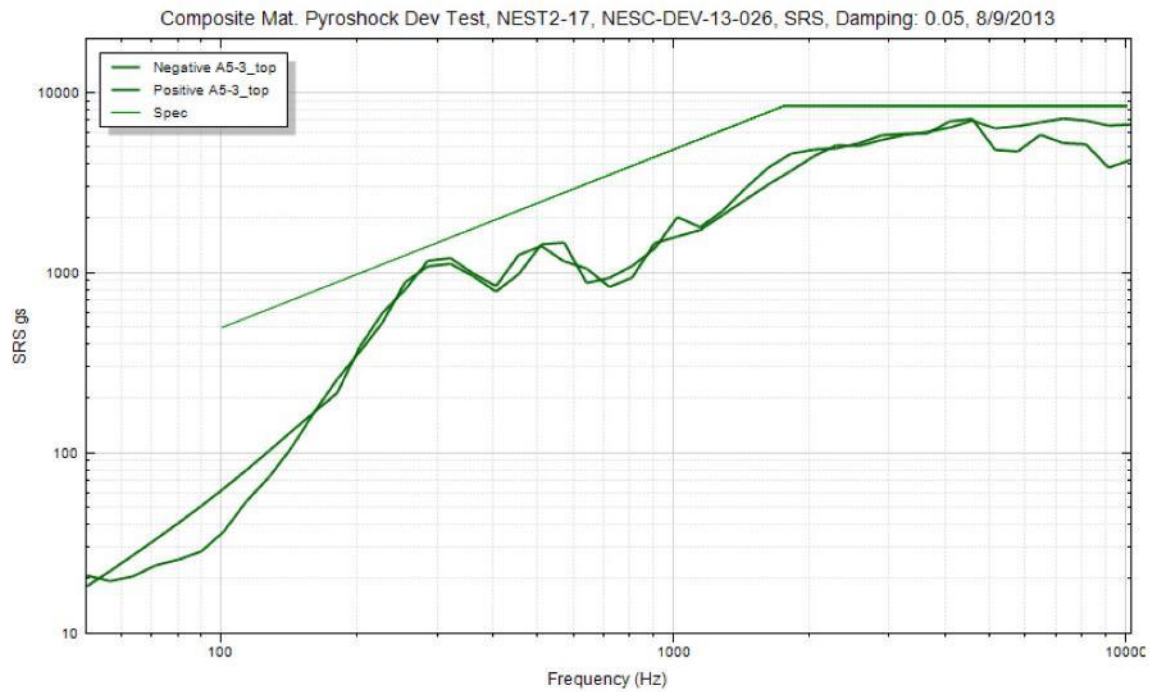
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
238 of 832



235 of 310



# NASA Engineering and Safety Center Technical Assessment Report

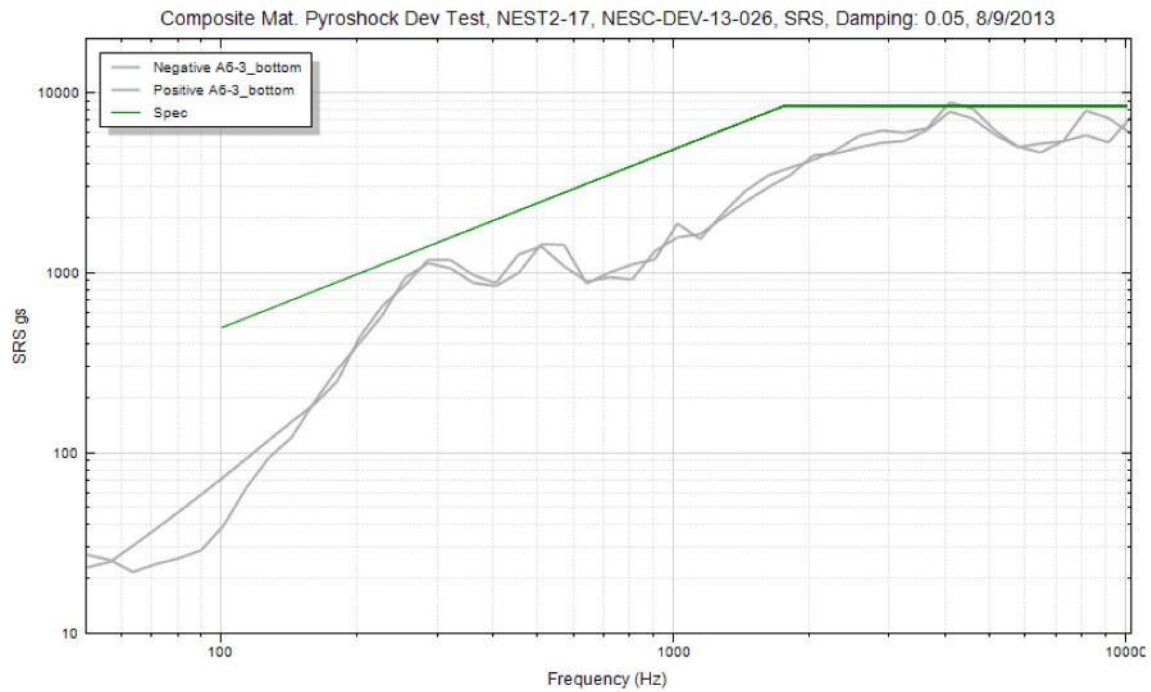
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
239 of 832





# NASA Engineering and Safety Center Technical Assessment Report

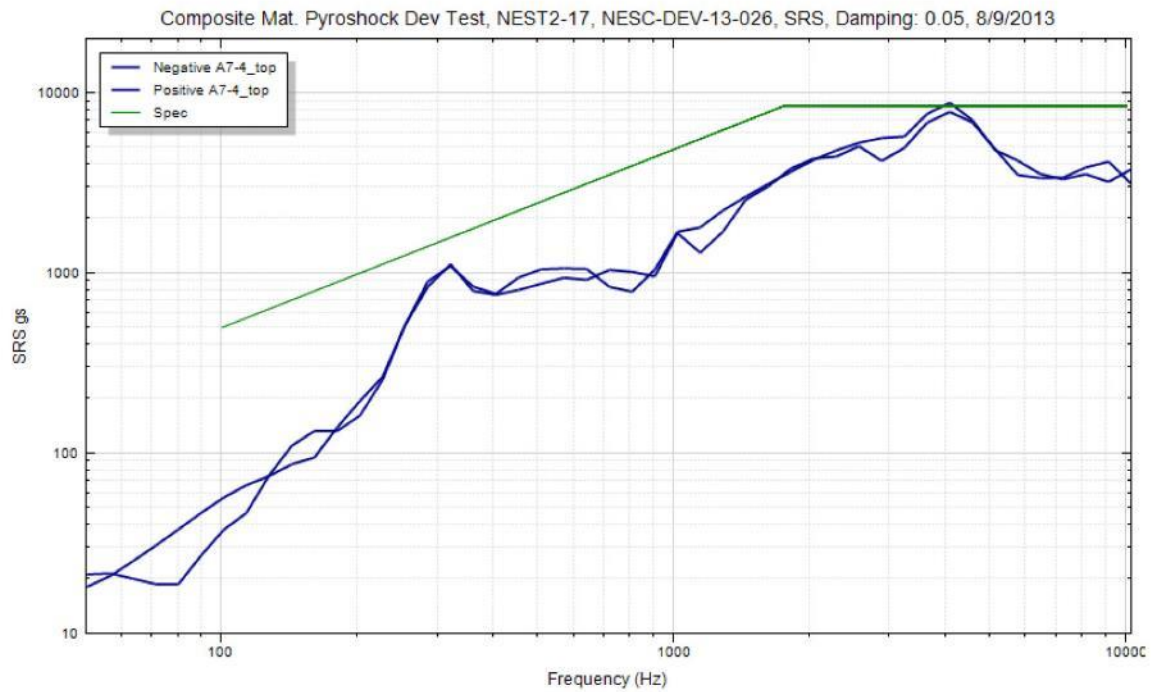
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
240 of 832





# NASA Engineering and Safety Center Technical Assessment Report

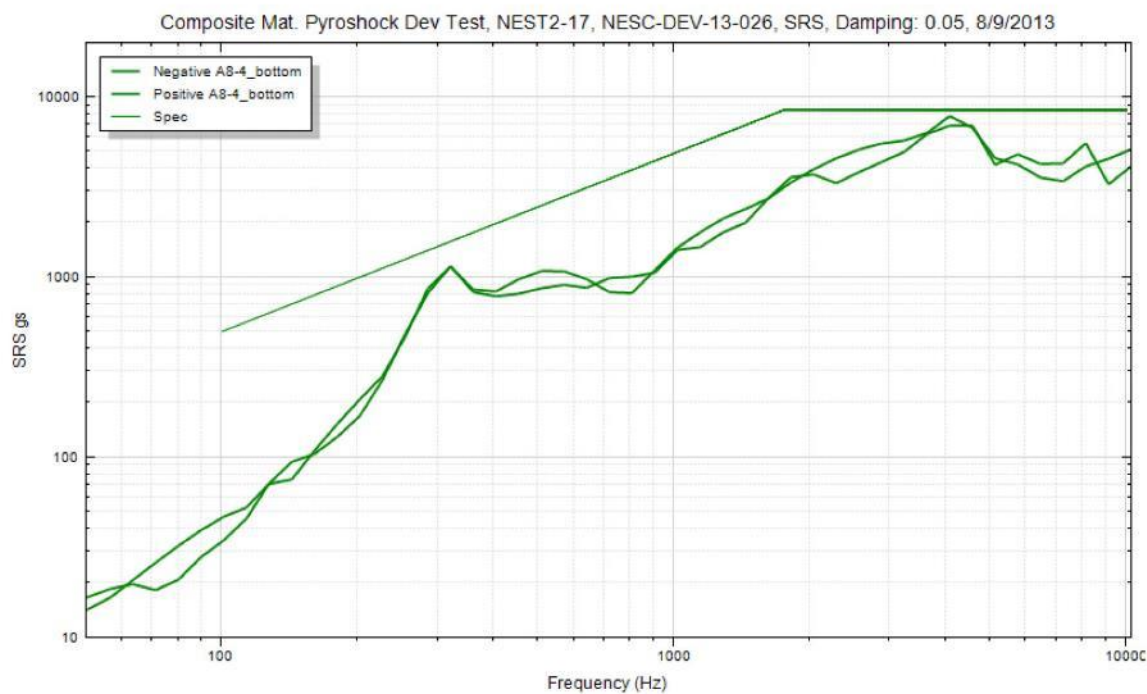
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
241 of 832





# NASA Engineering and Safety Center Technical Assessment Report

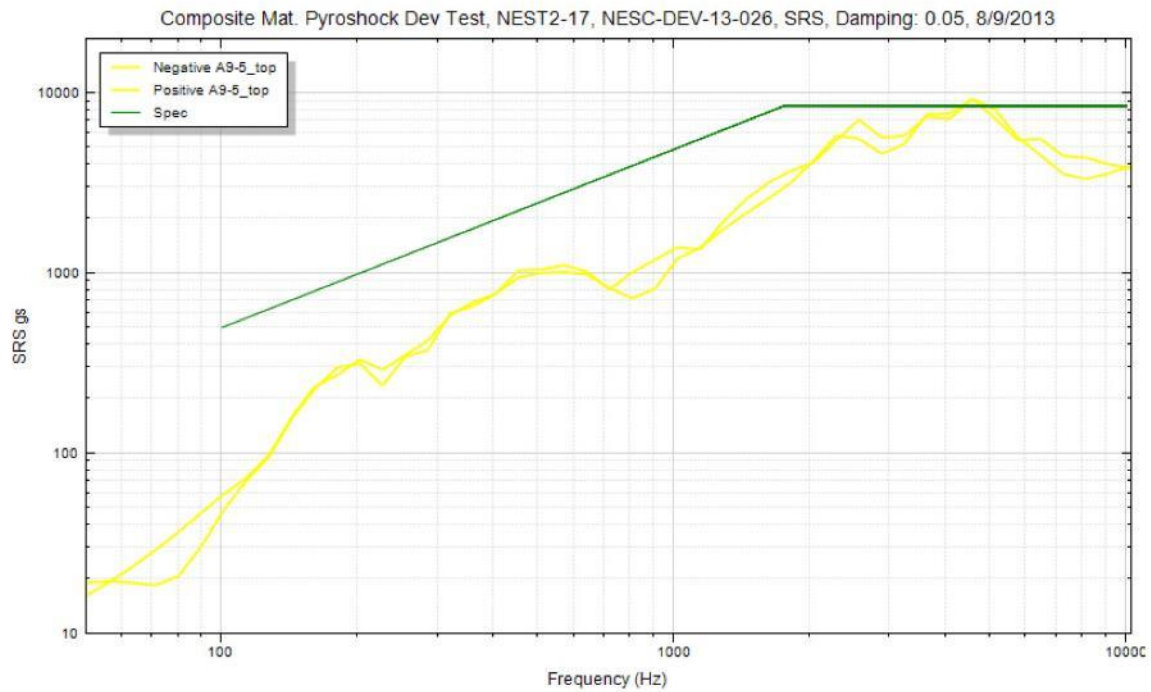
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
242 of 832





# NASA Engineering and Safety Center Technical Assessment Report

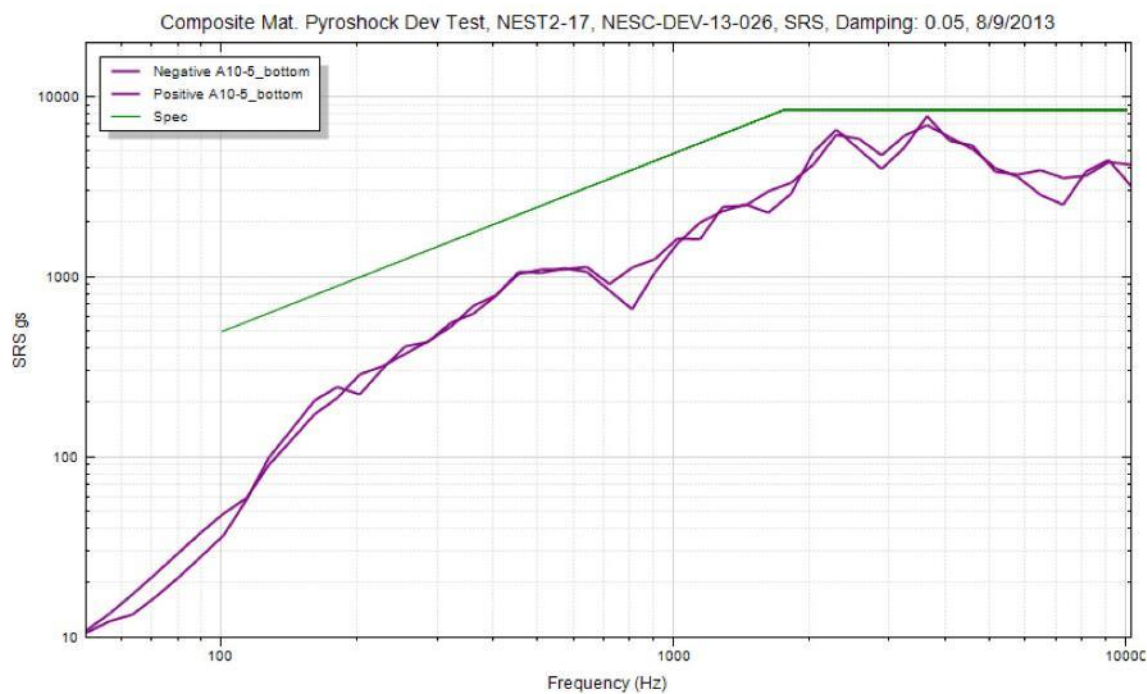
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
243 of 832





# NASA Engineering and Safety Center Technical Assessment Report

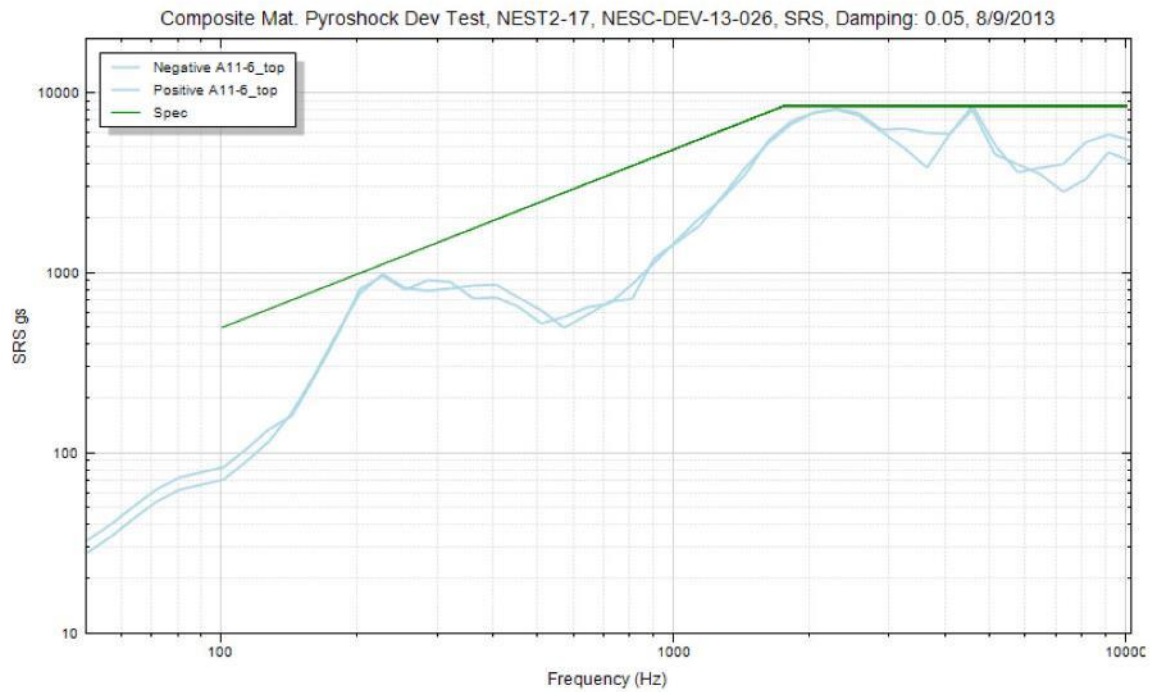
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
244 of 832







# NASA Engineering and Safety Center Technical Assessment Report

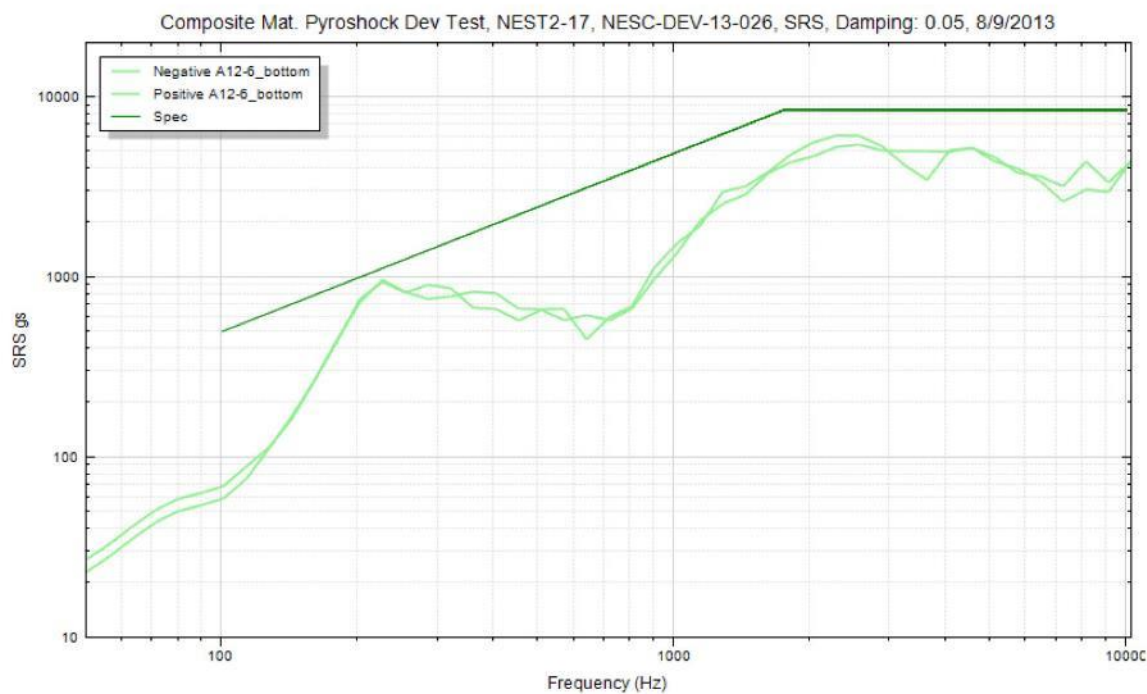
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
245 of 832





# NASA Engineering and Safety Center Technical Assessment Report

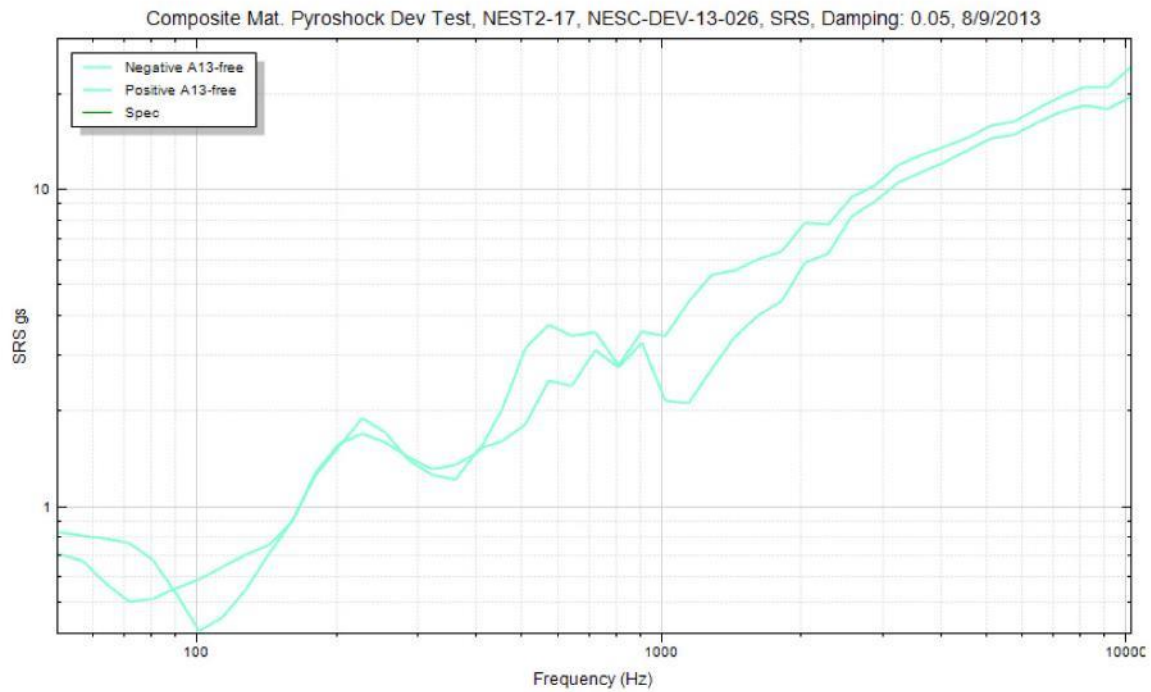
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
246 of 832





# NASA Engineering and Safety Center Technical Assessment Report

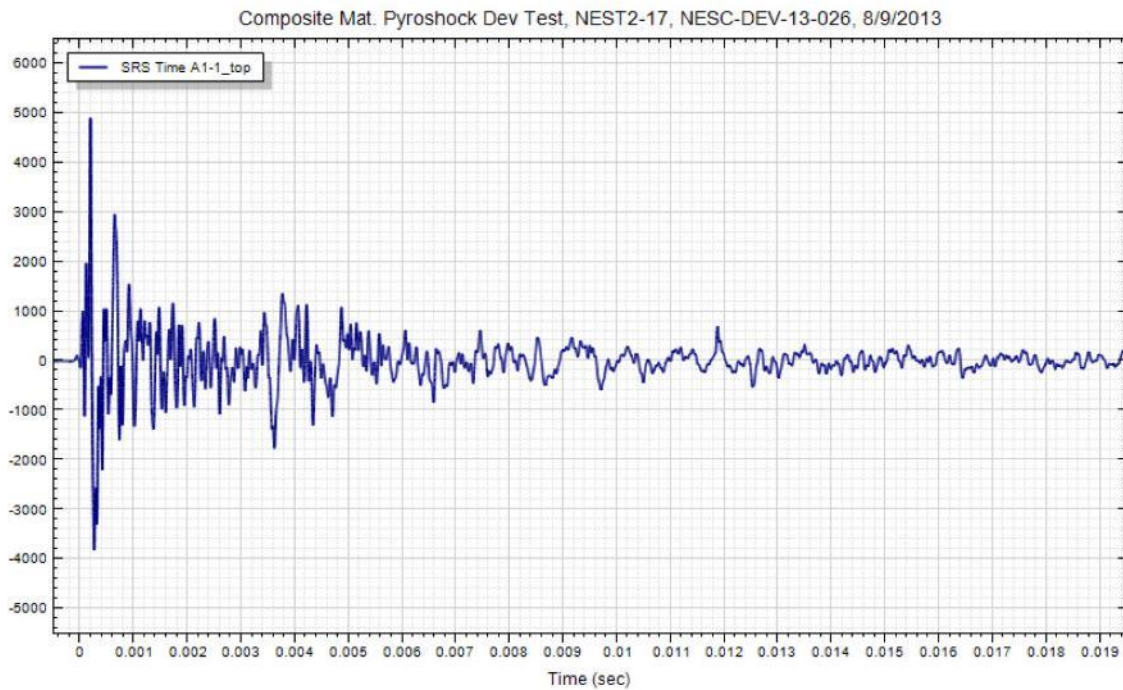
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
247 of 832





# NASA Engineering and Safety Center Technical Assessment Report

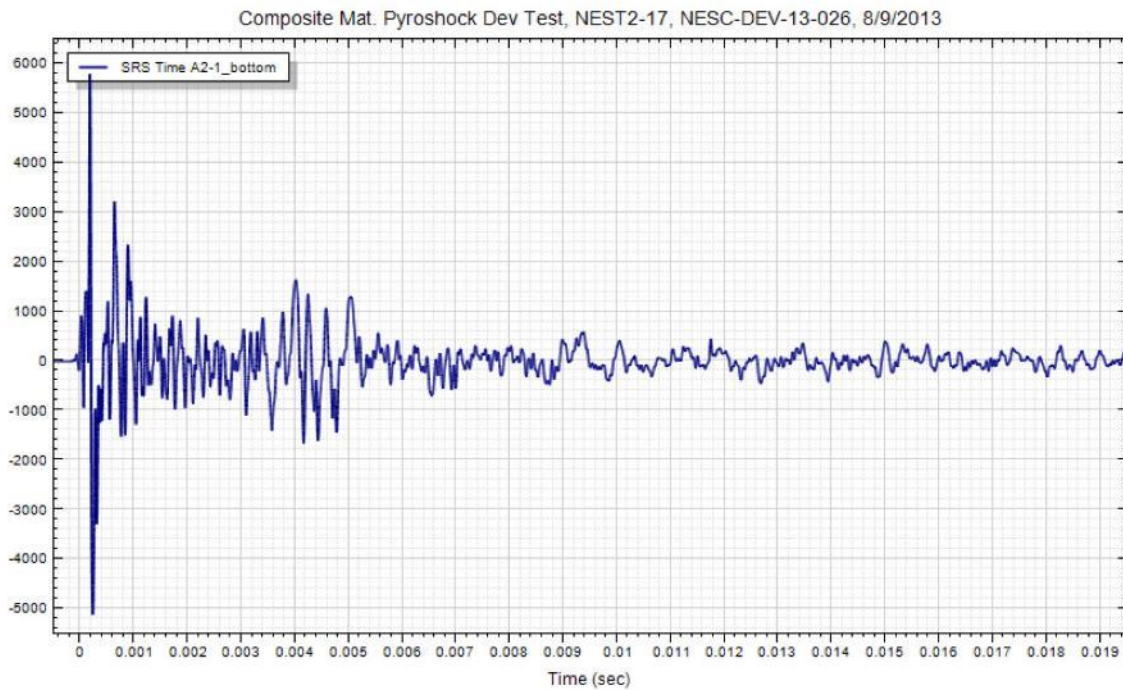
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
248 of 832





# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**

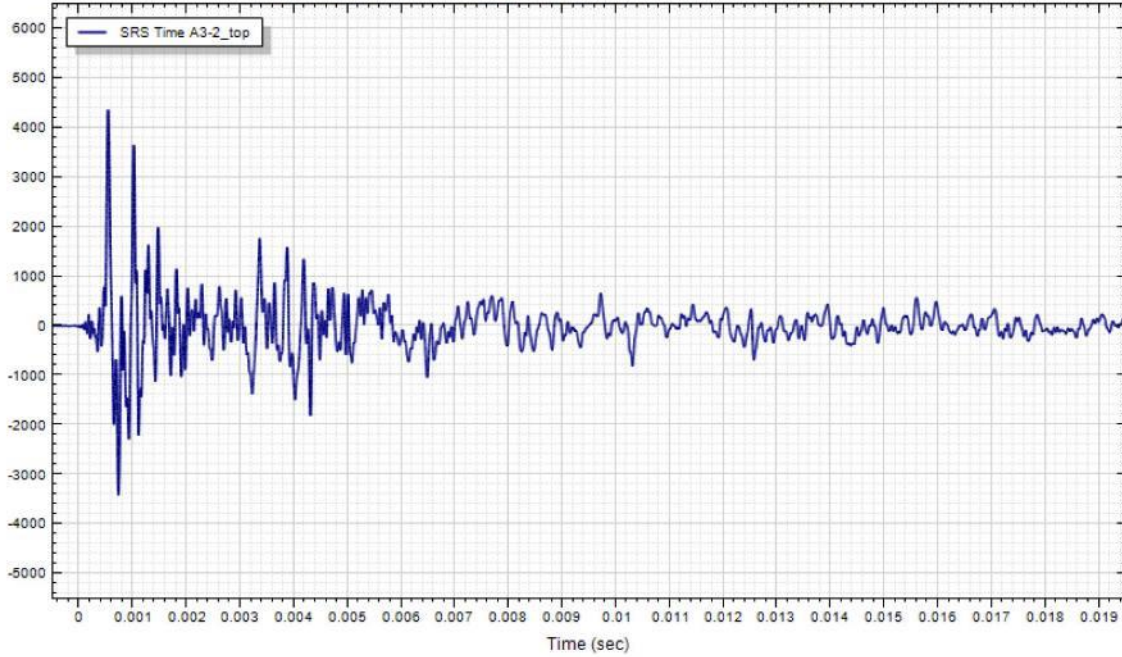
Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
249 of 832

Composite Mat. Pyroshock Dev Test, NEST2-17, NESC-DEV-13-026, 8/9/2013





# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**

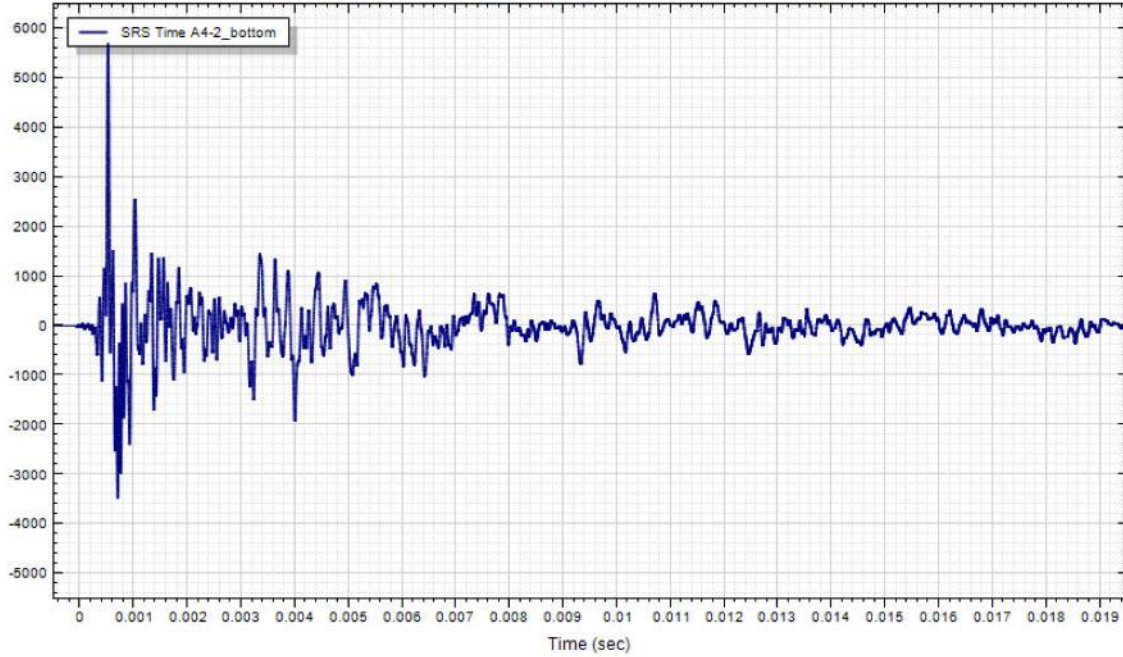
Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
250 of 832

Composite Mat. Pyroshock Dev Test, NEST2-17, NESC-DEV-13-026, 8/9/2013





# NASA Engineering and Safety Center Technical Assessment Report

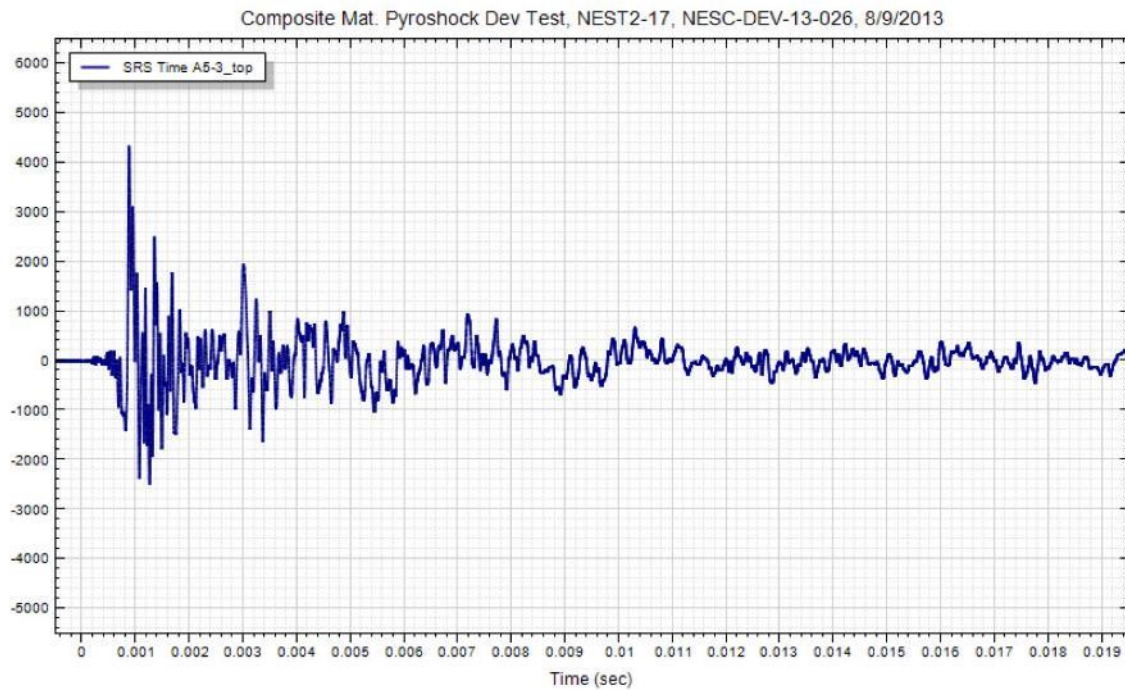
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
251 of 832





# NASA Engineering and Safety Center Technical Assessment Report

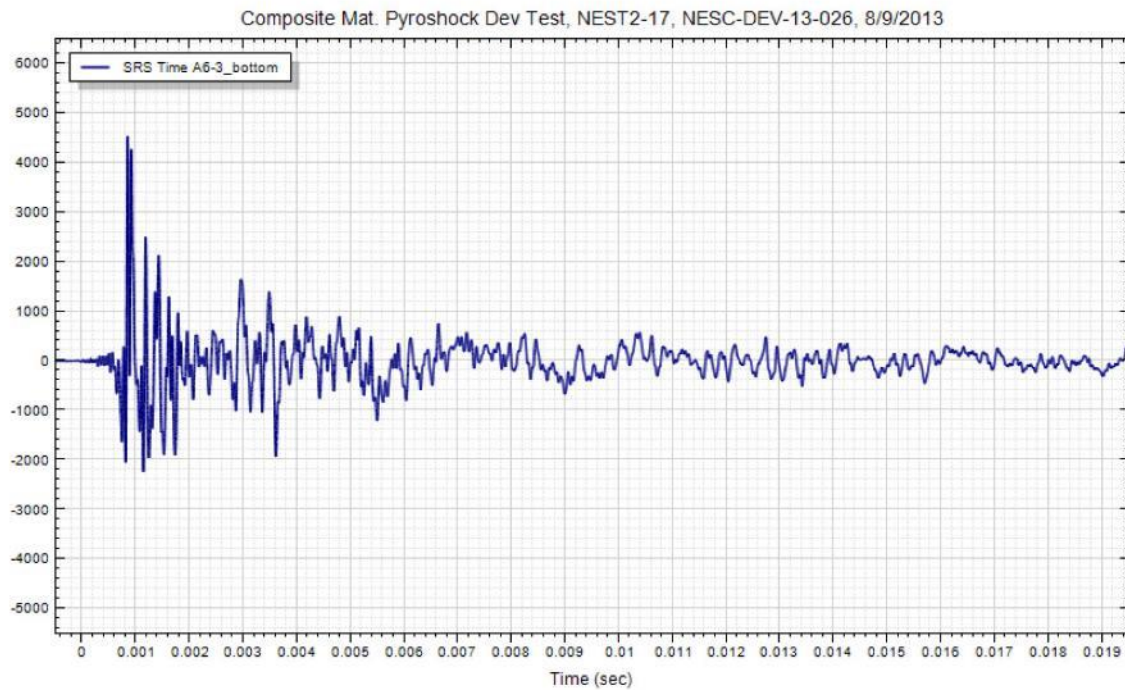
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
252 of 832







# NASA Engineering and Safety Center Technical Assessment Report

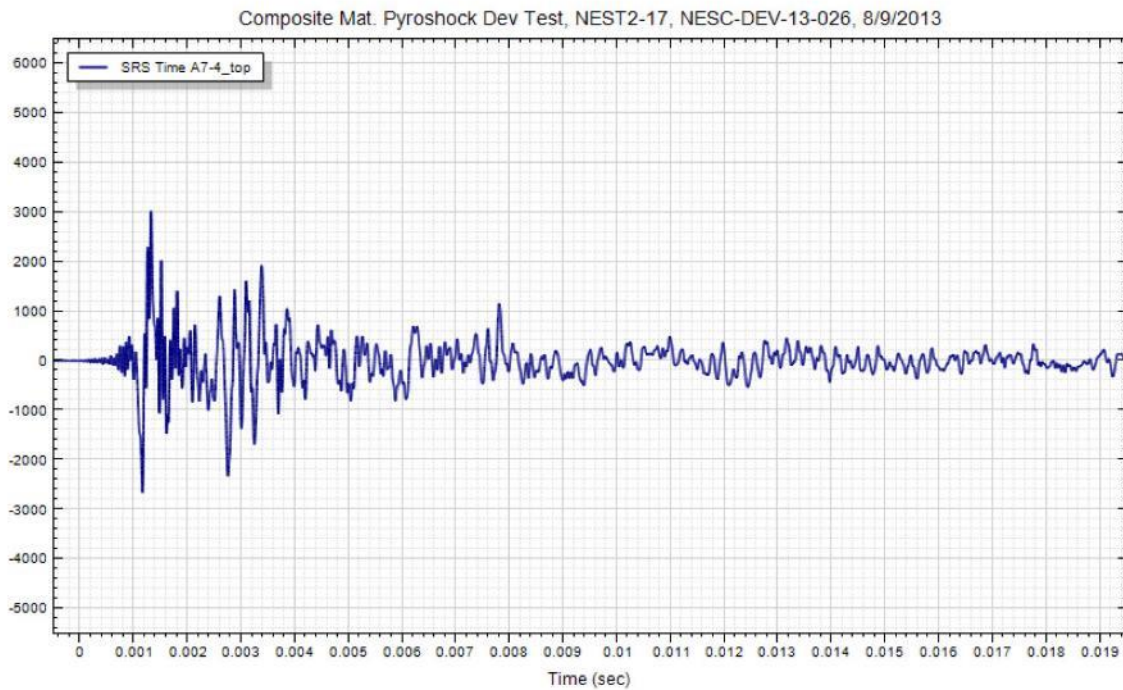
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
253 of 832





# NASA Engineering and Safety Center Technical Assessment Report

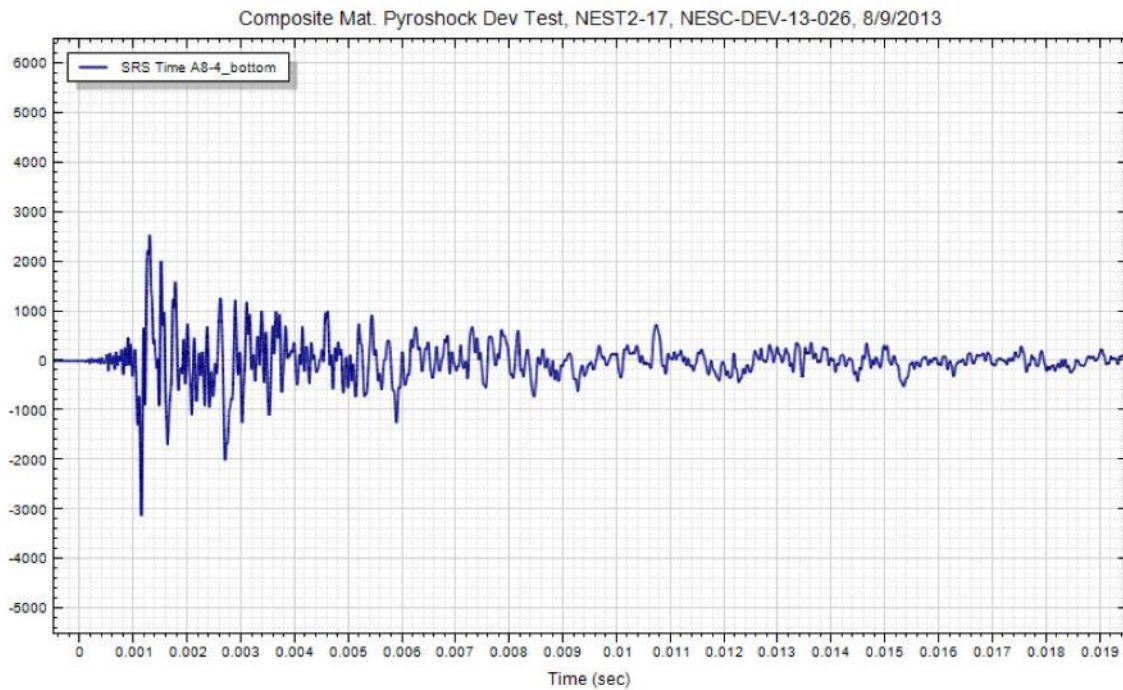
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
254 of 832





# NASA Engineering and Safety Center Technical Assessment Report

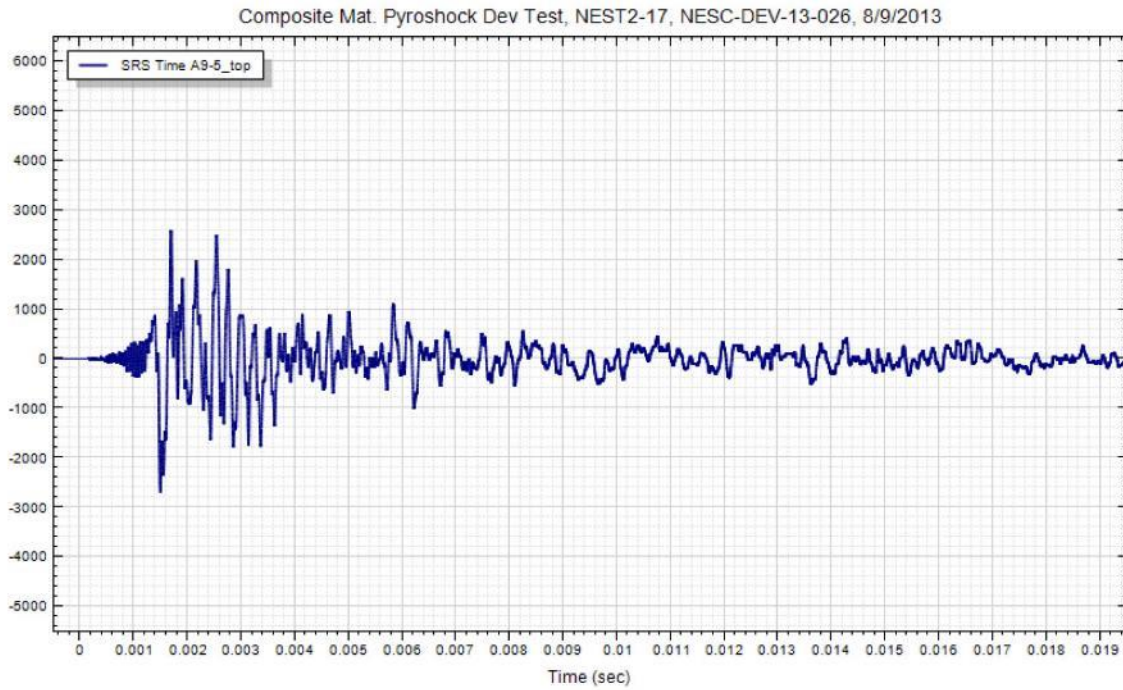
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
255 of 832





# NASA Engineering and Safety Center Technical Assessment Report

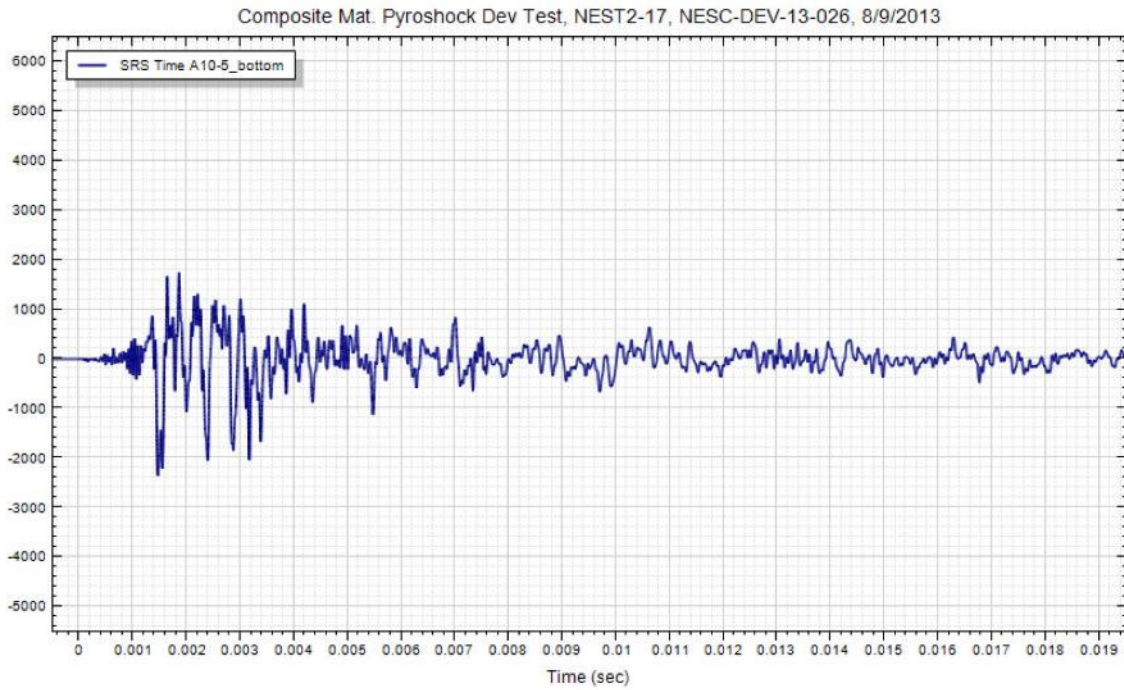
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
256 of 832





# NASA Engineering and Safety Center Technical Assessment Report

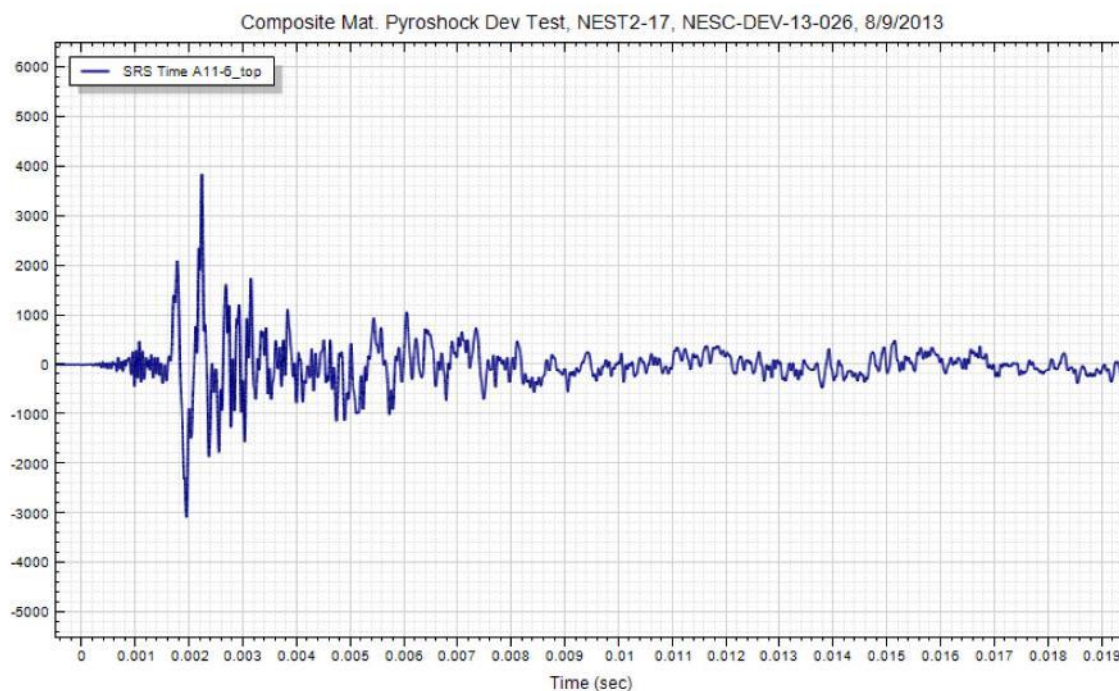
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
257 of 832





# NASA Engineering and Safety Center Technical Assessment Report

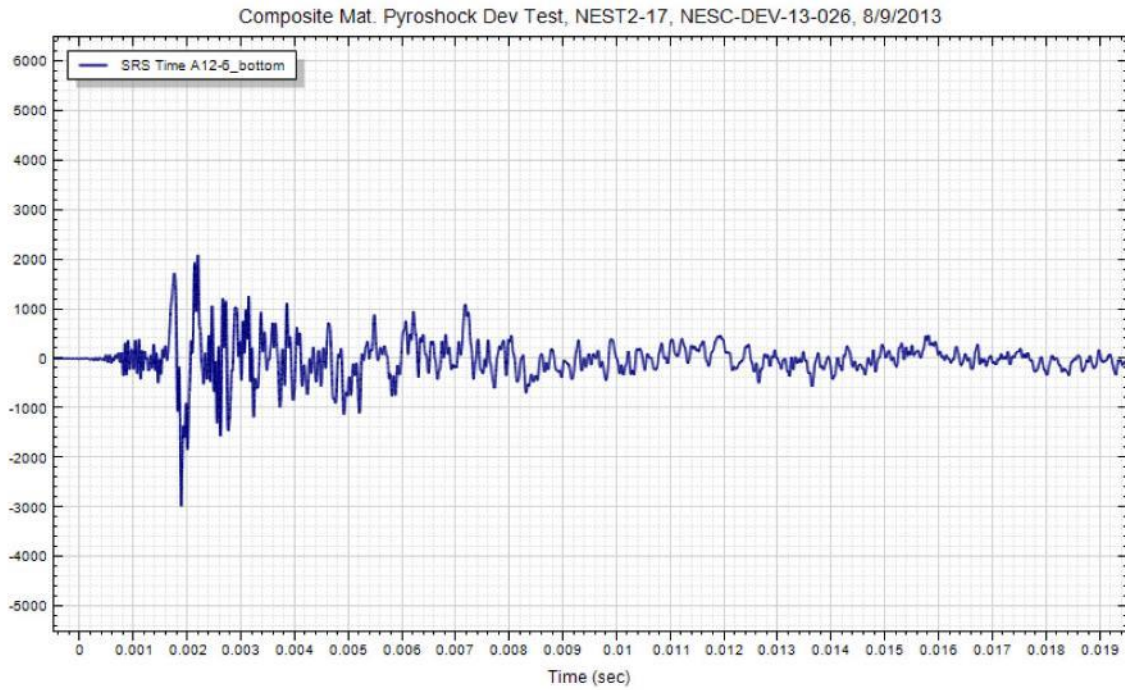
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
258 of 832





# NASA Engineering and Safety Center Technical Assessment Report

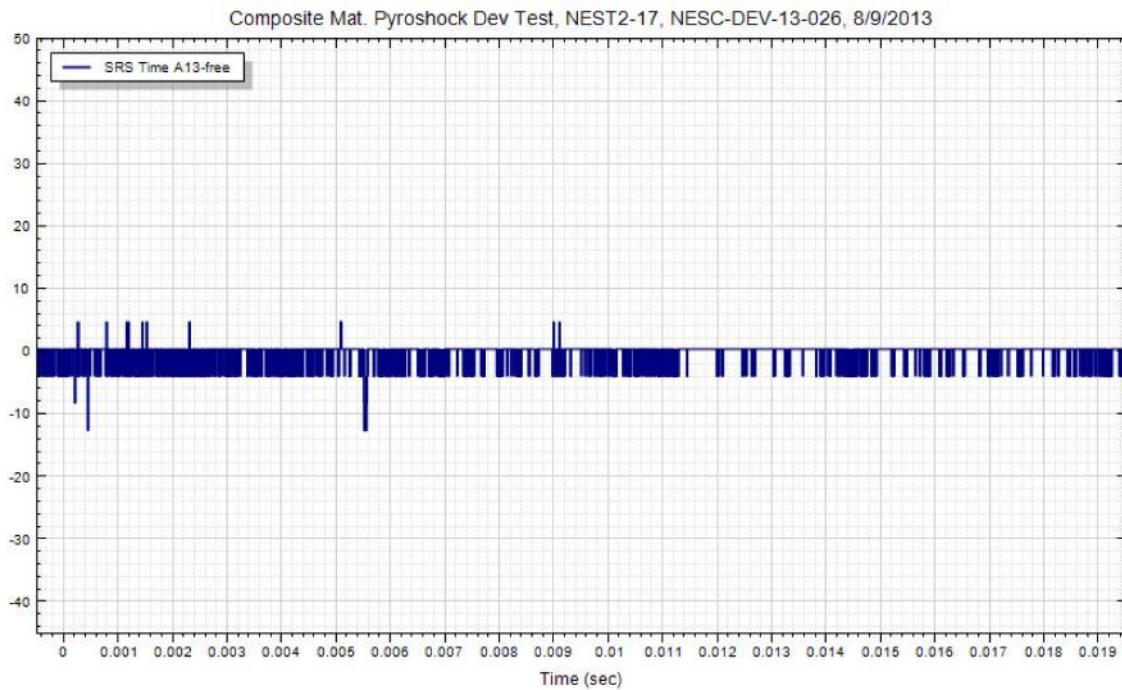
Document #:  
**NESC-RP-  
12-00783**


Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
259 of 832



	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 260 of 832	

**NESC-DEV-13-026**  
**Composite Materials**  
**Shock Test**  
  
**Test #8 Accelerometer Data**  
**Panel 0332A017**





# NASA Engineering and Safety Center Technical Assessment Report

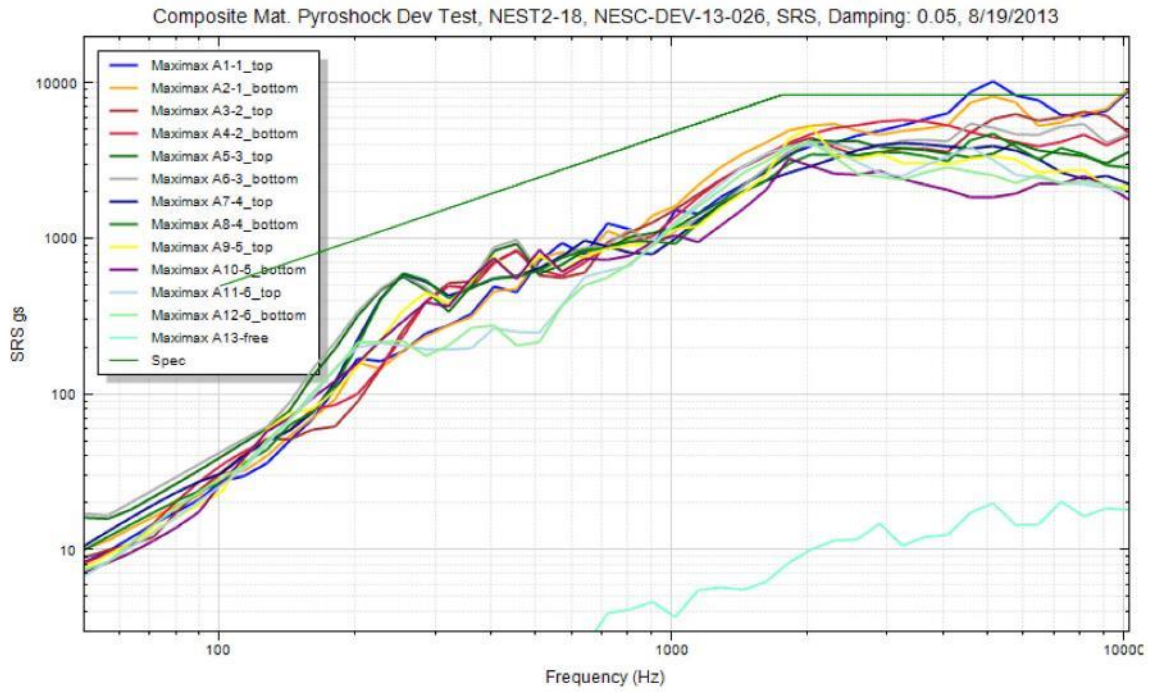
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
261 of 832





# NASA Engineering and Safety Center Technical Assessment Report

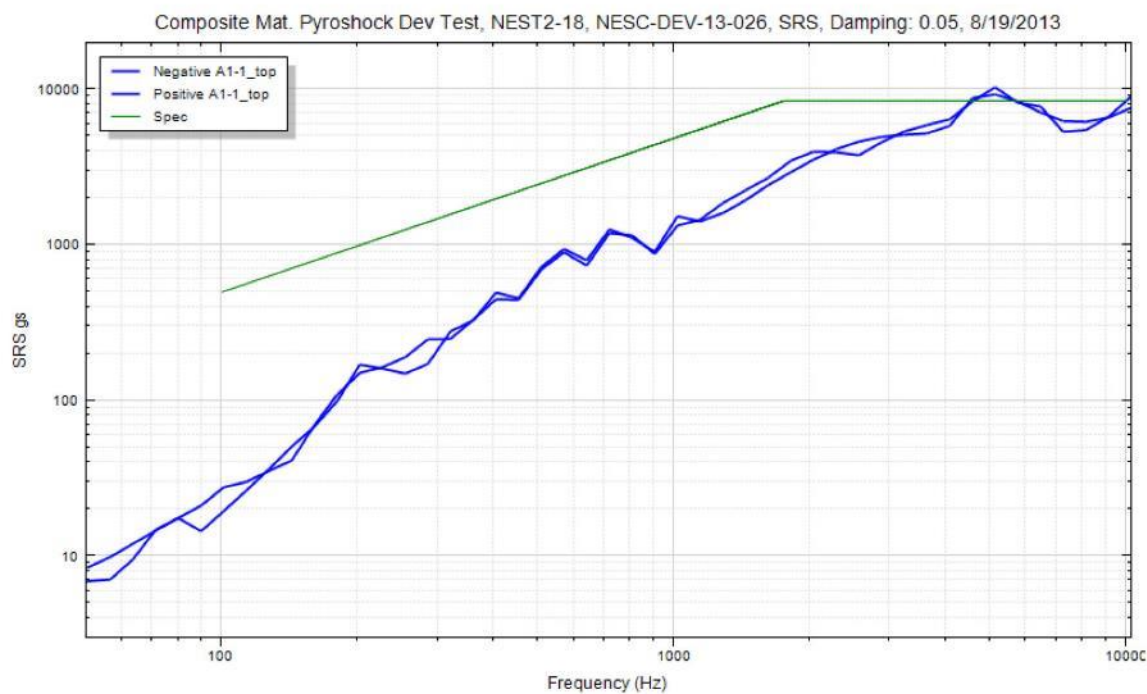
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
262 of 832





# NASA Engineering and Safety Center Technical Assessment Report

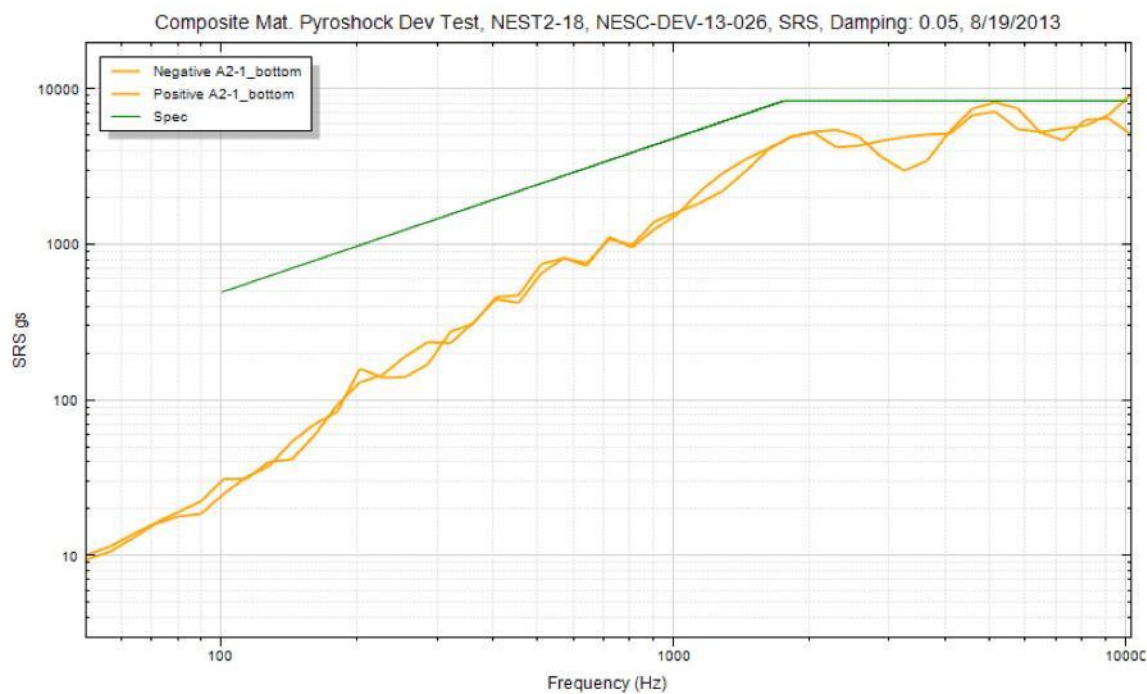
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
263 of 832





# NASA Engineering and Safety Center Technical Assessment Report

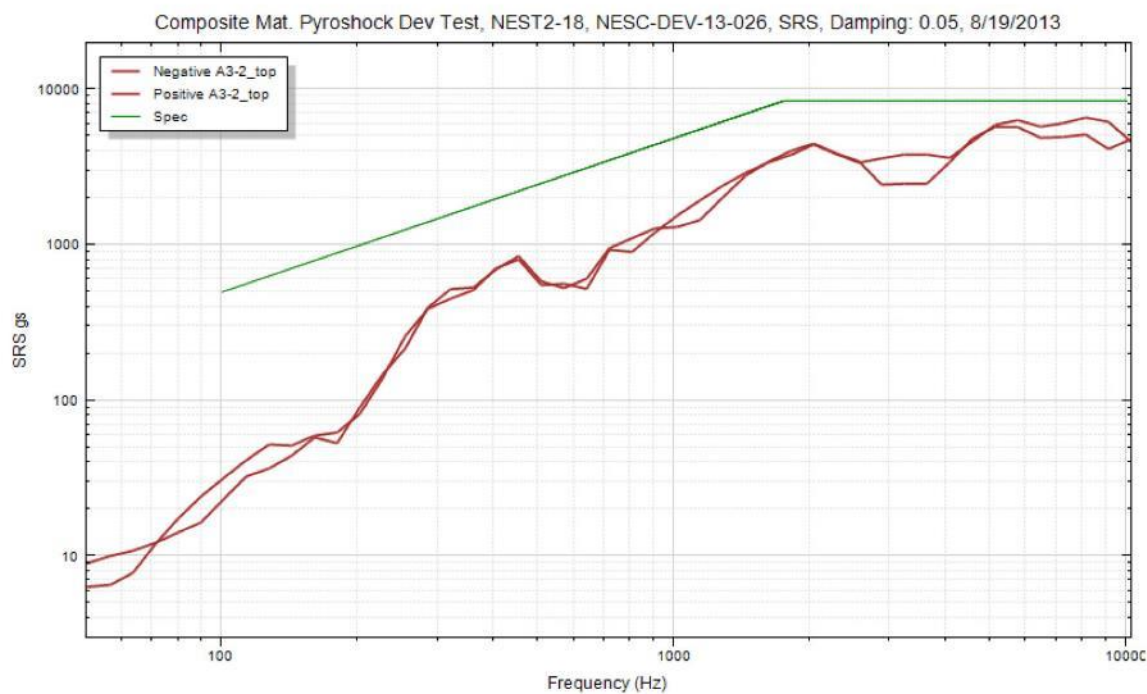
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
264 of 832





# NASA Engineering and Safety Center Technical Assessment Report

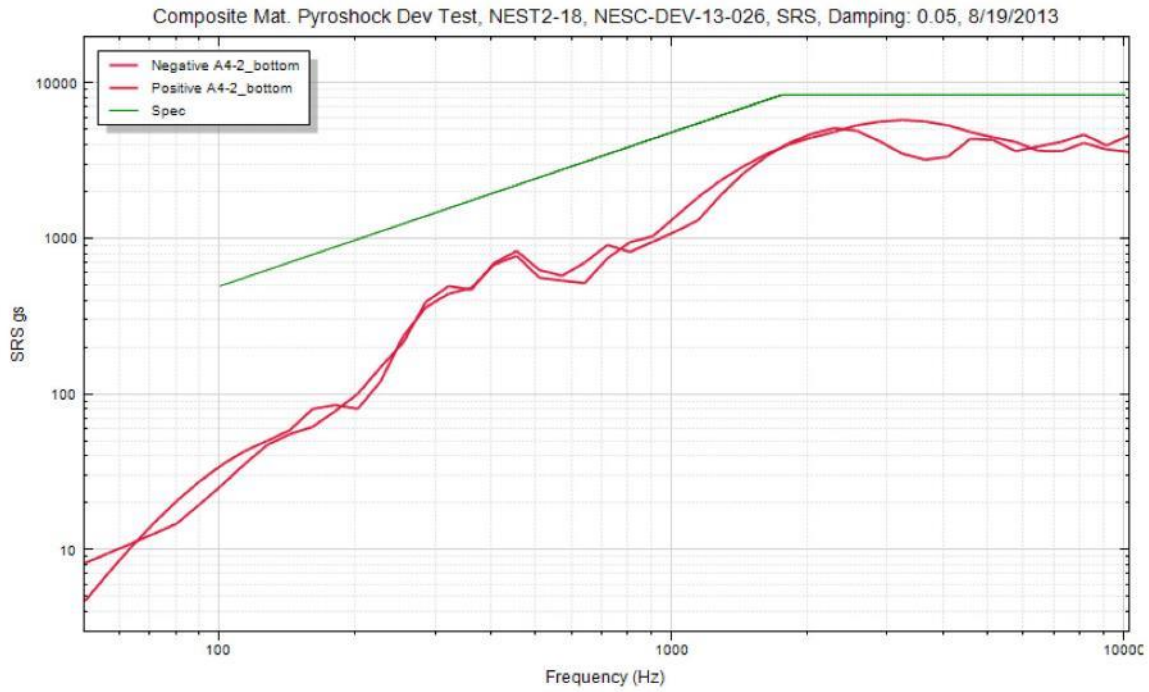
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
265 of 832





# NASA Engineering and Safety Center Technical Assessment Report

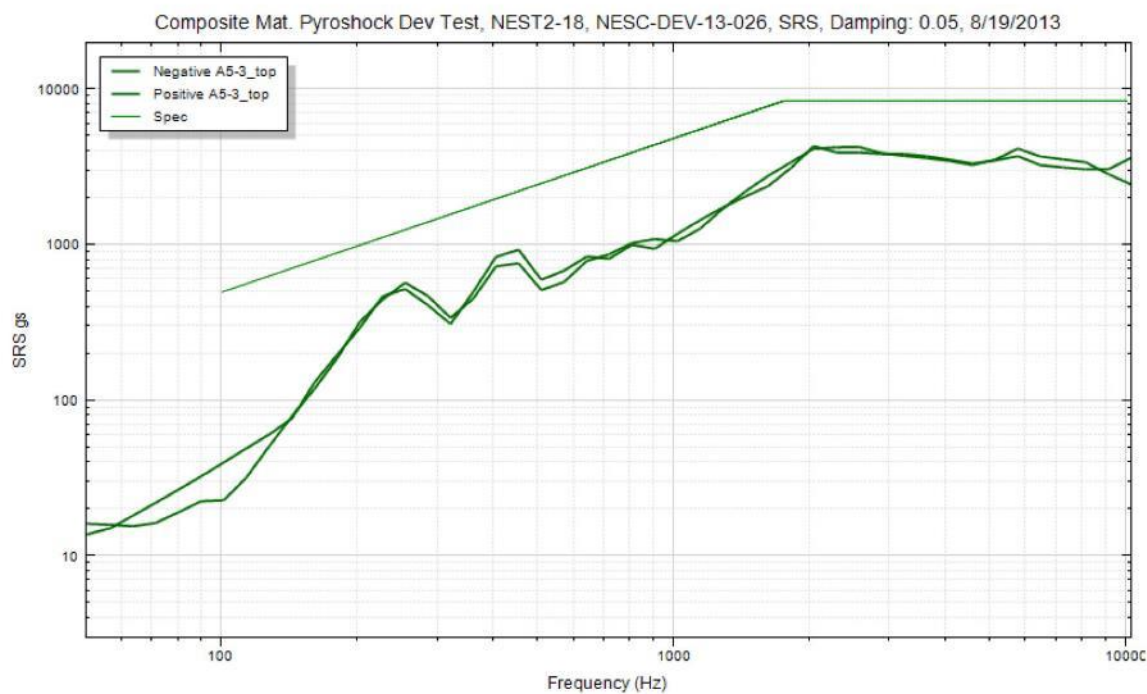
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
266 of 832





# NASA Engineering and Safety Center Technical Assessment Report

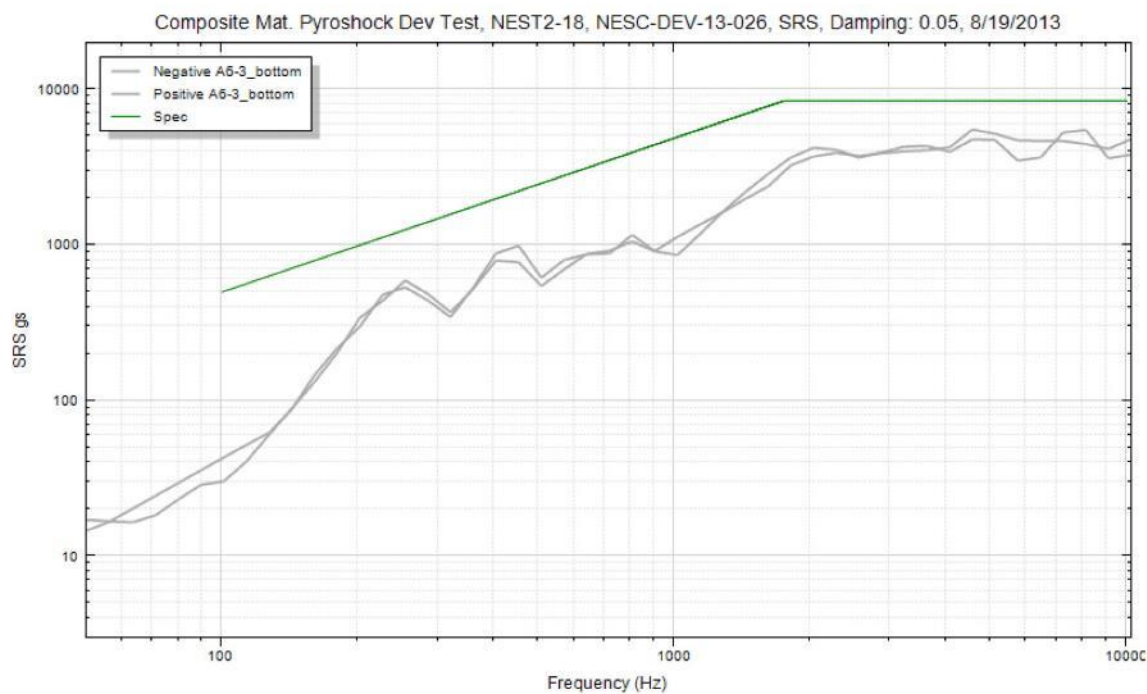
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
267 of 832





# NASA Engineering and Safety Center Technical Assessment Report

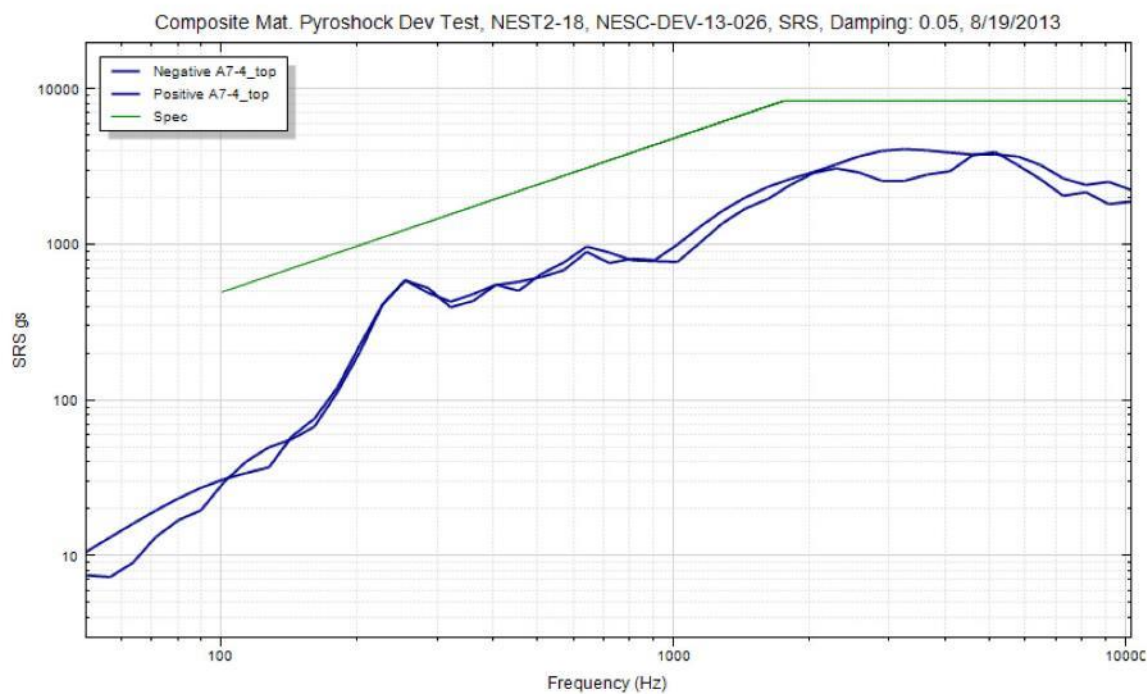
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
268 of 832







# NASA Engineering and Safety Center Technical Assessment Report

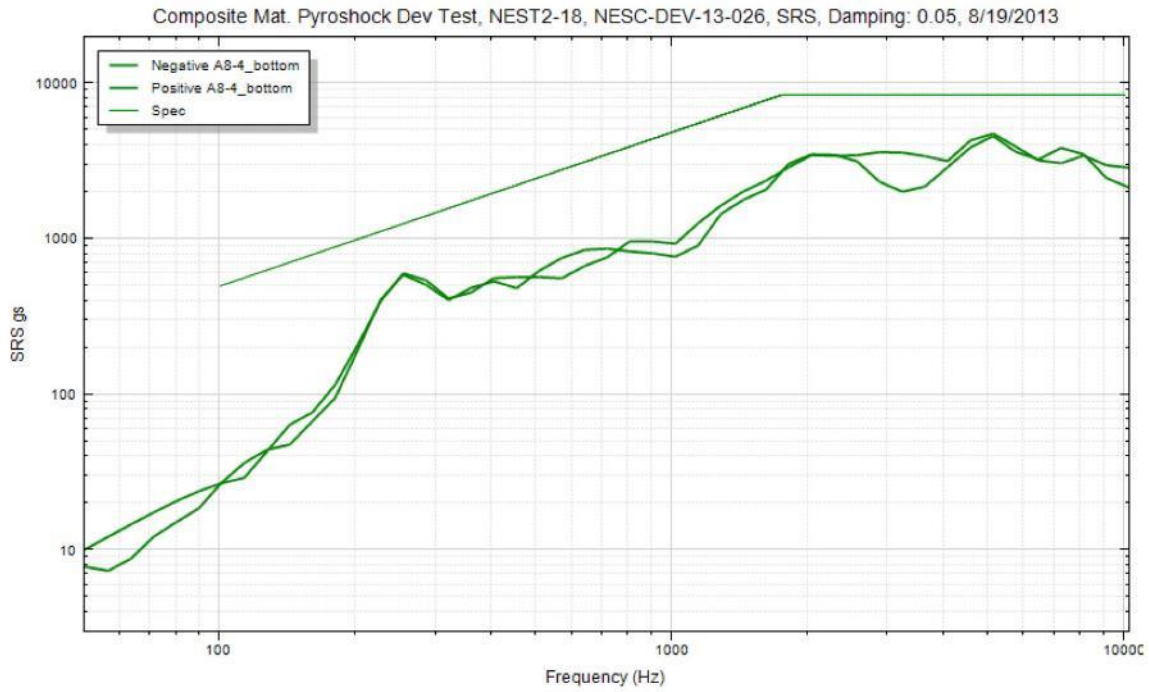
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
269 of 832





# NASA Engineering and Safety Center Technical Assessment Report

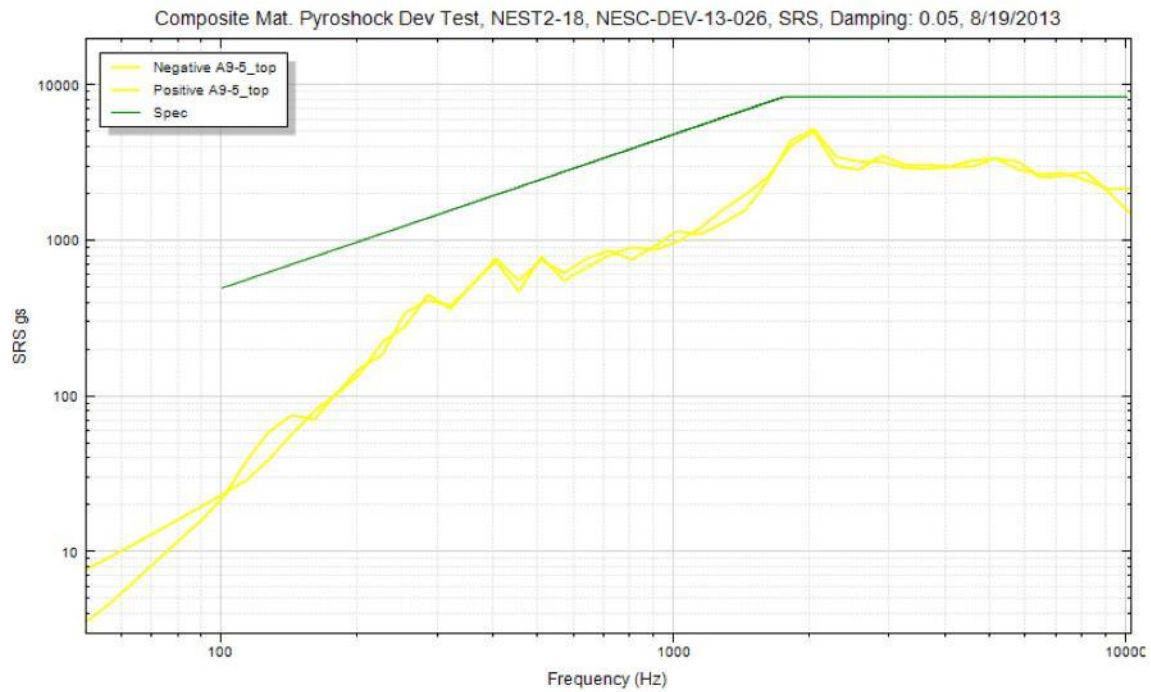
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
270 of 832





# NASA Engineering and Safety Center Technical Assessment Report

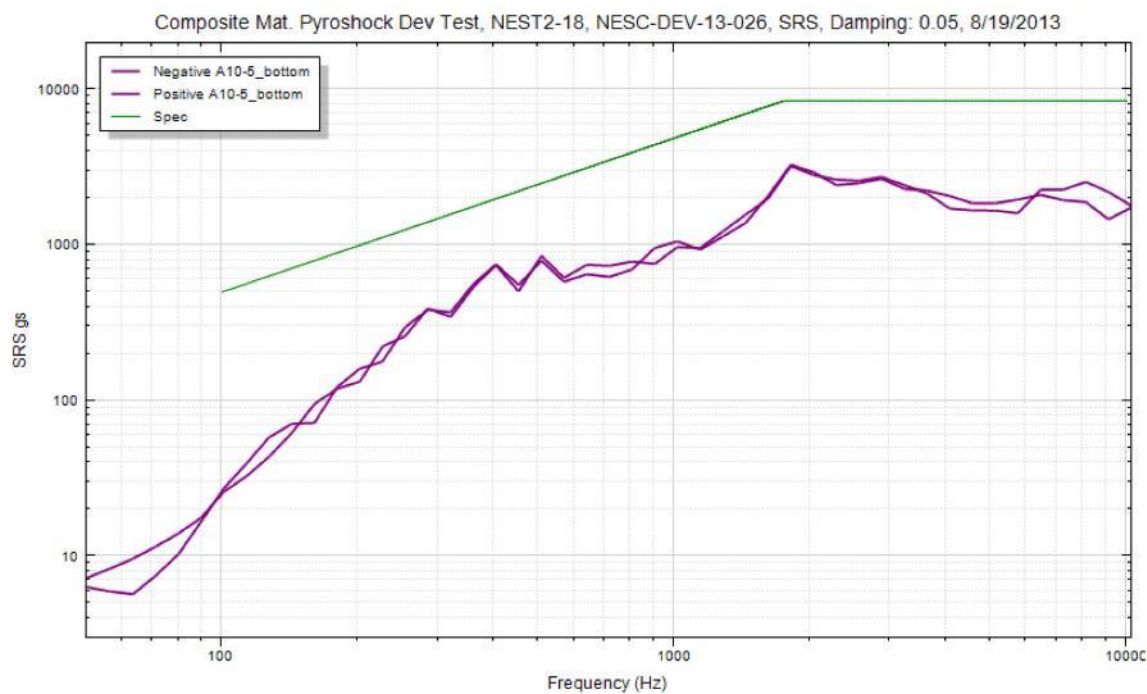
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
271 of 832





# NASA Engineering and Safety Center Technical Assessment Report

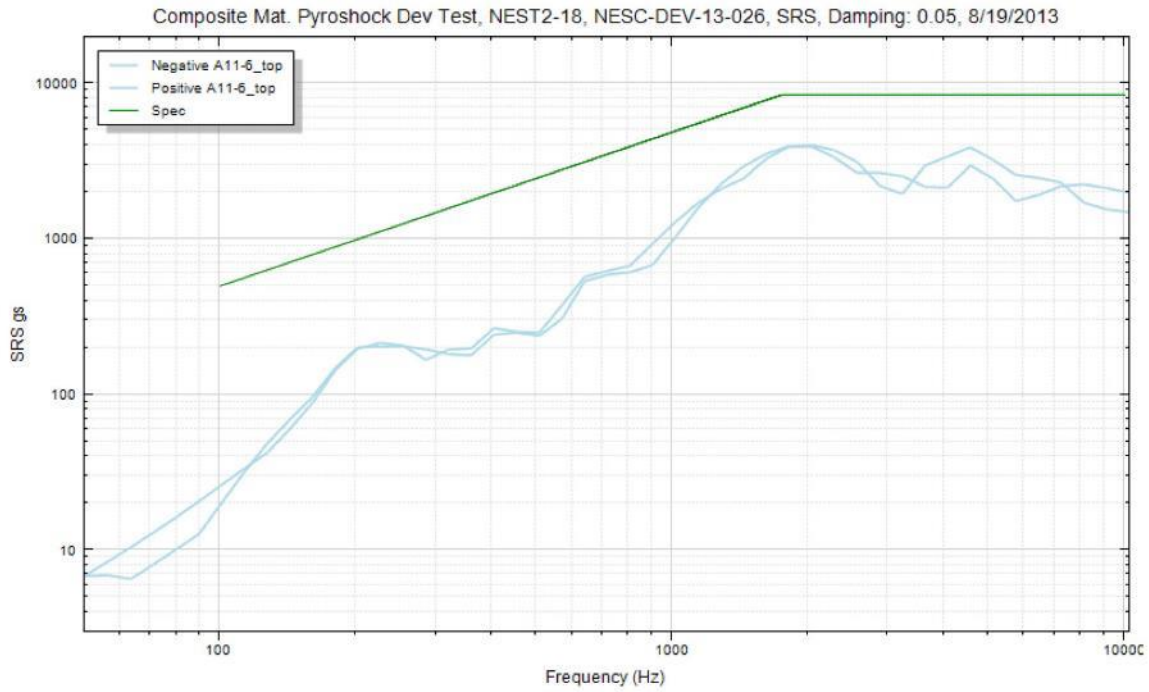
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
272 of 832





# NASA Engineering and Safety Center Technical Assessment Report

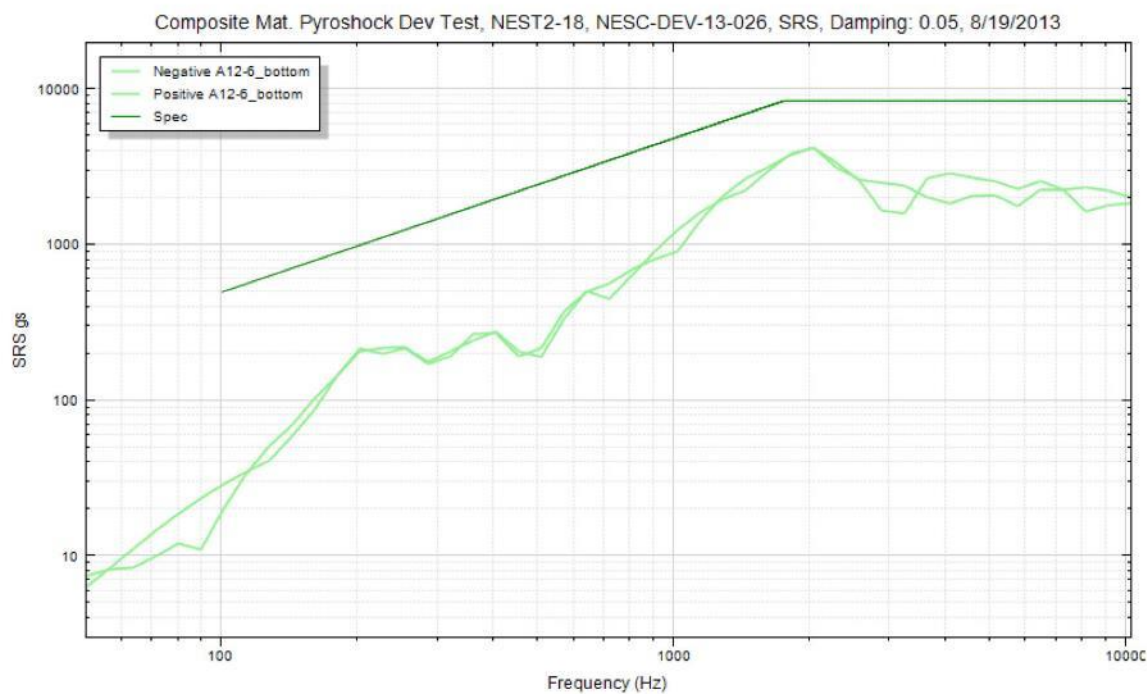
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
273 of 832





# NASA Engineering and Safety Center Technical Assessment Report

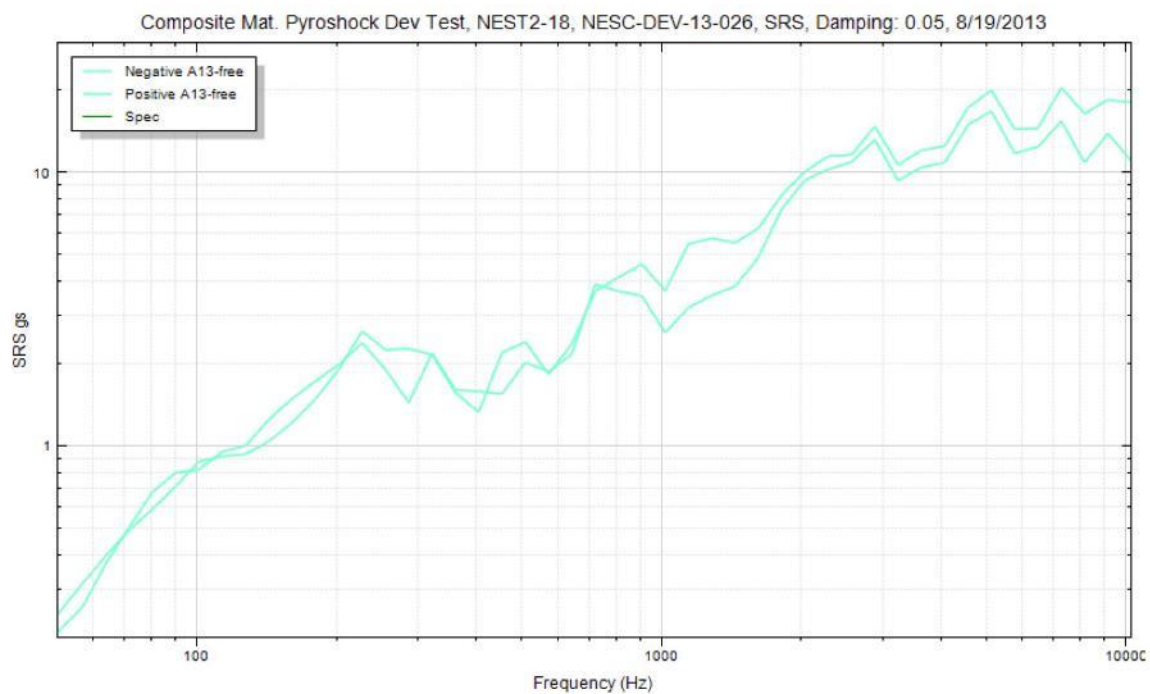
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
274 of 832



271 of 310



# NASA Engineering and Safety Center Technical Assessment Report

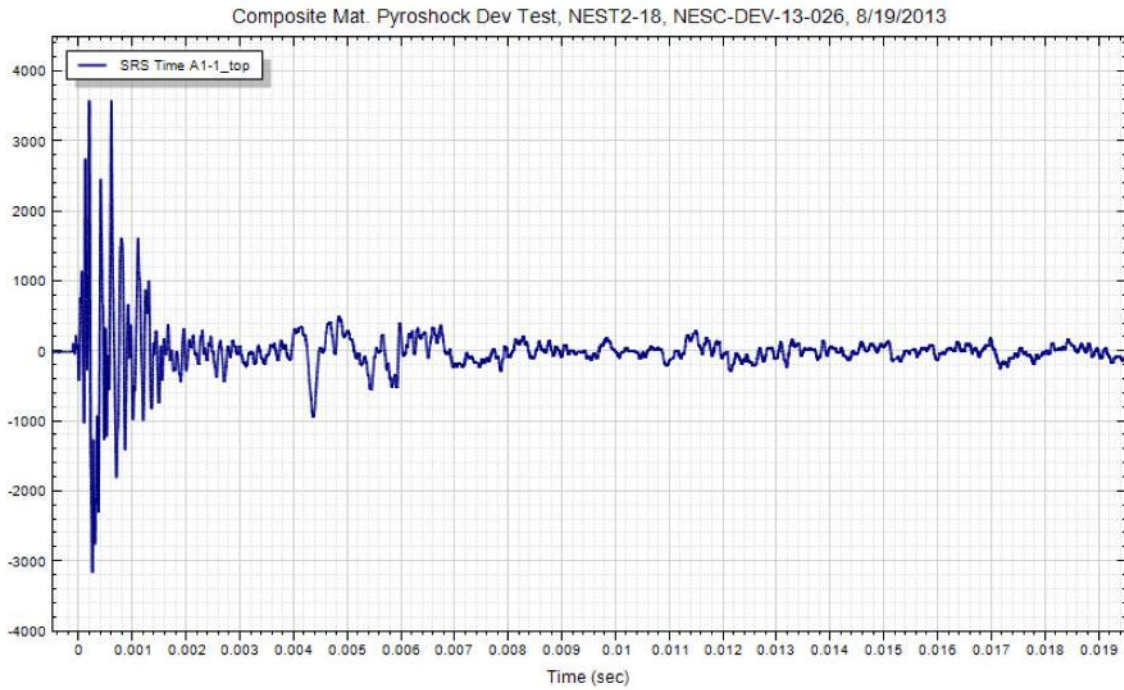
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
275 of 832





# NASA Engineering and Safety Center Technical Assessment Report

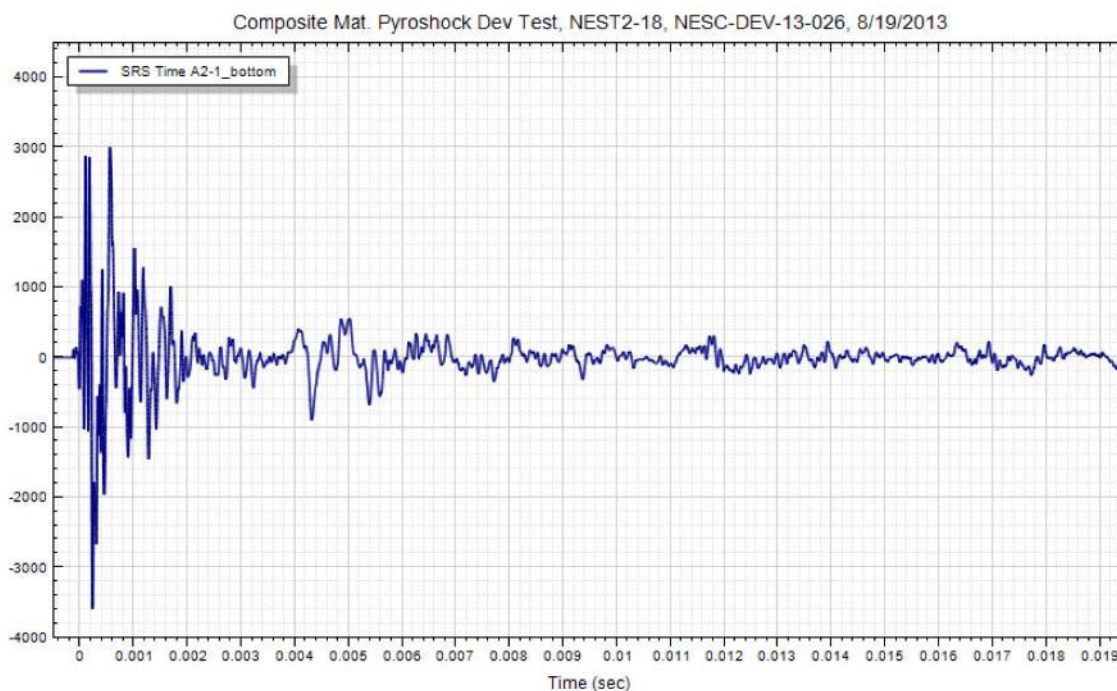
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
276 of 832



273 of 310





# NASA Engineering and Safety Center Technical Assessment Report

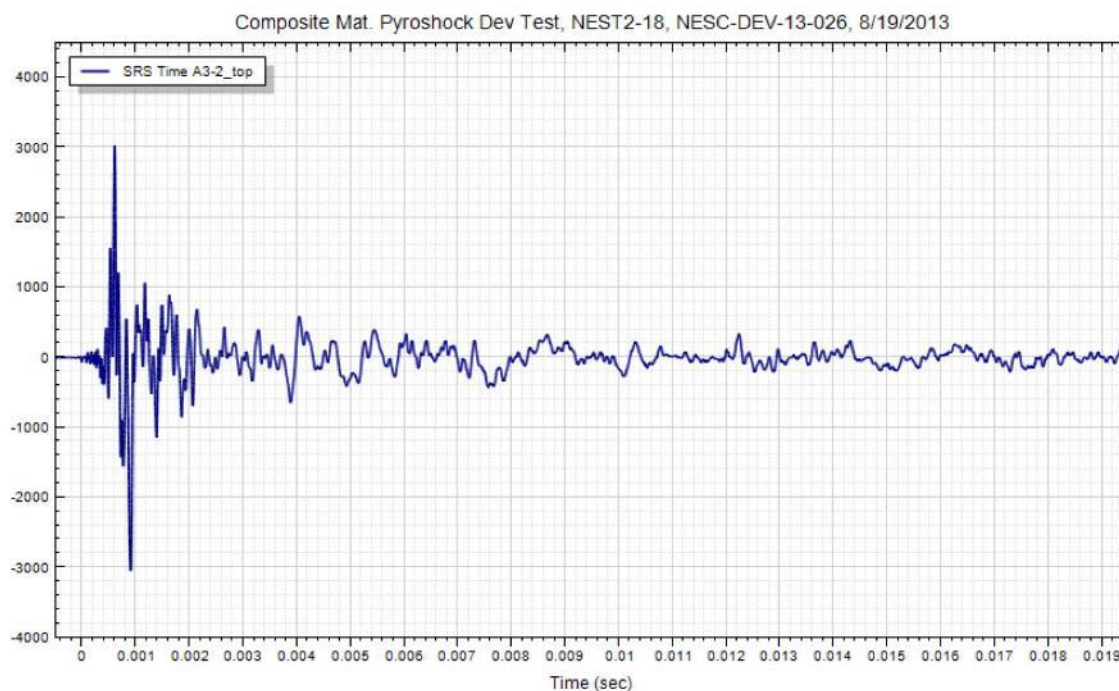
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
277 of 832





# NASA Engineering and Safety Center Technical Assessment Report

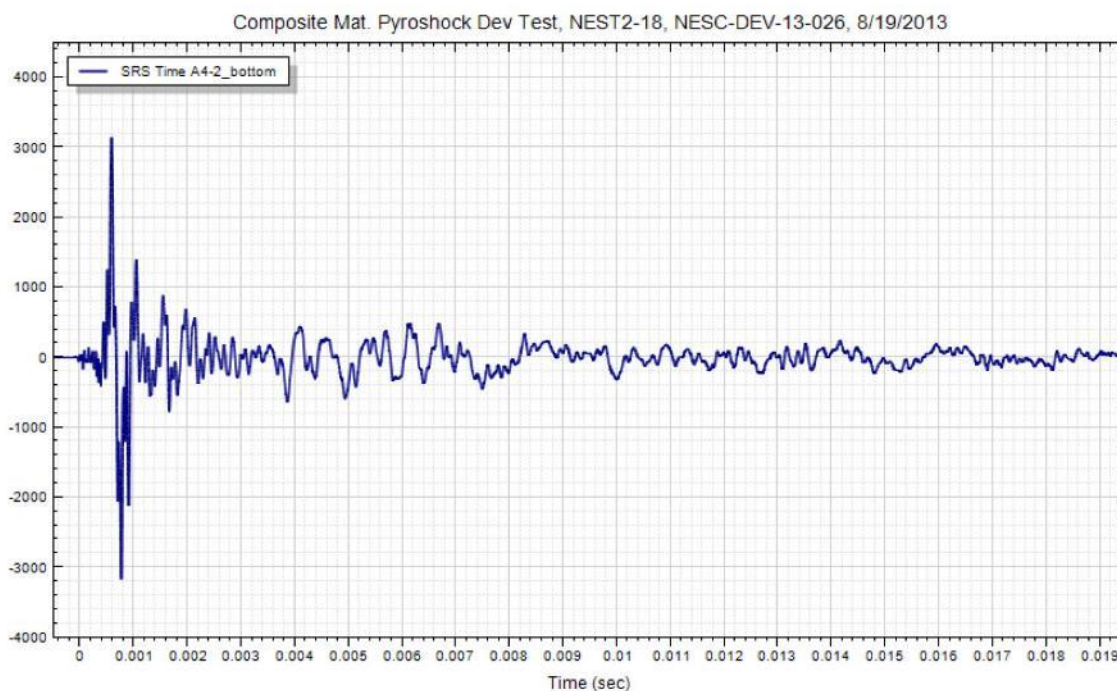
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
278 of 832





# NASA Engineering and Safety Center Technical Assessment Report

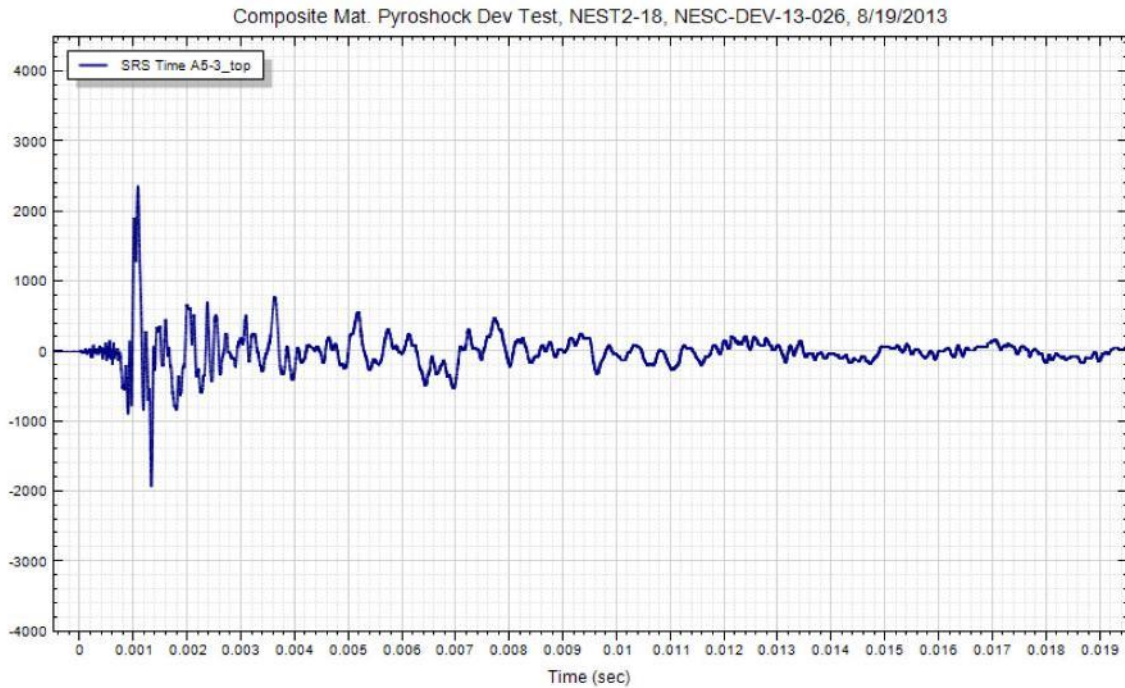
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
279 of 832





# NASA Engineering and Safety Center Technical Assessment Report

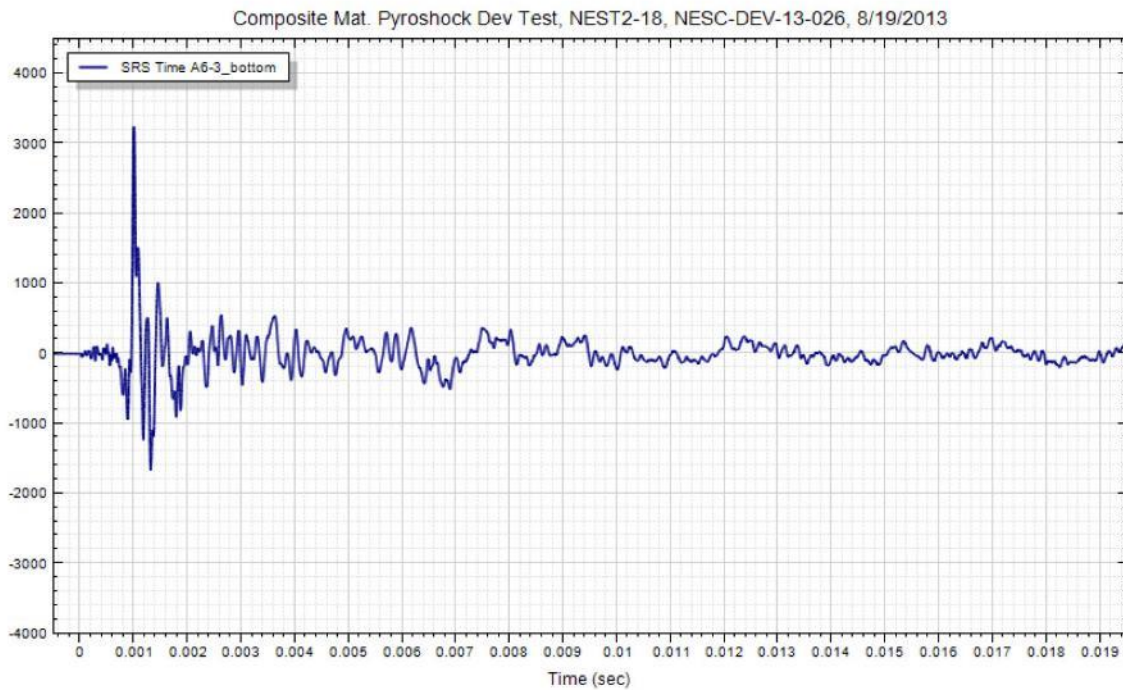
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
280 of 832





# NASA Engineering and Safety Center Technical Assessment Report

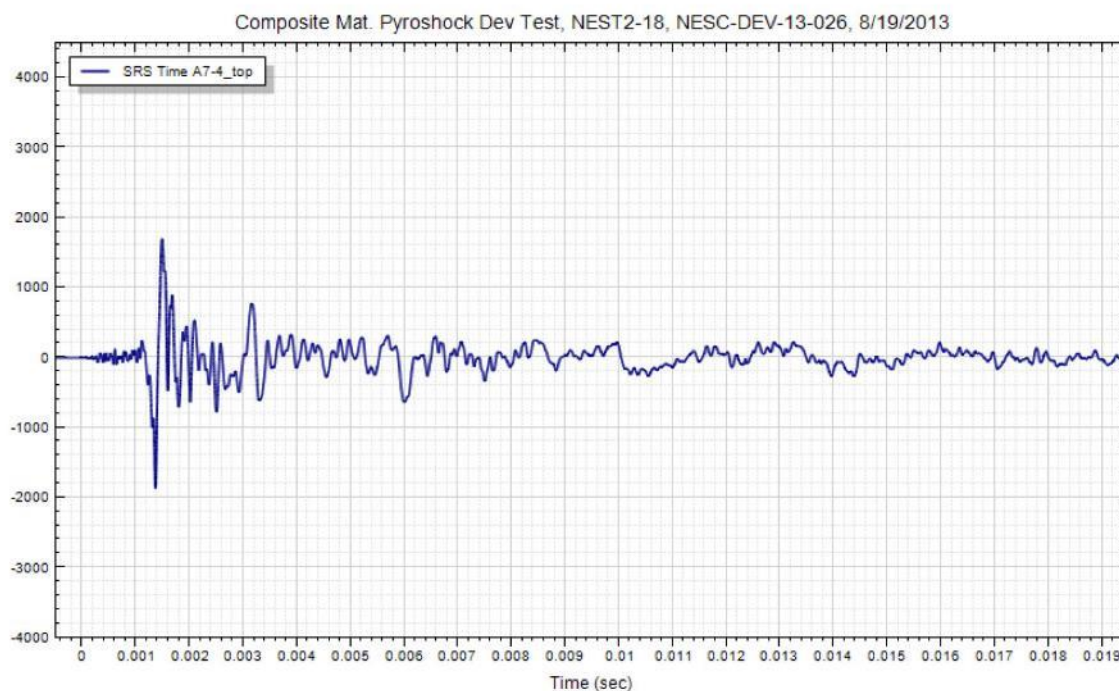
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
281 of 832





# NASA Engineering and Safety Center Technical Assessment Report

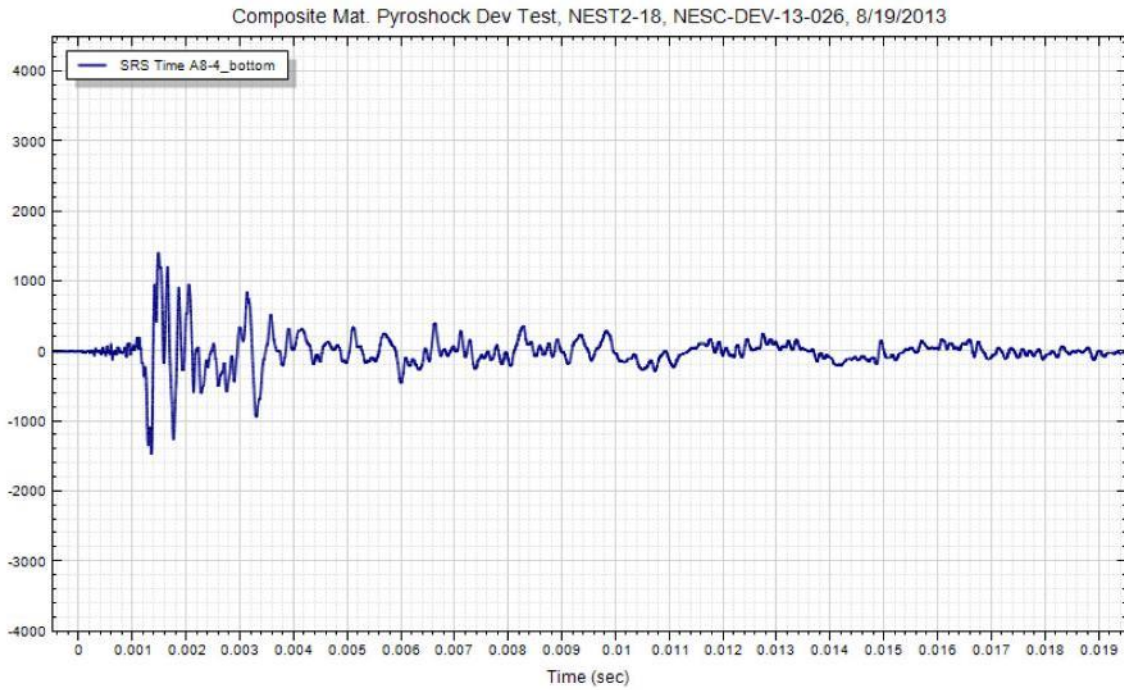
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
282 of 832





# NASA Engineering and Safety Center Technical Assessment Report

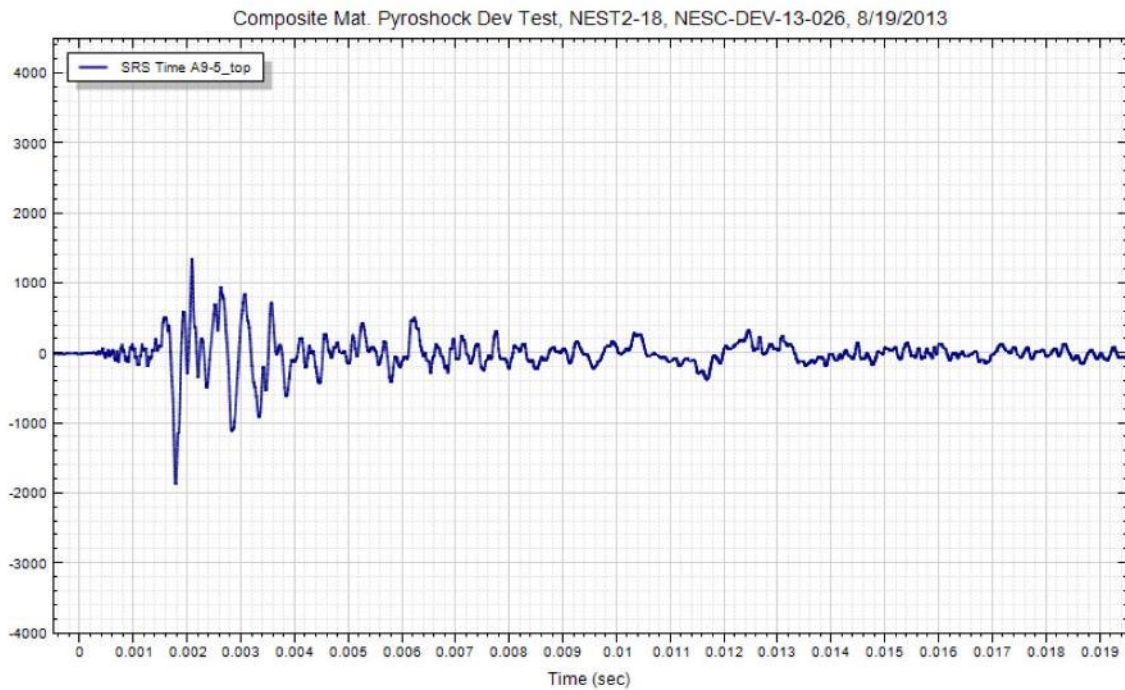
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
283 of 832





# NASA Engineering and Safety Center Technical Assessment Report

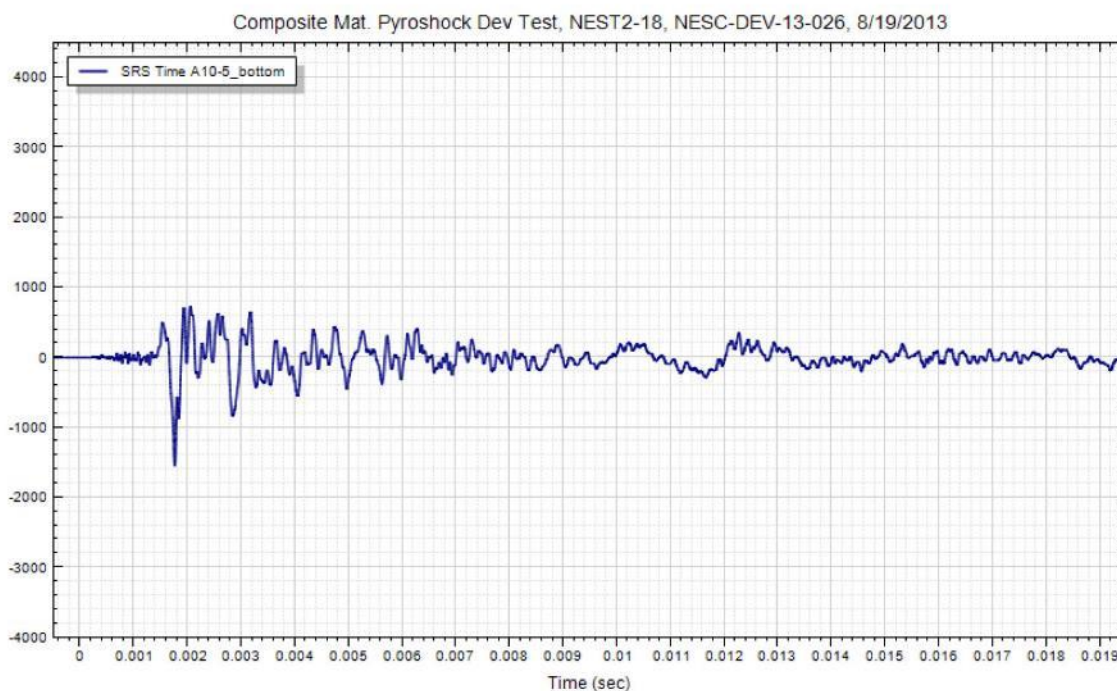
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
284 of 832



281 of 310





# NASA Engineering and Safety Center Technical Assessment Report

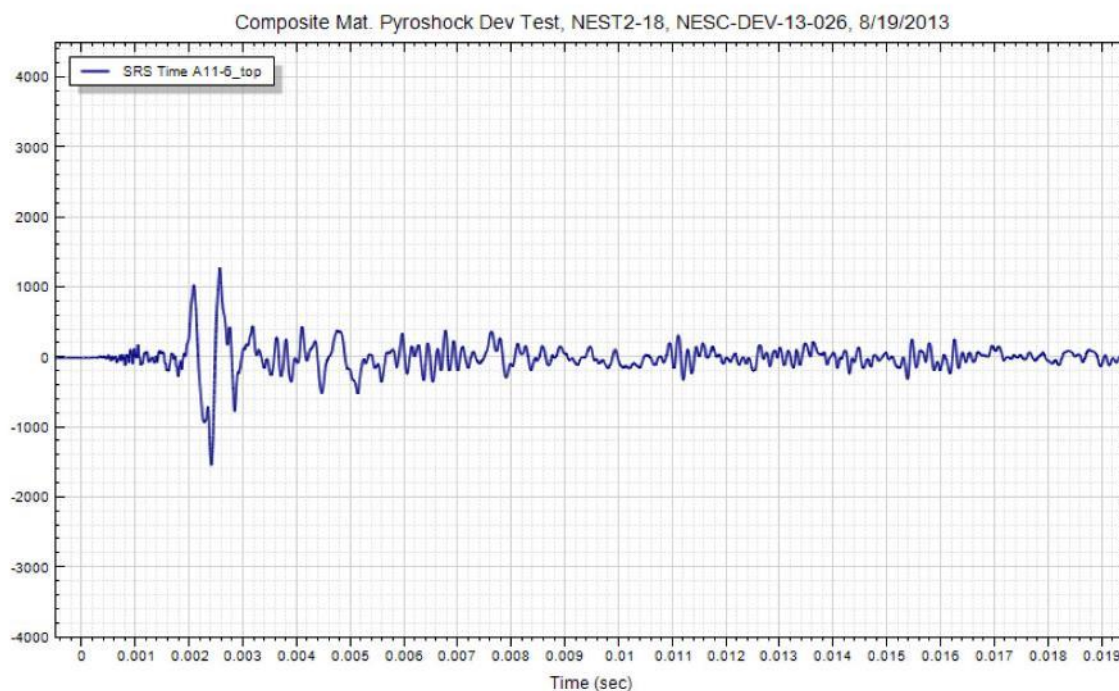
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
285 of 832





# NASA Engineering and Safety Center Technical Assessment Report

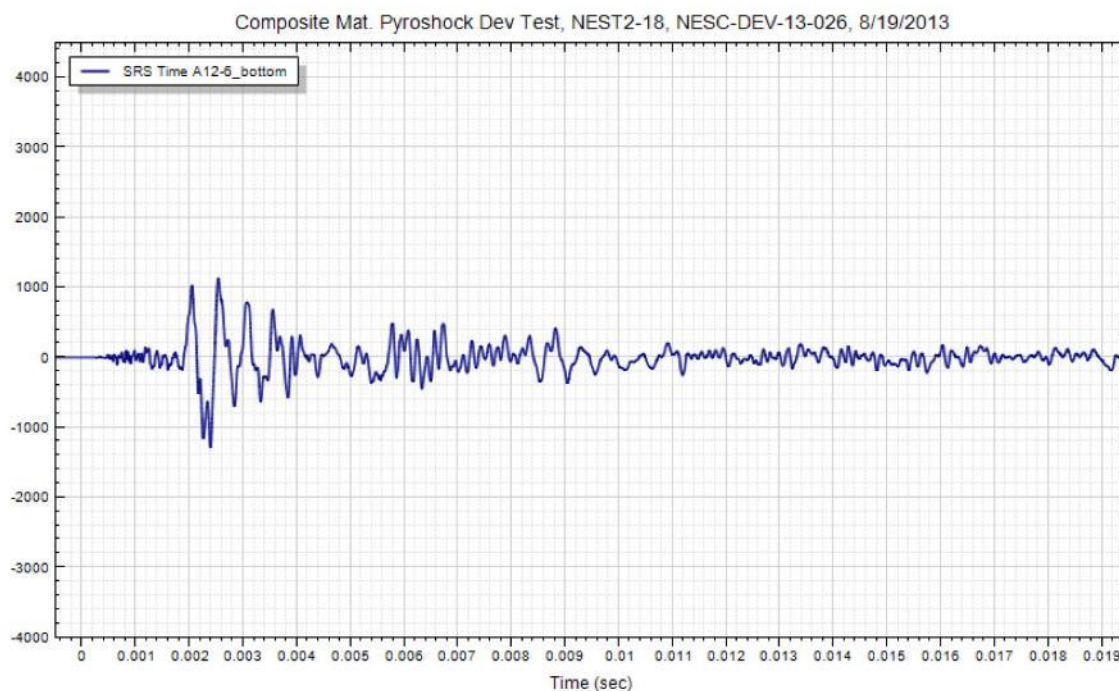
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
286 of 832





# NASA Engineering and Safety Center Technical Assessment Report

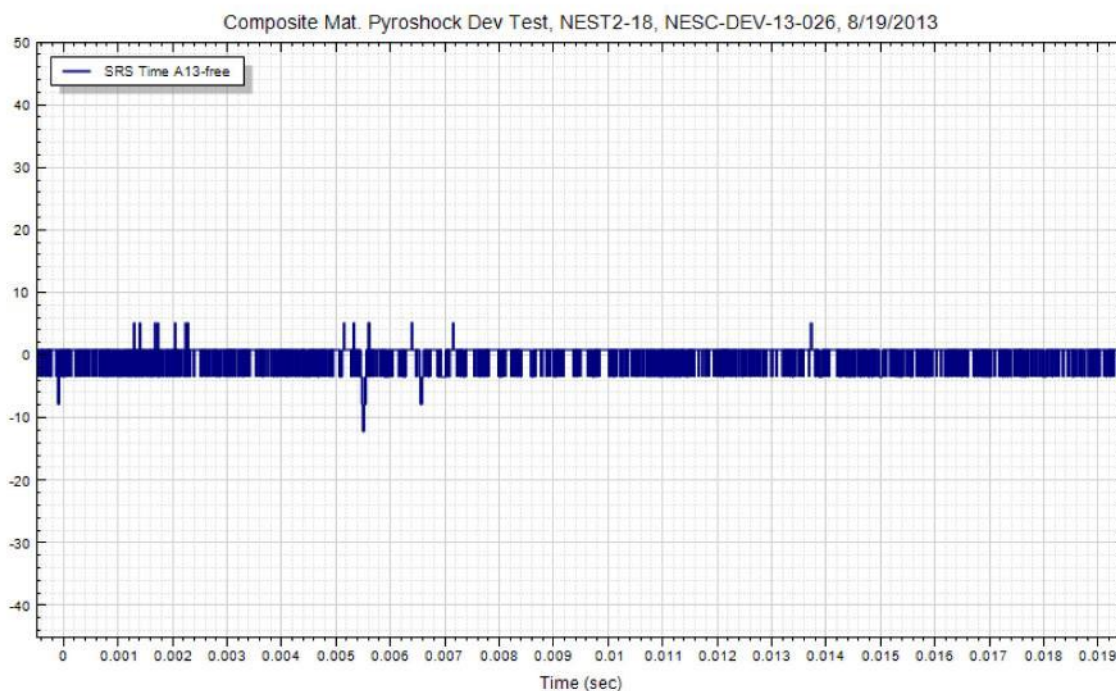
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**


Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading


Page #:  
287 of 832

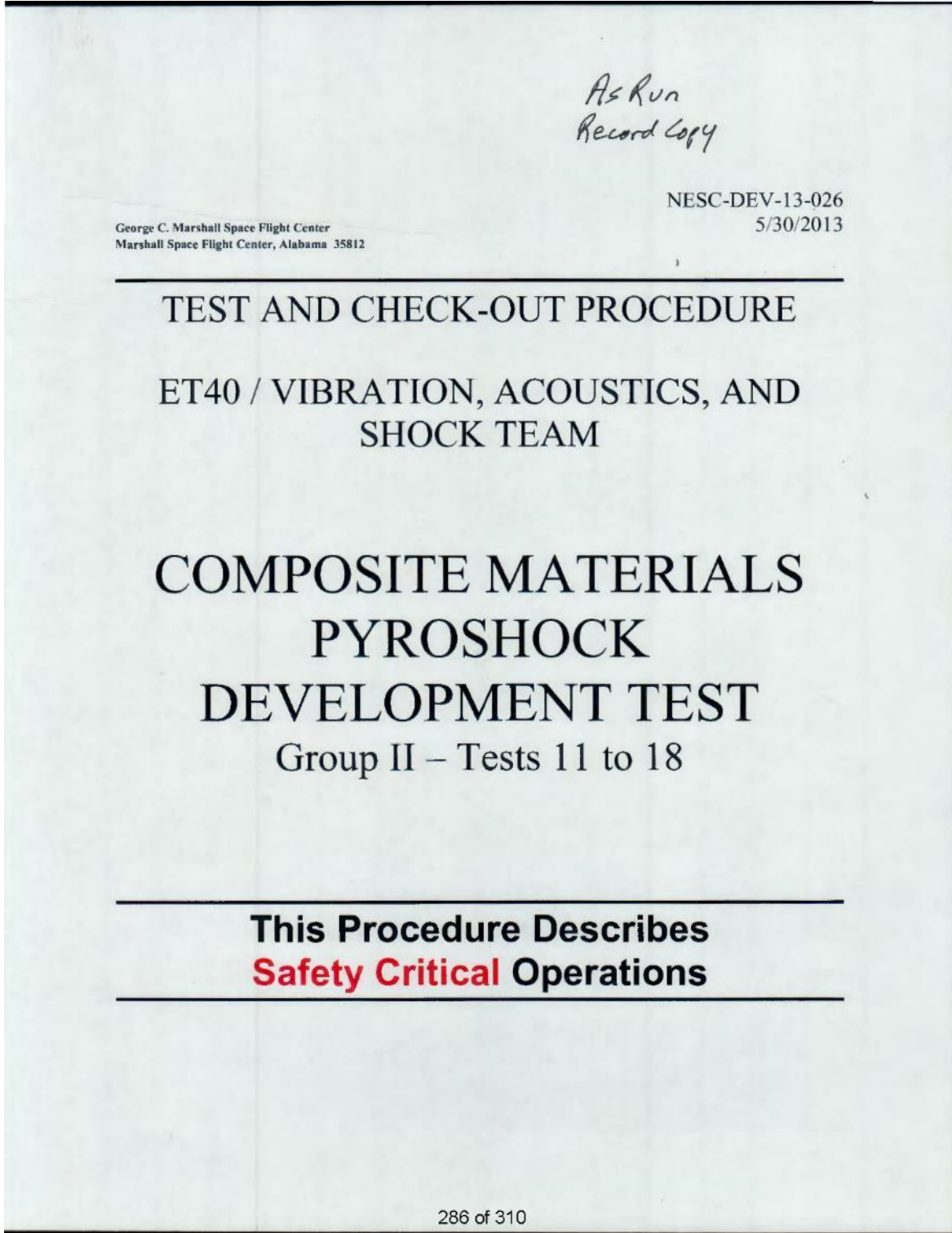


284 of 310

	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 288 of 832</p>	

**NESC-DEV-13-026**  
**Composite Materials**  
**Shock Test**  
  
**Test and Checkout Procedure**

	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 289 of 832</p>	





# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
290 of 832

ET40 / Vibration, Acoustics, and Shock Team		
Composite Materials Pyroshock Development Test	NESC-DEV-13-026	Revision: Baseline
Group II - Tests 11 to 18	Date: 5/30/2013	Page 1 of 18

PREPARED BY: John Craig Garrison 5/30/2013  
John Craig Garrison / ET40 Date  
Test Engineer

APPROVED BY: Kathy L. Owen 5/30/13  
Kathy L. Owen / ET40 Date  
Deputy Branch Chief  
Structural Dynamics Test Branch

APPROVED BY: David Ordway 5/31/2013  
David Ordway / EV32 Date  
Aerospace Engineer, Pyrotechnics  
Structural & Mechanical Design Branch  
Test Requester

APPROVED BY: \_\_\_\_\_ Date  
David Parsons / ES22  
Structural Dynamics  
Mechanical, Thermal and Life Support Branch



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
291 of 832

ET40 / Vibration, Acoustics, and Shock Team		
Composite Materials Pyroshock Development Test	NESC-DEV-13-026	Revision: Baseline
Group II - Tests 11 to 18	Date: 5/30/2013	Page 1 of 18

PREPARED BY:

John Craig Garrison / ET40  
Test Engineer

Date

APPROVED BY:

Kathy L. Owen / ET40  
Deputy Branch Chief  
Structural Dynamics Test Branch

Date

APPROVED BY:

David Ordway / EV32  
Aerospace Engineer, Pyrotechnics  
Structural & Mechanical Design Branch  
Test Requester

Date


APPROVED BY:

David Parsons / ES22  
Structural Dynamics  
Mechanical, Thermal and Life Support Branch

Date

**KAREN OLIVER**

Digitally signed by KAREN OLIVER  
DN: c=US, o=U.S. Government, ou=NASA, ou=PIV,  
cn=KAREN OLIVER, 0.9.2342.19200300.100.1.1=koolliver  
Date: 2013.05.31 11:20:01 -05'00'

	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 292 of 832	

1.0 INTRODUCTION

1.1 PURPOSE

The purpose of this procedure is to define the steps necessary to perform a pyrotechnic shock test in the Pyrotechnic Shock Facility in Building 4619 using pyrotechnic devices.

Test Matrix Test Articles: 3'x6' Sandwich composite panels with LSC plate and LSC backing plate. The 8 test articles of the test matrix are described in test plan, Table III, Group II, tests 11 to 18.

Program: NESC Type of Test: Pyrotechnic Shock Development Test

Test Purpose: To capture the acceleration time histories for group II – Test 11 to 18 tests.

The Pyrotechnic Shock Facility is located in Rooms 170, 170A and 170B of Building 4619. Room 170A is designated as the Control Room. The area between Room 169 and 170 is used for storage of secondary pyrotechnic devices. Room 170B is used for storage of initiators. All detonation of pyrotechnic devices will be in Room 170.

1.2 SCOPE

This document contains the steps and/or references the procedure to conduct the test.

2.0 SAFETY

Follow all emergency and safety requirements specified in ET01-DYN-SHK-FOP-001.

2.1 Responsibilities

The Test Engineer will be responsible for all activities occurring in the hazardous test area and for the safety of personnel involved in the test activities. It is the responsibility of each individual in a test program to fully comply with the requirements of this document and to report any individual not complying. Failure to do so could lead to serious personnel injuries or death.

3.0 TEST REQUIREMENTS AND INFORMATION


3.1 DOCUMENTS

3.1.1 APPLICABLE DOCUMENTS

Test Requirements: Pyroshock Response Characterization of Composite Materials Test Plan Revision B, NESC Task # TI-12-0783 (SLS ADO-21), 5/17/2013

Test Procedure: ET01-DYN-SHK-FOP-001 Pyrotechnic Shock Tests



	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 293 of 832	

97M00200-GRP II-PANEL 11-18 COMPOSITE TEST PANEL, GROUP II, TEST #11-#18  
 97M00202 LSC BACKING PLATE, COMPOSITE TEST PANEL PATHFINDER  
 97M00203-MOD LSC PLATE, COMPOSITE TEST PANEL PATHFINDER  
 97M00204-MOD-2-10 LSC SHIM, COMPOSITE TEST PANEL 10 GPF LSC  
 97M00204-MOD-2-22 LSC SHIM, COMPOSITE TEST PANEL 22 GPF LSC

### 3.1.2 REFERENCED DOCUMENTS

ET01-DYN-OWI-001 Documentation Control  
 ET01-DYN-OWI-002 Test Operation Procedure Preparation and Change Control

### 3.2 TEST INFORMATION

3.2.1 The instrumentation locations are given in the drawings listed in the applicable documents and appendix A for the test.  
 3.2.2 Pyrotechnic shock tests may be performed on the test article in the order and configuration directed by the test requester.

3.2.3 The shock test will be performed on a room temperature test article.

### 3.3 TEST REQUIREMENTS

3.3.1 The Test Engineer will be in charge of all test preparations and activities.  
 3.3.2 All activities will be coordinated with the Test Engineer.  
 3.3.3 All changes to the procedure will be coordinated with the Test Engineer.  
 3.3.4 The development test articles will be tested with pyrotechnic shock test runs as directed by the test requester. The test article information will be recorded in this TCP.

### 4.0 TEST DATA

- a. The test data includes a time history of the real time shock recorded over a 20 millisecond or longer interval and the units are g's peak versus time.
- b. The second plot is a Shock Response Spectrum (SRS) using 5% damping and a 1/6 octave shock spectrum analyzer. The SRS is computed over the frequency band from 50 to 10,000 Hertz. The SRS units are g's versus frequency.
- c. The data will be acquired on a Nicolet BE256LE data acquisition system and the SRS analysis will be performed using a personal computer and the Shock Analysis Tool Analysis Software.
- d. Sample rate of 1 million samples per second will be used for response from the



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
294 of 832

ET40 / Vibration, Acoustics, and Shock Team		
Composite Materials Pyroshock Development Test	NESC-DEV-13-026	Revision: Baseline
Group 11 - Tests 11 to 18	Date: 5/30/2013	Page 4 of 18

accelerometers.

### 5.0 TEST SETUP

#### 5.1 TEST ARTICLE AND SHOCK PLATE SETUP

- The test setup is shown in Appendix A.
- Suspend the shock plate from ceiling using straps or cables and shackles.
- Suspend 1 accelerometer near the plate. Connect to data system for recording.
- At the start of each test day, complete ET01-DYN-SHK-FOP-001, section 6.

### 6.0 TEST OPERATION

#### 6.1 COMPOSITE MATERIALS PYROSHOCK DEV. TEST

- Record and verify the test information below and in appendix C.

Group II - Test No.: 11 Panel #11 Date: 5-31-2013 Test Article Desc.: IM7/TC350 Sandwich Composite Panel, see appendix B for ply layup, 3'x6', Al Honeycomb & Tape PID# 03324011  
Shock Source LSC Core Load: 10 GR/FT Explosive Material: RDX Sheath: Al  
Actual Length Used: 4'6"

- Verify that the shock plate is ready for testing per section 5.1.
- Instrument shock plate. Use a #12 washer between the accelerometer and the insert. Each accelerometer's torque will be to 25±5 in.-lb.  
Torque wrench: M658783 Torque value: 25 Due: 10-4-2013 Cal.: 4-4-2013
- LSC plate & LSC backer plate to Test Panel ½-13 bolt's torque to 55±5 ft.-lb. 240 in.-lb. JCA 5-31-2013  
Torque wrench: M658396 Torque value: 240 Due: 10-8-2013 Cal.: 4-8-2013
- D-ring ½-13 bolt's torque to 28 ft.-lb. 240 in.-lb. LSC Plate B-rings; Far end B-rings 220 in.-lb. JCA 5-31-2013  
Torque wrench: M658396 Torque value: 240 Due: 10-8-2013 Cal.: 4-8-2013
- Photograph the locations and orientations of all accelerometers.
- Perform the test per sections 7, 8, and 9 of ET01-DYN-SHK-FOP-001.
- Photograph the test setup after the test. Photograph and document any post-test visually inspected observations under this test number in appendix C.
- Verify that the test run has been completed.

✓ 5-31-2013  
JCA



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
295 of 832

ET40 / Vibration, Acoustics, and Shock Team		
Composite Materials Pyroshock Development Test	NESC-DEV-13-026	Revision: Baseline
Group II - Tests 11 to 18	Date: 5/30/2013	Page 5 of 18

### 6.2 COMPOSITE MATERIALS PYROSHOCK DEV. TEST

- a. Record and verify the test information below and in appendix C.  
Group II - Test No.: 12 Panel #14 Date: 6-28-2013 Test Article Desc.: IM7/ TC350 Sandwich Composite Panel, see appendix B for ply layup, 3'x6', Rohacell Foam & Tape PID# 0332A014  
Shock Source LSC Core Load: 22 GR/FT Explosive Material: CH-6 Sheath: Al  
Actual Length Used: 4'
- b. Verify that the shock plate is ready for testing per section 5.1.
- c. Instrument shock plate. Use a #12 washer between the accelerometer and the insert. Each accelerometer's torque will be to 25±5 in.-lb.  
Torque wrench: M658783 Torque value: 25 Due: 10-4-2013 Cal.: 4-4-2013
- d. LSC plate & LSC backer plate to Test Panel 1/2-13 bolt's torque to 55±5 ft-lb. 240 in.-lb. JCA 8-31-2013  
Torque wrench: M658396 Torque value: 240 Due: 10-8-2013 Cal.: 4-8-2013
- e. D-ring 1/2-13 bolt's torque to 28 ft-lb. 240 in.-lb. LSC Plate D-rings; Far end D-rings 220 in.-lb. JCA 5-31-2013  
Torque wrench: M658396 Torque value: 240 Due: 10-8-2013 Cal.: 4-8-2013
- f. Photograph the locations and orientations of all accelerometers.
- g. Perform the test per sections 7, 8, and 9 of ET01-DYN-SHK-FOP-001.
- h. Photograph the test setup after the test. Photograph and document any post-test visually inspected observations under this test number in appendix C.
- i. Verify that the test run has been completed. JCA 6-28-2013

### START OF THE COMPOSITE MATERIALS PYROSHOCK DEV. TEST

### 6.3

- a. Record and verify the test information below and in appendix C.  
Group II - Test No.: 13 Panel #13 Date: 7-16-2013 Test Article Desc.: IM7/ TC350 Sandwich Composite Panel, see appendix B for ply layup, 3'x6', Rohacell Foam and Tape PID# 0332A013  
Shock Source LSC Core Load: 10 GR/FT Explosive Material: RDX Sheath: Al  
Actual Length Used: 4' 0.5"
- b. Verify that the shock plate is ready for testing per section 5.1.
- c. Instrument shock plate. Use a #12 washer between the accelerometer and the insert. Each accelerometer's torque will be to 25±5 in.-lb.  
Torque wrench: M658783 Torque value: 25 Due: 10-4-2013 Cal.: 4-4-2013
- d. LSC plate & LSC backer plate to Test Panel 1/2-13 bolt's torque to 55±5 ft-lb. 240 in.-lb. JCA  
Torque wrench: M658396 Torque value: 240 Due: 10-8-2013 Cal.: 4-8-2013
- e. D-ring 1/2-13 bolt's torque to 28 ft-lb. 240 in.-lb. LSC Plate D-rings; Far end D-rings 220 in.-lb. JCA  
Torque wrench: M658396 Torque value: 240 Due: 10/8/2013 Cal.: 4/8/2013
- f. Photograph the locations and orientations of all accelerometers.
- g. Perform the test per sections 7, 8, and 9 of ET01-DYN-SHK-FOP-001.
- h. Photograph the test setup after the test. Photograph and document any post-test visually inspected observations under this test number in appendix C.
- i. Verify that the test run has been completed. JCA 7-16-2013



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
296 of 832

ET40 / Vibration, Acoustics, and Shock Team		
Composite Materials Pyroshock Development Test	NESC-DEV-13-026	Revision: Baseline
Group II - Tests 11 to 18	Date: 5/30/2013	Page 6 of 18

### 6.4 START OF THE COMPOSITE MATERIALS PYROSHOCK DEV. TEST

- a. Record and verify the test information below and in appendix C.  
Group II - Test No.: 14 Panel #12 Date: 7-17-2013 Test Article Desc.: IM7/TC350 Sandwich Composite Panel, see appendix B for ply layup, 3'x6', Al Honeycomb and Tape PID# 0332A012  
Shock Source LSC Core Load: 22 GR/FT Explosive Material: CH-6 Sheath: Al  
Actual Length Used: 4'
- b. Verify that the shock plate is ready for testing per section 5.1.
- c. Instrument shock plate. Use a #12 washer between the accelerometer and the insert. Each accelerometer's torque will be to 25±5 in.-lb.  
Torque wrench: M658783 Torque value: 25 Due: 10-4-2013 Cal.: 4-4-2013
- d. LSC plate & LSC backer plate to Test Panel 1/2-13 bolt's torque to 55±5 ft-lb. 240 in-lb. PCD 5-31-2013  
Torque wrench: M658396 Torque value: 240 Due: 10-8-2013 Cal.: 4-8-2013
- e. D-ring 1/2-13 bolt's torque to 28 ft-lb. 240 in-lb. LSC Plate D-rings; Far end D-rings 220 in-lb. PCD 5-31-2013  
Torque wrench: M658396 Torque value: 240 Due: 10-8-2013 Cal.: 4-8-2013
- f. Photograph the locations and orientations of all accelerometers.
- g. Perform the test per sections 7, 8, and 9 of ET01-DYN-SHK-FOP-001.
- h. Photograph the test setup after the test. Photograph and document any post-test visually inspected observations under this test number in appendix C.
- i. Verify that the test run has been completed. ✓PCD 7-17-2013

### 6.5 START OF THE COMPOSITE MATERIALS PYROSHOCK DEV. TEST

- a. Record and verify the test information below and in appendix C.  
Group II - Test No.: 15 Panel #16 Date: 7-18-2013 Test Article Desc.: IM7/TC350 Sandwich Composite Panel, see appendix B for ply layup, 3'x6', Al Honeycomb & Tape PID# 0332A016  
Shock Source LSC Core Load: 22 GR/FT Explosive Material: CH-6 Sheath: Al  
Actual Length Used: 4'
- b. Verify that the shock plate is ready for testing per section 5.1.
- c. Instrument shock plate. Use a #12 washer between the accelerometer and the insert. Each accelerometer's torque will be to 25±5 in.-lb.  
Torque wrench: M658783 Torque value: 25 Due: 10-4-2013 Cal.: 4-4-2013
- d. LSC plate & LSC backer plate to Test Panel 1/2-13 bolt's torque to 55±5 ft-lb. 240 in-lb. PCD 5-31-2013  
Torque wrench: M658396 Torque value: 240 Due: 10-8-2013 Cal.: 4-8-2013
- e. D-ring 1/2-13 bolt's torque to 28 ft-lb. 240 in-lb. LSC Plate D-rings; Far end D-rings 220 in-lb. PCD 5-31-2013  
Torque wrench: M658396 Torque value: 240 Due: 10-8-2013 Cal.: 4-8-2013
- f. Photograph the locations and orientations of all accelerometers.
- g. Perform the test per sections 7, 8, and 9 of ET01-DYN-SHK-FOP-001.
- h. Photograph the test setup after the test. Photograph and document any post-test visually inspected observations under this test number in appendix C.
- i. Verify that the test run has been completed. ✓PCD 7-18-2013



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
297 of 832

ET40 / Vibration, Acoustics, and Shock Team		
Composite Materials Pyroshock Development Test	NESC-DEV-13-026	Revision: Baseline
Group II - Tests 11 to 18	Date: 5/30/2013	Page 7 of 18

### 6.6 START OF THE COMPOSITE MATERIALS PYROSHOCK DEV. TEST

- a. Record and verify the test information below and in appendix C.  
Group II - Test No.: 16 Panel #18 Date: 7-23-2013 Test Article Desc.: IM7/TC350 Sandwich Composite Panel, see appendix B for ply layup, 3'x6', Rohacell Foam & Tape PID# 0332A-018  
Shock Source LSC Core Load: 22 GR/FT Explosive Material: CH-6 Sheath: Al  
Actual Length Used: 4'
- b. Verify that the shock plate is ready for testing per section 5.1.
- c. Instrument shock plate. Use a #12 washer between the accelerometer and the insert. Each accelerometer's torque will be to 25±5 in.-lb.  
Torque wrench: M658783 Torque value: 25 Due: 10-4-2013 Cal.: 4-4-2013
- d. LSC plate & LSC backer plate to Test Panel ½-13 bolt's torque to 55±5 ft-lb, 240 in.-lb. JCA 5-31-2013  
Torque wrench: M658396 Torque value: 240 Due: 10-8-2013 Cal.: 4-8-2013
- e. D-ring ½-13 bolt's torque to 28 ft-lb, 240 in.-lb. LSC Plate D-rings; Far end D-rings 220 in.-lb. JCA 5-31-2013  
Torque wrench: M658396 Torque value: 240 Due: 10-8-2013 Cal.: 4-8-2013
- f. Photograph the locations and orientations of all accelerometers.
- g. Perform the test per sections 7, 8, and 9 of ET01-DYN-SHK-FOP-001.
- h. Photograph the test setup after the test. Photograph and document any post-test visually inspected observations under this test number in appendix C.
- i. Verify that the test run has been completed. ✓ JCA 7/23/2013

### 6.7 START OF THE COMPOSITE MATERIALS PYROSHOCK DEV. TEST

- a. Record and verify the test information below and in appendix C.  
Group II - Test No.: 17 Panel #15 Date: 8-9-2013 Test Article Desc.: IM7/TC350 Sandwich Composite Panel, see appendix B for ply layup, 3'x6', Al Honeycomb & Tape PID# 0332A-015  
Shock Source LSC Core Load: 10 GR/FT Explosive Material: RDX Sheath: Al  
Actual Length Used: 4' 0.5"
- b. Verify that the shock plate is ready for testing per section 5.1.
- c. Instrument shock plate. Use a #12 washer between the accelerometer and the insert. Each accelerometer's torque will be to 25±5 in.-lb.  
Torque wrench: M658783 Torque value: 25 Due: 10-4-2013 Cal.: 4-4-2013
- d. LSC plate & LSC backer plate to Test Panel ½-13 bolt's torque to 55±5 ft-lb, 240 in.-lb. JCA 5-31-2013  
Torque wrench: M658396 Torque value: 240 Due: 10-8-2013 Cal.: 4-8-2013
- e. D-ring ½-13 bolt's torque to 28 ft-lb, 240 in.-lb. LSC Plate D-rings; Far end D-rings 220 in.-lb. JCA 5-31-2013  
Torque wrench: M658396 Torque value: 240 Due: 10-8-2013 Cal.: 4-8-2013
- f. Photograph the locations and orientations of all accelerometers.
- g. Perform the test per sections 7, 8, and 9 of ET01-DYN-SHK-FOP-001.
- h. Photograph the test setup after the test. Photograph and document any post-test visually inspected observations under this test number in appendix C.
- i. Verify that the test run has been completed. ✓ JCA 8/7/2013



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
298 of 832

ET-40 / Vibration, Acoustics, and Shock Team		
Composite Materials Pyroshock Development Test	NESC-DEV-13-026	Revision: Baseline
Group II - Tests 11 to 18	Date: 5/30/2013	Page 8 of 18

### 6.8 START OF THE COMPOSITE MATERIALS PYROSHOCK DEV. TEST

- a. Record and verify the test information below and in appendix C.

Group II - Test No.: 18 Panel #17 Date: 8-19-2013 Test Article Desc.: IM7/TC350 Sandwich Composite Panel, see appendix B for ply layup, 3'x6', Rohacell Foam and Tape PID# 0332A017  
Shock Source LSC Core Load:10 GR/FT Explosive Material: RDX Sheath: Al  
Actual Length Used: 4' 0.5"

- b. Verify that the shock plate is ready for testing per section 5.1.  
c. Instrument shock plate. Use a #12 washer between the accelerometer and the insert. Each accelerometer's torque will be to 25±5 in.-lb.  
Torque wrench: M658783 Torque value: 25 Due: 10-4-2013 Cal.: 4-4-2013  
d. LSC plate & LSC backer plate to Test Panel 1/2-13 bolt's torque to 55±5 ft-lb. 240 in.-lb. J.C.A.  
Torque wrench: M658396 Torque value: 240 Due: 10-8-2013 Cal.: 4-8-2013 5-31-2013  
e. D-ring 1/2-13 bolt's torque to 28 ft-lb. 240 in.-lb. LSC Plate D-rings; Far end D-rings 220 in.-lb. J.C.A.  
Torque wrench: M658396 Torque value: 240/220 Due: 10-8-2013 Cal.: 4-8-2013 5-31-2013  
f. Photograph the locations and orientations of all accelerometers.  
g. Perform the test per sections 7, 8, and 9 of ET01-DYN-SHK-FOP-001.  
h. Photograph the test setup after the test. Photograph and document any post-test visually inspected observations under this test number in appendix C.  
i. Verify that the test run has been completed. J.C.A. 8-19-2013

### 7.0 RECORDS

The test report for this test will control and include the following records:

- a. This "AS RUN" TCP.  
b. The test data and the equipment list.

The test report is controlled by ET01-DYN-OWI-001, Documentation Control. However, due to the ITAR designation for the test results, the test report and data will be securely controlled. The test report will be available no later than 30 days after test completion. The Test Requirements will not be included in this TCP or in the report, but a copy may be filed with the report for future reference.

### 8.0 TOOLS, EQUIPMENT, AND MATERIALS

The equipment used during this test will be listed in a table as part of the test report. The list will include test equipment calibration due dates.

### 9.0 PERSONNEL TRAINING AND CERTIFICATION

Personnel certified as Propellant and Explosive Handler are required to conduct this test.



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
299 of 832


ET40 / Vibration, Acoustics, and Shock Team		
Composite Materials Pyroshock Development Test	NESC-DEV-13-026	Revision: Baseline
Group II - Tests 11 to 18	Date: 5/30/2013	Page 9 of 18

## POST-TEST VERIFICATION

The Test and Check-out Procedure NESC-DEV-13-026 has been satisfactorily completed and documented.

Craig Damico  
Test Engineer / ET40

8/19/2013  
Date

	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 300 of 832</p>	

## APPENDIX A

### TEST SETUP





# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

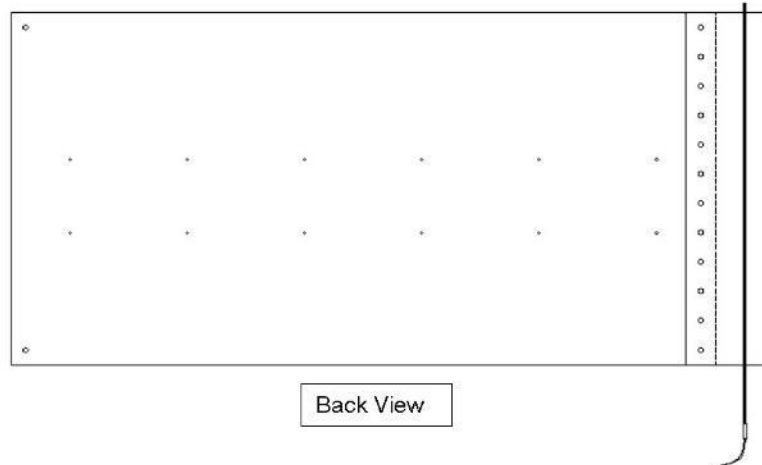
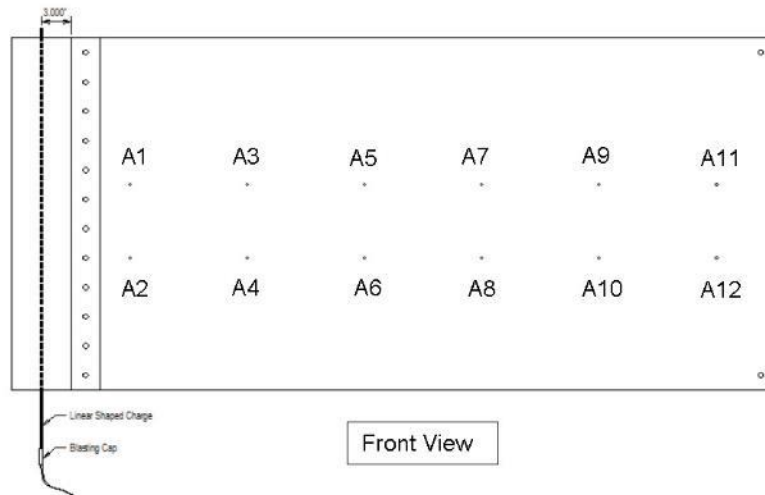
Title:


## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
301 of 832

### Composite Materials Pyroshock Development Test

Test Article Panel: Sandwich Composite, Vertical Position  
Supports: Straps and Shackles



	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 302 of 832	

## APPENDIX B

GROUP II – TEST #11 - #18 PLY LAYUP



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-12-00783**

Version:  
**1.0**


Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
303 of 832

### Group II Tests #11-#18 Fill and Ply Layup

Group II – Sandwich Composite Panels							
Panel Number	Test Number	Material	Panel Thickness	Fill/Ply	Orientation	Type	LSC Core Load
11	11	Composite, IM7/TC350	8 Ply/ 1-inch thick fill	Al Honeycomb & Tape	90°/+45°/-45°/0°/0°/ -45°/+45°/90°, 8 ply both faces	Sandwich	10
12	14	Composite, IM7/TC350	8 Ply/ 1-inch thick fill	Al Honeycomb & Tape	90°/+45°/-45°/0°/0°/ -45°/+45°/90°, 8 ply both faces	Sandwich	22
13	13	Composite, IM7/TC350	8 Ply/ 1-inch thick fill	Rohacell Foam & Tape	90°/+45°/-45°/0°/0°/ -45°/+45°/90°, 8 ply both faces	Sandwich	10
14	12	Composite, IM7/TC350	8 Ply/ 1-inch thick fill	Rohacell Foam & Tape	90°/+45°/-45°/0°/0°/ -45°/+45°/90°, 8 ply both faces	Sandwich	22
15	17	Composite, IM7/TC350	8 Ply/ 1-inch thick fill	Al Honeycomb & Tape	90°/+45°/-45°/0°/0°/ -45°/+45°/90°, 8 ply both faces	Sandwich	10
16	15	Composite, IM7/TC350	8 Ply/ 1-inch thick fill	Al Honeycomb & Tape	90°/+45°/-45°/0°/0°/ -45°/+45°/90°, 8 ply both faces	Sandwich	22
17	18	Composite, IM7/TC350	8 Ply/ 1-inch thick fill	Rohacell Foam & Tape	90°/+45°/-45°/0°/0°/ -45°/+45°/90°, 8 ply both faces	Sandwich	10
18	16	Composite, IM7/TC350	8 Ply/ 1-inch thick fill	Rohacell Foam & Tape	90°/+45°/-45°/0°/0°/ -45°/+45°/90°, 8 ply both faces	Sandwich	22

	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 304 of 832</p>	

## APPENDIX C

### TEST DATA SHEET

(Reference Appendix B for Test Number and Corresponding Test Panel Number)



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
305 of 832

ET40 / Vibration, Acoustics, and Shock Team		
Composite Materials Pyroshock Development Test	NESC-DEV-13-026	Revision: Baseline
Group II - Tests 11 to 18	Date: 5/30/2013	Page 15 of 18

### TEST DATA SHEET

Group: II - Test No.: 11 Panel #11 Date: 5-31-2013 Test Article Desc.: IM7/TC350 Sandwich Composite Panel, see appendix B for ply layup, 3'x6', Al Honeycomb & Tape  
 Test Article Configuration: hanging  
 Test Article Drawing #: 97M00200-GRP II-PANEL 11 Material: IM7/TC350 PID# 0332A0011  
 Test Article Drawing #: 97M00202 Material: Aluminum S/N: Pathfinder  
 Test Article Drawing #: 97M00203-MOD Material: Aluminum S/N: Pathfinder  
 Test Article Drawing #: 97M00204-MOD-2-10 Material: Aluminum S/N: Pathfinder  
 Shock Source: LSC L/N: none LSC Core Load: 10 GR/FT Explosive Material: RDX  
 Sheath: Aluminum Actual Length Used: 42.5"  
 Accelerometer MFG: PCB Model: 350XXX

Loc.	Model	S/N	Loc.	Model	S/N	Loc.	Model	S/N	Loc.	Model	S/N
1	C02	31334	2	D02	43026	3	D02	43028	4	C02	31331
5	C02	31328	6	D02	43029	7	D02	43179	8	C02	31351
9	C02	31330	10	D02	43180	11	D02	43181	12	C02	40274
13	B02	11439									

Aluminum LSC panel severance: ( Yes  No ) Not Completely  
 Post-test visually inspected observations: Bolts torqued between 150-240 in-lb. The Center bolts were at 150 in-lb. The accel bolts torqued to at least 20 in-lb.

Group: II - Test No.: 12 Panel #14 Date: 6/28/2013 Test Article Desc.: IM7/TC350 Sandwich Composite Panel, see appendix B for ply layup, 3'x6', Rohacell Foam & Tape  
 Test Article Configuration: hanging  
 Test Article Drawing #: 97M00200-GRP II-PANEL 14 Material: IM7/TC350 PID# 0332A014  
 Test Article Drawing #: 97M00202 Material: Aluminum S/N: Pathfinder  
 Test Article Drawing #: 97M00203-MOD Material: Aluminum S/N: Pathfinder  
 Test Article Drawing #: 97M00204-MOD-2-22 Material: Aluminum S/N: Pathfinder  
 Shock Source: LSC L/N: none LSC Core Load: 22 GR/FT Explosive Material: CH-6  
 Sheath: Aluminum Actual Length Used: 4'  
 Accelerometer MFG: PCB Model: 350XXX

Loc.	Model	S/N	Loc.	Model	S/N	Loc.	Model	S/N	Loc.	Model	S/N
1	D02	43026	2	C02	31340	3	C02	31338	4	D02	43028
5	D02	43029	6	C02	31333	7	C02	40292	8	D02	43179
9	D02	43180	10	C02	40295	11	C02	31336	12	D02	43181
13	B02	11439									

Aluminum LSC panel severance: (  Yes / No )  
 Post-test visually inspected observations: No loose bolts or accel. after test.



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
306 of 832

ET40 / Vibration, Acoustics, and Shock Team		
Composite Materials Pyroshock Development Test	NESC-DEV-13-026	Revision: Baseline
Group II - Tests 11 to 18	Date: 5/30/2013	Page 16 of 18

## TEST DATA SHEET, cont.

Group: II - Test No.: 13 Panel #13 Date: 7-16-2013 Test Article Desc.: IM7/TC350 Sandwich Composite Panel, see appendix B for ply layup, 3'x6', Rohacell Foam & Tape  
 Test Article Configuration: hanging  
 Test Article Drawing #: 97M00200-GRP II-PANEL 13 Material: IM7/TC350 PID# 0322A013  
 Test Article Drawing #: 97M00202 Material: Aluminum S/N: Pathfinder  
 Test Article Drawing #: 97M00203-MOD Material: Aluminum S/N: Pathfinder  
 Test Article Drawing #: 97M00204-MOD-2-10 Material: Aluminum S/N: Pathfinder  
 Shock Source: LSC L/N: none LSC Core Load: 10 GR/FT Explosive Material: RDX  
 Sheath: Aluminum Actual Length Used: 4' 05"  
 Accelerometer MFG: PCB Model: 350XXX

Loc.	Model	S/N	Loc.	Model	S/N	Loc.	Model	S/N	Loc.	Model	S/N
1	C02	31334	2	D02	43026	3	D02	43028	4	C02	31331
5	C02	31328	6	D02	43029	7	D02	43179	8	C02	31351
9	C02	31330	10	D02	43180	11	D02	43181	12	C02	40274
13	B02	11439									

Aluminum LSC panel severance: (Yes) No )  
 Post-test visually inspected observations: Bolts torqued to 220 in-lb. Accels. torqued to at least 20 in-lb. after test.

Group: II - Test No.: 14 Panel #12 Date: 7-17-2013 Test Article Desc.: IM7/TC350 Sandwich Composite Panel, see appendix B for ply layup, 3'x6', Al Honeycomb & Tape  
 Test Article Configuration: hanging  
 Test Article Drawing #: 97M00200-GRP II-PANEL 12 Material: IM7/TC350 PID# 0332A012  
 Test Article Drawing #: 97M00202 Material: Aluminum S/N: Pathfinder  
 Test Article Drawing #: 97M00203-MOD Material: Aluminum S/N: Pathfinder  
 Test Article Drawing #: 97M00204-MOD-2-22 Material: Aluminum S/N: Pathfinder  
 Shock Source: LSC L/N: none LSC Core Load: 22 GR/FT Explosive Material: CH-6  
 Sheath: Aluminum Actual Length Used: 4'  
 Accelerometer MFG: PCB Model: 350XXX

Loc.	Model	S/N	Loc.	Model	S/N	Loc.	Model	S/N	Loc.	Model	S/N
1	D02	43026	2	C02	31340	3	C02	31338	4	D02	43028
5	D02	43029	6	C02	31333	7	C02	40292	8	D02	43179
9	D02	43180	10	C02	40295	11	C02	31336	12	D02	43181
13	B02	11439									

Aluminum LSC panel severance: (Yes) No )  
 Post-test visually inspected observations: No loose accels. LSC plate bolts torqued slightly less than 210 in-lb. The far side D-rings were not loose.



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
307 of 832

ET40 / Vibration, Acoustics, and Shock Team		
Composite Materials Pyroshock Development Test	NESC-DEV-13-026	Revision: Baseline
Group II - Tests 11 to 18	Date: 5/30/2013	Page 17 of 18

## TEST DATA SHEET, cont.

Group: II - Test No.: 15 Panel #16 Date: 7-18-2013 Test Article Desc.: IM7/TC350 Sandwich Composite Panel, see appendix B for ply layup, 3'x6', Al Honeycomb & Tape

Test Article Configuration: hanging

Test Article Drawing #: 97M00200-GRP II-PANEL 16 Material: IM7/TC350 PID# 0332A016

Test Article Drawing #: 97M00202 Material: Aluminum S/N: Pathfinder

Test Article Drawing #: 97M00203-MOD Material: Aluminum S/N: Pathfinder

Test Article Drawing #: 97M00204-MOD-2-10 Material: Aluminum S/N: Pathfinder

Shock Source: LSC L/N: none LSC Core Load: 22 GR/FT Explosive Material: CH-6

Sheath: Aluminum Actual Length Used: 4'

Accelerometer MFG: PCB Model: 350XXX

Loc.	Model	S/N	Loc.	Model	S/N	Loc.	Model	S/N	Loc.	Model	S/N
1	C02	31334	2	D02	43026	3	D02	43028	4	C02	31331
5	C02	31328	6	D02	43029	7	D02	43179	8	C02	31351
9	C02	31330	10	D02	43180	11	D02	43181	12	C02	40274
13	B02	11439									

Aluminum LSC panel severance: (Yes) No )

Post-test visually inspected observations: The accels. torqued to at least 20 in/lb.

Bolts torqued slightly less than 210 in/lb. on LSC plate. Far side Drings were not loose.

Group: II - Test No.: 16 PANEL #18 Date: 7-23-2013 Test Article Desc.: IM7/TC350 Sandwich Composite Panel, see appendix B for ply layup, 3'x6', Rohacell Foam & Tape

Test Article Configuration: hanging

Test Article Drawing #: 97M00200-GRP II-PANEL 18 Material: IM7/TC350 PID# 0332A018

Test Article Drawing #: 97M00202 Material: Aluminum S/N: Pathfinder

Test Article Drawing #: 97M00203-MOD Material: Aluminum S/N: Pathfinder

Test Article Drawing #: 97M00204-MOD-2-22 Material: Aluminum S/N: Pathfinder

Shock Source: LSC L/N: None LSC Core Load: 22 GR/FT Explosive Material: CH-6

Sheath: Aluminum Actual Length Used: 4'

Accelerometer MFG: PCB Model: 350XXX

Loc.	Model	S/N	Loc.	Model	S/N	Loc.	Model	S/N	Loc.	Model	S/N
1	D02	43026	2	C02	31340	3	C02	31338	4	D02	43028
5	D02	43029	6	C02	31333	7	C02	40292	8	D02	43179
9	D02	43180	10	C02	40295	11	C02	31336	12	D02	43181
13	B02	11439									

Aluminum LSC panel severance: (Yes) No )

Post-test visually inspected observations: No loose bolts or accels. after test.



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
308 of 832

ET40 / Vibration, Acoustics, and Shock Team		
Composite Materials Pyroshock Development Test	NESC-DEV-13-026	Revision: Baseline
Group II - Tests 11 to 18	Date: 5/30/2013	Page 18 of 18

### TEST DATA SHEET, cont.

Group: II - Test No.: 17 Panel #15 Date: 8-7-2013 Test Article Desc.: IM7/TC350 Sandwich Composite Panel, see appendix B for ply layup, 3'x6', Al Honeycomb & Tape  
 Test Article Configuration: hanging  
 Test Article Drawing #: 97M00200-GRP II-PANEL 15 Material: IM7/TC350 PID# 0332A015  
 Test Article Drawing #: 97M00202 Material: Aluminum S/N: Pathfinder  
 Test Article Drawing #: 97M00203-MOD Material: Aluminum S/N: Pathfinder  
 Test Article Drawing #: 97M00204-MOD-2-10 Material: Aluminum S/N: Pathfinder  
 Shock Source: LSC L/N: none LSC Core Load: 10 GR/FT Explosive Material: RDX  
 Sheath: Aluminum Actual Length Used: 4' 0.5"  
 Accelerometer MFG: PCB Model: 350XXX

Loc.	Model	S/N	Loc.	Model	S/N	Loc.	Model	S/N	Loc.	Model	S/N
1	C02	31334	2	D02	43026	3	D02	43028	4	C02	31331
5	C02	31328	6	D02	43029	7	D02	43179	8	C02	31351
9	C02	31330	10	D02	43180	11	D02	43181	12	C02	40274
13	B02	11439									

Aluminum LSC panel severance: (Yes/No) (Yes)

Post-test visually inspected observations: Bolts and accels. did not loose torque.


Group: II - Test No.: 18 Panel #17 Date: 8-19-2013 Test Article Desc.: IM7/TC350 Sandwich Composite Panel, see appendix B for ply layup, 3'x6', Rohacell Foam & Tape  
 Test Article Configuration: hanging  
 Test Article Drawing #: 97M00200-GRP II-PANEL 17 Material: IM7/TC350 PID# 0332A017  
 Test Article Drawing #: 97M00202 Material: Aluminum S/N: Pathfinder  
 Test Article Drawing #: 97M00203-MOD Material: Aluminum S/N: Pathfinder  
 Test Article Drawing #: 97M00204-MOD-2-22 Material: Aluminum S/N: Pathfinder  
 Shock Source: LSC L/N: none LSC Core Load: 10 GR/FT Explosive Material: RDX  
 Sheath: Aluminum Actual Length Used: 4' 0.5"  
 Accelerometer MFG: PCB Model: 350XXX

Loc.	Model	S/N	Loc.	Model	S/N	Loc.	Model	S/N	Loc.	Model	S/N
1	D02	43026	2	C02	31340	3	C02	31338	4	D02	43028
5	D02	43029	6	C02	31333	7	C02	40292	8	D02	43179
9	D02	43180	10	C02	40295	11	C02	31336	12	D02	43181
13	B02	11439									

Aluminum LSC panel severance: (Yes/No) (Yes)

Post-test visually inspected observations: No loose accels. or bolts.



	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 309 of 832</p>	

**NESC-DEV-13-026**  
**Composite Materials**  
**Shock Test**  
  
**Equipment List**



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-12-00783**

Version:  
**1.0**

Title:


## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
310 of 832

### NESC-DEV-13-026 Equipment List

Description	Manufacturer	Model/Version	ID/Serial Number	Location	Cal Due Date
Shock Analysis Tool	ET40	1.2.5			Verified 5/21/2009
TEAM256	Nicolet	7.20			Verified 7/26/2012
Torque Wrench	Proto	6066C	M658396		10/8/2013
Torque Wrench	Precision Instruments	44620	M658783		10/4/2013
Power Supply	Endevco	2793	M652262	Channels 1-15	1/10/2014
Data Acquisition System	Nicolet	BE256LE	2011288	Channels 2-8, 10-15	7/26/2013, 8/6/2014 *
Channel 2	Nicolet	614CB	001-2	A1	7/26/2013, 8/6/2014
Channel 3	Nicolet	614CB	001-3	A2	7/26/2013, 8/6/2014
Channel 4	Nicolet	614CB	001-4	A3	7/26/2013, 8/6/2014
Channel 5	Nicolet	614CB	002-1	A4	7/26/2013, 8/6/2014
Channel 6	Nicolet	614CB	002-2	A5	7/26/2013, 8/6/2014
Channel 7	Nicolet	614CB	002-3	A6	7/26/2013, 8/6/2014
Channel 8	Nicolet	614CB	002-4	A7	7/26/2013, 8/6/2014
Channel 10	Nicolet	614CB	003-2	A8	7/26/2013, 8/6/2014
Channel 11	Nicolet	614CB	003-3	A9	7/26/2013, 8/6/2014
Channel 12	Nicolet	614CB	003-4	A10	7/26/2013, 8/6/2014
Channel 13	Nicolet	614CB	004-1	A11	7/26/2013, 8/6/2014
Channel 14	Nicolet	614CB	004-2	A12	7/26/2013, 8/6/2014
Channel 15	Nicolet	614CB	004-3	A13	7/26/2013, 8/6/2014
Accelerometer	PCB	350B02	11439	A13	4/29/2014
Accelerometer	PCB	350C02	31334	Set 1 A1	4/23/2014
Accelerometer	PCB	350C02	31331	Set 1 A4	4/24/2014
Accelerometer	PCB	350C02	31328	Set 1 A5	4/24/2014
Accelerometer	PCB	350C02	31351	Set 1 A8	4/24/2014
Accelerometer	PCB	350C02	31330	Set 1 A9	4/24/2014
Accelerometer	PCB	350C02	40274	Set 1 A12	4/24/2014
Accelerometer	PCB	350C02	31340	Set 2 A2	4/23/2014
Accelerometer	PCB	350C02	31338	Set 2 A3	4/24/2014
Accelerometer	PCB	350C02	31333	Set 2 A6	4/24/2014
Accelerometer	PCB	350C02	40292	Set 2 A7	4/24/2014
Accelerometer	PCB	350C02	40295	Set 2 A10	4/24/2014
Accelerometer	PCB	350C02	31336	Set 2 A11	4/24/2014
Accelerometer	PCB	350D02	43026	Set 1 A2, Set 2 A1	4/23/2014
Accelerometer	PCB	350D02	43028	Set 1 A3, Set 2 A4	4/23/2014
Accelerometer	PCB	350D02	43029	Set 1 A6, Set 2 A5	4/23/2014
Accelerometer	PCB	350D02	43179	Set 1 A7, Set 2 A8	4/22/2014
Accelerometer	PCB	350D02	43180	Set 1 A10, Set 2 A9	4/23/2014
Accelerometer	PCB	350D02	43181	Set 1 A11, Set 2 A12	4/23/2014

\* DAS was recalibrated prior to test #7

	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 311 of 832</p>	

**NESC-DEV-13-026**  
**Composite Materials**  
**Shock Test**  
  
**Data Acquisition Setups**



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
312 of 832

TEAM256 SETTINGS

TESTS 1,3,7,8

Date: 08-09-2013  
Time: 08:32:44

\*\*\*\*\* GLOBAL SETTINGS \*\*\*\*\*

Storage Path: C:\TEAMPRO  
Filename: Data  
File Number: 001  
Settings Path: C:\TEAM256  
Settings File: NES217.SET  
Export Path: D:\ATEST\NESC\_4\NEST2-17\RAWDAT-1  
Export Format: FAMOS  
Average Blocks: No  
Between Cursors: No

\*\*\*\*\* RECORDER SETTINGS \*\*\*\*\*

BE1

Frequency A : 1.0000 MHz(Internal)  
Pre Trigger : 48000 Samples (48.00 ms)  
Segment A : 1000576 Samples (1.001 s)  
Number of Blocks : 1  
Digital Event Channels : 0  
Analog Channels :

Nr.	Name	Min	Max	Units	Coup.	Amp.	Filter	Trigger
1	XXX_1	-6.000	6.000	kg's pk	GND	+	33.00 k	Off
2	NES_2	-28.85	28.85	kg's pk	DC	+	33.00 k	Basic
3	NES_3	-30.93	30.93	kg's pk	DC	+	33.00 k	Basic
4	NES_4	-31.25	31.25	kg's pk	DC	+	33.00 k	Basic
5	NES_5	-27.78	27.78	kg's pk	DC	+	33.00 k	Basic
6	NES_6	-28.04	28.04	kg's pk	DC	+	33.00 k	Basic
7	NES_7	-30.30	30.30	kg's pk	DC	+	33.00 k	Basic
8	NES_8	-30.61	30.61	kg's pk	DC	+	33.00 k	Off
9	XXX_9	-6.000	6.000	kg's pk	GND	+	33.00 k	Off
10	NES_10	-28.04	28.04	kg's pk	DC	+	33.00 k	Off
11	NES_11	-27.03	27.03	kg's pk	DC	+	33.00 k	Off
12	NES_12	-31.58	31.58	kg's pk	DC	+	33.00 k	Off
13	NES_13	-30.61	30.61	kg's pk	DC	+	33.00 k	Off
14	NES_14	-27.27	27.27	kg's pk	DC	+	33.00 k	Off
15	NES_15	-8.929	8.929	kg's pk	DC	+	33.00 k	Off
16	ROC_16	-55.56	55.56	kg's pk	DC	+	33.00 k	Off
17	ROC_17	-55.56	55.56	kg's pk	DC	+	33.00 k	Off
18	ROC_18	-55.56	55.56	kg's pk	DC	+	33.00 k	Off
19	ROC_19	-55.56	55.56	kg's pk	DC	+	33.00 k	Off
20	ROC_20	-55.56	55.56	kg's pk	DC	+	33.00 k	Off

Engineering Units Scaling

XXX\_1 0 + 1.0000 k \* Voltage (g's pk)  
NES\_2 0 + 9.6154 k \* Voltage (g's pk)  
NES\_3 0 + 10.309 k \* Voltage (g's pk)  
NES\_4 0 + 10.417 k \* Voltage (g's pk)  
NES\_5 0 + 9.2593 k \* Voltage (g's pk)  
NES\_6 0 + 9.3458 k \* Voltage (g's pk)  
NES\_7 0 + 10.101 k \* Voltage (g's pk)  
NES\_8 0 + 10.204 k \* Voltage (g's pk)  
XXX\_9 0 + 1.0000 k \* Voltage (g's pk)  
NES\_10 0 + 9.3458 k \* Voltage (g's pk)  
NES\_11 0 + 9.0090 k \* Voltage (g's pk)  
NES\_12 0 + 10.526 k \* Voltage (g's pk)  
NES\_13 0 + 10.204 k \* Voltage (g's pk)  
NES\_14 0 + 9.0909 k \* Voltage (g's pk)  
NES\_15 0 + 8.9286 k \* Voltage (g's pk)  
ROC\_16 0 + 9.2593 k \* Voltage (g's pk)  
ROC\_17 0 + 9.2593 k \* Voltage (g's pk)  
ROC\_18 0 + 9.2593 k \* Voltage (g's pk)  
ROC\_19 0 + 9.2593 k \* Voltage (g's pk)  
ROC\_20 0 + 9.2593 k \* Voltage (g's pk)

Trigger Settings :  
Auto Trigger: Off



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
313 of 832

TEAM256 SETTINGS

TESTS 2, 4, 5, 6

Date: 07-23-2013  
Time: 08:21:22

\*\*\*\*\* GLOBAL SETTINGS \*\*\*\*\*

Storage Path: C:\TEAMPRO  
Filename: Data  
File Number: 001  
Settings Path: C:\TEAM256  
Settings File: NES216.SET  
Export Path: D:\ATEST\NESC\_4\NEST2-16\RAWDAT-1  
Export Format: FAMOS  
Average Blocks: No  
Between Cursors: No

\*\*\*\*\* RECORDER SETTINGS \*\*\*\*\*

BE1


Frequency A : 1.0000 MHz (Internal)  
Pre Trigger : 48000 Samples (48.00 ms)  
Segment A : 1000576 Samples (1.001 s)  
Number of Blocks : 1  
Digital Event Channels : 0  
Analog Channels :

Nr.	Name	Min	Max	Units	Coup.	Amp.	Filter	Trigger
1	XXX_1	-6.000	6.000	kg's pk	GND	+	33.00 k	Off
2	NES_2	-30.93	30.93	kg's pk	DC	+	33.00 k	Basic
3	NES_3	-31.58	31.58	kg's pk	DC	+	33.00 k	Basic
4	NES_4	-30.00	30.00	kg's pk	DC	+	33.00 k	Basic
5	NES_5	-31.25	31.25	kg's pk	DC	+	33.00 k	Basic
6	NES_6	-30.30	30.30	kg's pk	DC	+	33.00 k	Basic
7	NES_7	-28.57	28.57	kg's pk	DC	+	33.00 k	Basic
8	NES_8	-28.30	28.30	kg's pk	DC	+	33.00 k	Basic
9	XXX_9	-6.000	6.000	kg's pk	GND	+	33.00 k	Off
10	NES_10	-30.61	30.61	kg's pk	DC	+	33.00 k	Off
11	NES_11	-31.58	31.58	kg's pk	DC	+	33.00 k	Off
12	NES_12	-28.30	28.30	kg's pk	DC	+	33.00 k	Off
13	NES_13	-27.78	27.78	kg's pk	DC	+	33.00 k	Off
14	NES_14	-30.61	30.61	kg's pk	DC	+	33.00 k	Off
15	NES_15	-8.929	8.929	kg's pk	DC	+	33.00 k	Off
16	ROC_16	-55.56	55.56	kg's pk	DC	+	33.00 k	Off
17	ROC_17	-55.56	55.56	kg's pk	DC	+	33.00 k	Off
18	ROC_18	-55.56	55.56	kg's pk	DC	+	33.00 k	Off
19	ROC_19	-55.56	55.56	kg's pk	DC	+	33.00 k	Off
20	ROC_20	-55.56	55.56	kg's pk	DC	+	33.00 k	Off

Engineering Units Scaling


XXX_1	0 +	1.0000	k * Voltage (g's pk)
NES_2	0 +	10.309	k * Voltage (g's pk)
NES_3	0 +	10.526	k * Voltage (g's pk)
NES_4	0 +	10.000	k * Voltage (g's pk)
NES_5	0 +	10.417	k * Voltage (g's pk)
NES_6	0 +	10.101	k * Voltage (g's pk)
NES_7	0 +	9.5238	k * Voltage (g's pk)
NES_8	0 +	9.4340	k * Voltage (g's pk)
XXX_9	0 +	1.0000	k * Voltage (g's pk)
NES_10	0 +	10.204	k * Voltage (g's pk)
NES_11	0 +	10.526	k * Voltage (g's pk)
NES_12	0 +	9.4340	k * Voltage (g's pk)
NES_13	0 +	9.2593	k * Voltage (g's pk)
NES_14	0 +	10.204	k * Voltage (g's pk)
NES_15	0 +	8.9286	k * Voltage (g's pk)
ROC_16	0 +	9.2593	k * Voltage (g's pk)
ROC_17	0 +	9.2593	k * Voltage (g's pk)
ROC_18	0 +	9.2593	k * Voltage (g's pk)
ROC_19	0 +	9.2593	k * Voltage (g's pk)
ROC_20	0 +	9.2593	k * Voltage (g's pk)

Trigger Settings :  
Auto Trigger: Off

	<b>NASA Engineering and Safety Center      Technical Assessment Report</b>	Document #: <b>NESC-RP-          12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on          Composite Materials Subjected to Pyroshock Loading</b>		Page #: 314 of 832	

#### **B4. Group III (Sandwich Panel Tests)**

The test report documenting the test results for the Group III composite sandwich panel tests are documented in the attachment below.

	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 315 of 832	

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



January 9, 2015

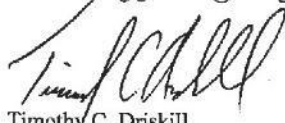
Reply to Attn of: ET40-15-003

TO: EV32/David O. Ordway  
FROM: ET40/Timothy C. Driskill  
SUBJECT: Composite Materials Pyroshock Development Test, Group III – Tests 19 to 28 and Group I Retests 1 to 4, NESC-DEV-13-037  
REF: ED73.1.

The solid and sandwich composite panels test articles were tested in the ET40 Pyrotechnic Shock Facility, building 4619, room 170. Testing was completed on June 11, 2014. The test was run in accordance with Test and Checkout Procedure, (TCP) NESC-DEV-13-037. Ten sandwich composite panels were tested and 4 solid composite panels were retested. A total of 14 tests were performed.

The accelerometer test setup is shown in appendix A of the TCP and in the photographs section of this report. Three composite and 2 aluminum LSC panels did not sever. Four tests noted a small degree of post-test torque loss to some bolts or accelerometers.


Please direct any questions or comments regarding this test to Mr. Craig Garrison at (256) 544-7197 or [craig.garrison@nasa.gov](mailto:craig.garrison@nasa.gov).



Timothy C. Driskill  
Branch Chief  
Structural Dynamics Test Branch

Enclosure  
cc:

ET01/File (w/o enclosure)  
ET40/File  
C105/Steve Gentz  
ES22/David Parsons

	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 316 of 832	

**NESC-DEV-13-037**  
**Composite Materials**  
**Shock Test**  
  
**General Test Setup**





# NASA Engineering and Safety Center Technical Assessment Report

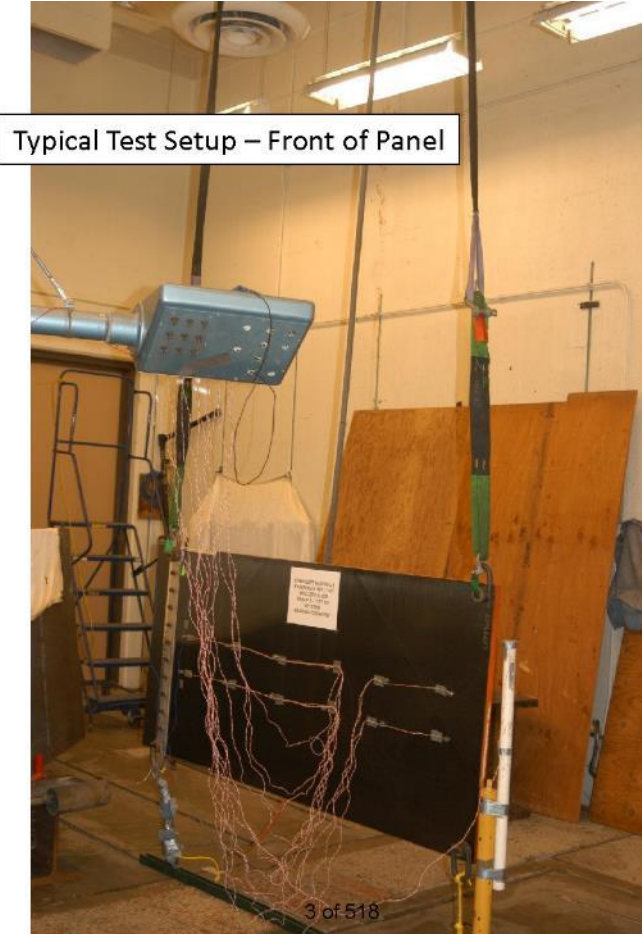
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
317 of 832





# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**


Version:  
**1.0**

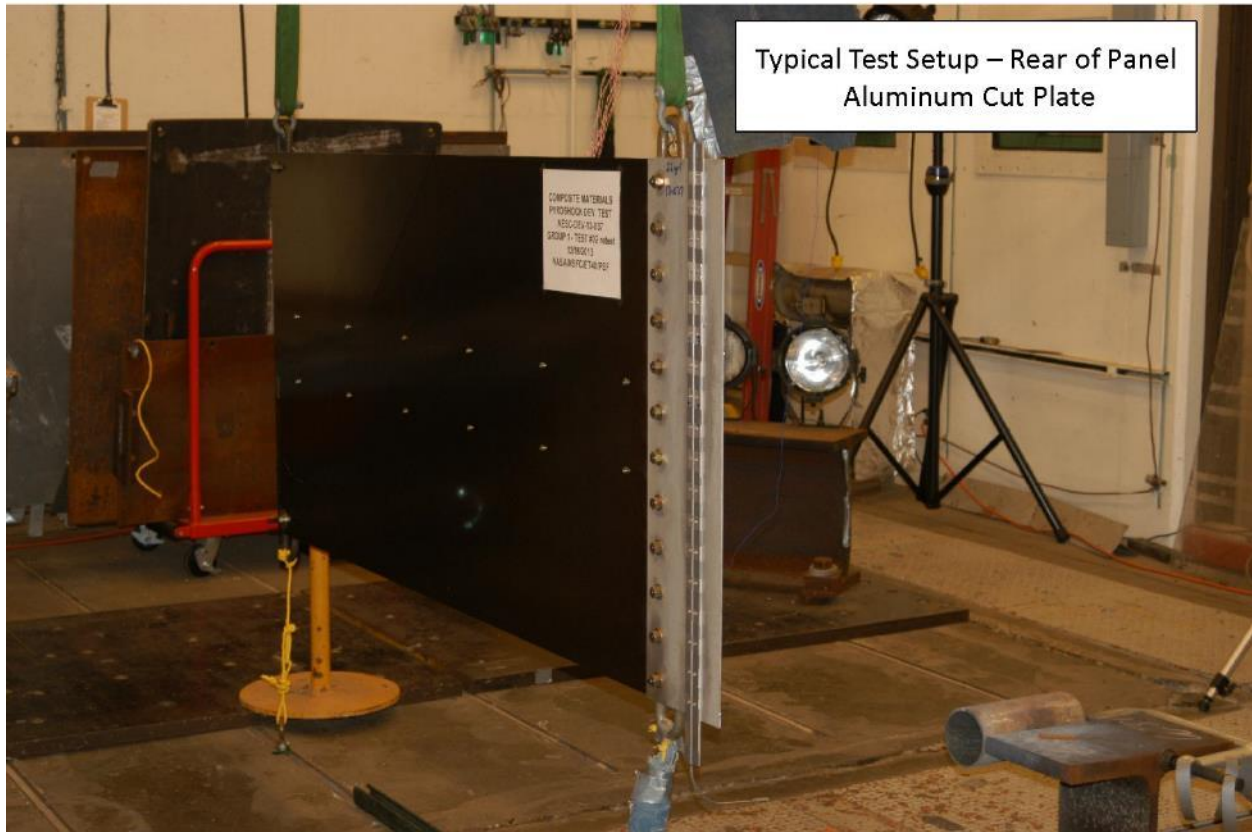
Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**


Page #:  
318 of 832



	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 319 of 832</p>	



5 of 518

	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 320 of 832</p>	



6 of 518



# NASA Engineering and Safety Center Technical Assessment Report

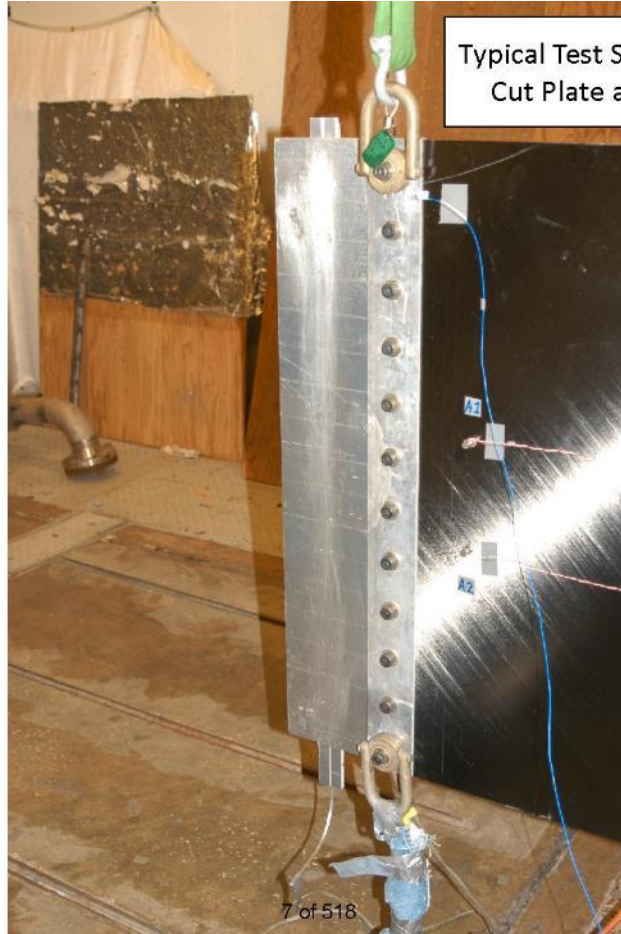
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
321 of 832





# NASA Engineering and Safety Center Technical Assessment Report

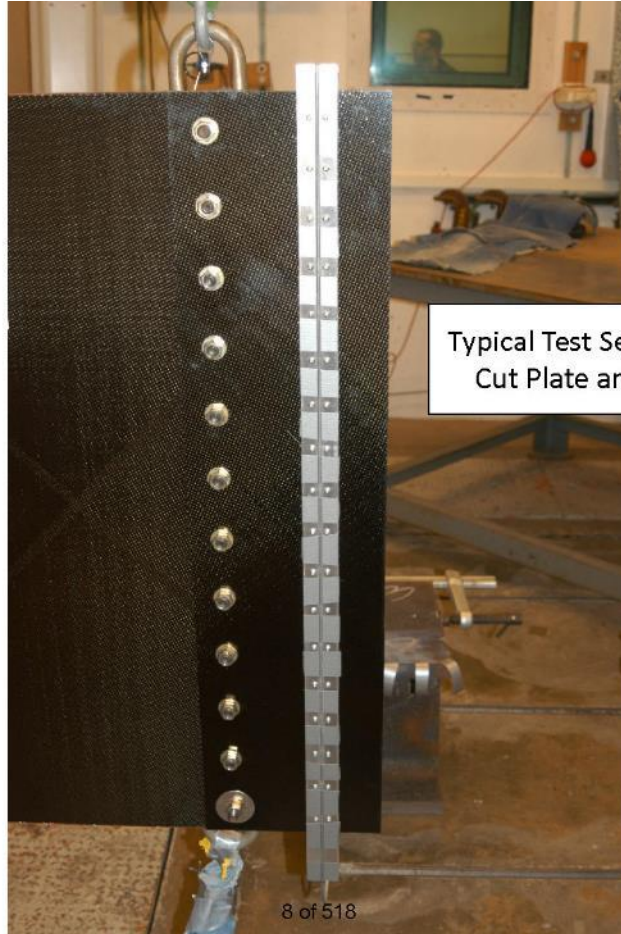
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
322 of 832



Typical Test Setup – Rear of Panel  
Cut Plate and LSC Installation

8 of 518



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**


Title:

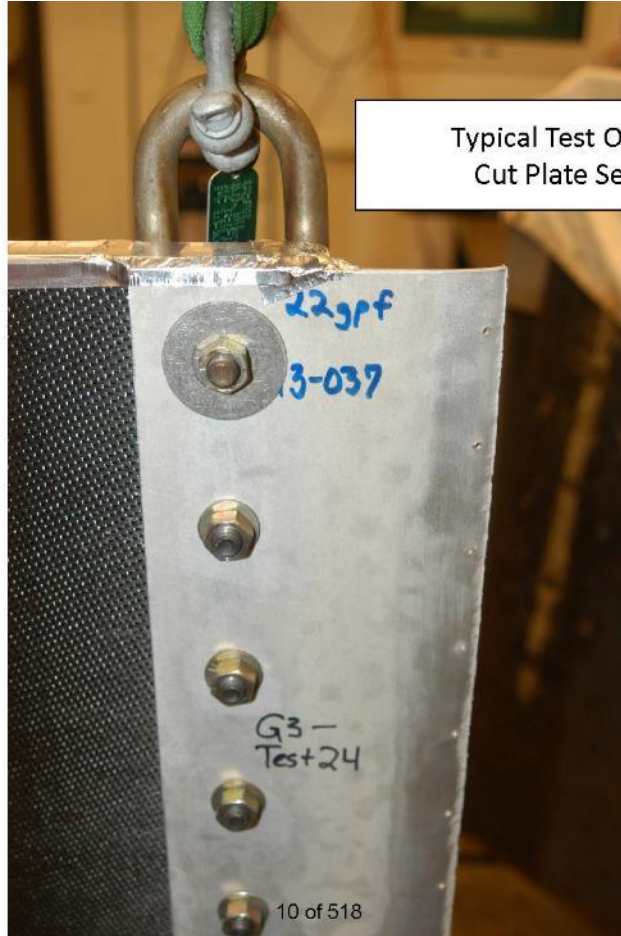
**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
323 of 832




9 of 518

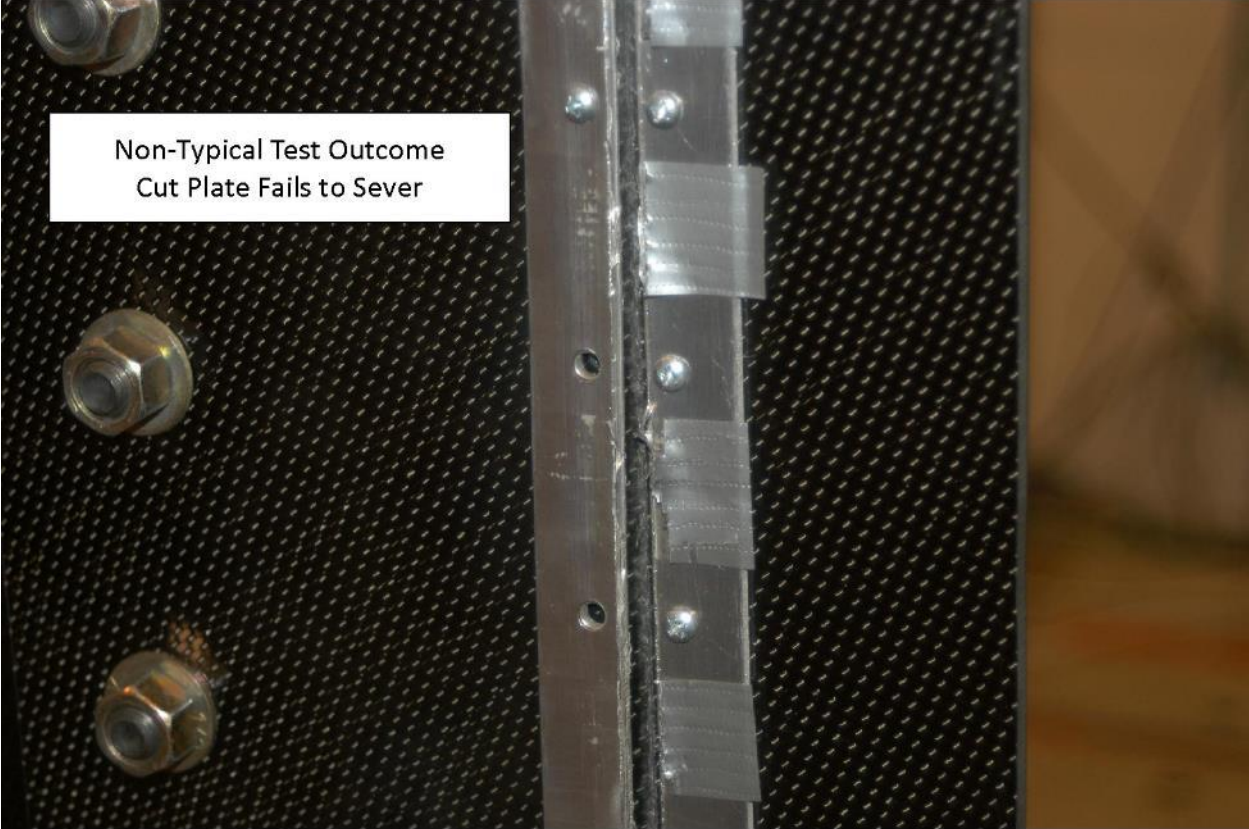
	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 324 of 832</p>	



Typical Test Outcome  
Cut Plate Severed



	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 325 of 832</p>	





# NASA Engineering and Safety Center Technical Assessment Report

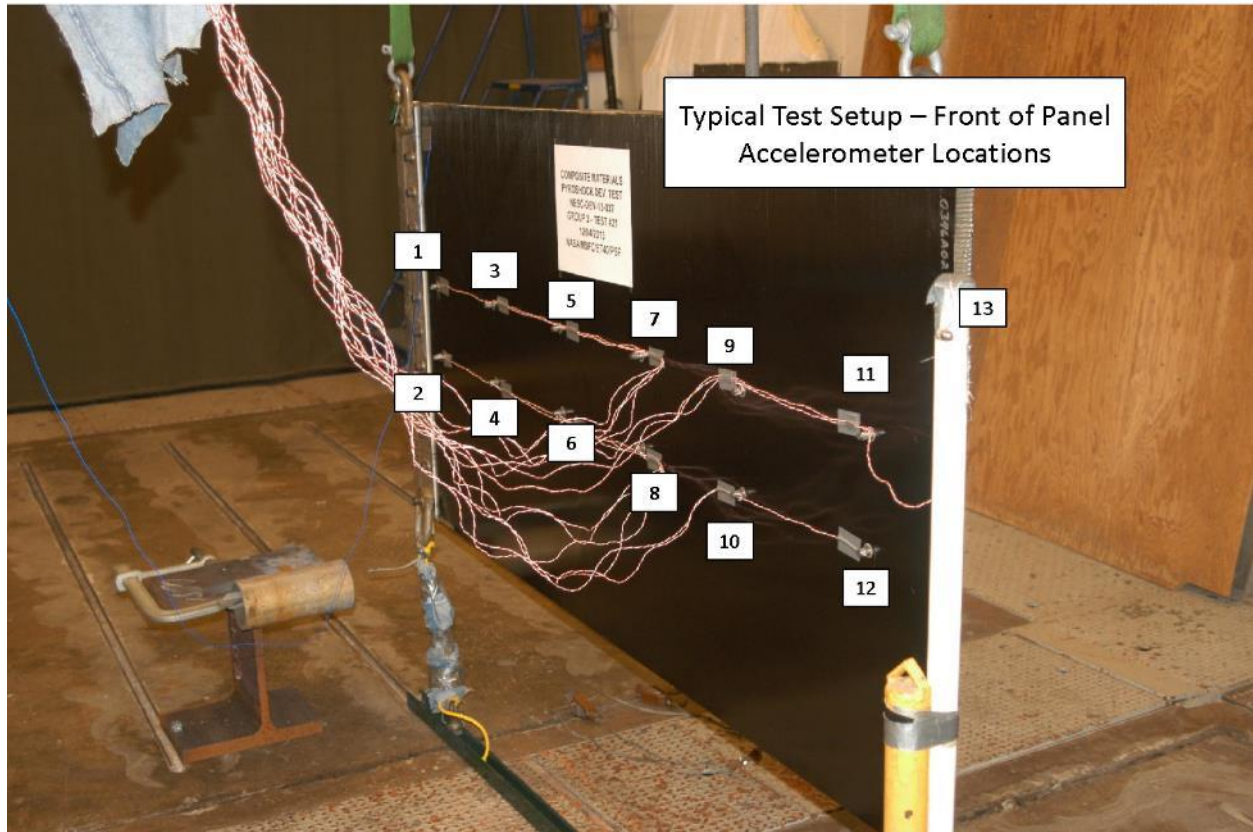
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
326 of 832



12 of 518



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
327 of 832

Test Matrix As Run			
Test	Date	Panel ID	Test ID
1	10-31-13	0346A019	Group 3 - Test 19
2	11-19-13	0346A020	Group 3 - Test 20
3	11-25-13	0346A022	Group 3 - Test 22
4	12-4-13	0346A021	Group 3 - Test 21
5	12-12-13	0320A004	Group 1 - Test 4 Retest
6	12-16-13	0320A002	Group 1 - Test 2 Retest
7	12-18-13	0346A026	Group 3 - Test 26
8	1-16-14	0326A010	Group 1 - Test 10 Retest
9	1-23-14	0326A009	Group 1 - Test 9 Retest
10	1-24-14	0346A028	Group 3 - Test 28
11	4-18-14	0346A023	Group 3 - Test 23
12	4-22-14	0346A024	Group 3 - Test 24
13	6-10-14	0346A025	Group 3 - Test 25
14	6-11-14	0346A027	Group 3 - Test 27

13 of 518



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
328 of 832

Panel Location	Set 1 Accelerometers	Set 2 Accelerometers
1	350C02 31334	350D02 43026
2	350D02 43026	350C02 31340
3	350D02 43028	350C02 31338
4	350C02 31331	350D02 43028
5	350C02 31328	350D02 43029 350D02 43373 *
6	350D02 43029 350D02 43373 *	350C02 31333
7	350D02 43179	350C02 40292
8	350C02 31351	350D02 43179
9	350C02 31330	350D02 43180
10	350D02 43180	350C02 40295
11	350D02 43181	350C02 31336
12	350C02 40274	350D02 43181
13	350B02 11439	350B02 11439
Set 1 used in tests 1, 4, 6, 8, 11, 13, and 14 Set 2 used in tests 2, 3, 5, 7, 9, 10, and 12 * 43029 replaced with 43373 prior to test 8		



# NASA Engineering and Safety Center Technical Assessment Report

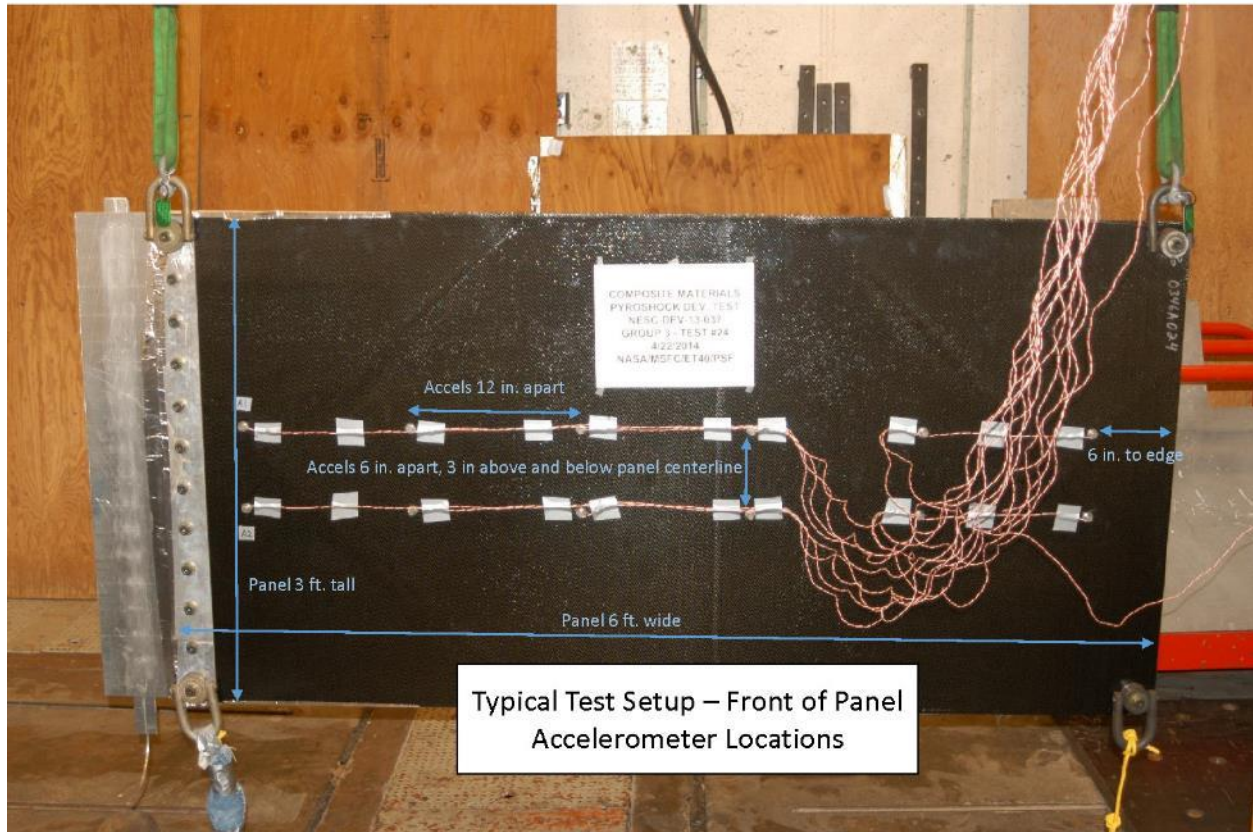
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**


Title:

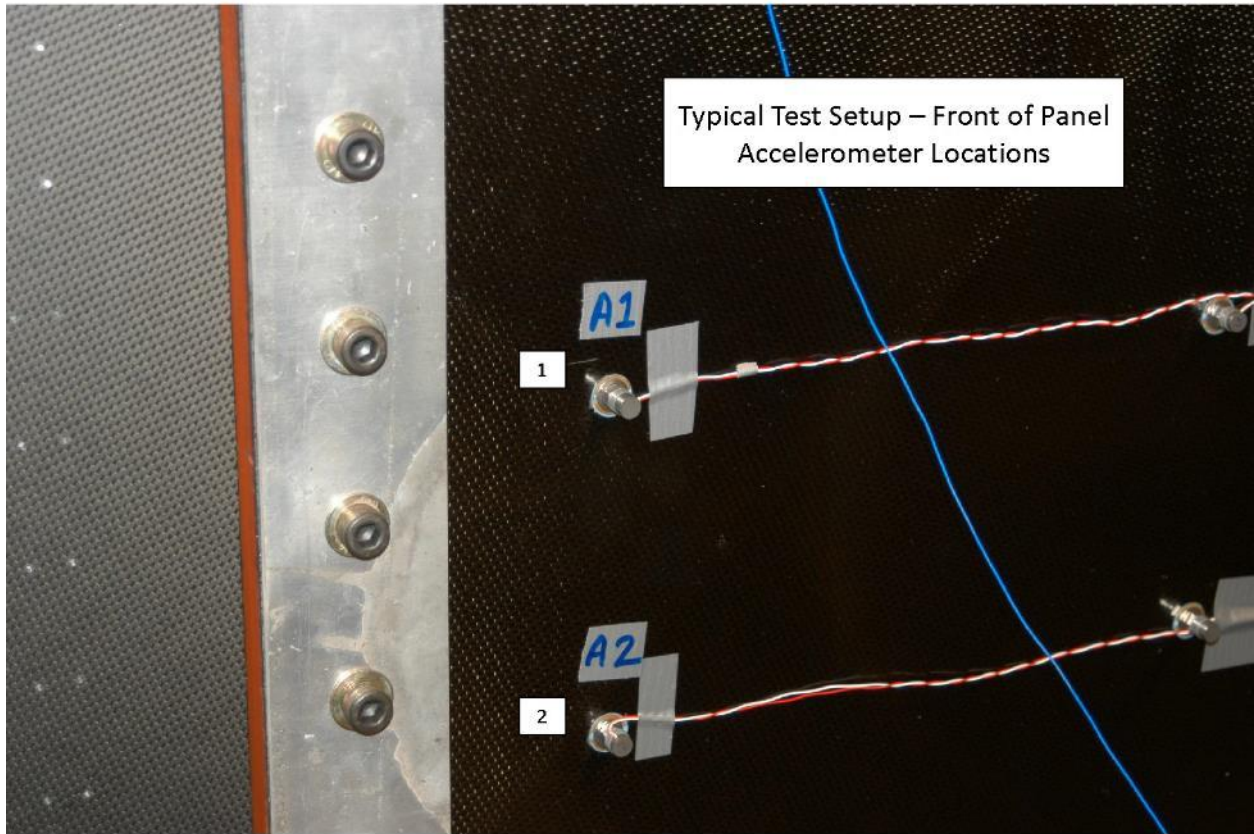
**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**


Page #:  
329 of 832

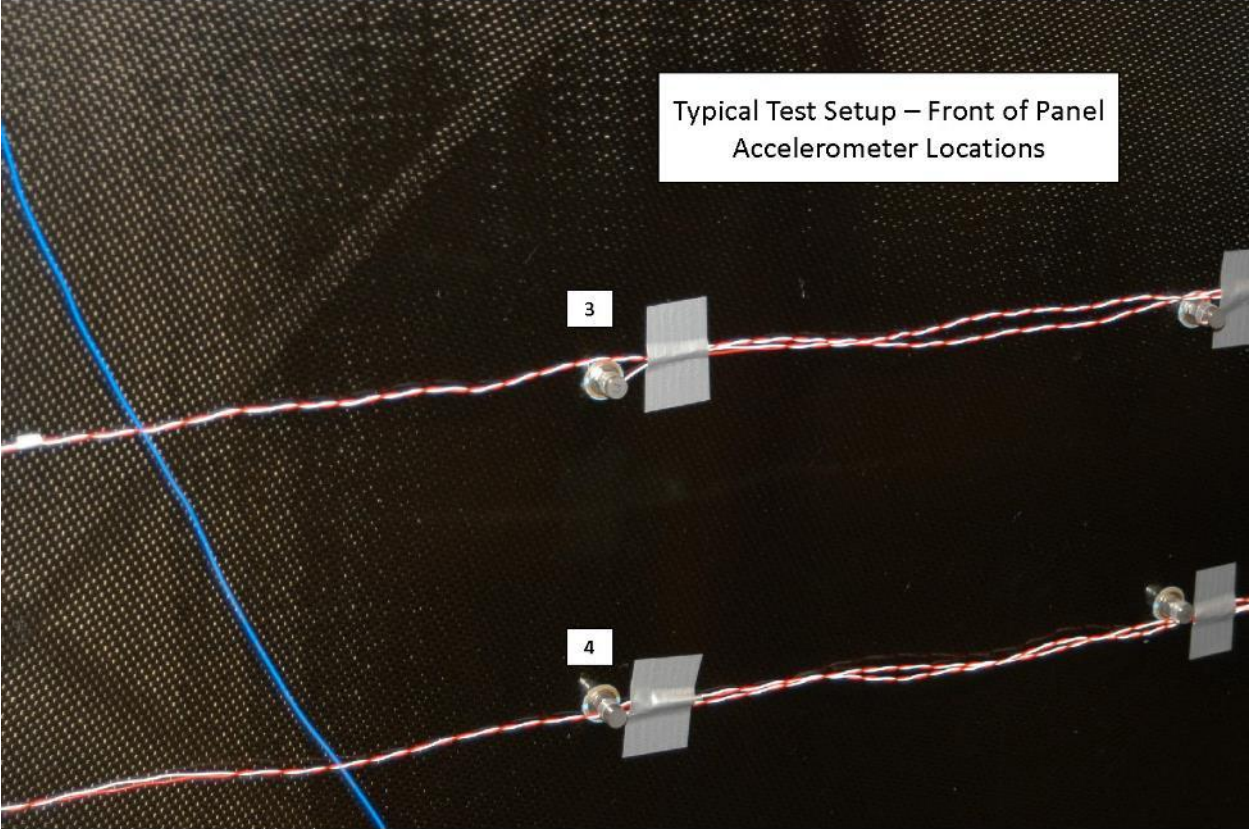



15 of 518

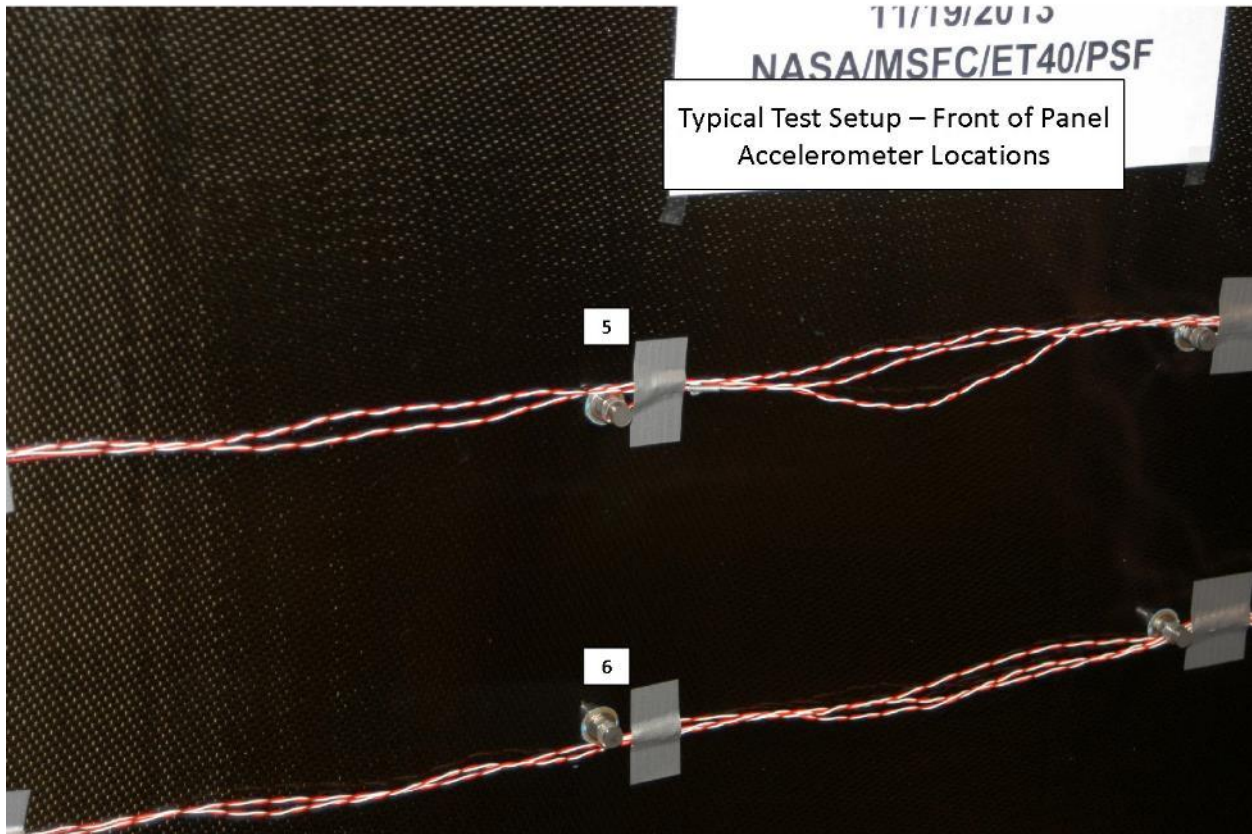
	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 330 of 832</p>	




	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 331 of 832</p>	

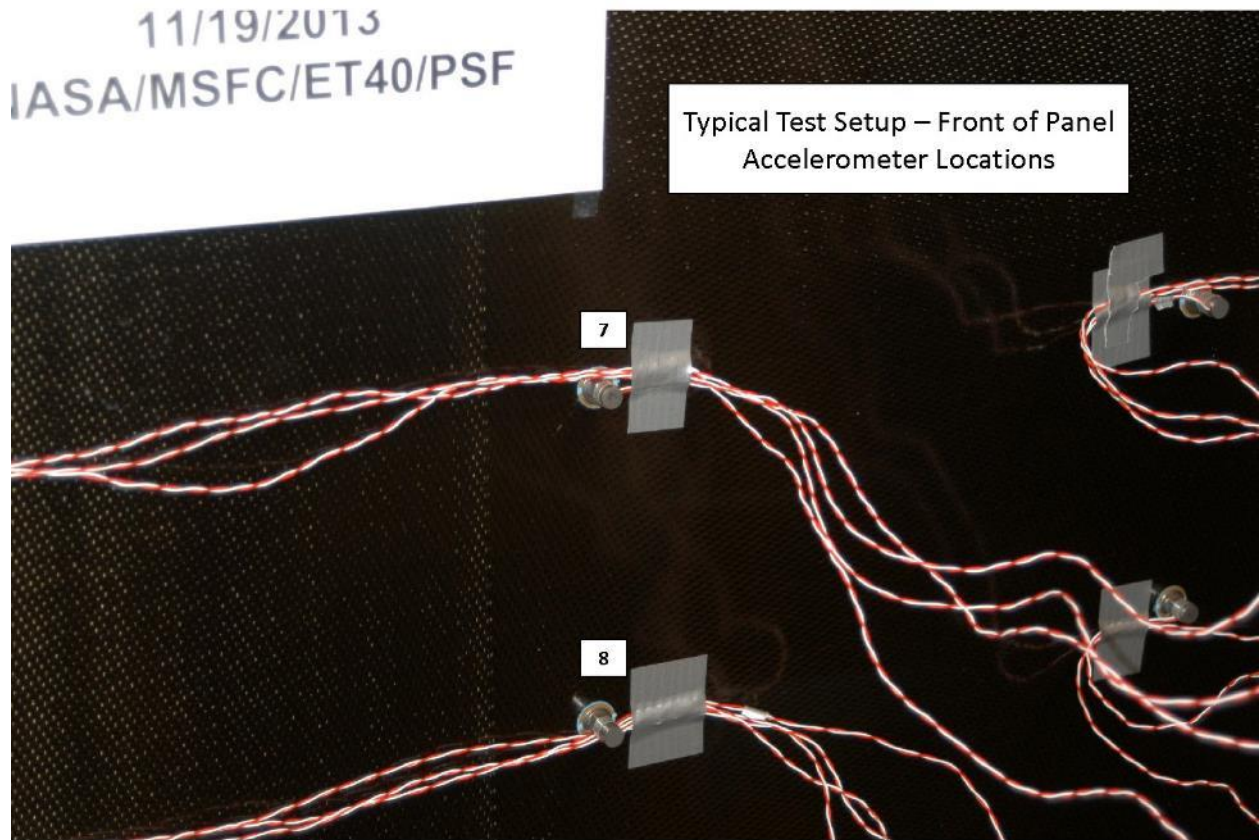



	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 332 of 832</p>	

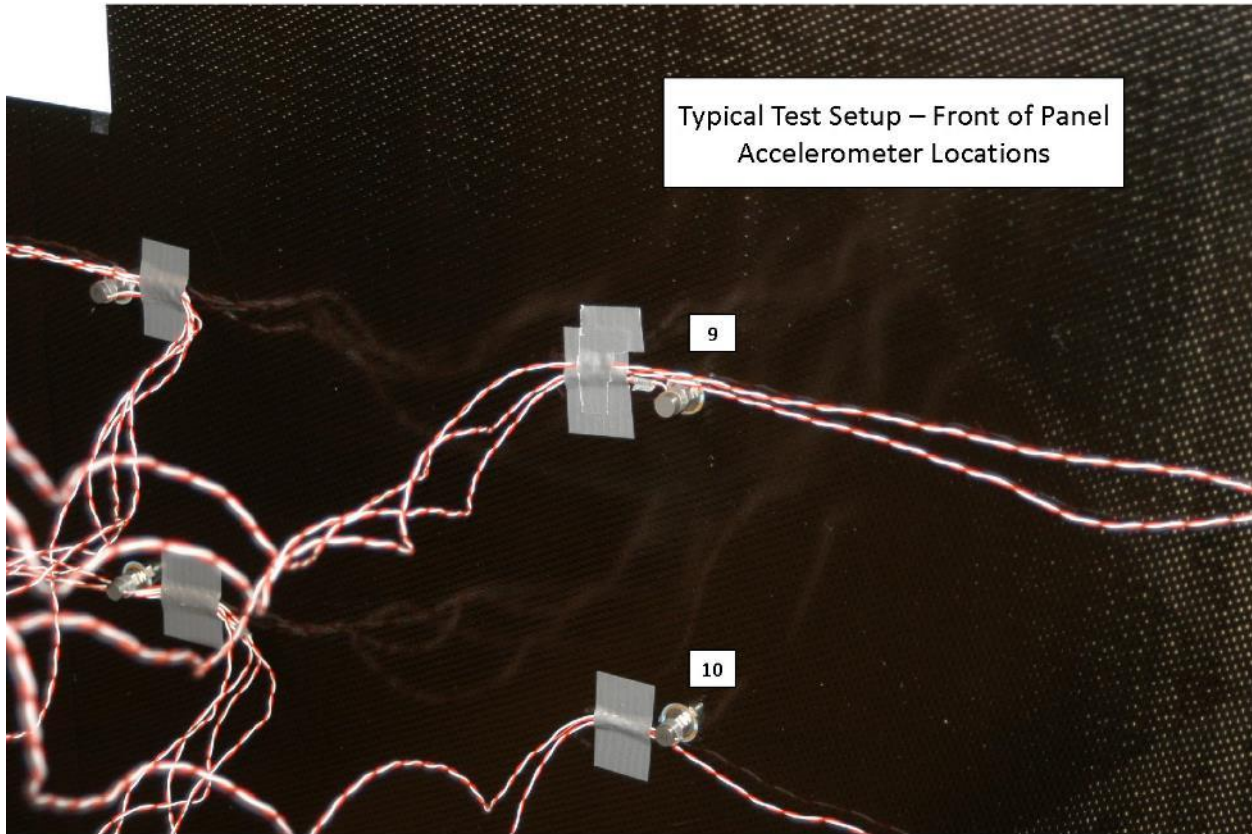





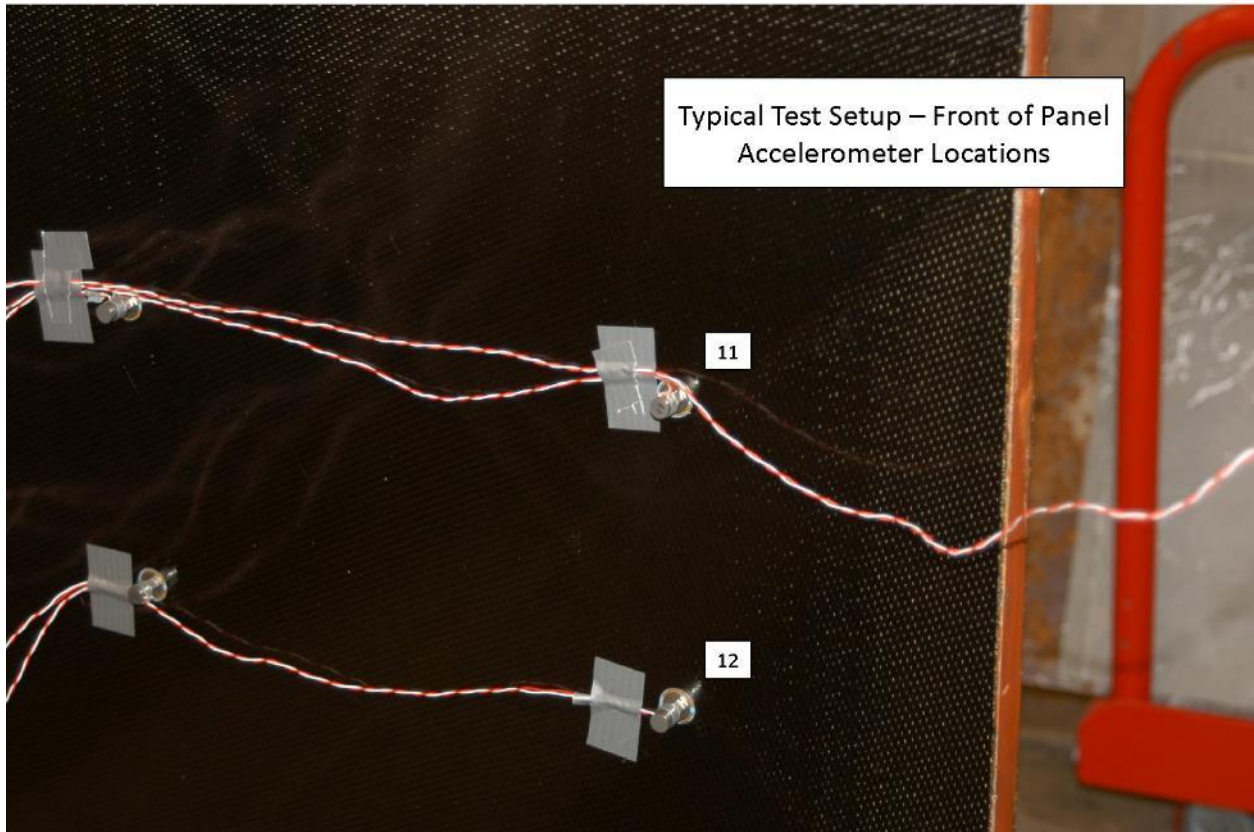
	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 333 of 832</p>	




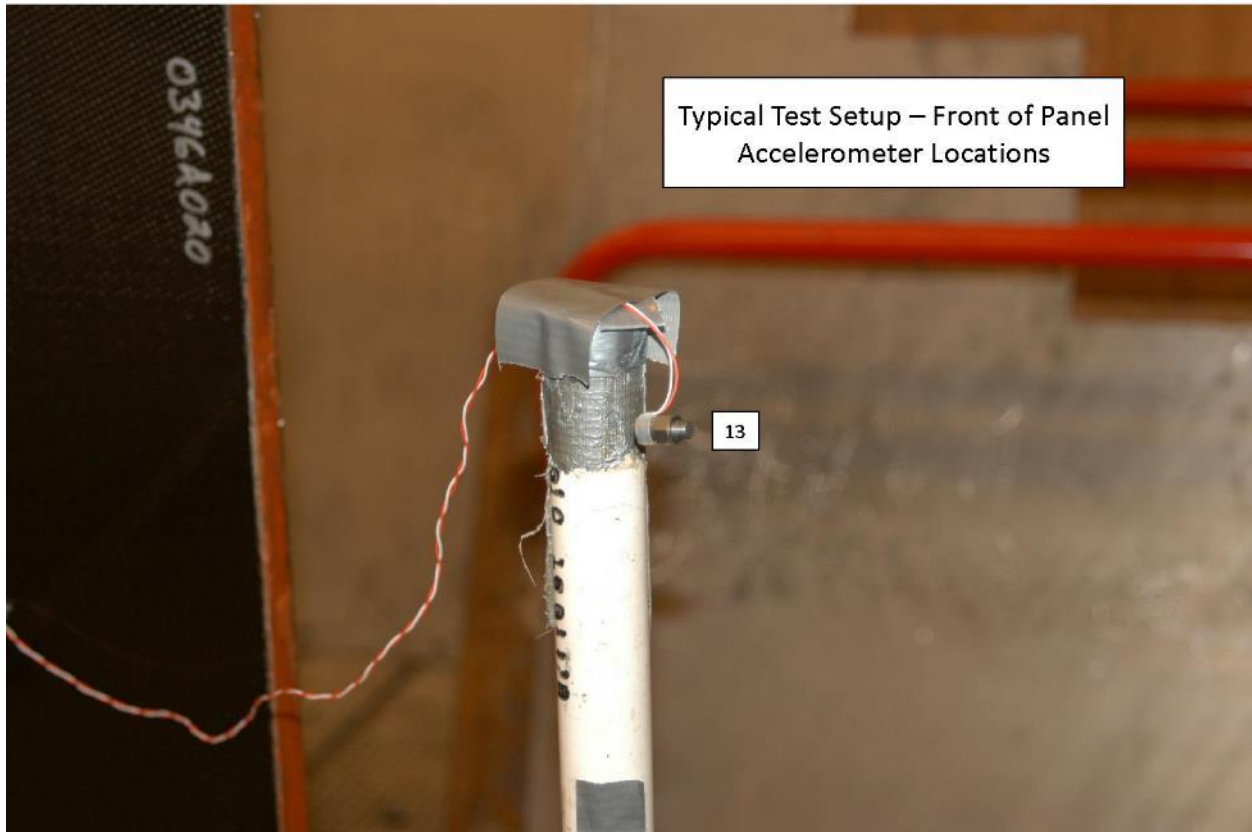
	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 334 of 832</p>	




	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 335 of 832</p>	




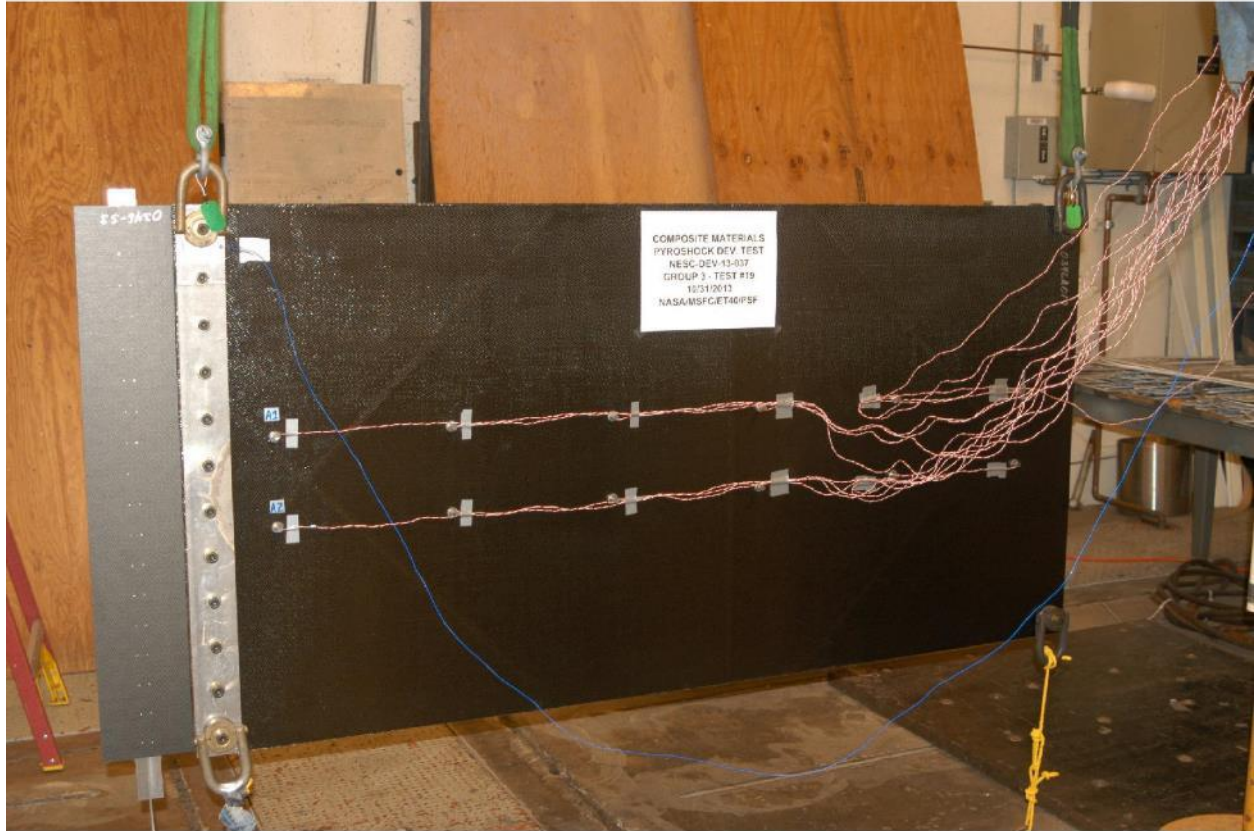
	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 336 of 832</p>	



	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 337 of 832	

**NESC-DEV-13-037**  
**Composite Materials**  
**Shock Test**  
  
**Test #1 Setup**

	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 338 of 832</p>	



24 of 518



# NASA Engineering and Safety Center Technical Assessment Report

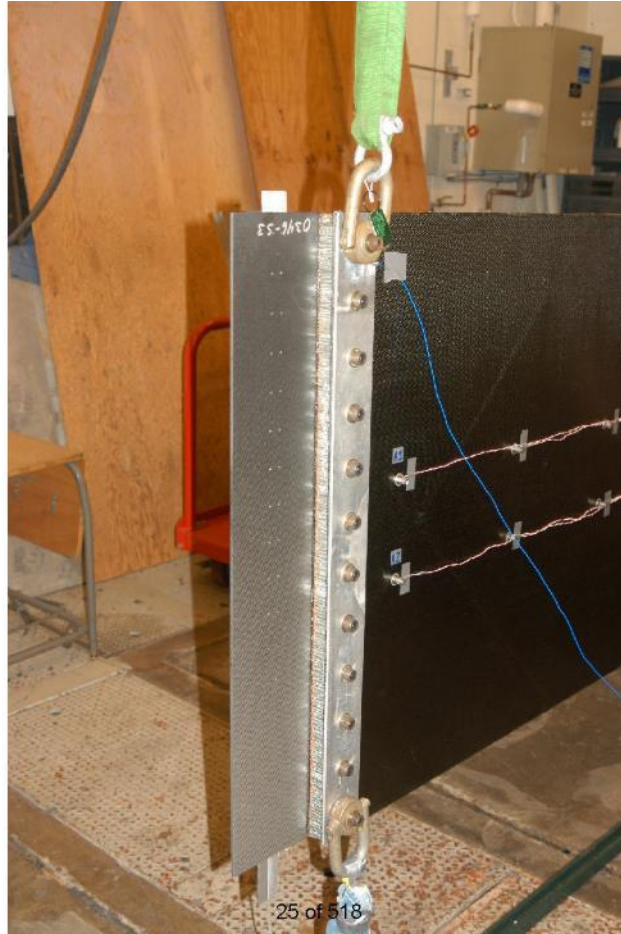
Document #:  
**NESC-RP-  
12-00783**


Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**


Page #:  
339 of 832



	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 340 of 832</p>	







	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 341 of 832</p>	

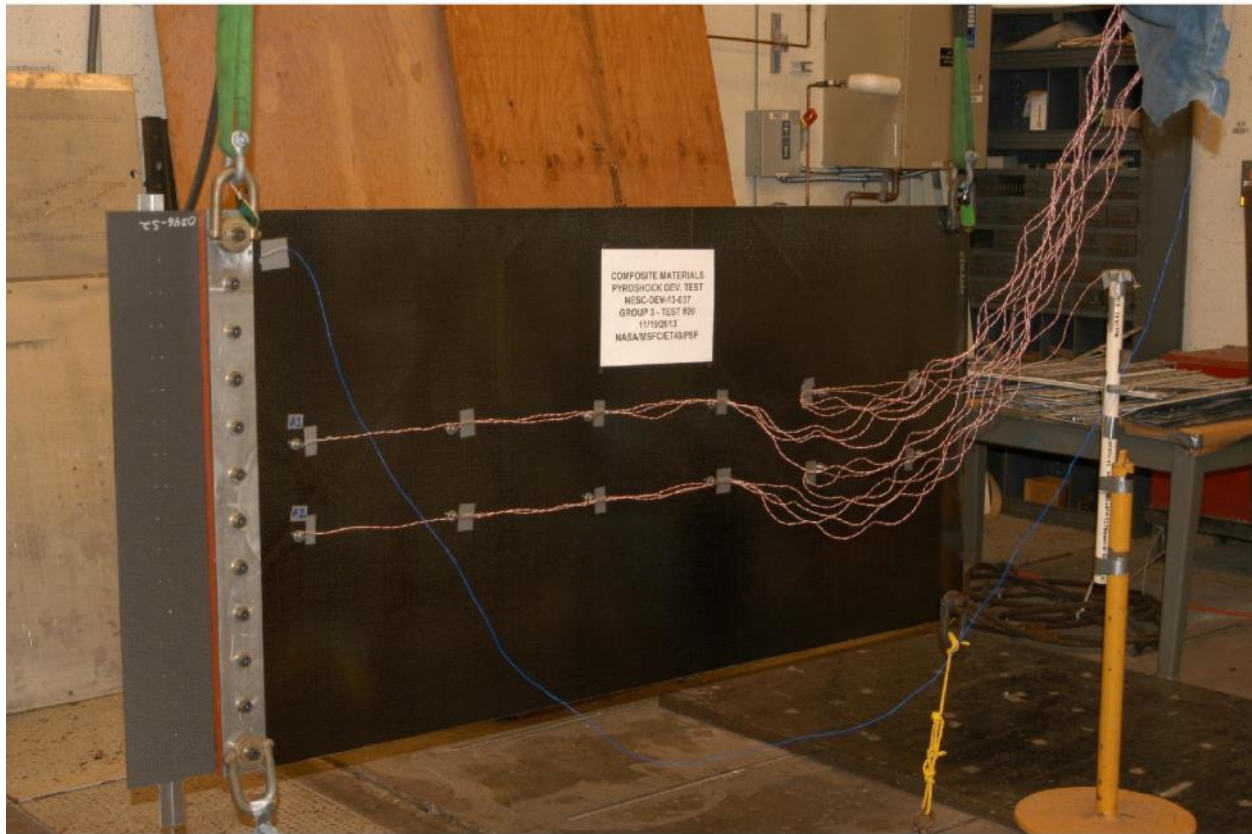


27 of 318

	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP- 12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 342 of 832	

**NESC-DEV-13-037  
Composite Materials  
Shock Test  
  
Test #2 Setup**

	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 343 of 832</p>	





# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**


Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**


Page #:  
344 of 832




30 of 518

	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 345 of 832</p>	




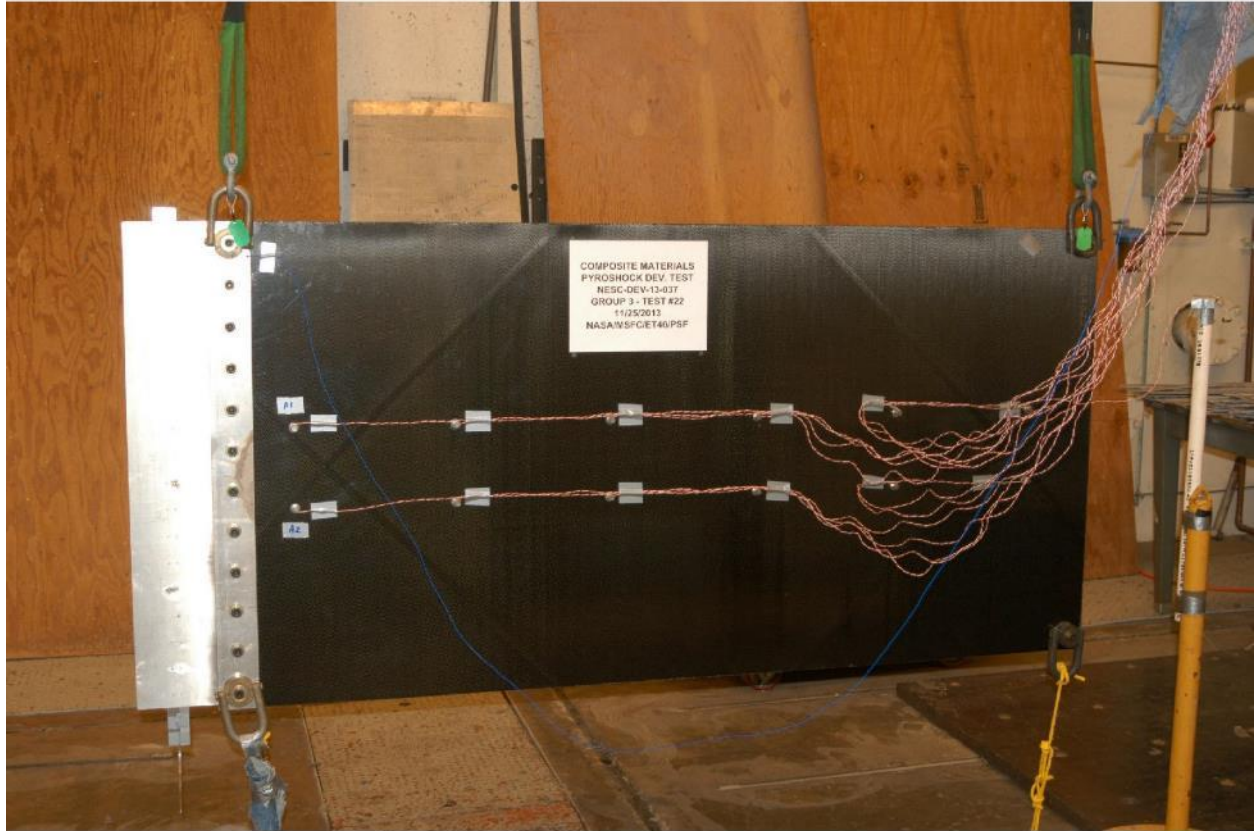
	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 346 of 832</p>	



	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 347 of 832	

**NESC-DEV-13-037**  
**Composite Materials**  
**Shock Test**  
  
**Test #3 Setup**

	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 348 of 832</p>	



34 of 518





# NASA Engineering and Safety Center Technical Assessment Report

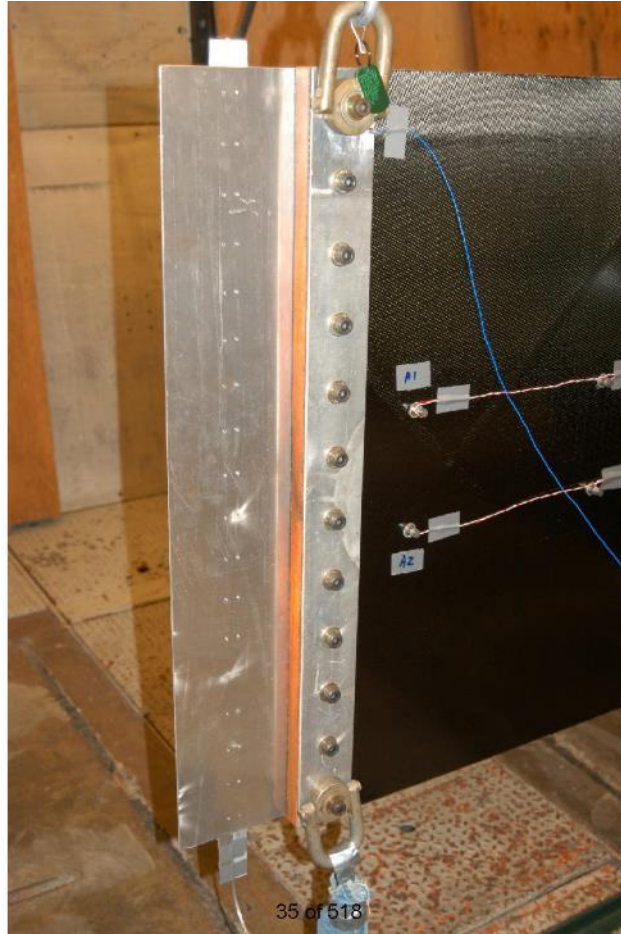
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
349 of 832





# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
350 of 832





# NASA Engineering and Safety Center Technical Assessment Report

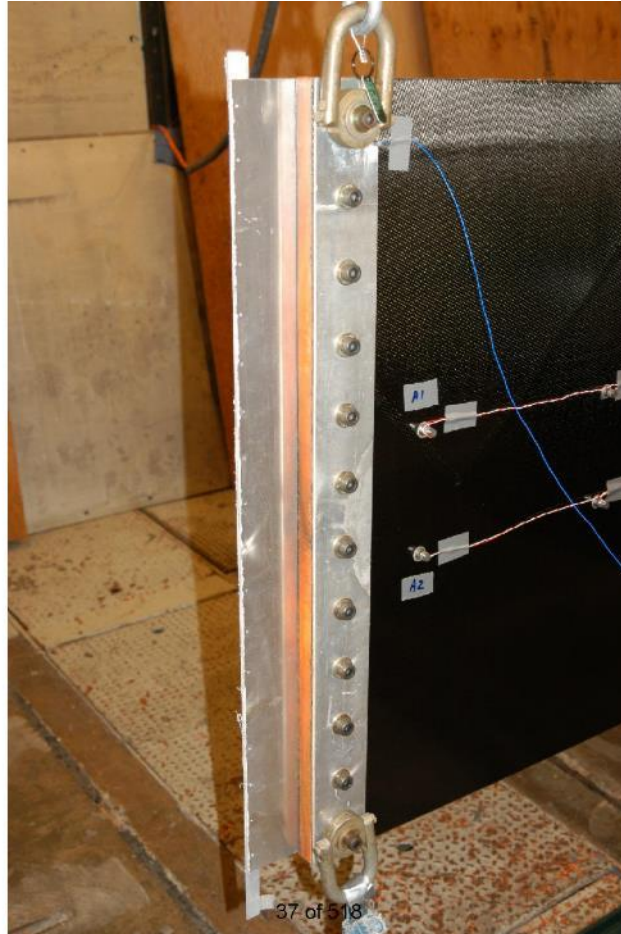
Document #:  
**NESC-RP-  
12-00783**


Version:  
**1.0**

Title:


**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
351 of 832



	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 352 of 832</p>	

**NESC-DEV-13-037**  
**Composite Materials**  
**Shock Test**  
  
**Test #4 Setup**

	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 353 of 832</p>	





# NASA Engineering and Safety Center Technical Assessment Report

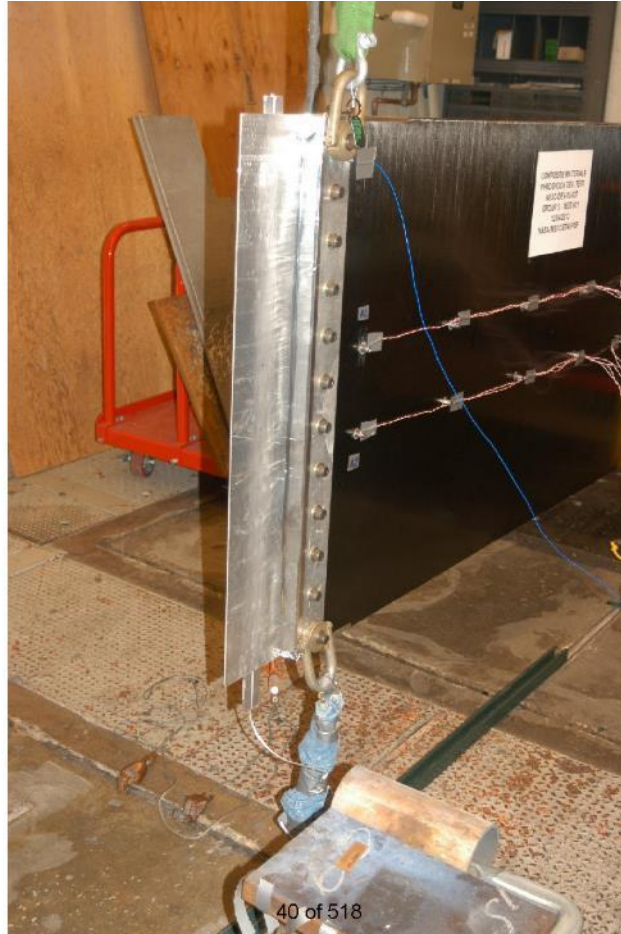
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
354 of 832



40 of 518



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
355 of 832





# NASA Engineering and Safety Center Technical Assessment Report

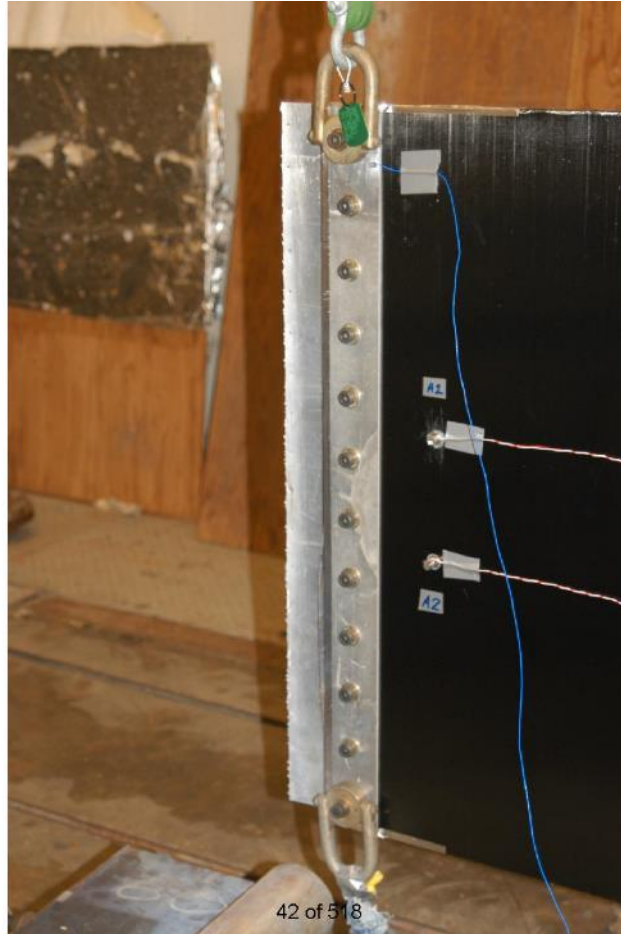
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:


**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
356 of 832




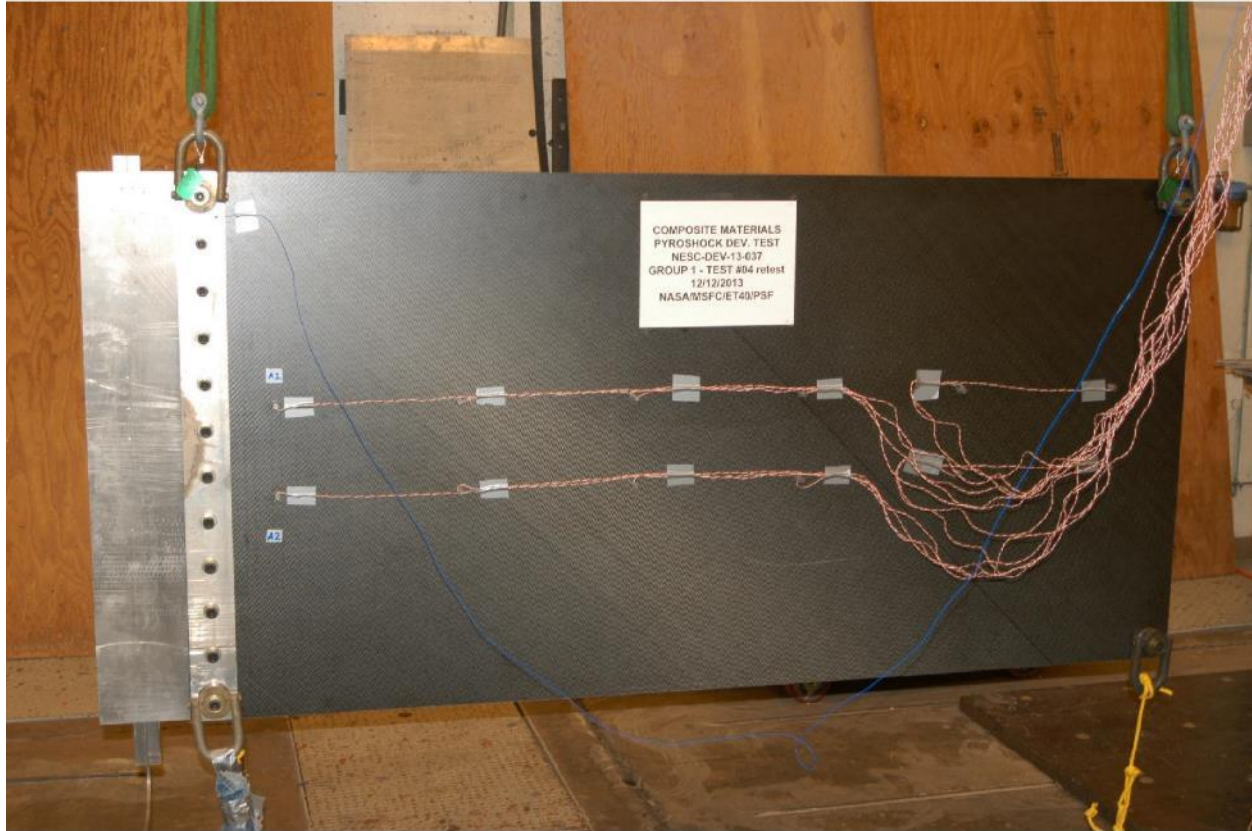
42 of 518




	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 357 of 832</p>	


**NESC-DEV-13-037**  
**Composite Materials**  
**Shock Test**  
  
**Test #5 Setup**

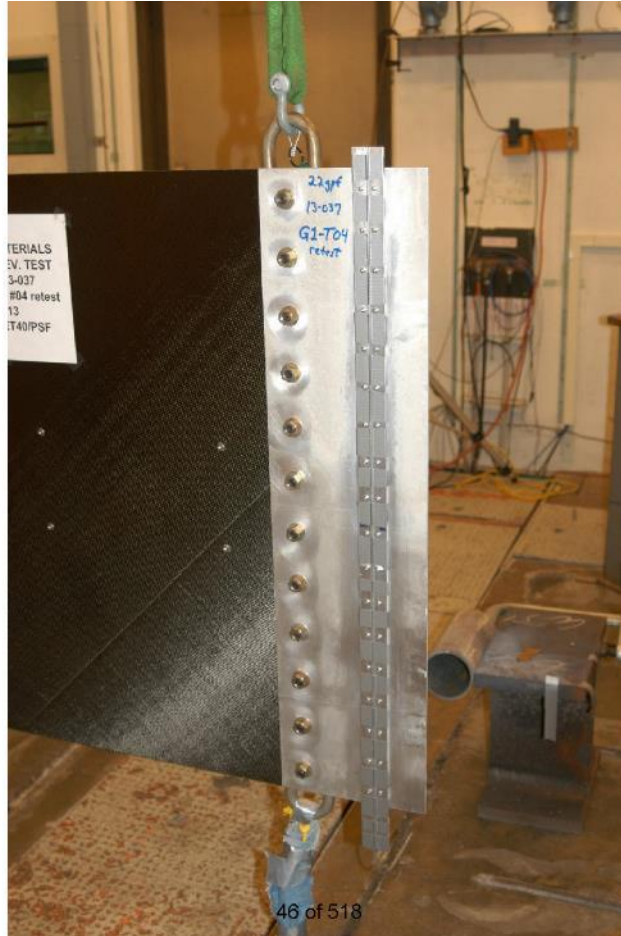
	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 358 of 832</p>	




	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 359 of 832</p>	

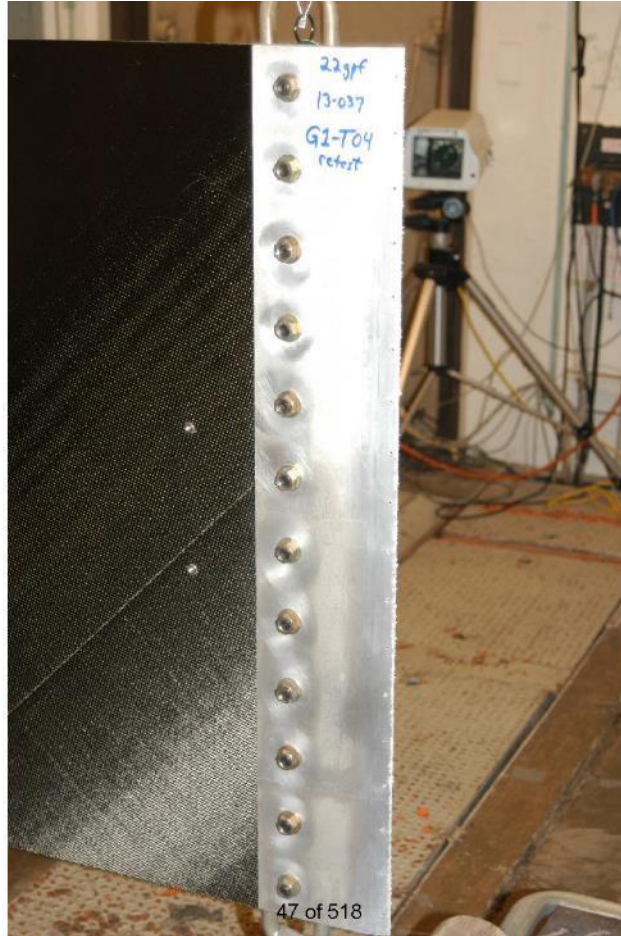



	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 360 of 832</p>	




46 of 518

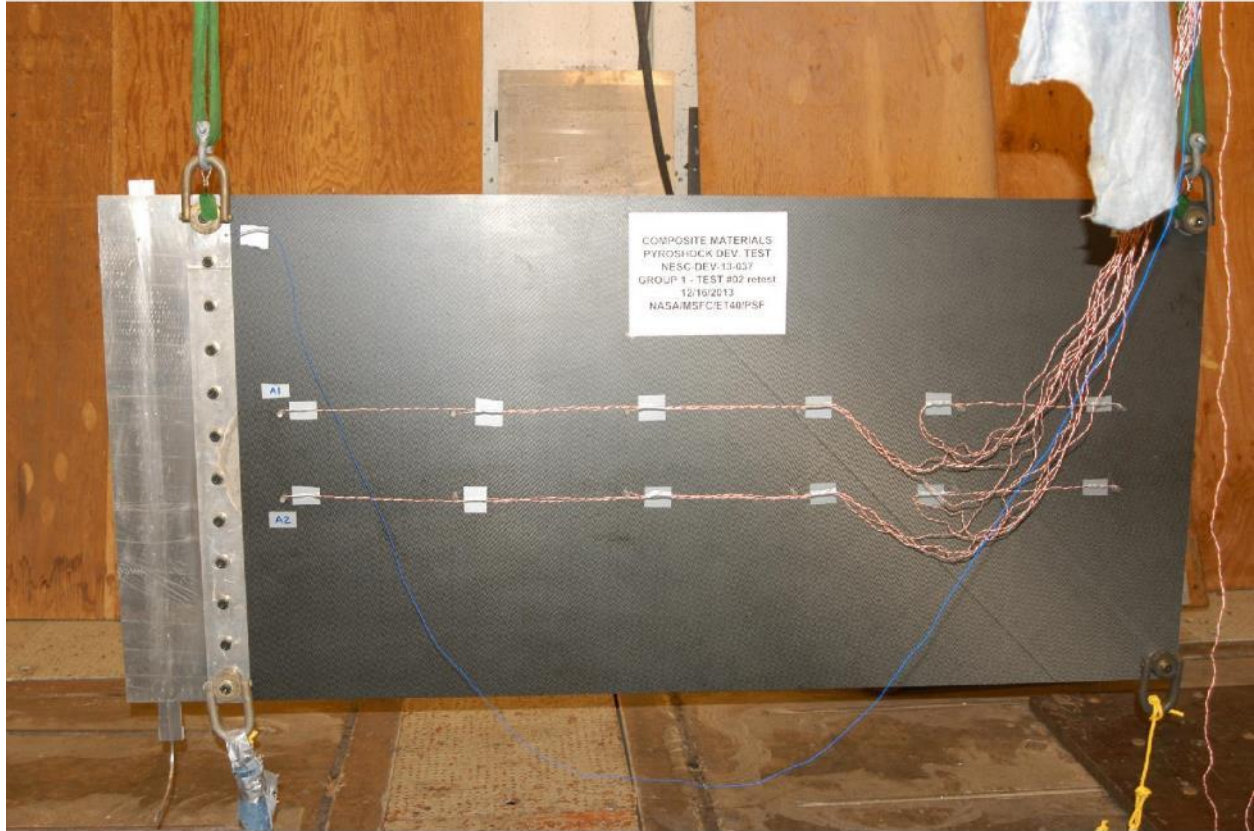
	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 361 of 832	



	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 362 of 832</p>	

**NESC-DEV-13-037**  
**Composite Materials**  
**Shock Test**  
  
**Test #6 Setup**

	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 363 of 832	





# NASA Engineering and Safety Center Technical Assessment Report

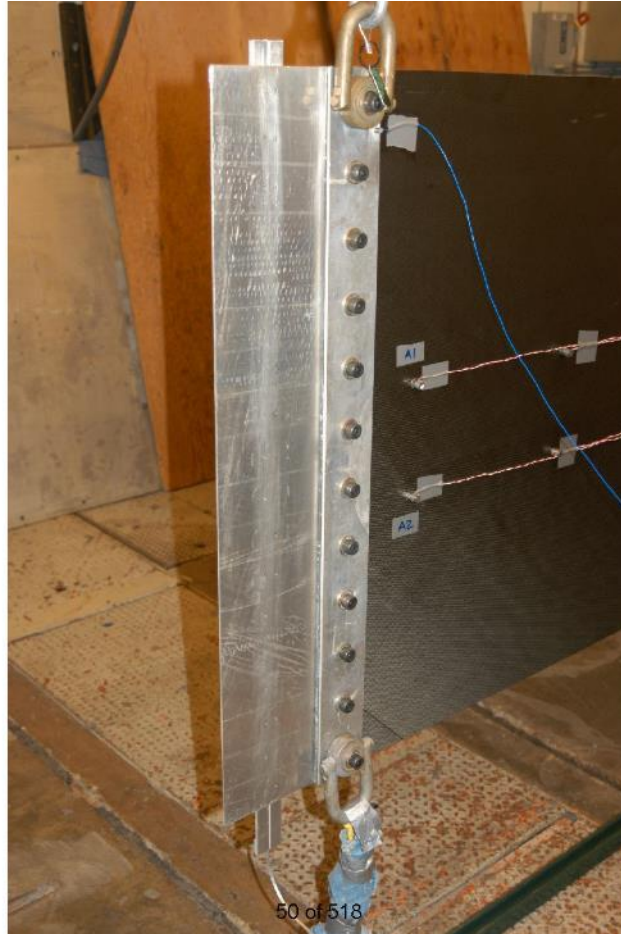
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**


Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
364 of 832







	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 365 of 832</p>	




51 of 518

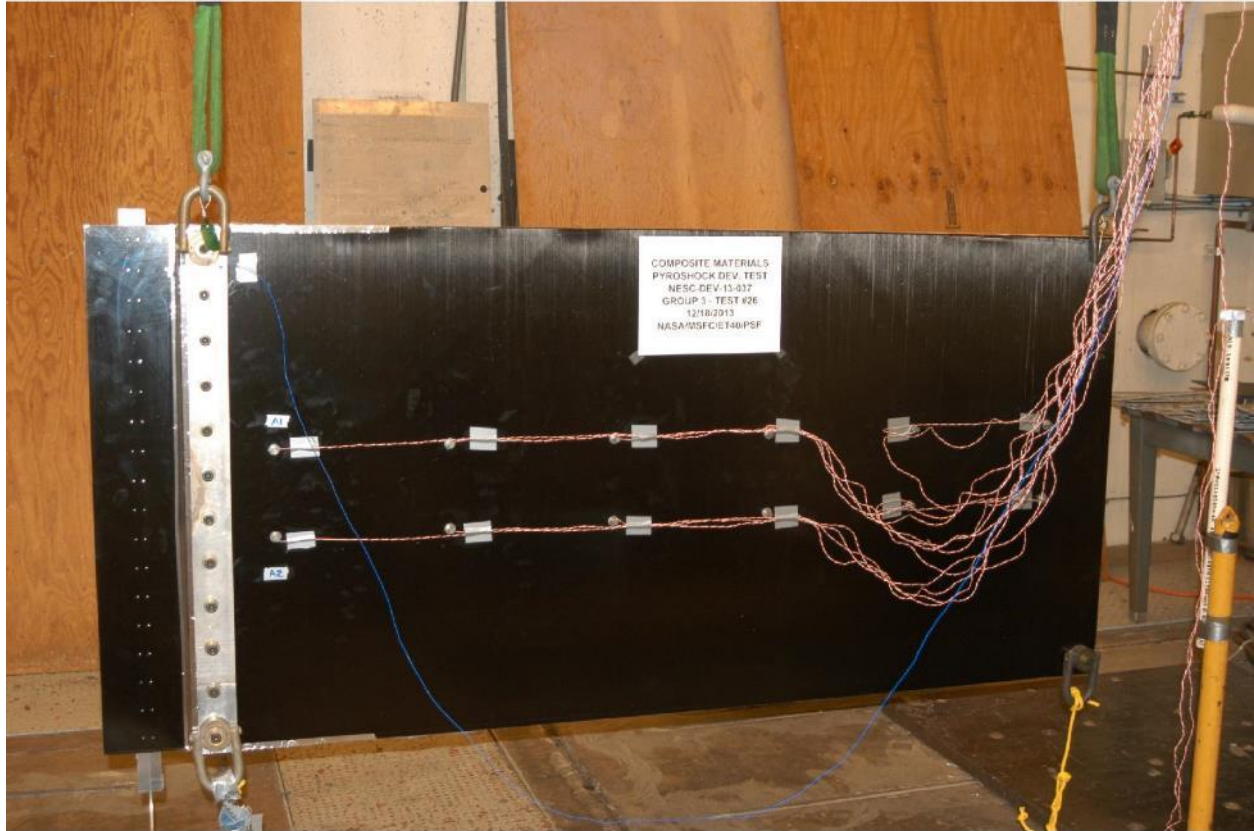
	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 366 of 832</p>	




	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 367 of 832	

**NESC-DEV-13-037**  
**Composite Materials**  
**Shock Test**  
  
**Test #7 Setup**

	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 368 of 832</p>	




54 of 518

	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 369 of 832	



55 of 518

	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 370 of 832</p>	



56 of 518



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**


Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**


Page #:  
371 of 832

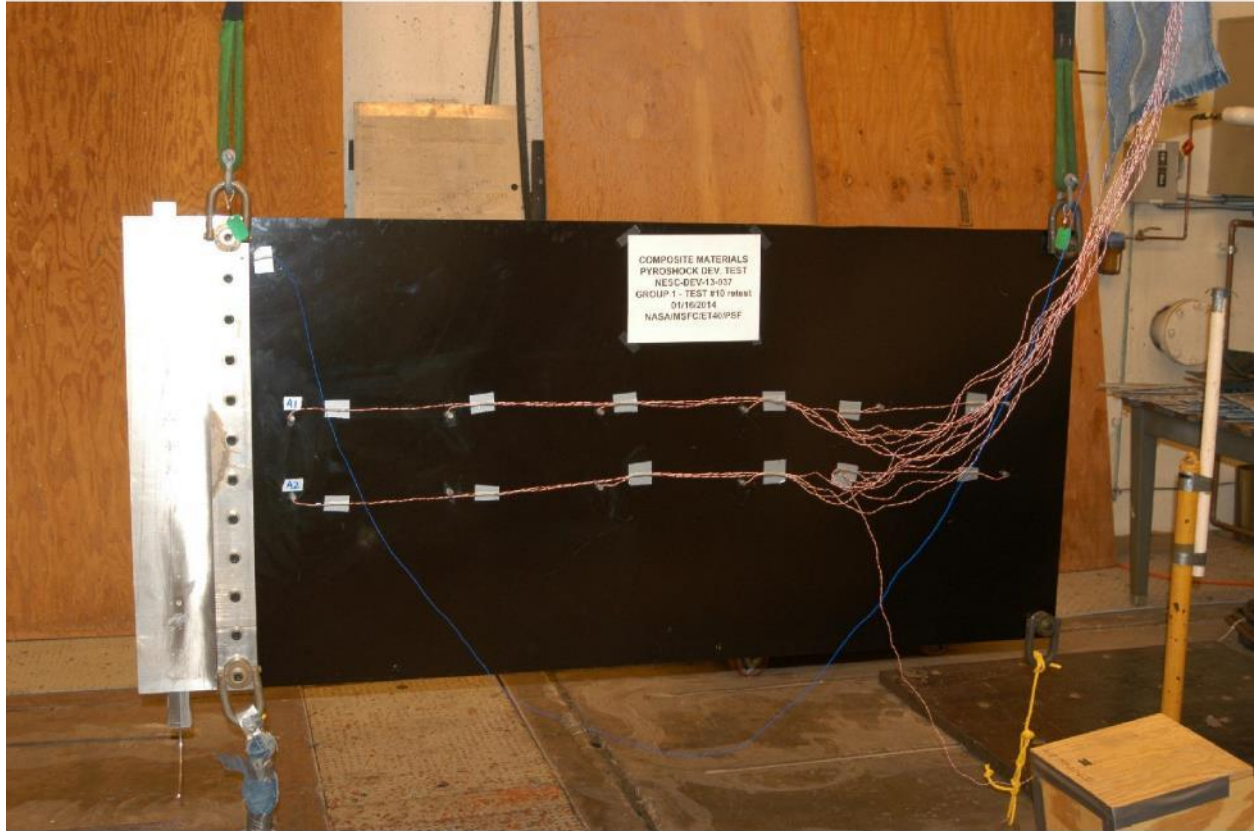


	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 372 of 832</p>	

**NESC-DEV-13-037**  
**Composite Materials**  
**Shock Test**  
  
**Test #8 Setup**



	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 373 of 832</p>	



59 of 518



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
374 of 832





# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**


Version:  
**1.0**

Title:


**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
375 of 832




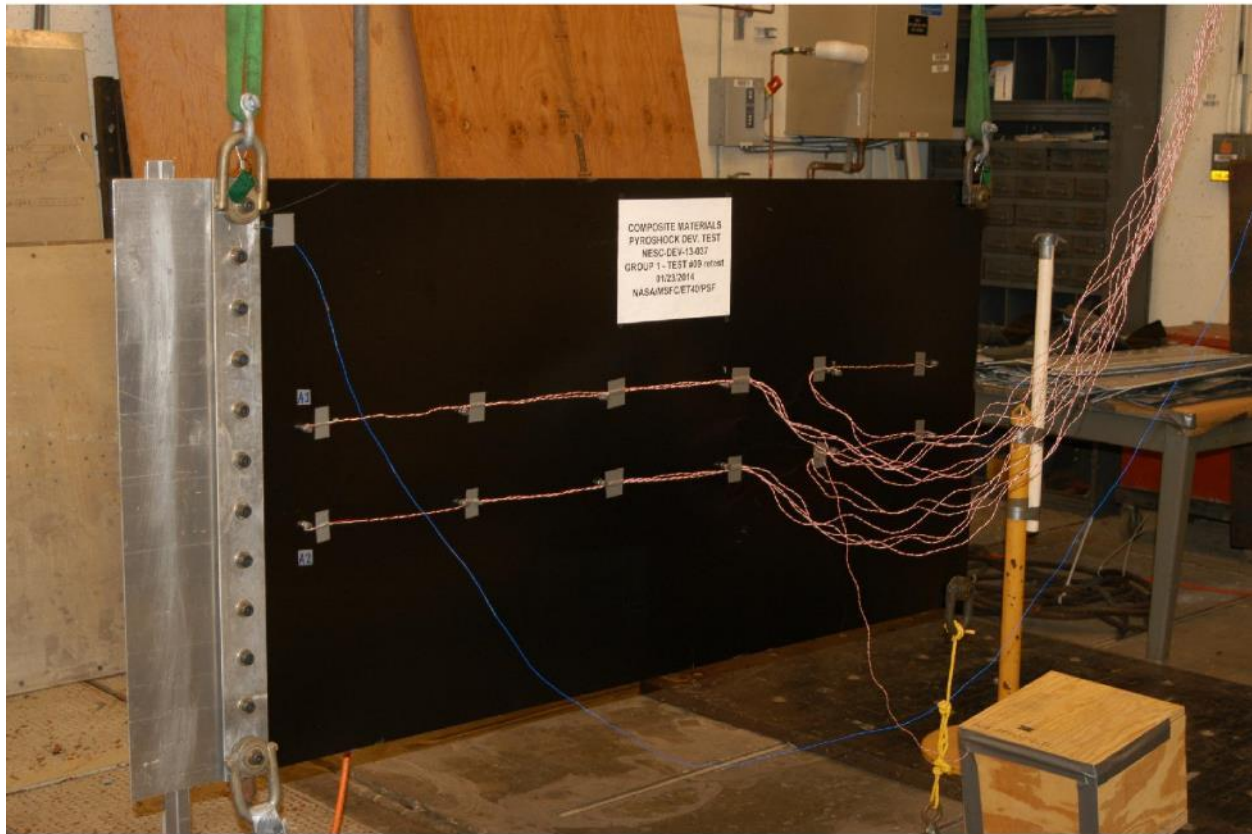
	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 376 of 832	



	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 377 of 832</p>	

**NESC-DEV-13-037**  
**Composite Materials**  
**Shock Test**  
  
**Test #9 Setup**

	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 378 of 832</p>	



64 of 518



# NASA Engineering and Safety Center Technical Assessment Report

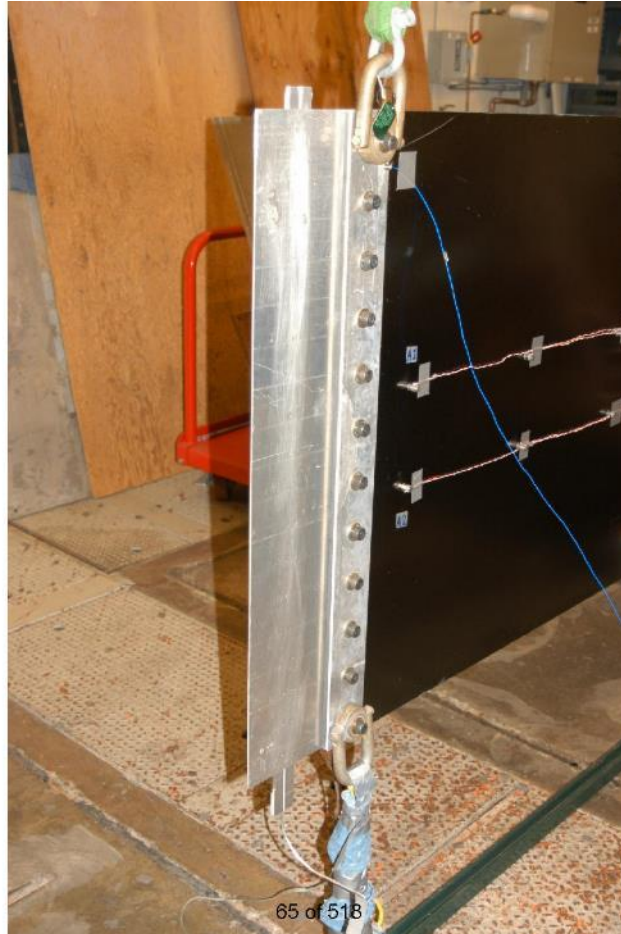
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
379 of 832





# NASA Engineering and Safety Center Technical Assessment Report

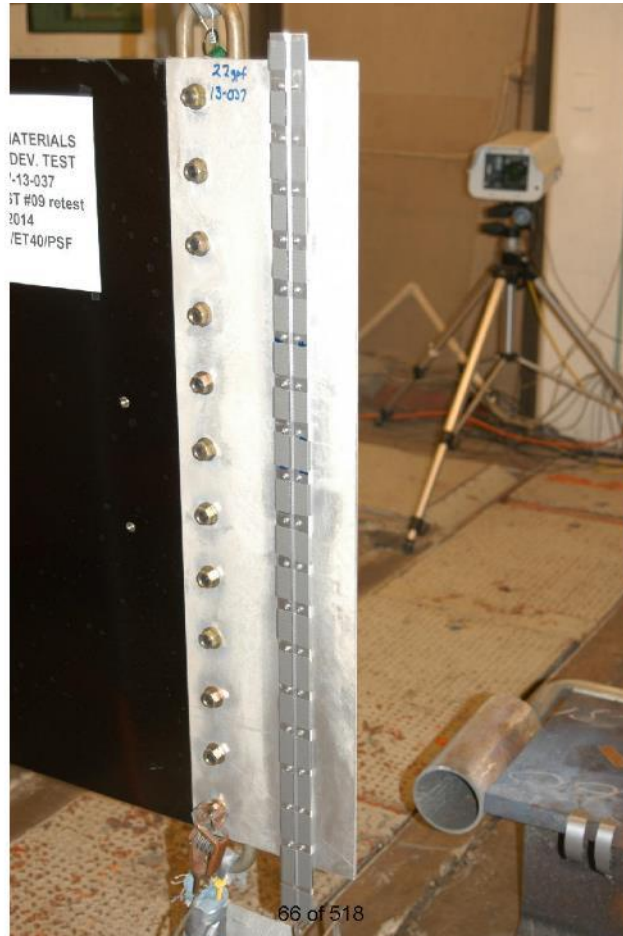
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**


Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
380 of 832







	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 381 of 832</p>	

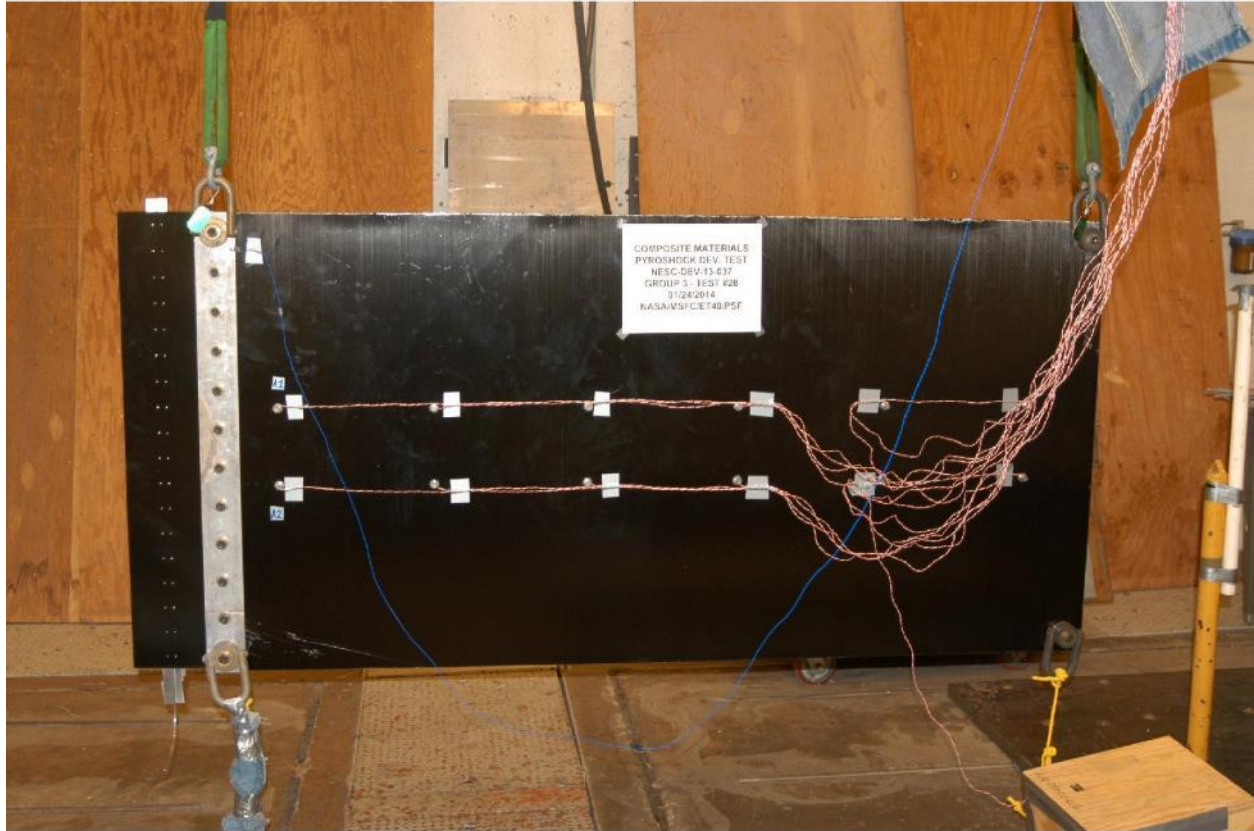


67 of 518

	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 382 of 832</p>	

**NESC-DEV-13-037**  
**Composite Materials**  
**Shock Test**  
  
**Test #10 Setup**

	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 383 of 832	



69 of 518



# NASA Engineering and Safety Center Technical Assessment Report

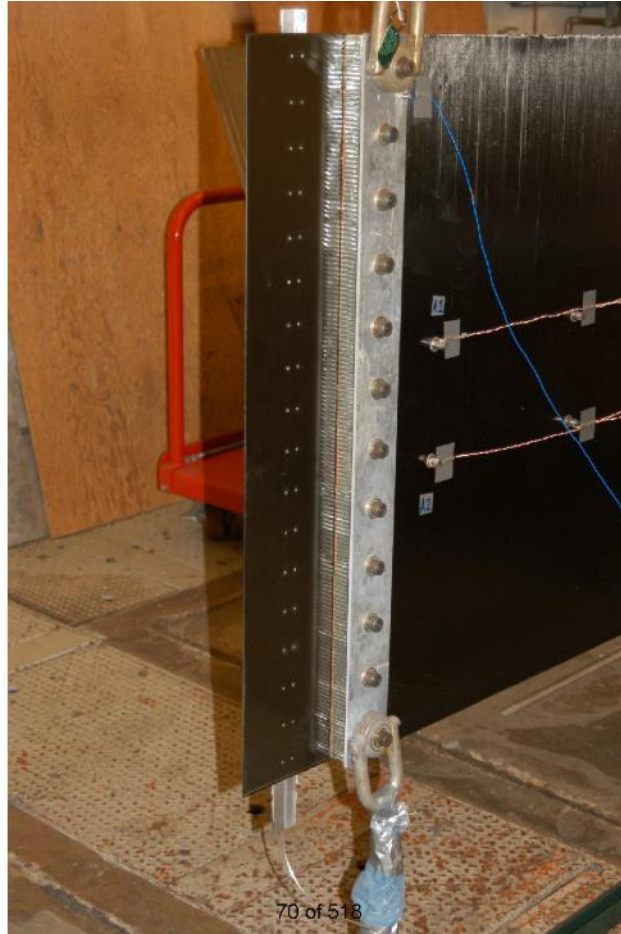
Document #:  
**NESC-RP-  
12-00783**


Version:  
**1.0**

Title:


**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
384 of 832




	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 385 of 832	




	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 386 of 832</p>	

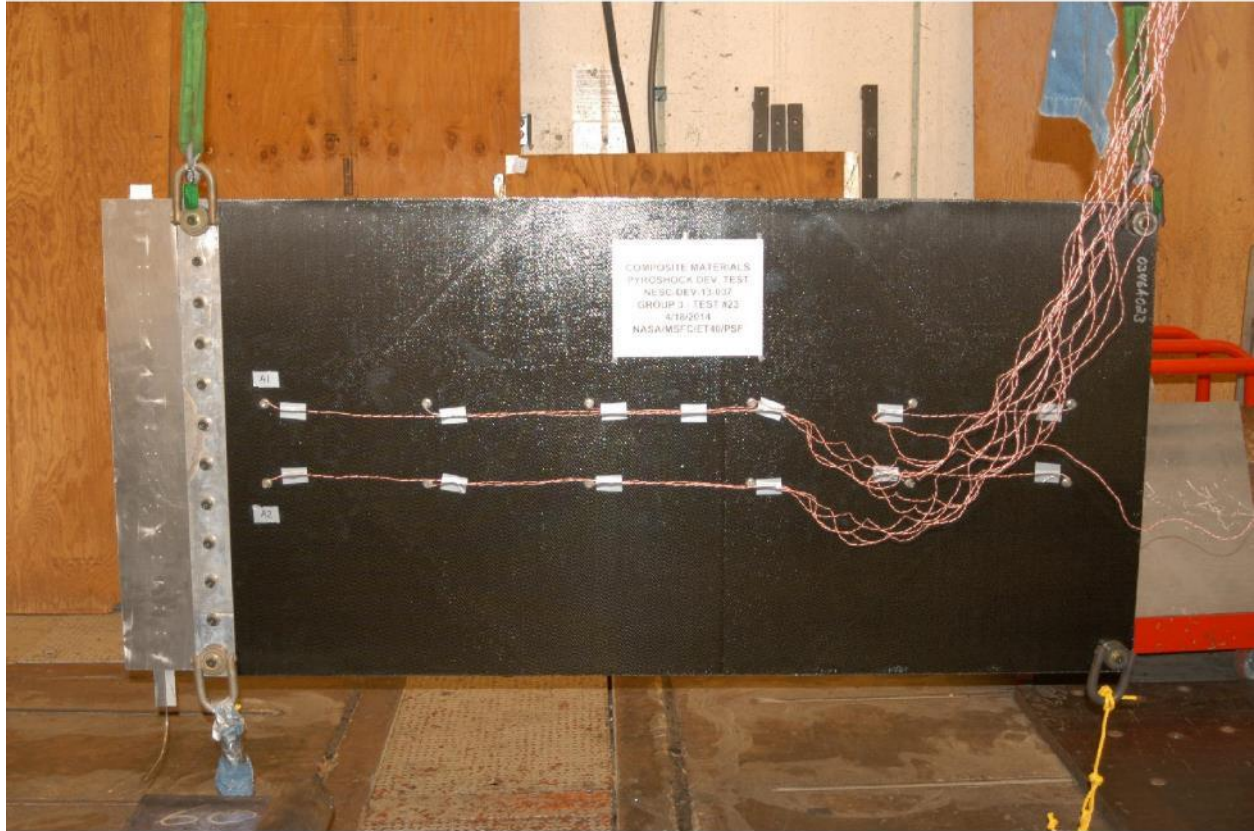


72 of 518

	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 387 of 832	

**NESC-DEV-13-037**  
**Composite Materials**  
**Shock Test**  
  
**Test #11 Setup**

	<b>NASA Engineering and Safety Center          Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 388 of 832	



74 of 518





# NASA Engineering and Safety Center Technical Assessment Report

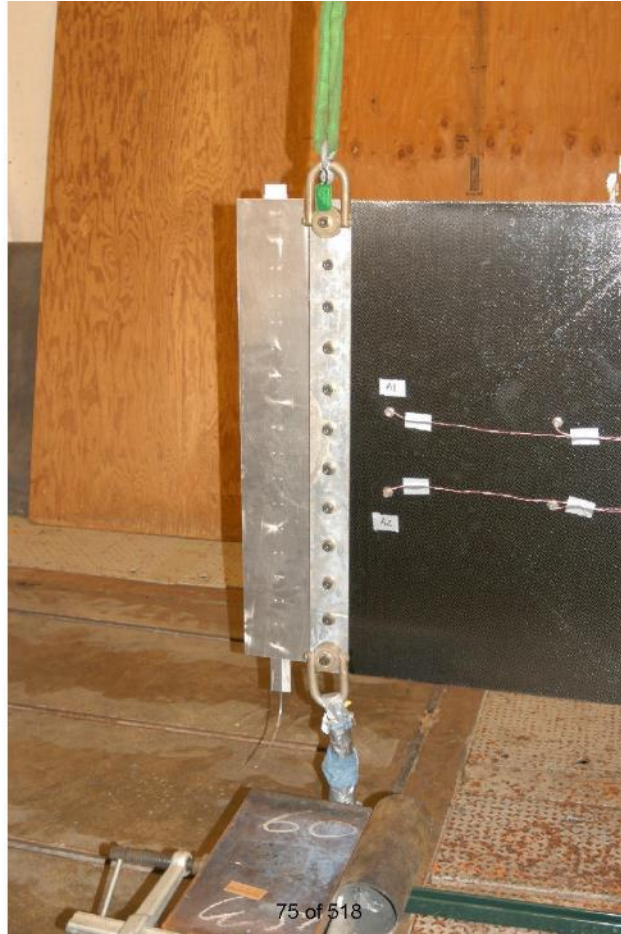
Document #:  
**NESC-RP-  
12-00783**


Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**


Page #:  
389 of 832



	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 390 of 832</p>	




76 of 518


	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 391 of 832	

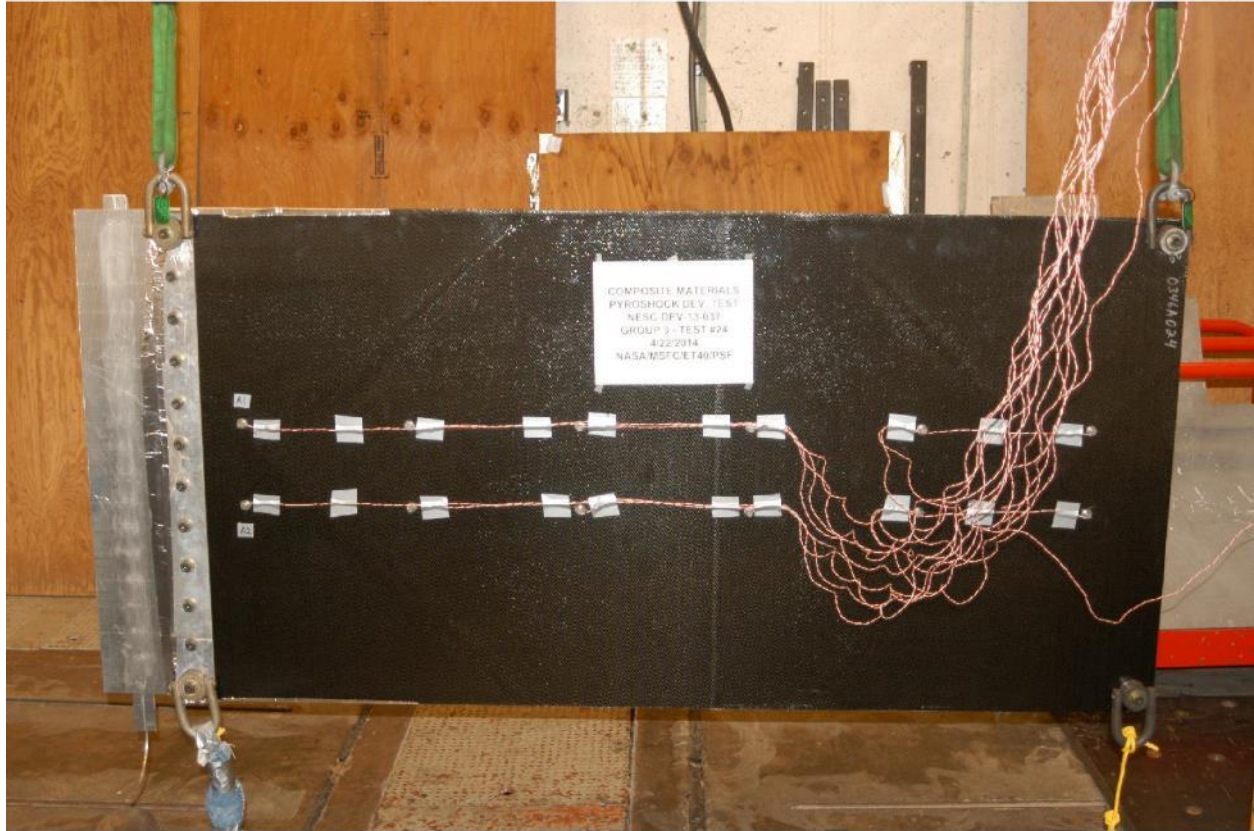


77 of 518

	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 392 of 832	

**NESC-DEV-13-037**  
**Composite Materials**  
**Shock Test**  
  
**Test #12 Setup**

	<b>NASA Engineering and Safety Center          Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 393 of 832	



79 of 518



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
394 of 832





# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**


Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
395 of 832




81 of 818

	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 396 of 832</p>	




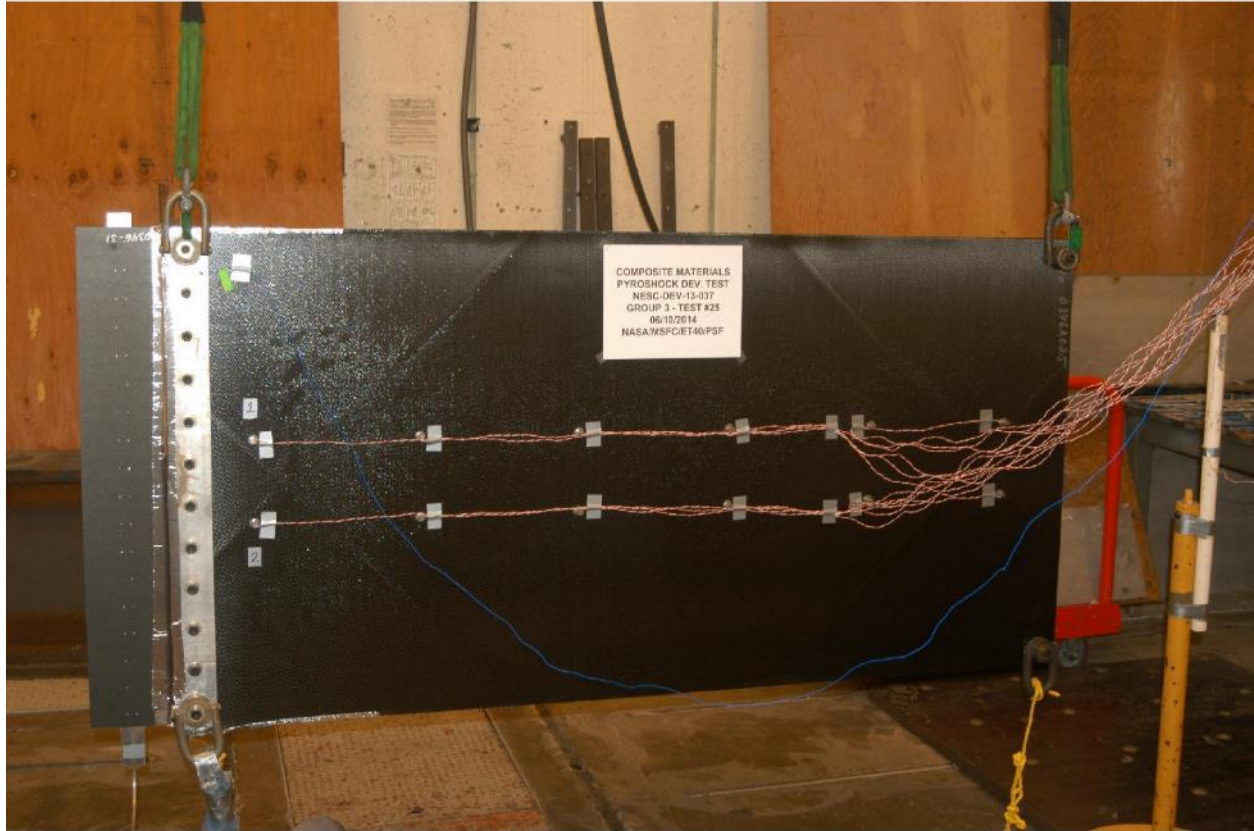
82 of 518



	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 397 of 832	

**NESC-DEV-13-037**  
**Composite Materials**  
**Shock Test**  
  
**Test #13 Setup**

	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 398 of 832</p>	



84 of 518



# NASA Engineering and Safety Center Technical Assessment Report

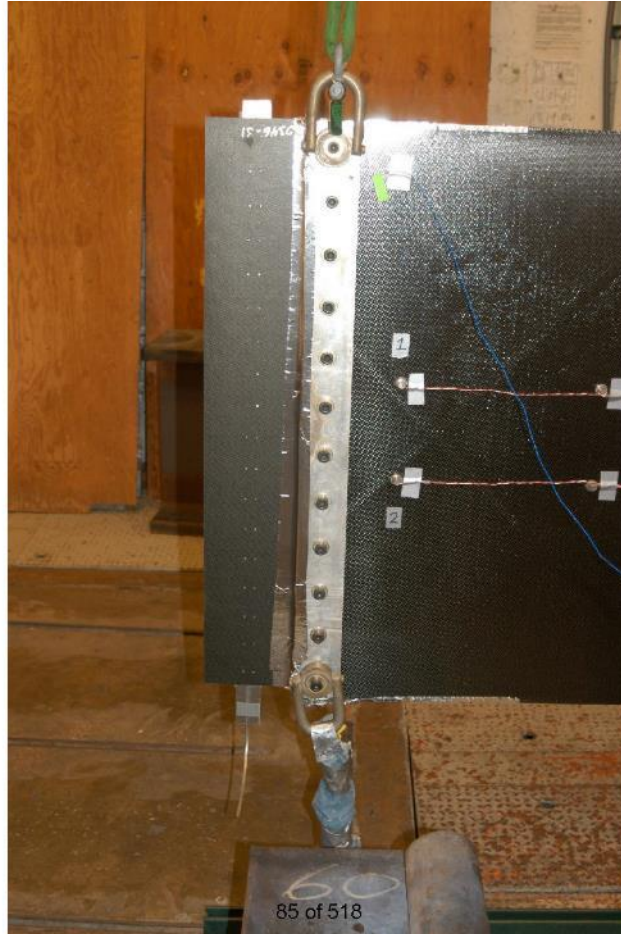
Document #:  
**NESC-RP-  
12-00783**


Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**


Page #:  
399 of 832



	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 400 of 832</p>	




86 of 518


	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 401 of 832	




87 of 518

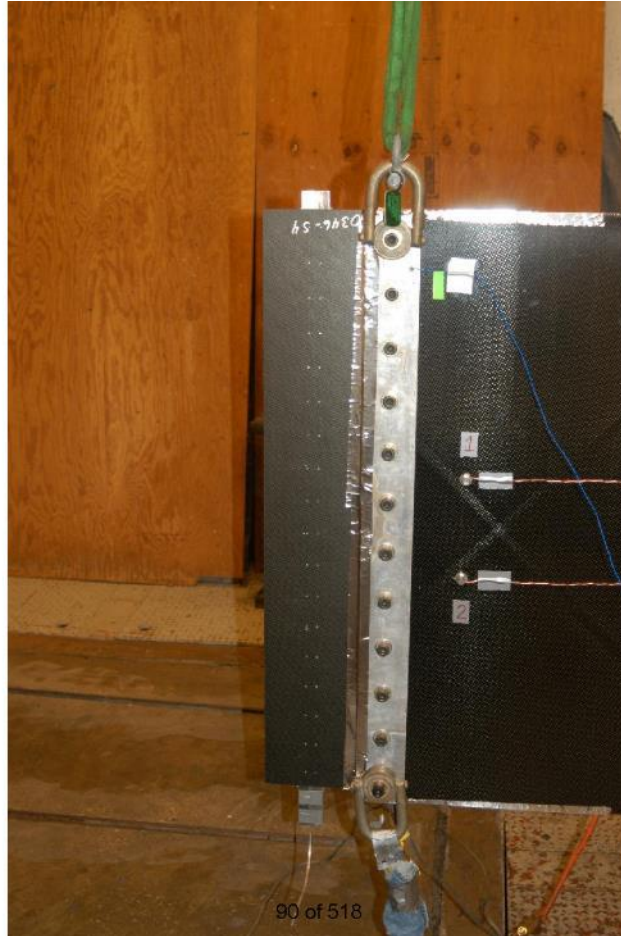
	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 402 of 832	

**NESC-DEV-13-037**  
**Composite Materials**  
**Shock Test**  
  
**Test #14 Setup**


	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 403 of 832</p>	



	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP- 12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 404 of 832	






	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 405 of 832	




91 of 518

	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 406 of 832</p>	



92 of 518

	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 407 of 832	

**NESC-DEV-13-037**  
**Composite Materials**  
**Shock Test**  
  
**Test #1 Accelerometer Data**  
**Panel 0346A019**



# NASA Engineering and Safety Center Technical Assessment Report

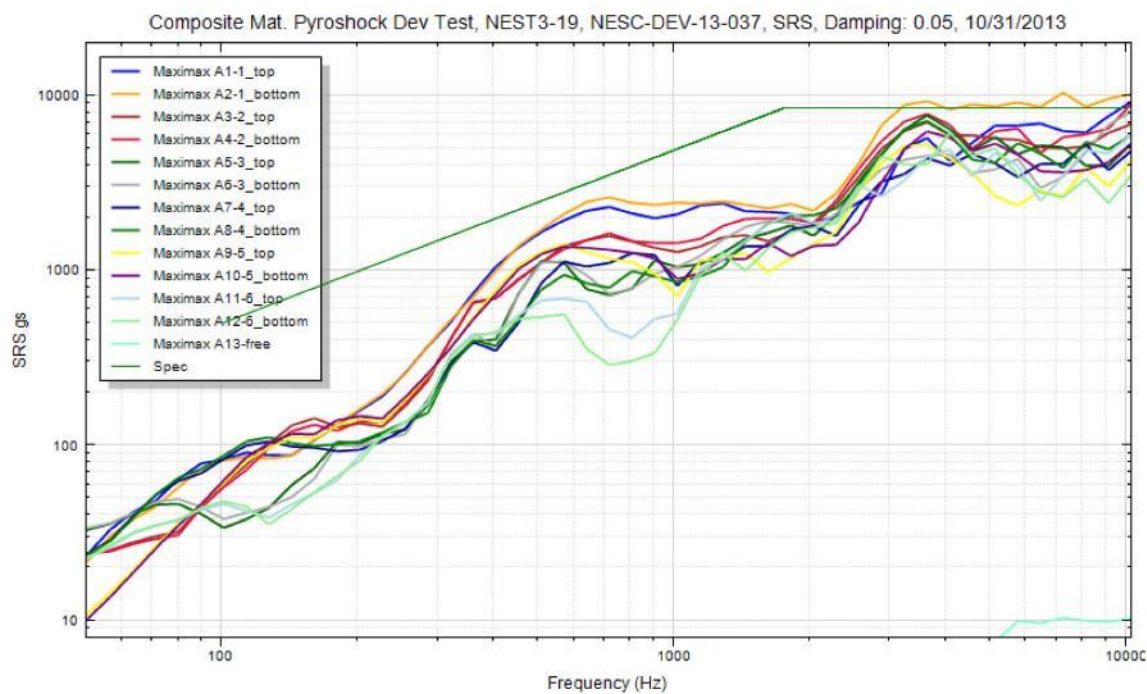
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
408 of 832





# NASA Engineering and Safety Center Technical Assessment Report

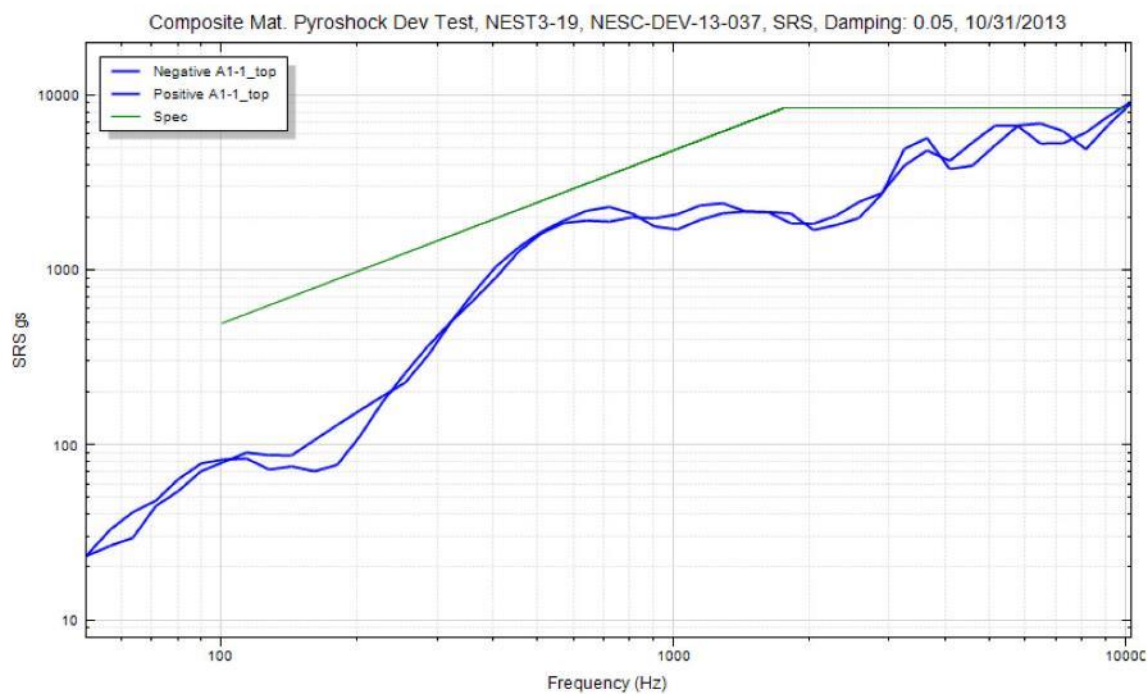
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
409 of 832





# NASA Engineering and Safety Center Technical Assessment Report

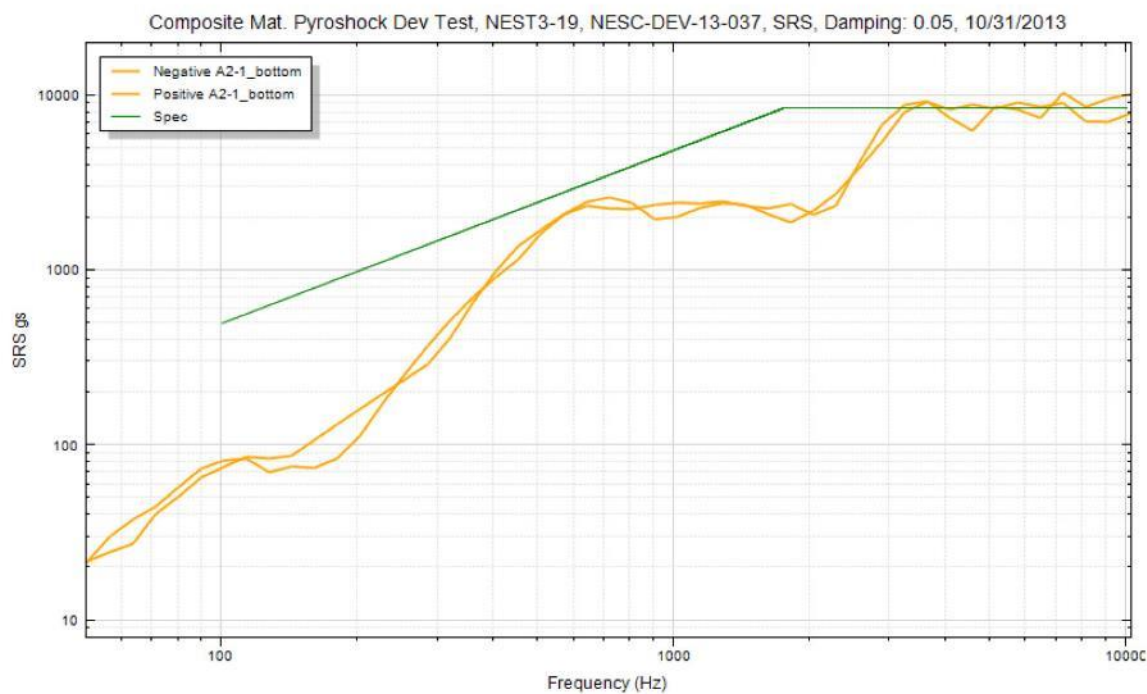
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
410 of 832





# NASA Engineering and Safety Center Technical Assessment Report

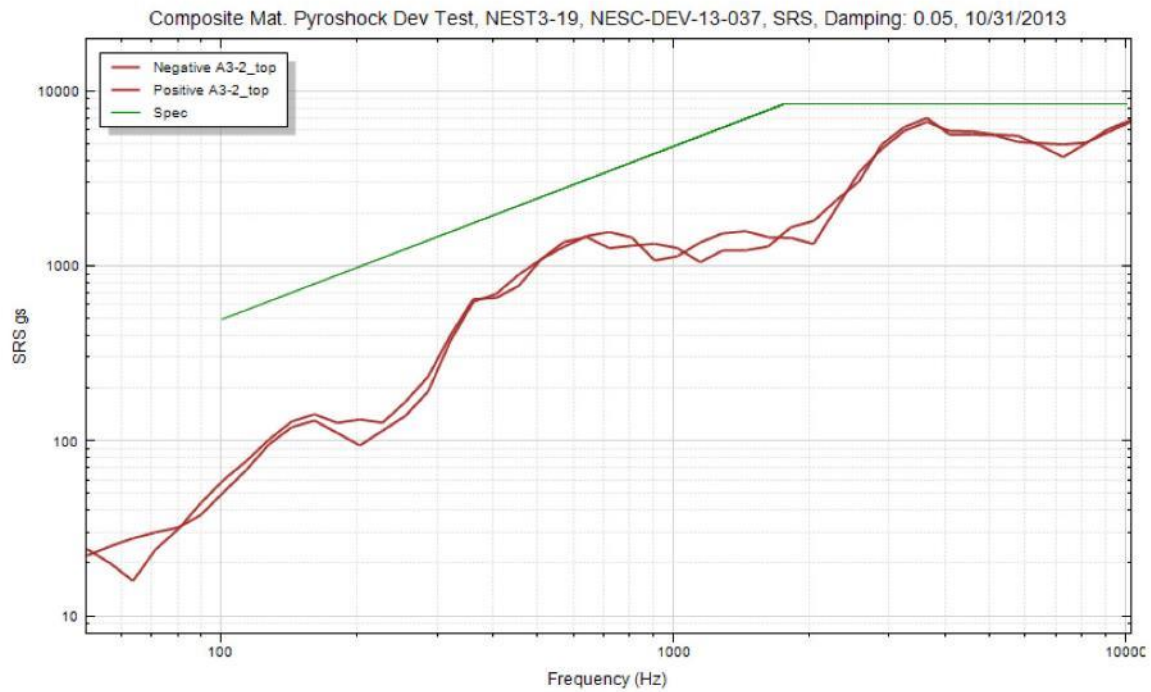
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
411 of 832





# NASA Engineering and Safety Center Technical Assessment Report

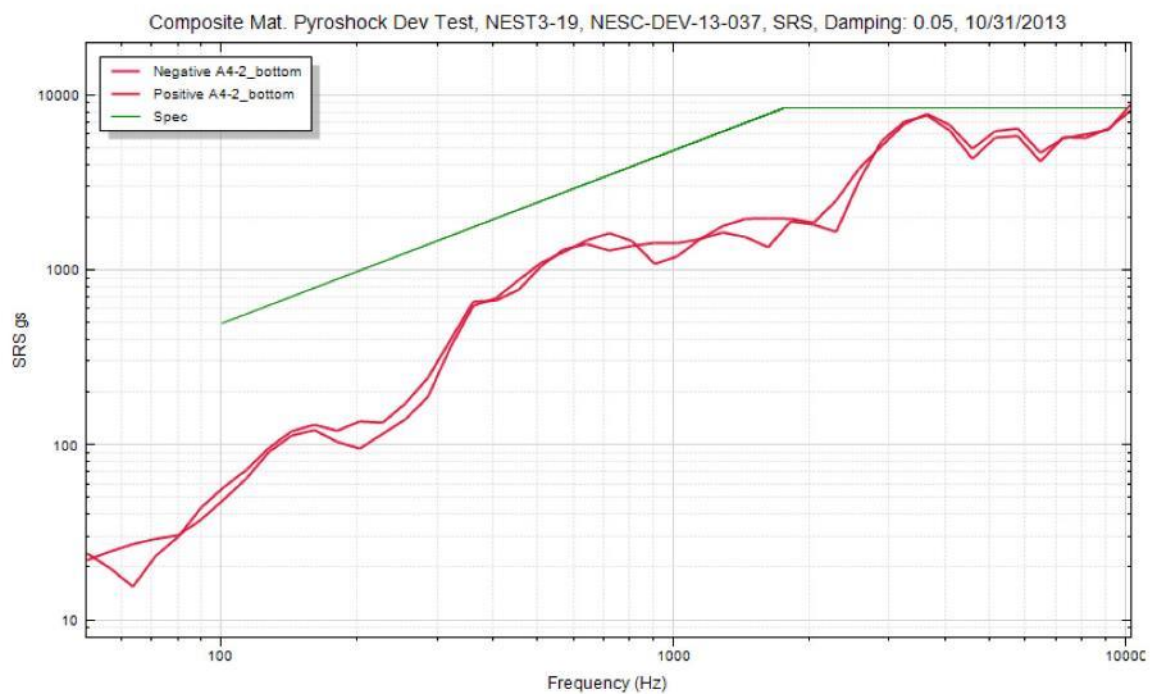
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
412 of 832







# NASA Engineering and Safety Center Technical Assessment Report

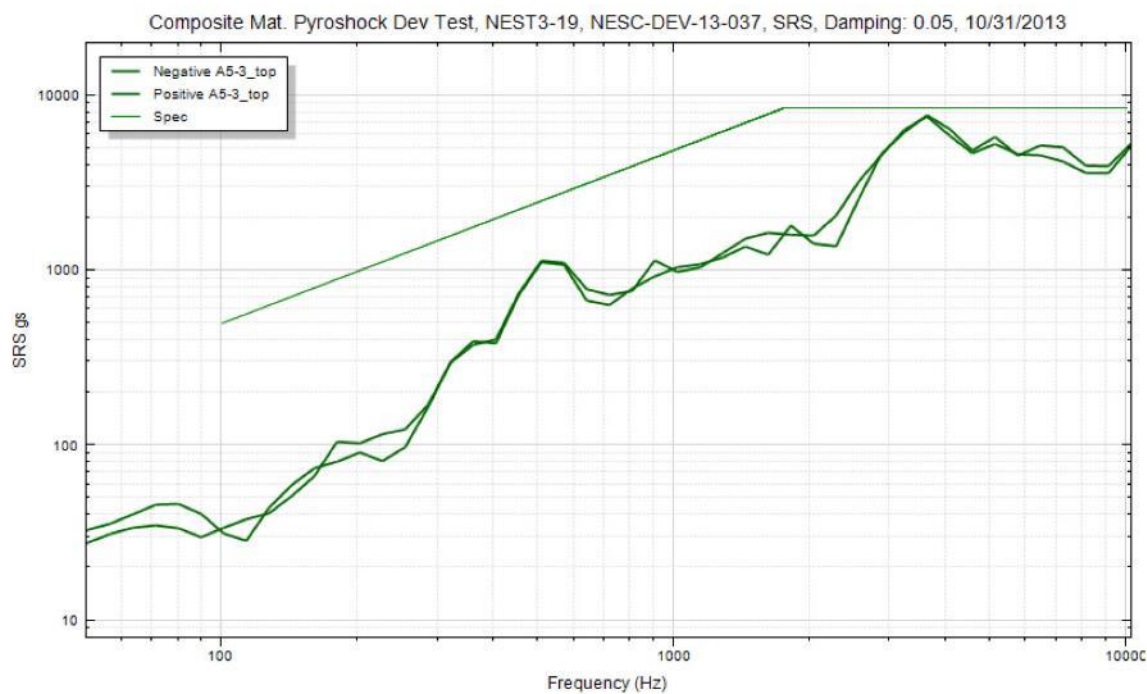
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
413 of 832





# NASA Engineering and Safety Center Technical Assessment Report

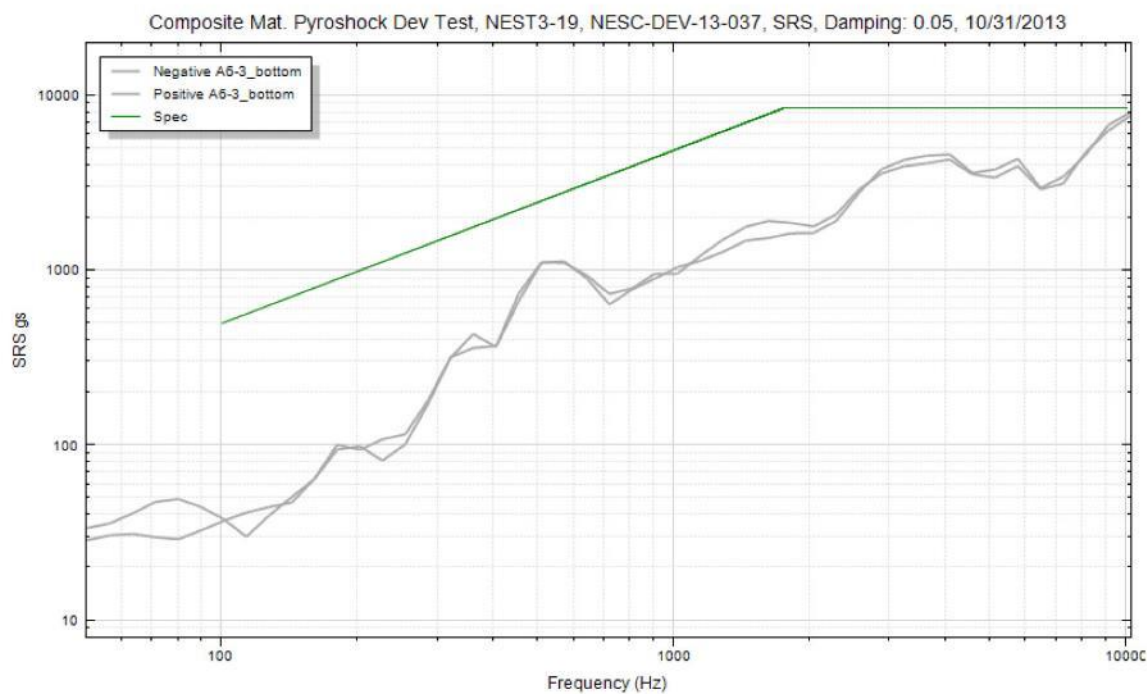
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
414 of 832





# NASA Engineering and Safety Center Technical Assessment Report

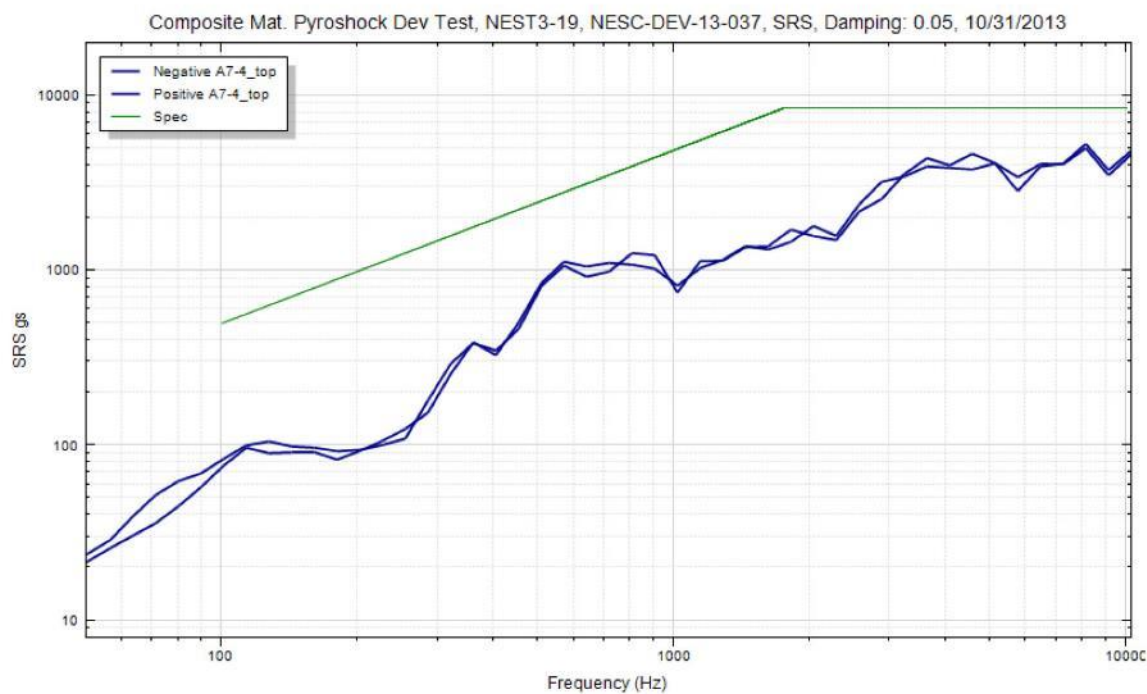
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
415 of 832





# NASA Engineering and Safety Center Technical Assessment Report

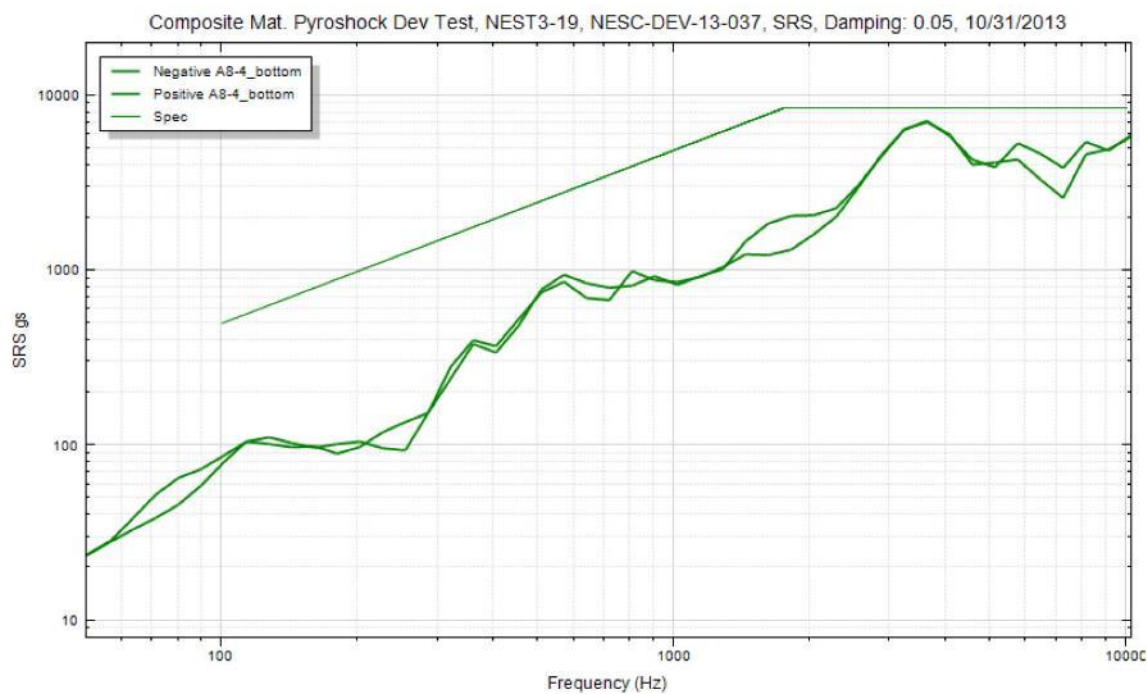
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
416 of 832





# NASA Engineering and Safety Center Technical Assessment Report

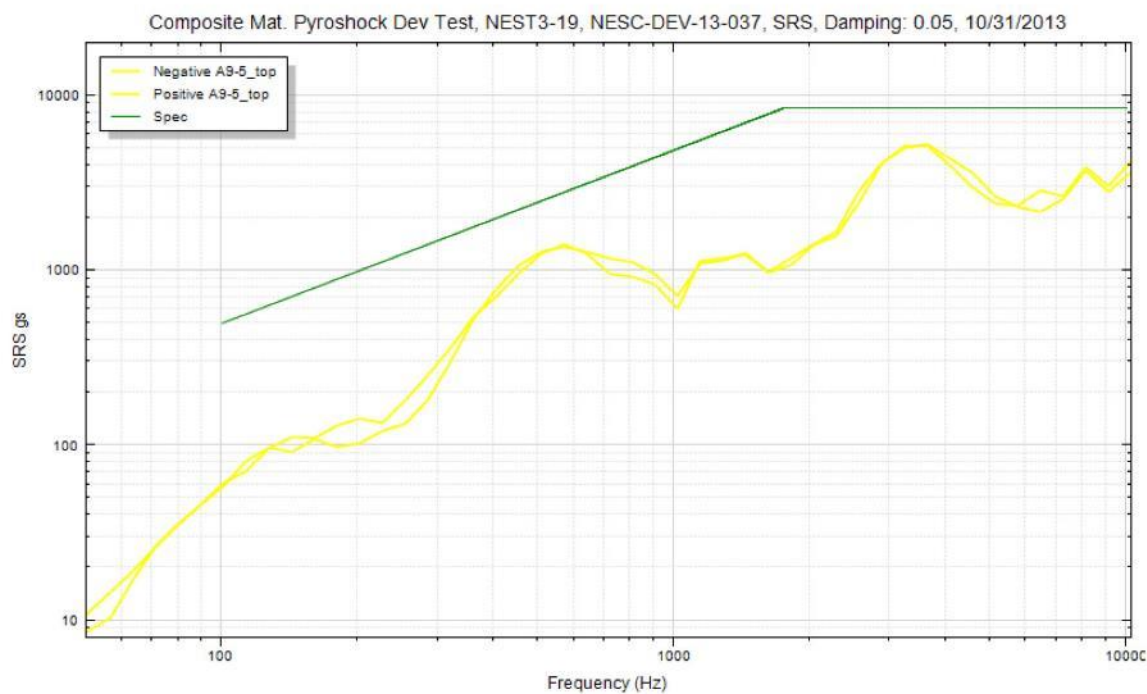
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
417 of 832





# NASA Engineering and Safety Center Technical Assessment Report

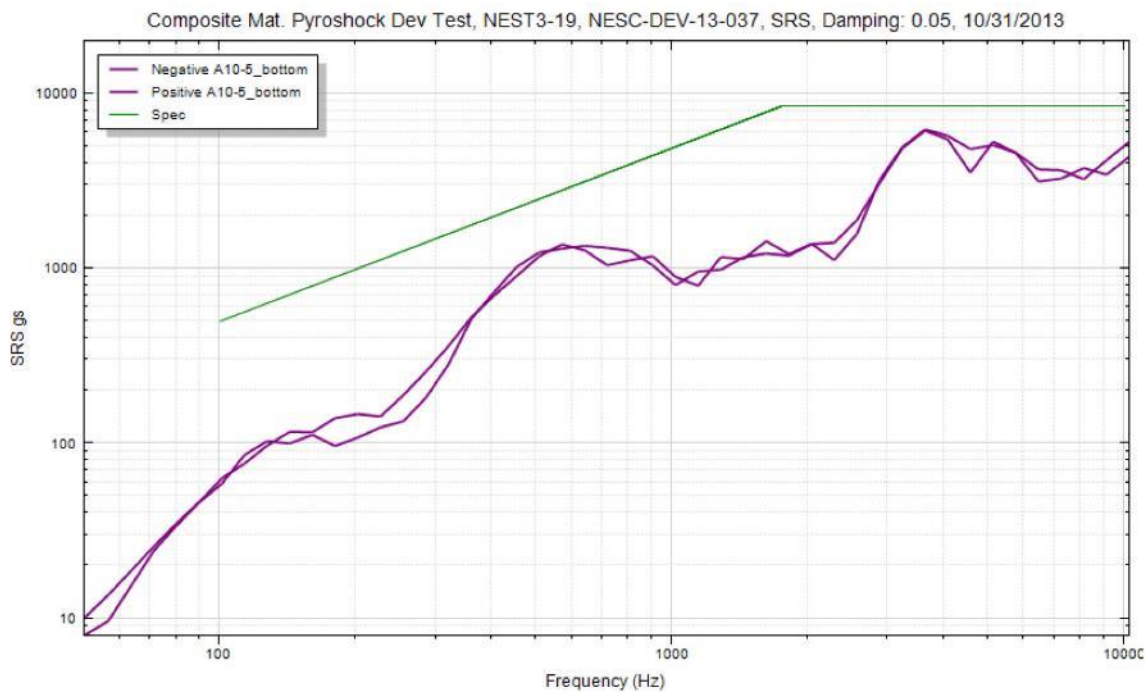
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
418 of 832





# NASA Engineering and Safety Center Technical Assessment Report

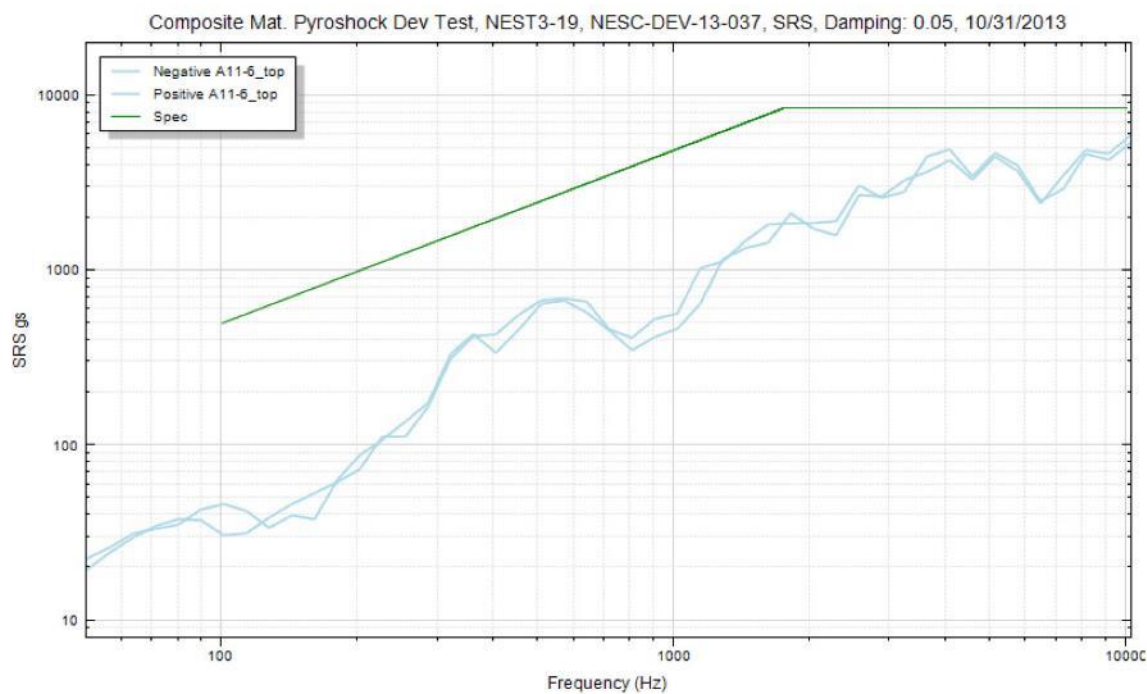
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
419 of 832





# NASA Engineering and Safety Center Technical Assessment Report

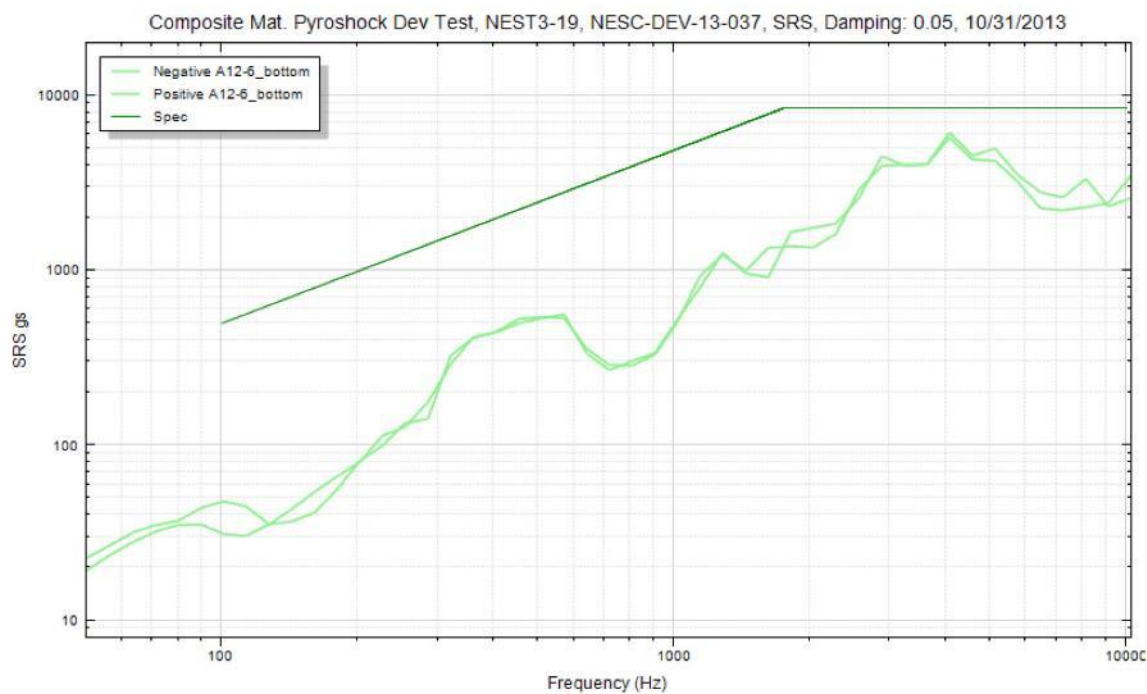
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
420 of 832







# NASA Engineering and Safety Center Technical Assessment Report

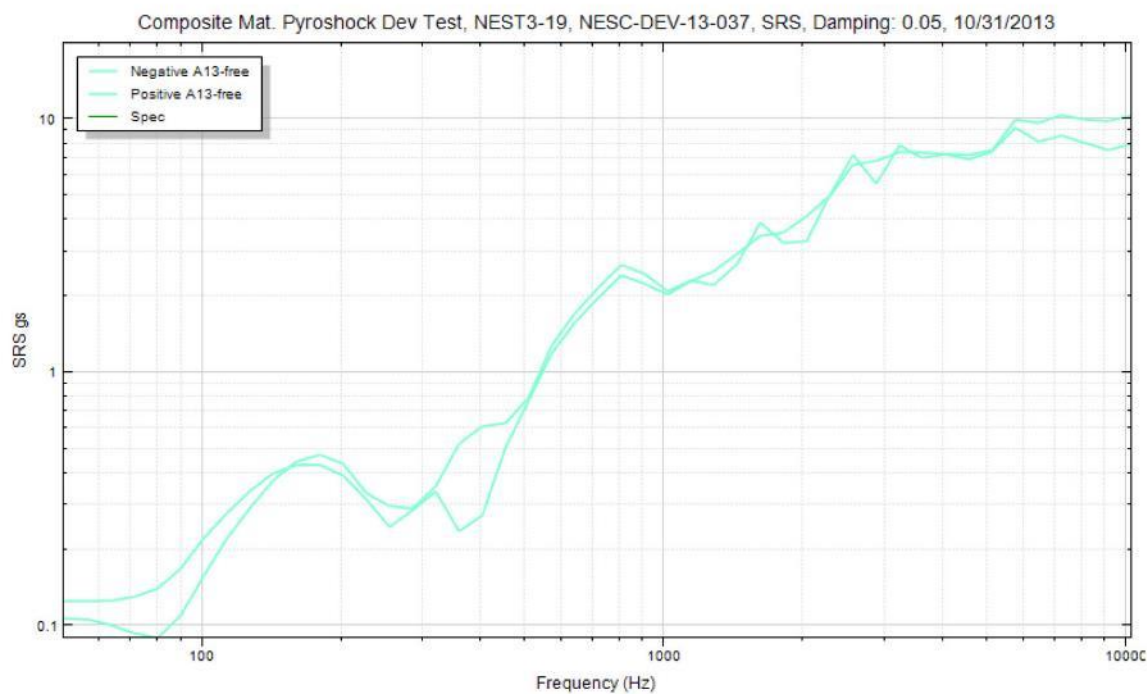
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
421 of 832





# NASA Engineering and Safety Center Technical Assessment Report

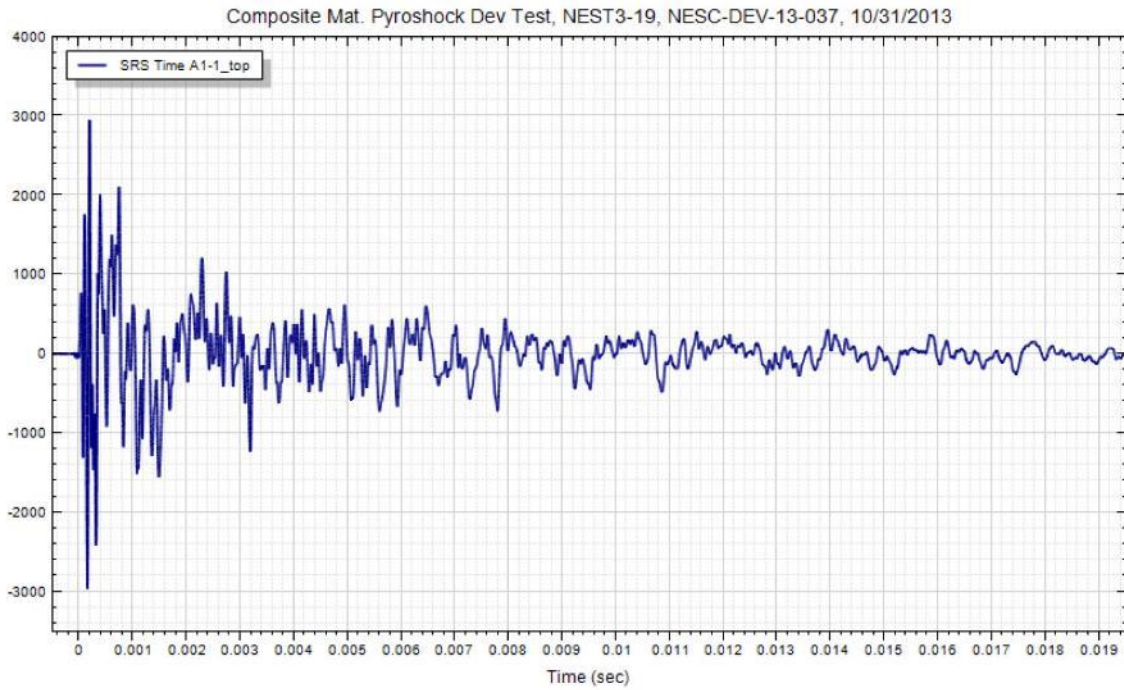
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
422 of 832





# NASA Engineering and Safety Center Technical Assessment Report

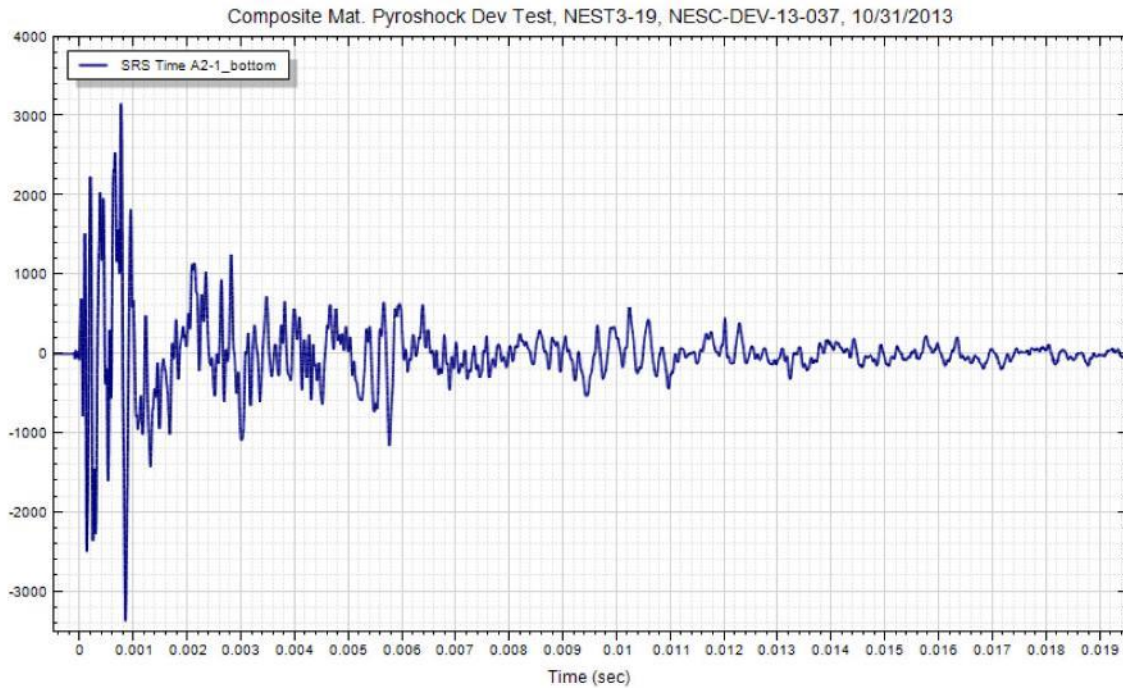
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
423 of 832





# NASA Engineering and Safety Center Technical Assessment Report

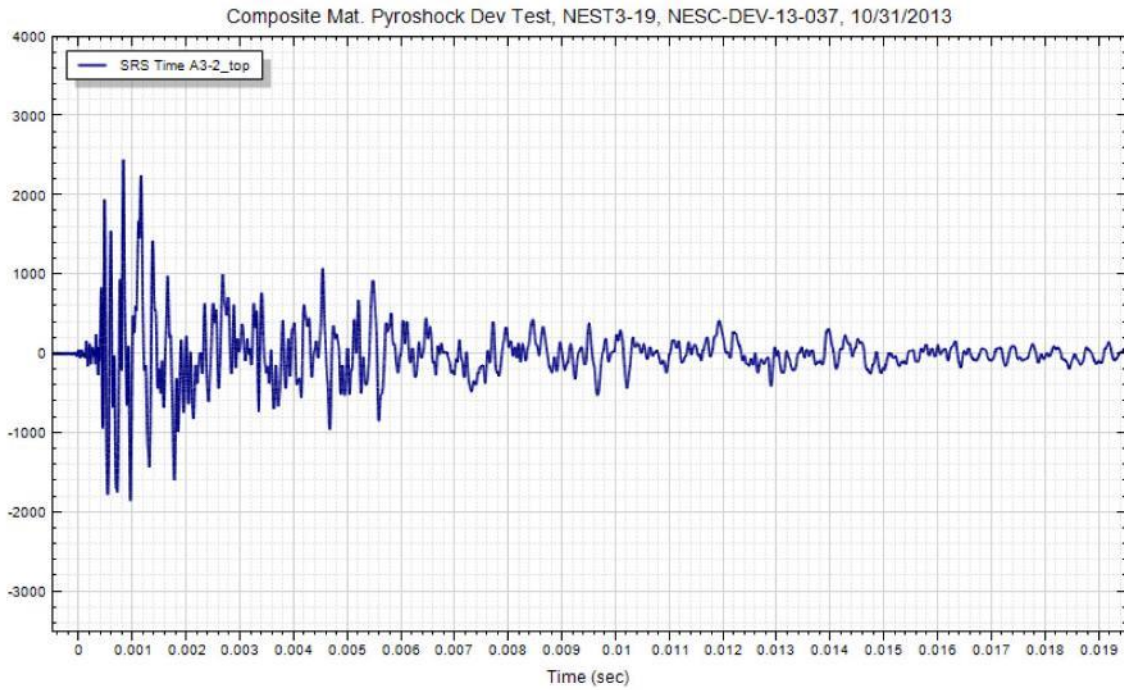
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
424 of 832





# NASA Engineering and Safety Center Technical Assessment Report

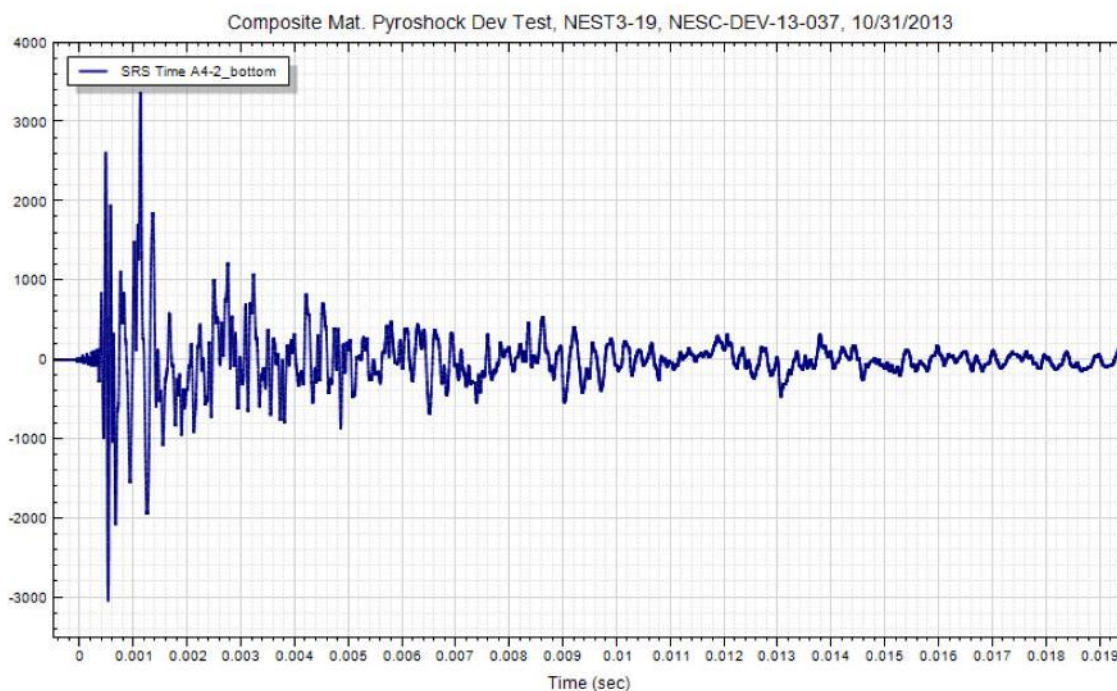
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
425 of 832





# NASA Engineering and Safety Center Technical Assessment Report

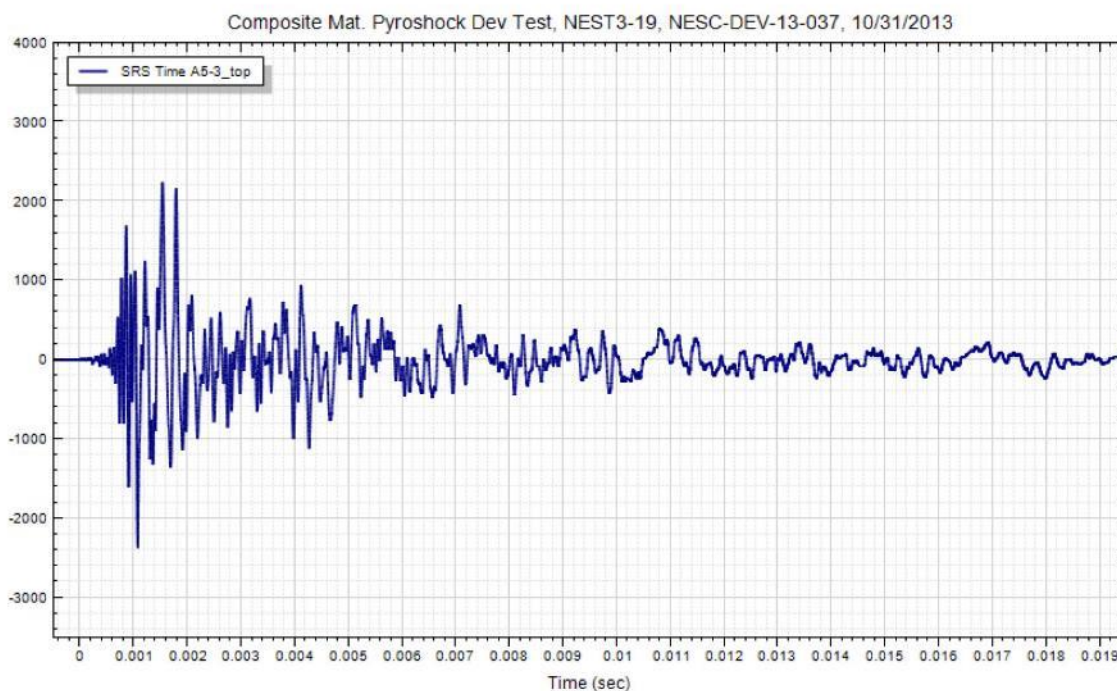
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
426 of 832





# NASA Engineering and Safety Center Technical Assessment Report

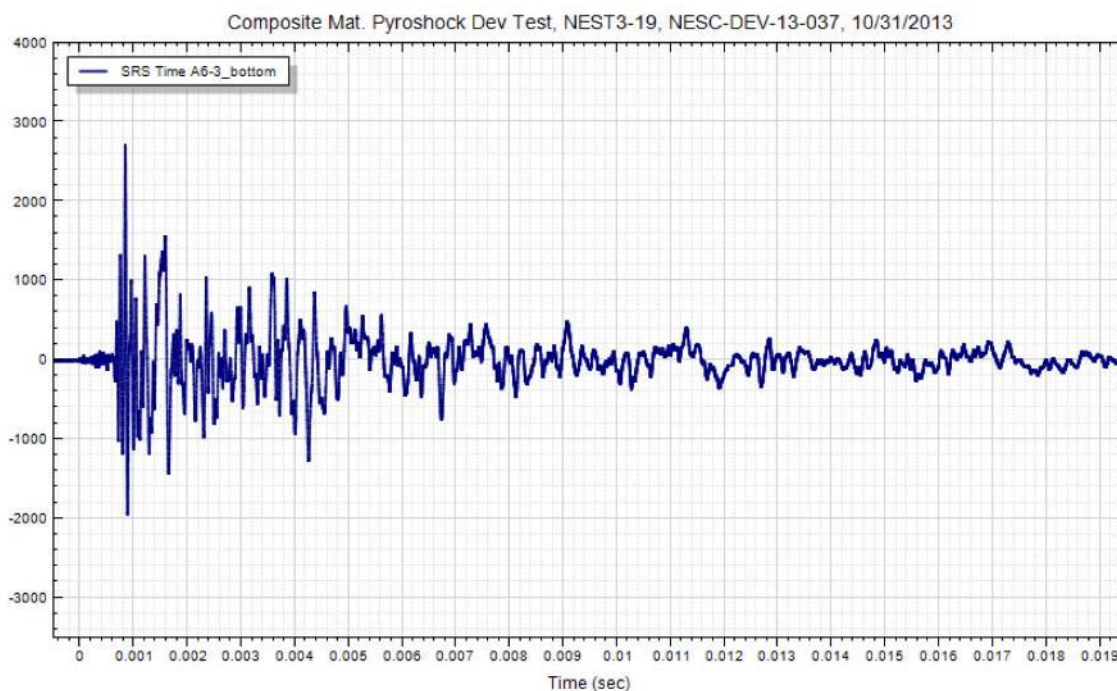
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
427 of 832





# NASA Engineering and Safety Center Technical Assessment Report

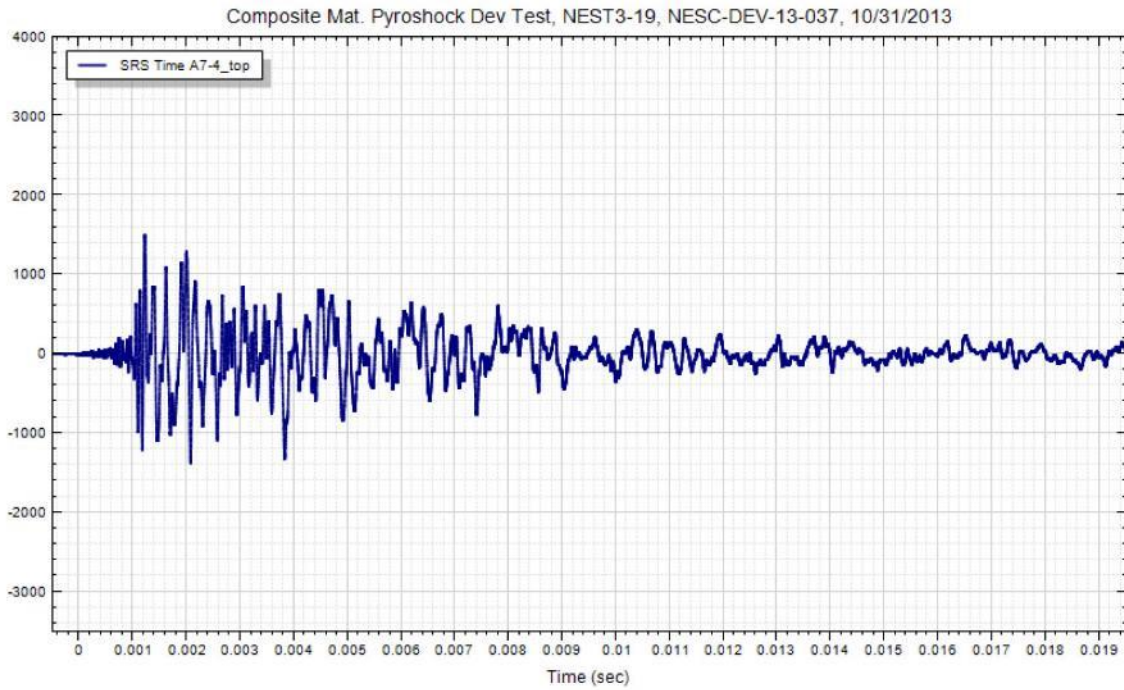
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
428 of 832







# NASA Engineering and Safety Center Technical Assessment Report

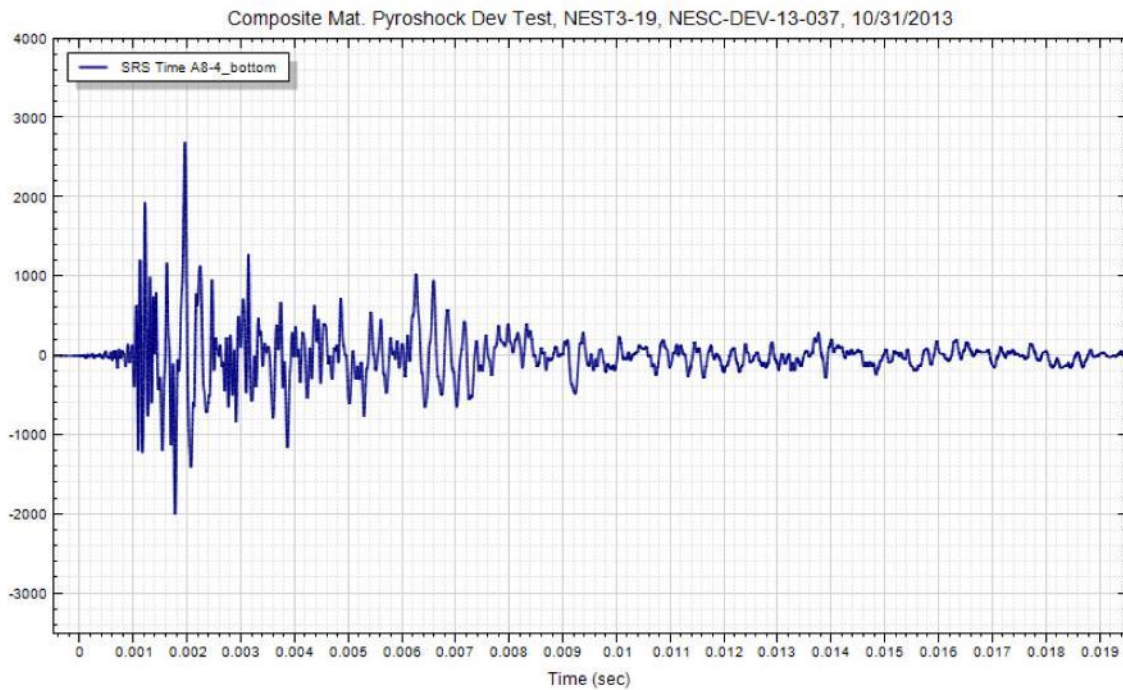
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
429 of 832





# NASA Engineering and Safety Center Technical Assessment Report

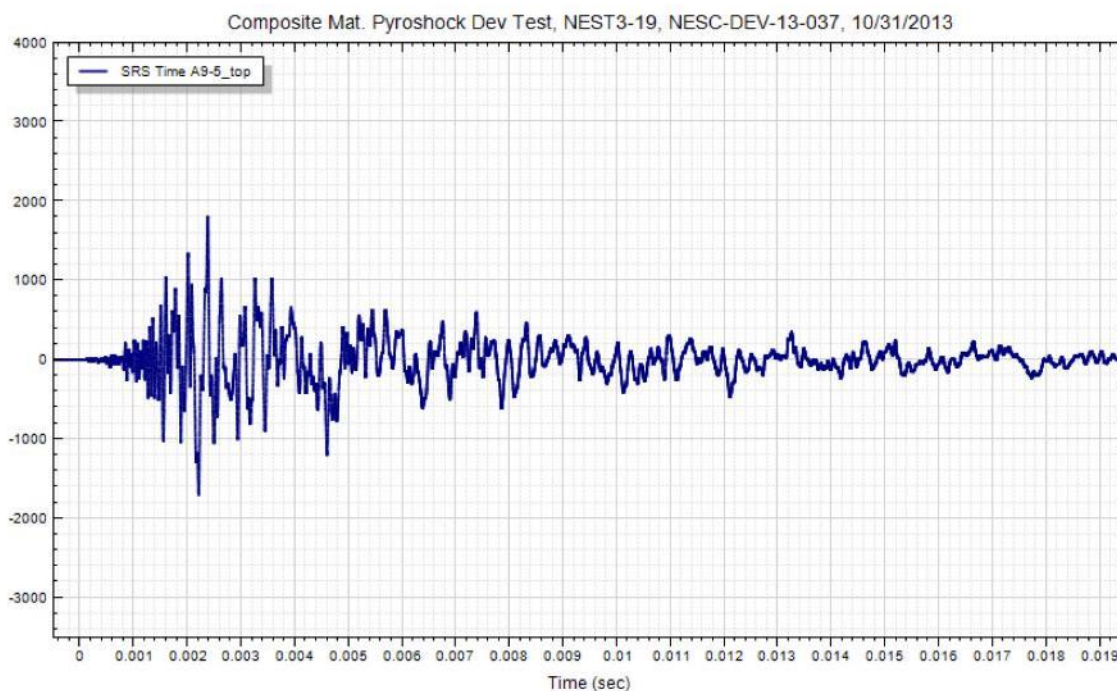
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
430 of 832





# NASA Engineering and Safety Center Technical Assessment Report

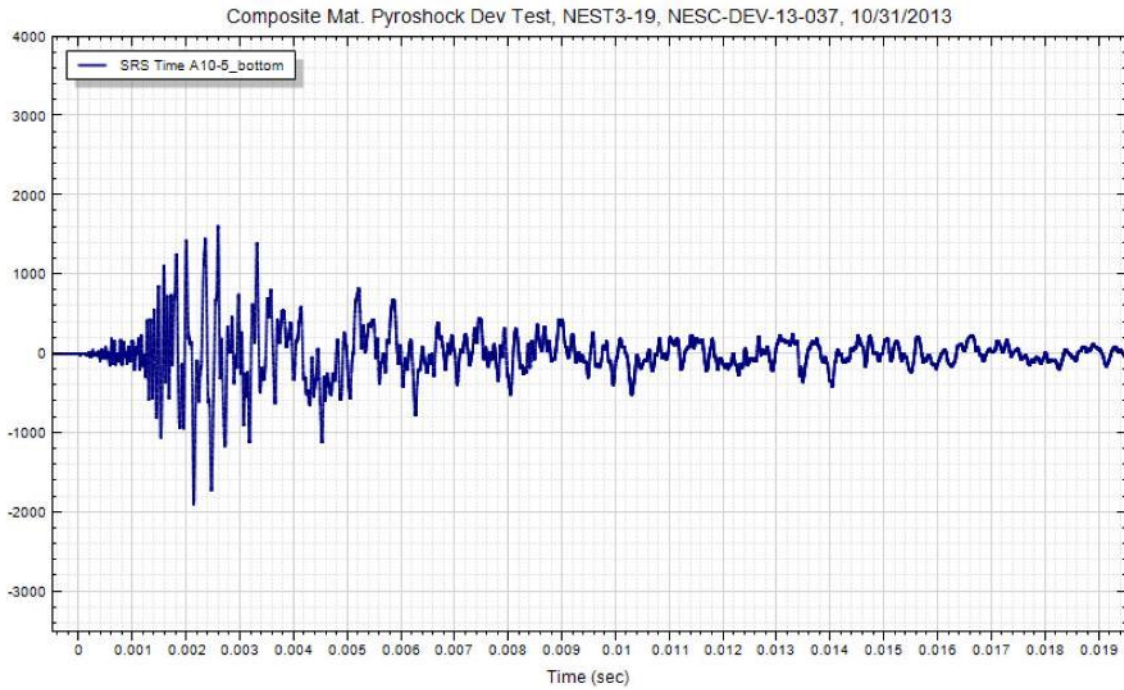
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
431 of 832





# NASA Engineering and Safety Center Technical Assessment Report

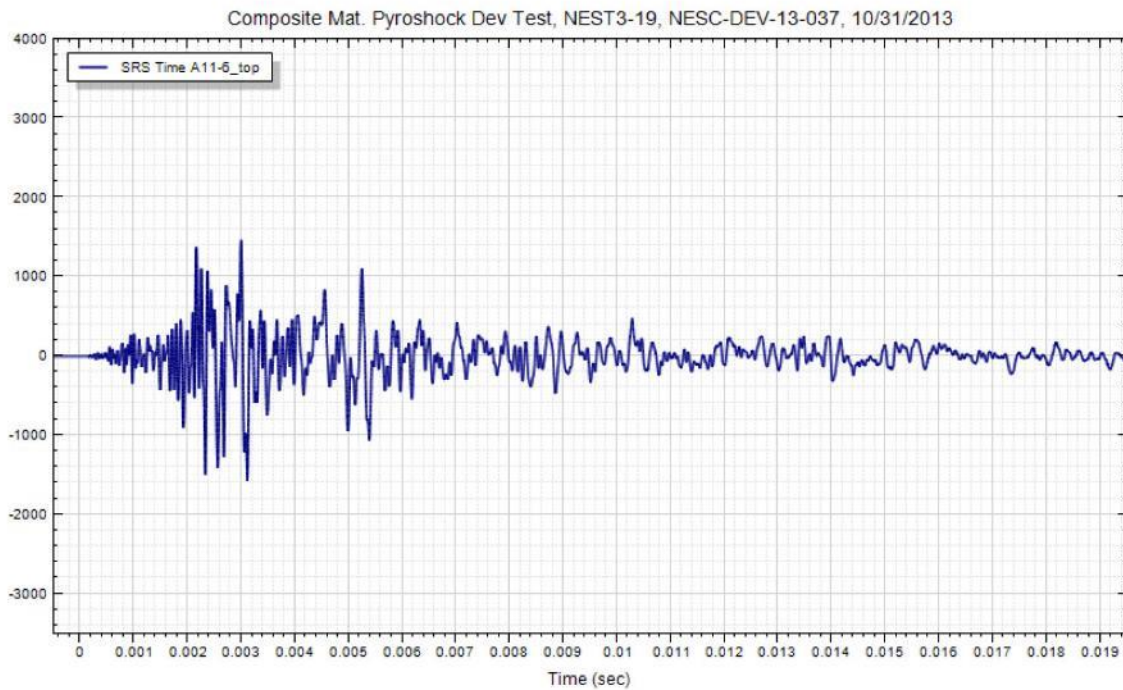
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
432 of 832





# NASA Engineering and Safety Center Technical Assessment Report

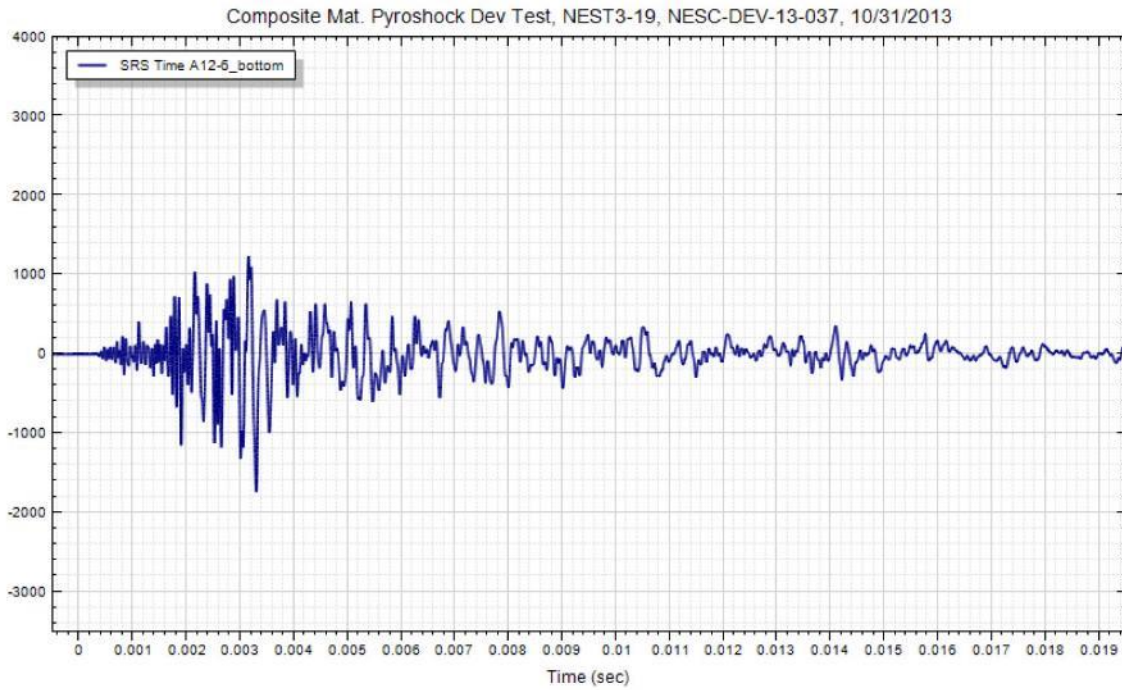
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
433 of 832





# NASA Engineering and Safety Center Technical Assessment Report

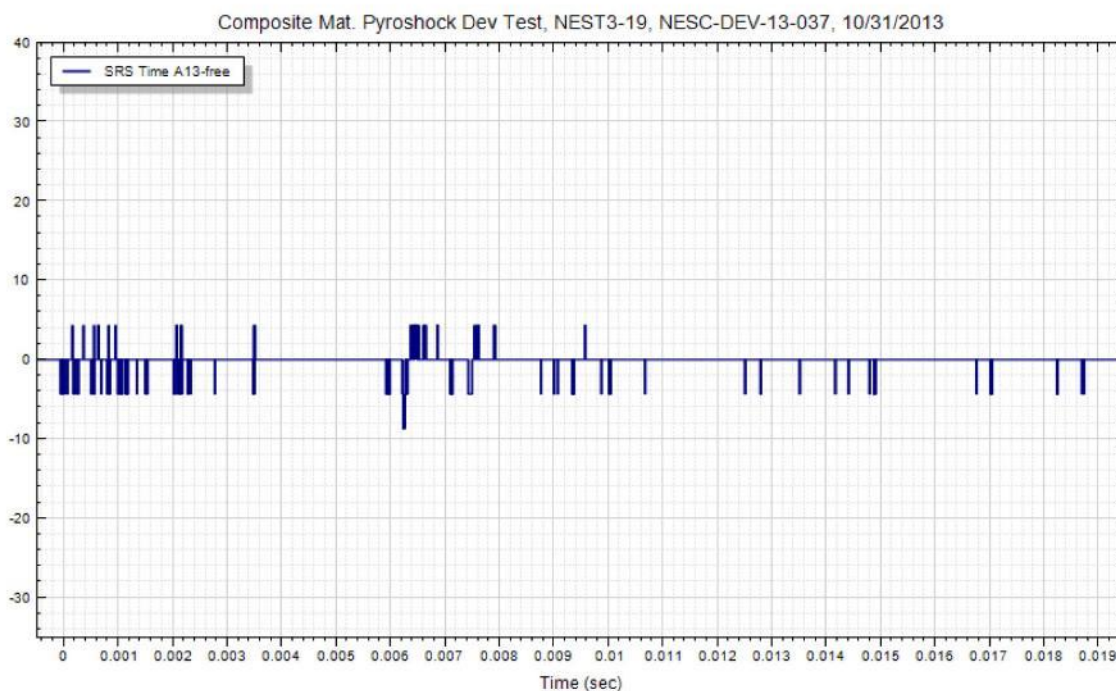
Document #:  
**NESC-RP-  
12-00783**


Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
434 of 832



	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 435 of 832	

**NESC-DEV-13-037**  
**Composite Materials**  
**Shock Test**  
  
**Test #2 Accelerometer Data**  
**Panel 0346A020**



# NASA Engineering and Safety Center Technical Assessment Report

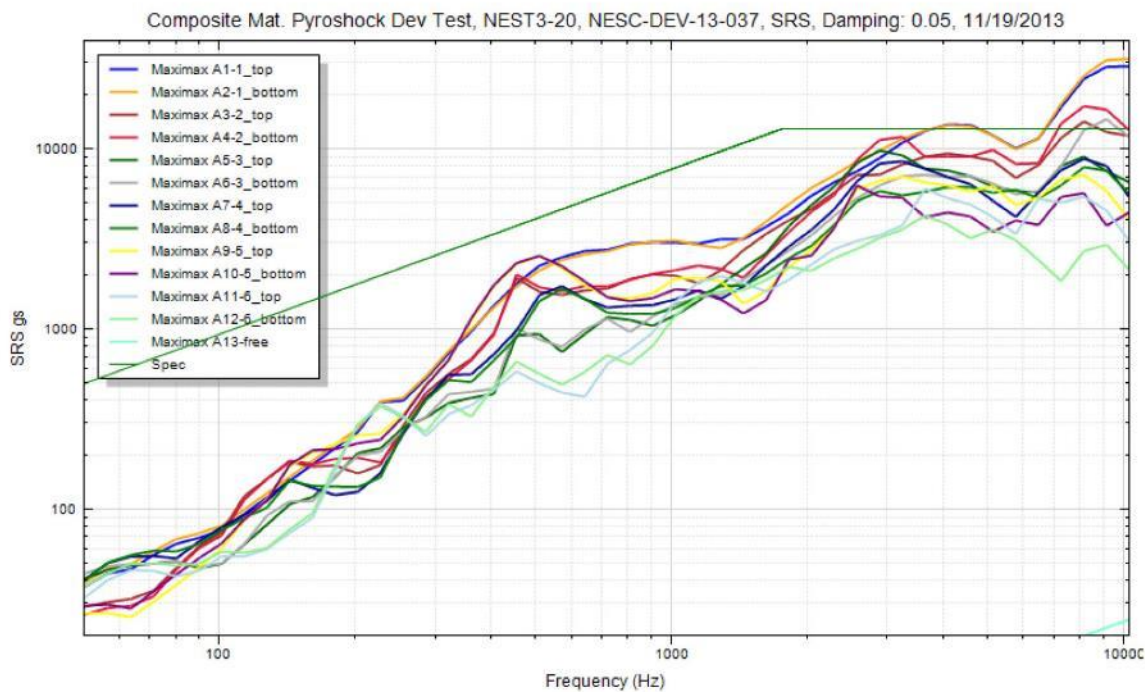
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
436 of 832







# NASA Engineering and Safety Center Technical Assessment Report

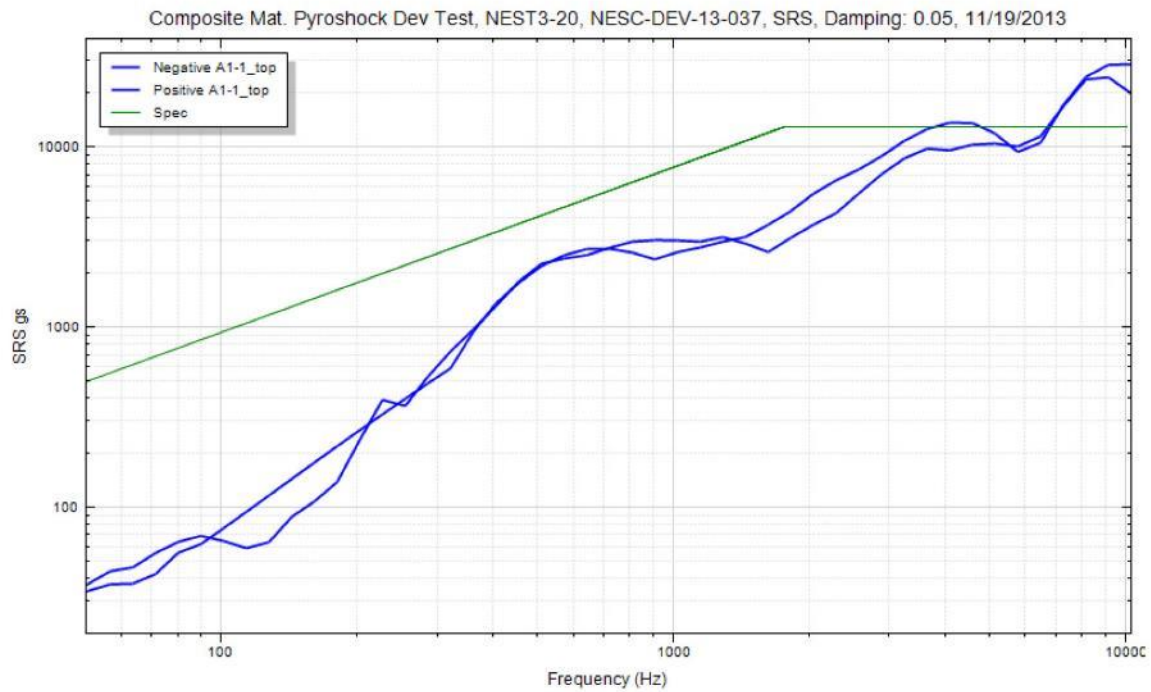
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
437 of 832





# NASA Engineering and Safety Center Technical Assessment Report

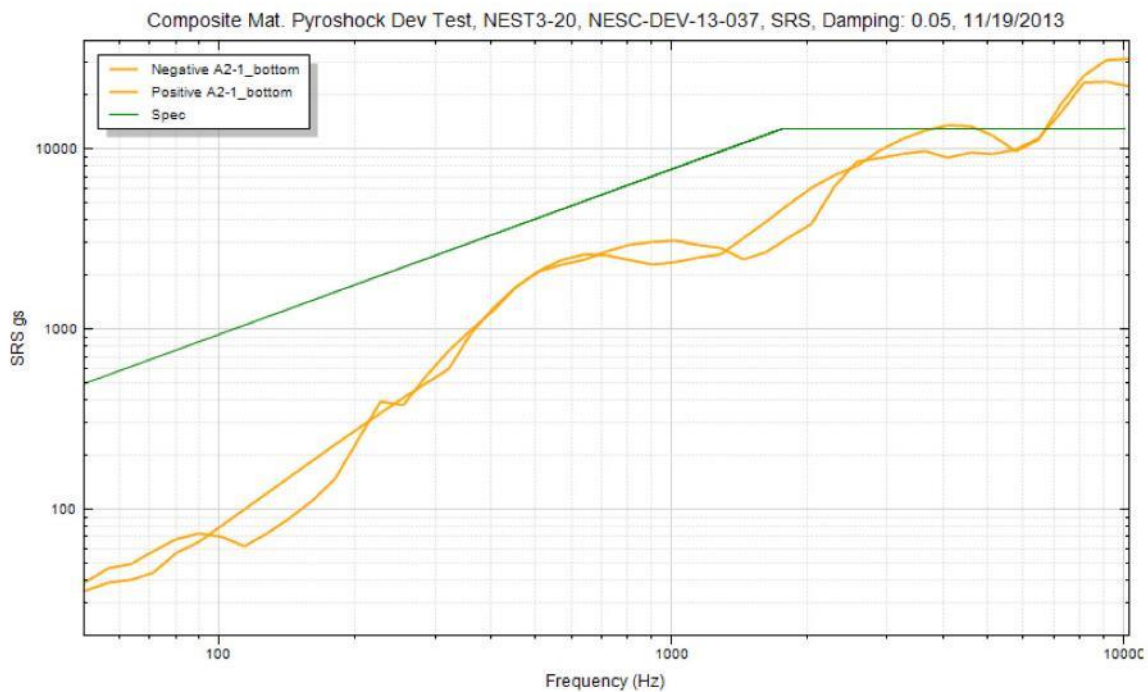
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
438 of 832





# NASA Engineering and Safety Center Technical Assessment Report

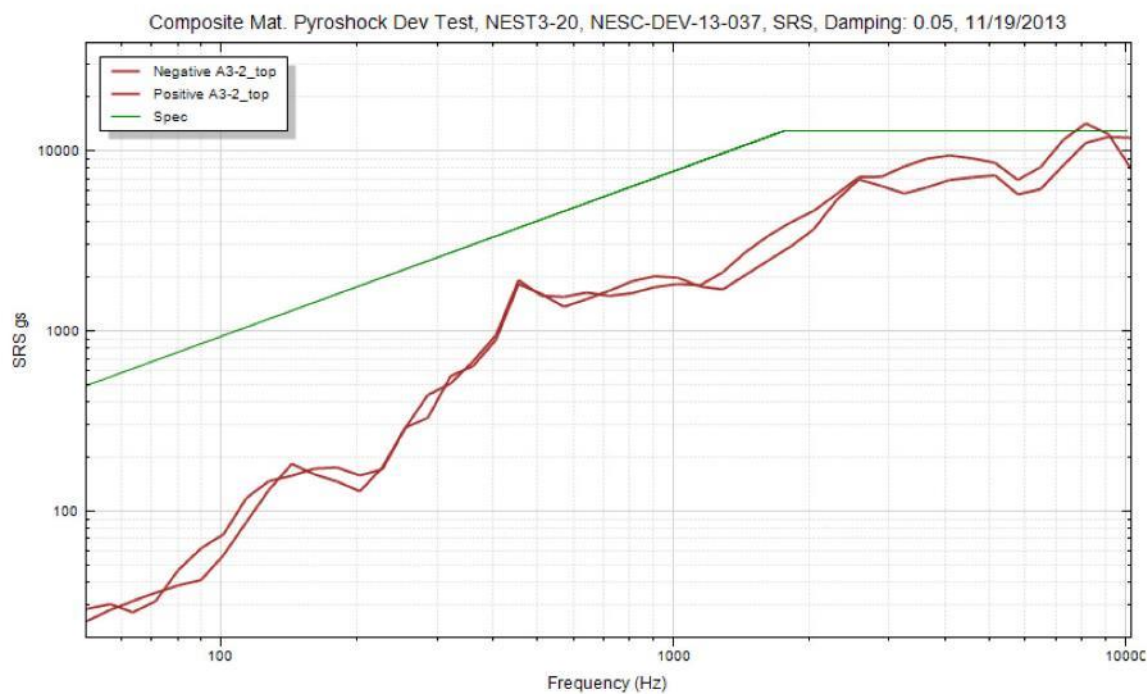
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
439 of 832





# NASA Engineering and Safety Center Technical Assessment Report

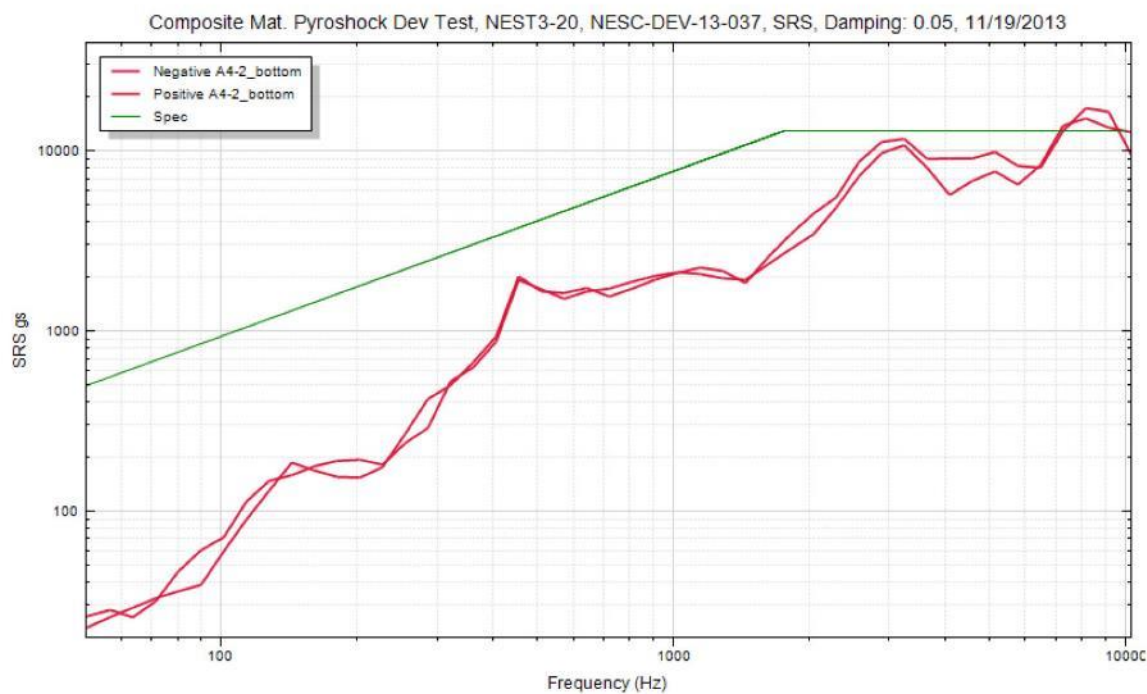
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
440 of 832





# NASA Engineering and Safety Center Technical Assessment Report

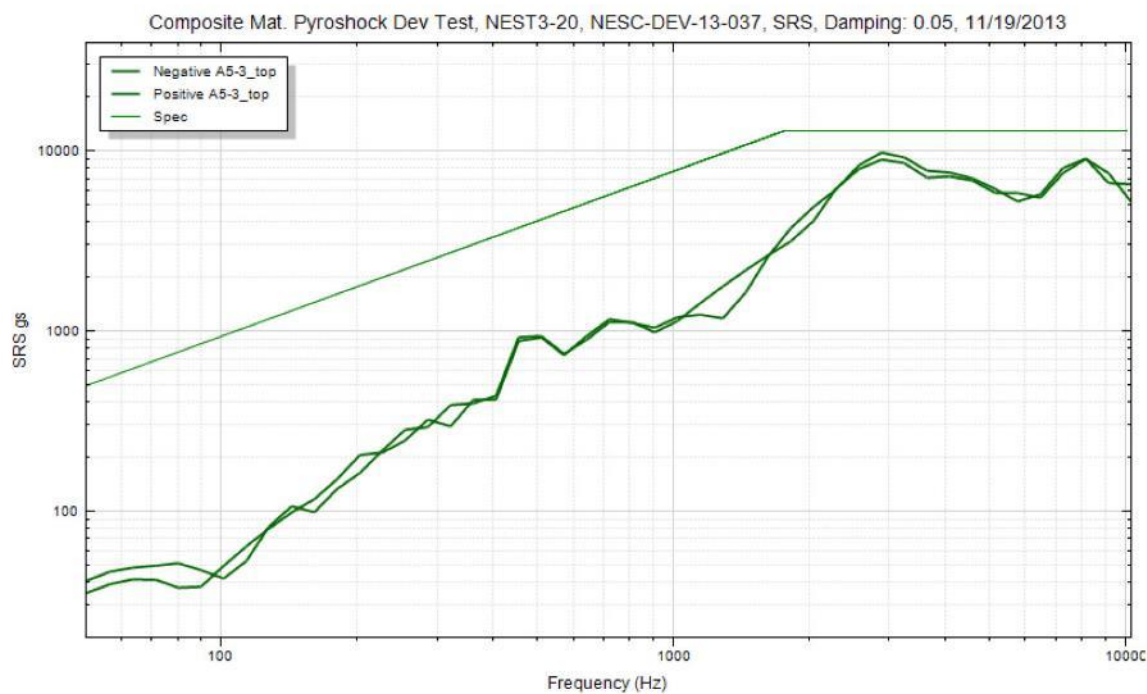
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
441 of 832





# NASA Engineering and Safety Center Technical Assessment Report

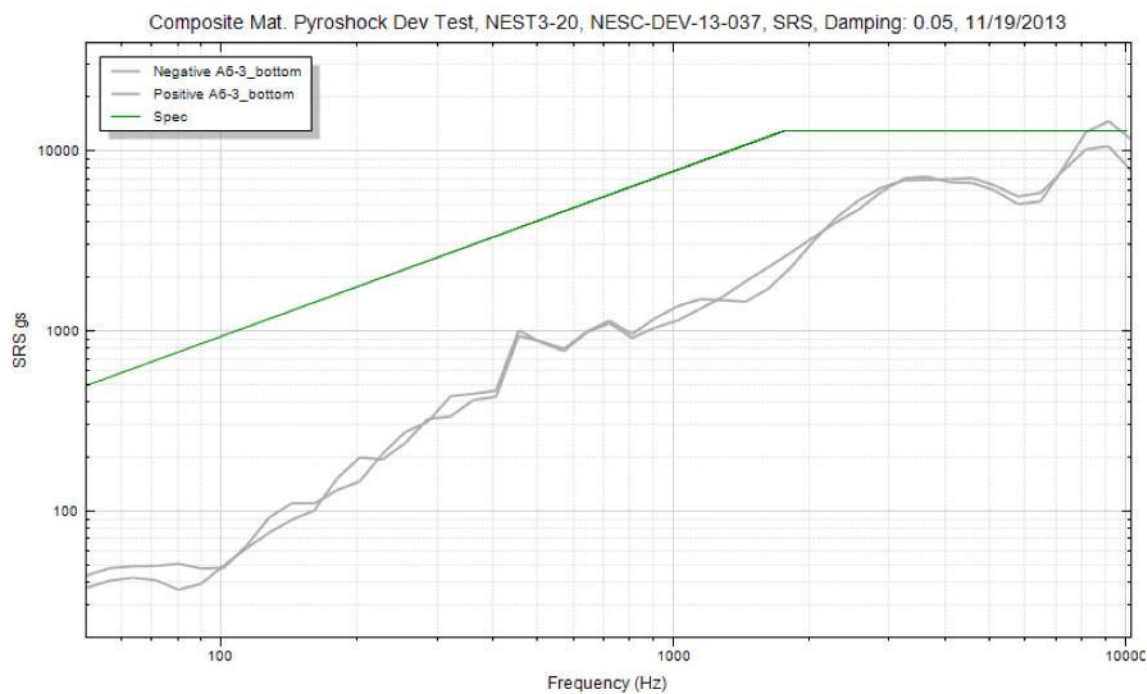
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
442 of 832





# NASA Engineering and Safety Center Technical Assessment Report

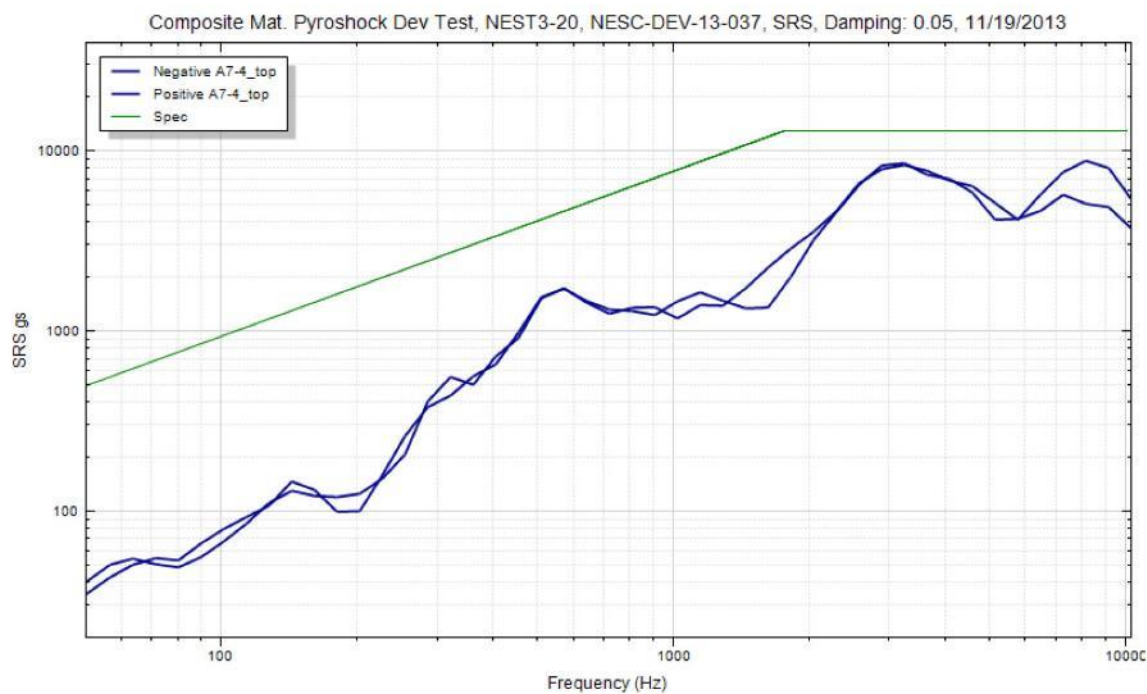
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
443 of 832





# NASA Engineering and Safety Center Technical Assessment Report

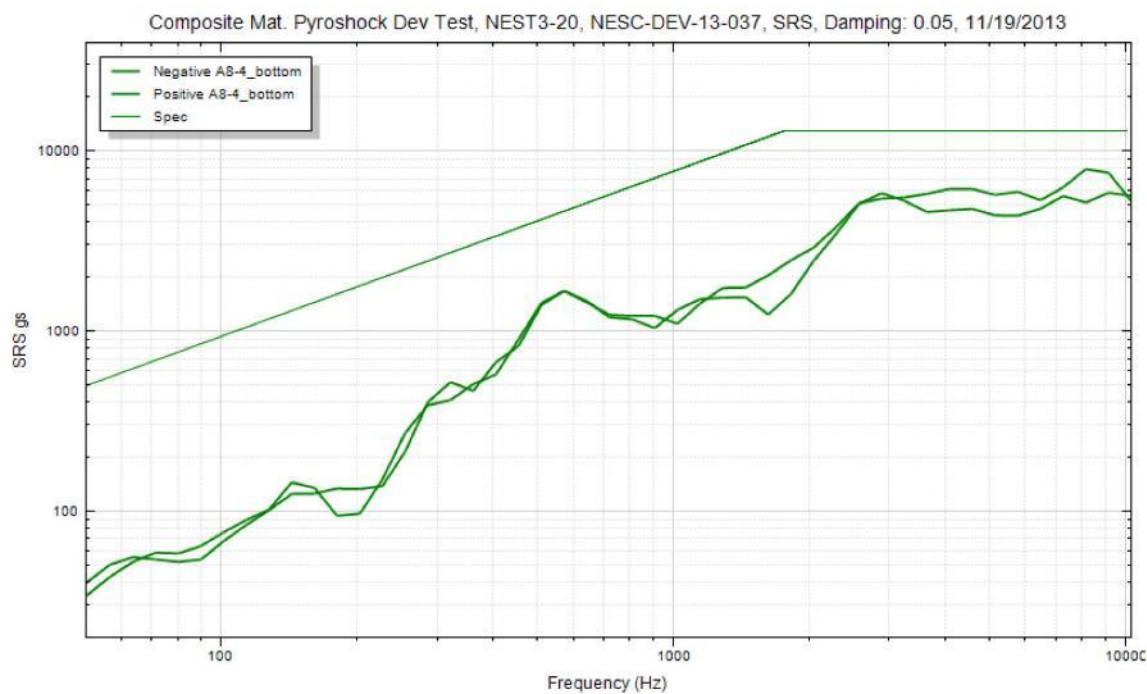
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
444 of 832







# NASA Engineering and Safety Center Technical Assessment Report

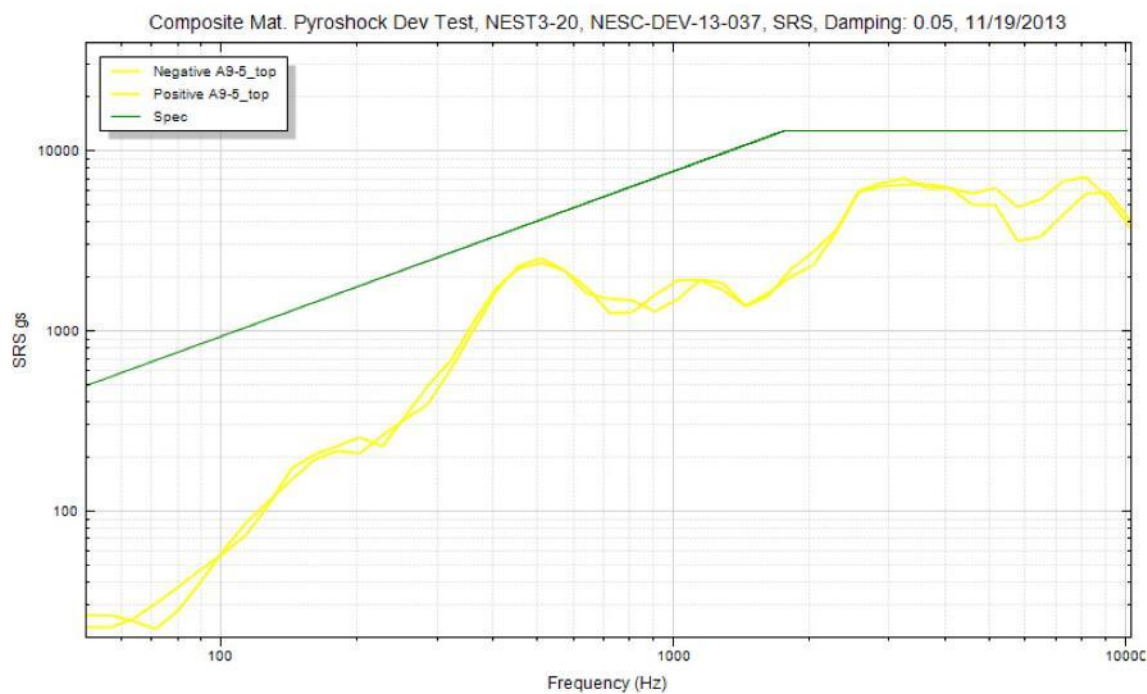
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
445 of 832





# NASA Engineering and Safety Center Technical Assessment Report

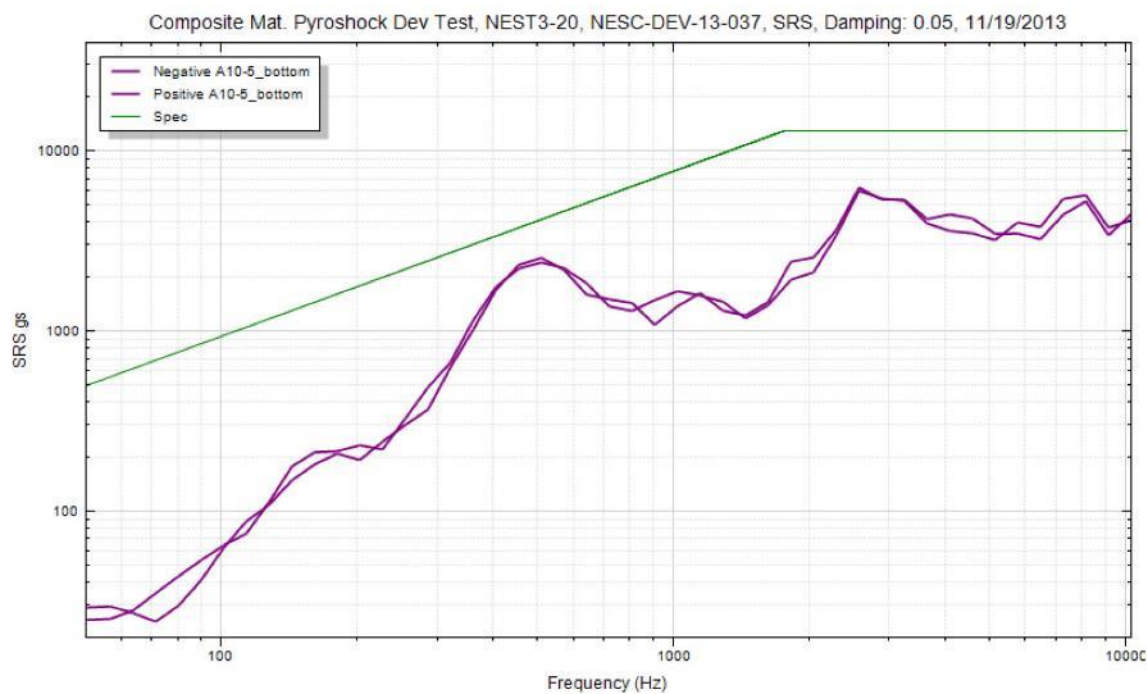
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
446 of 832





# NASA Engineering and Safety Center Technical Assessment Report

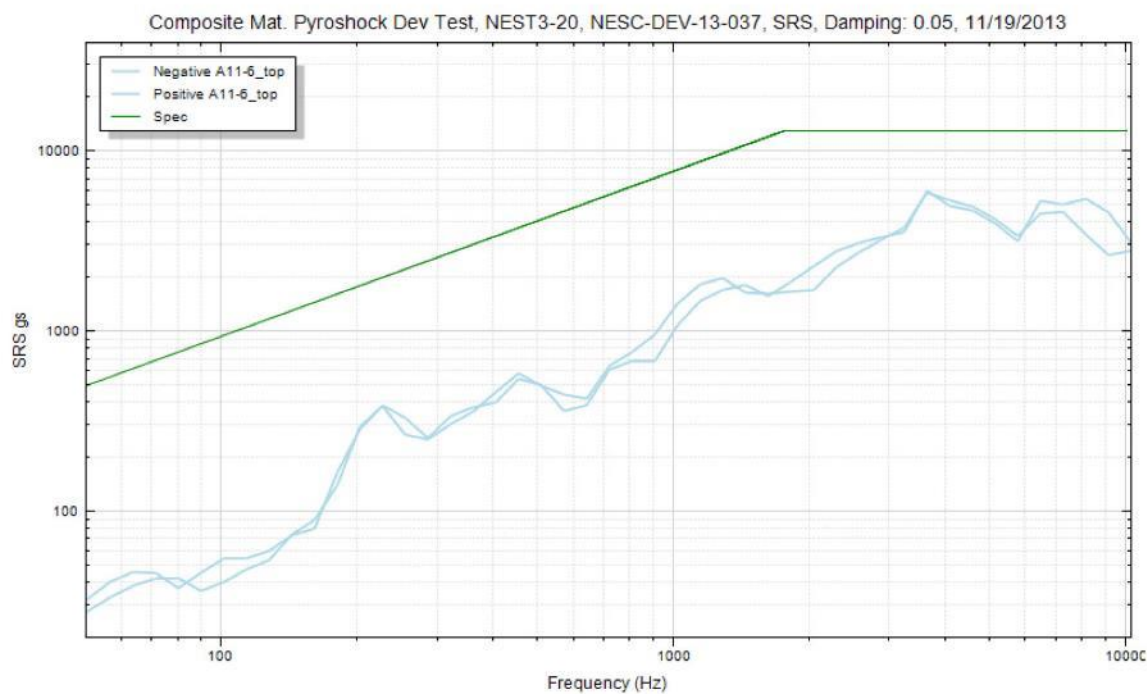
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
447 of 832





# NASA Engineering and Safety Center Technical Assessment Report

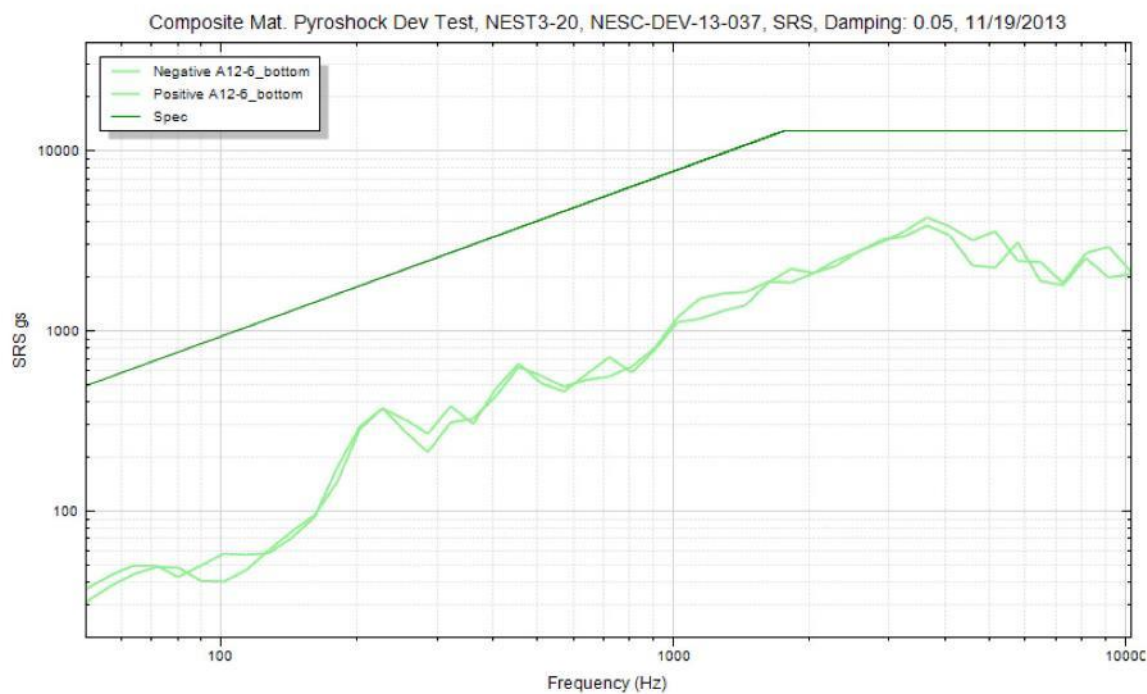
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
448 of 832





# NASA Engineering and Safety Center Technical Assessment Report

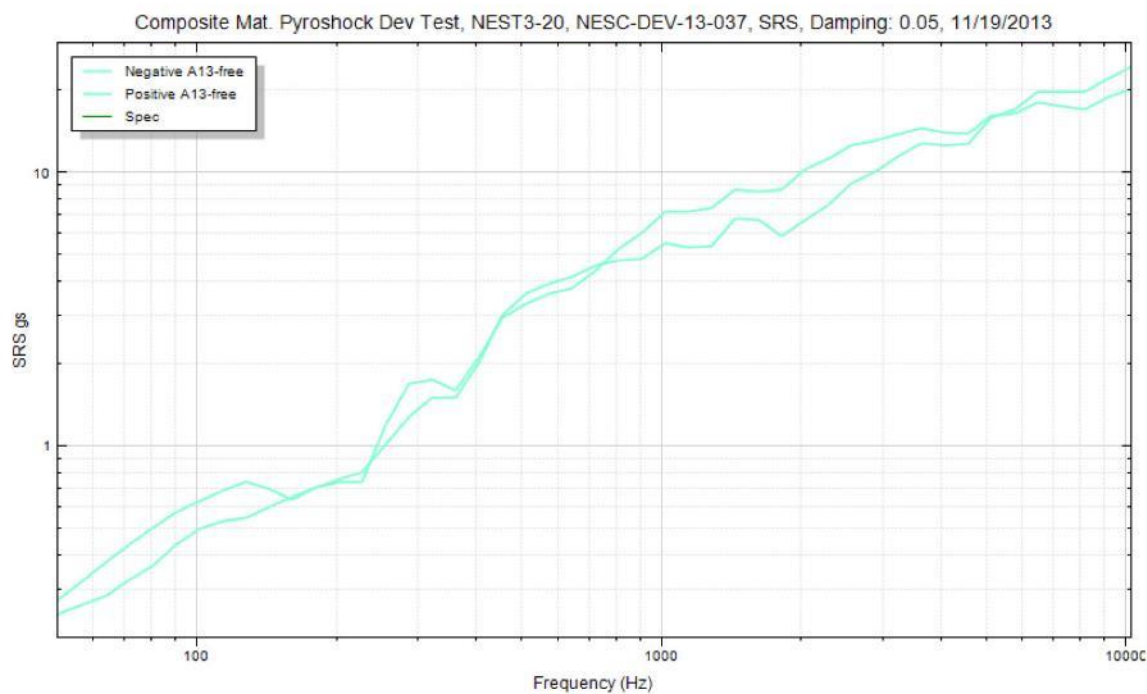
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
449 of 832





# NASA Engineering and Safety Center Technical Assessment Report

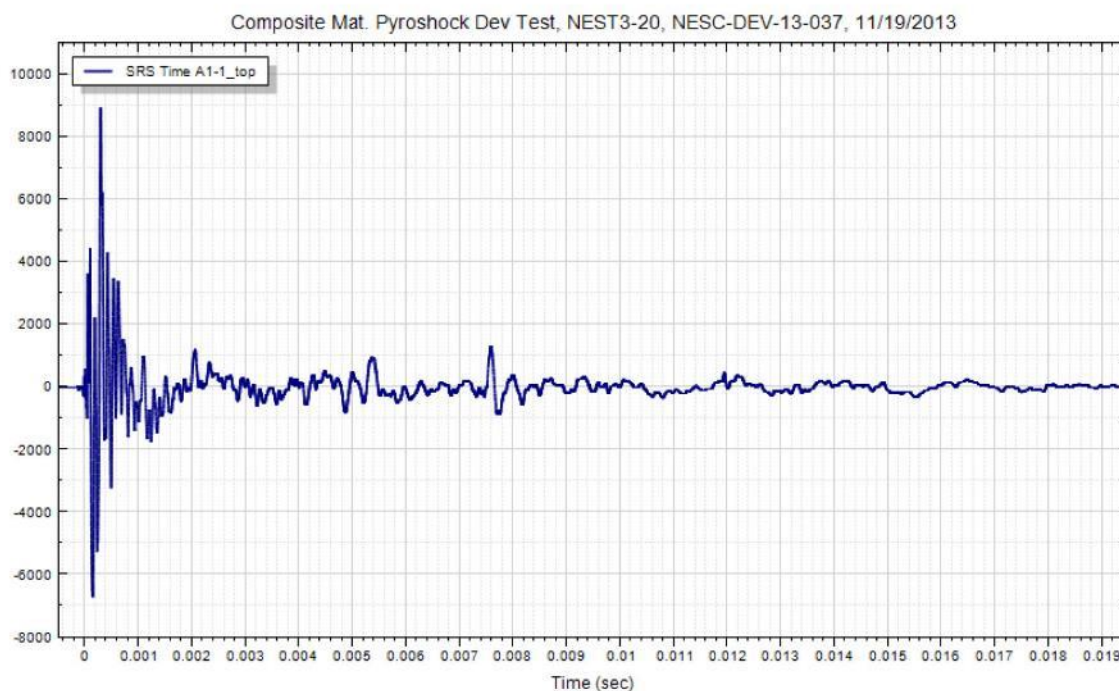
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
450 of 832





# NASA Engineering and Safety Center Technical Assessment Report

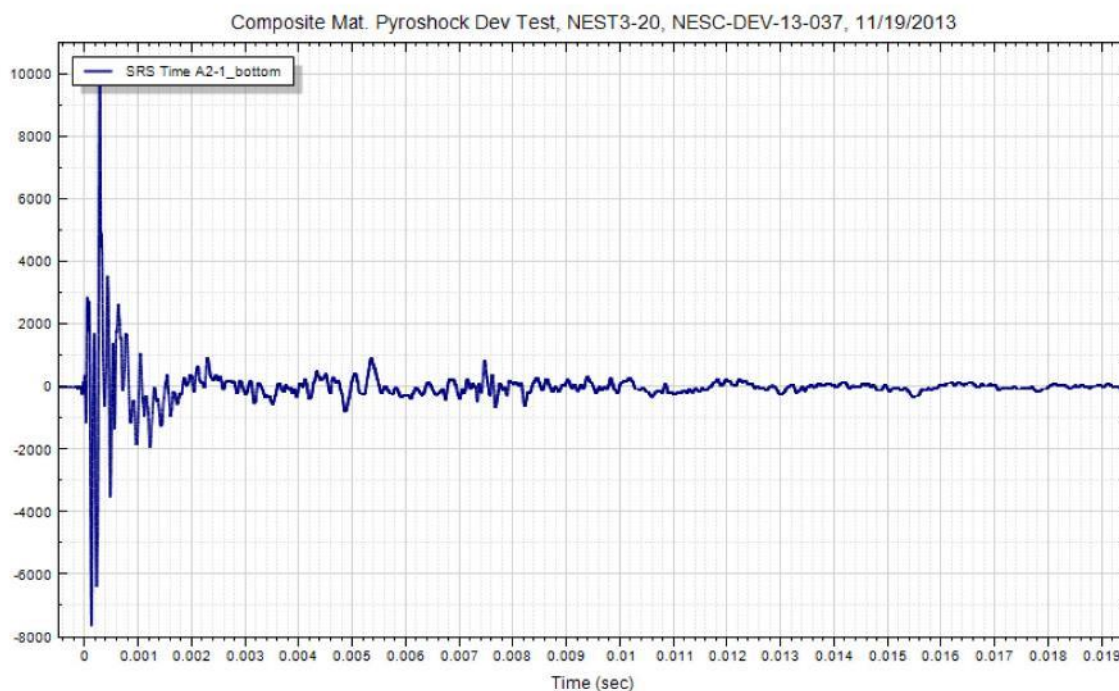
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
451 of 832





# NASA Engineering and Safety Center Technical Assessment Report

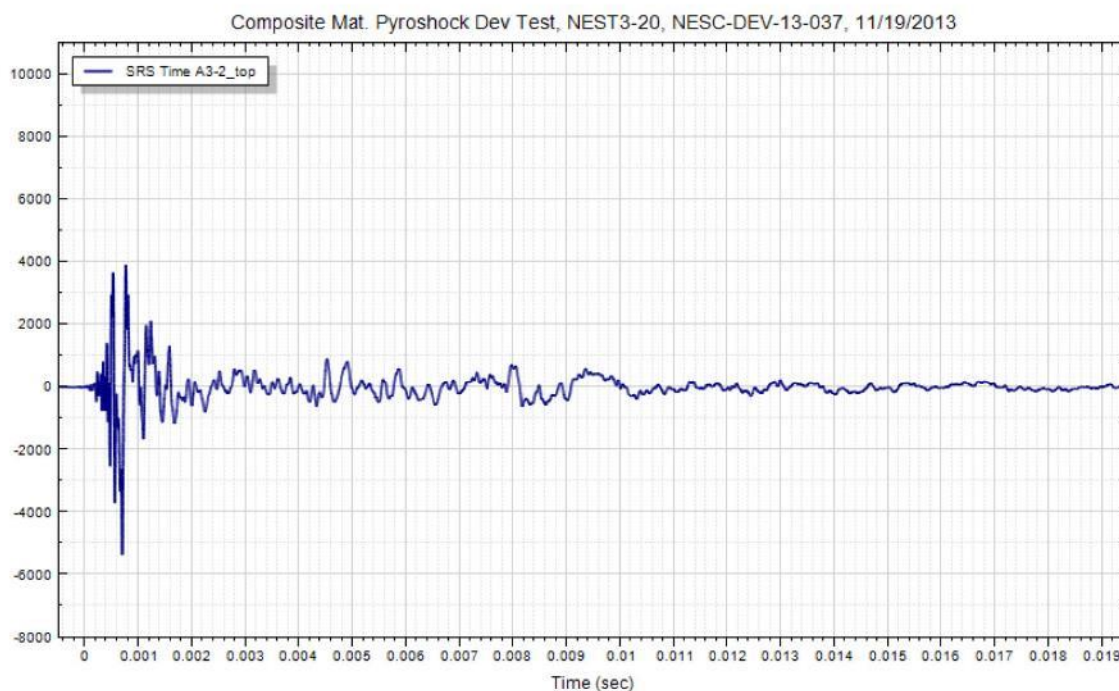
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
452 of 832







# NASA Engineering and Safety Center Technical Assessment Report

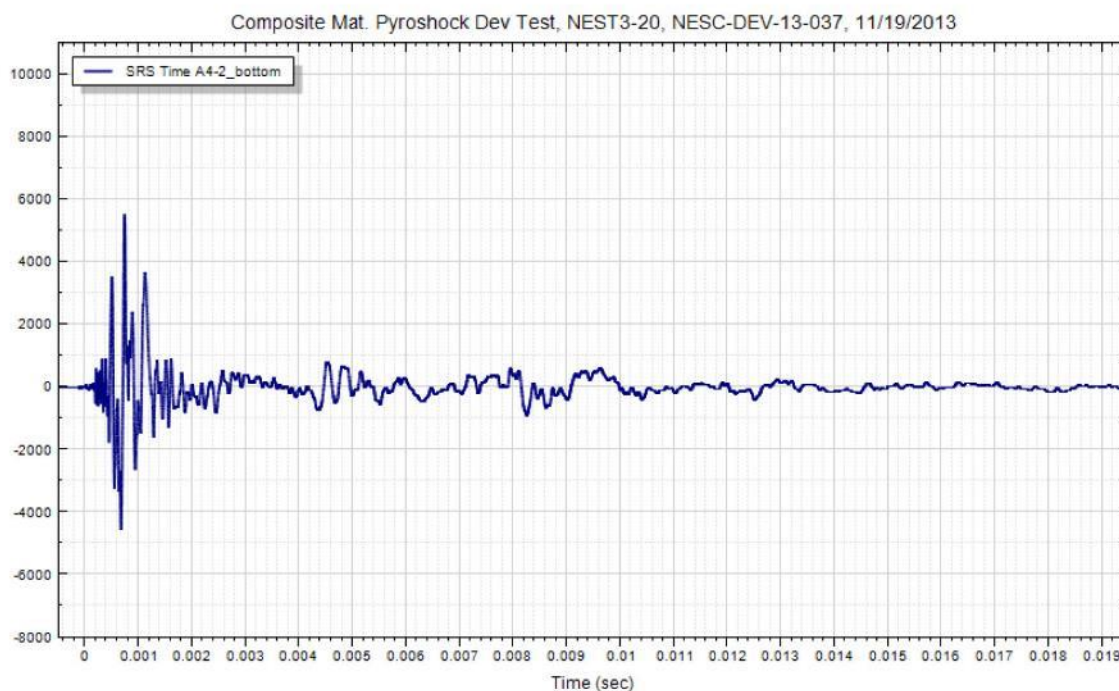
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
453 of 832





# NASA Engineering and Safety Center Technical Assessment Report

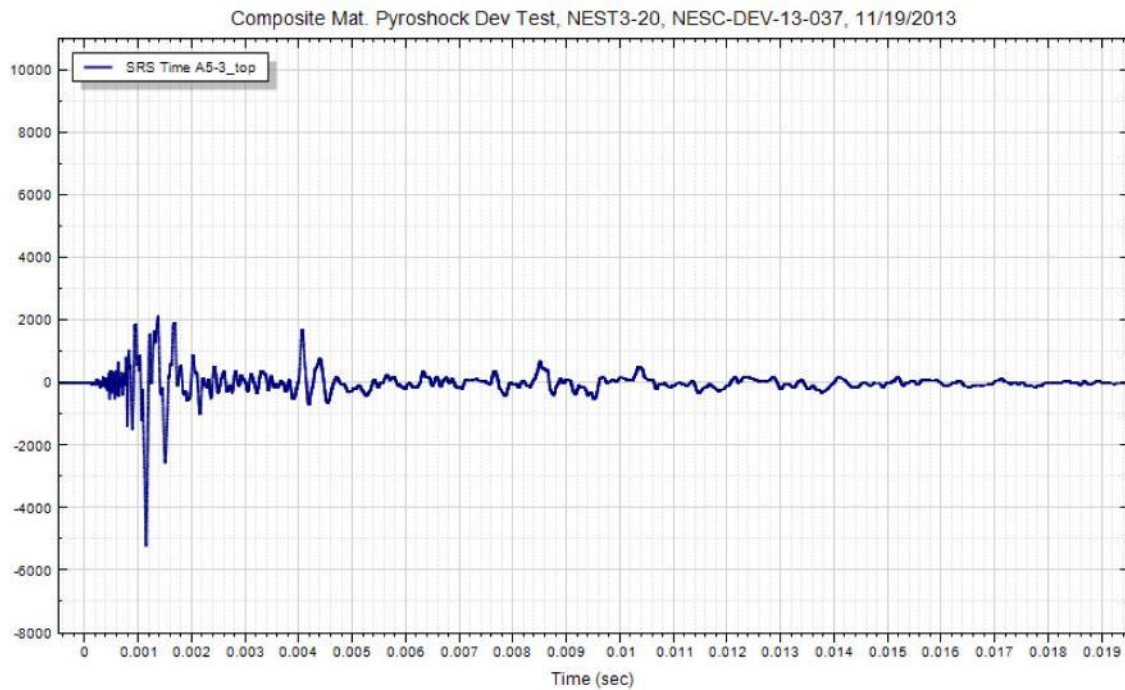
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
454 of 832





# NASA Engineering and Safety Center Technical Assessment Report

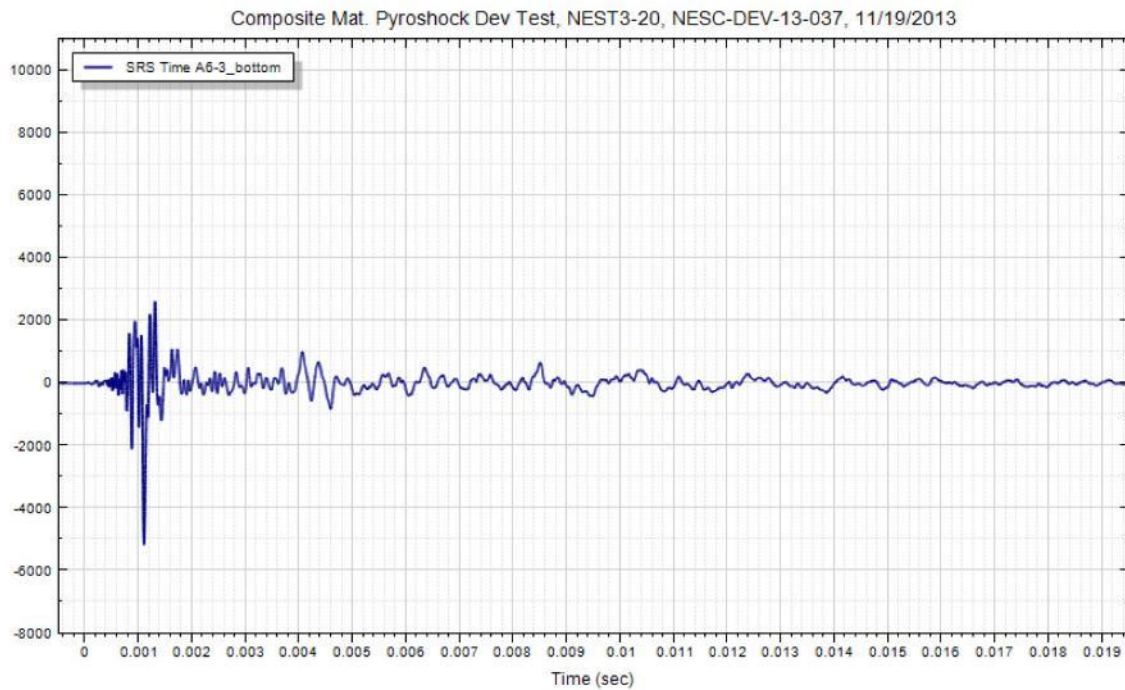
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
455 of 832





# NASA Engineering and Safety Center Technical Assessment Report

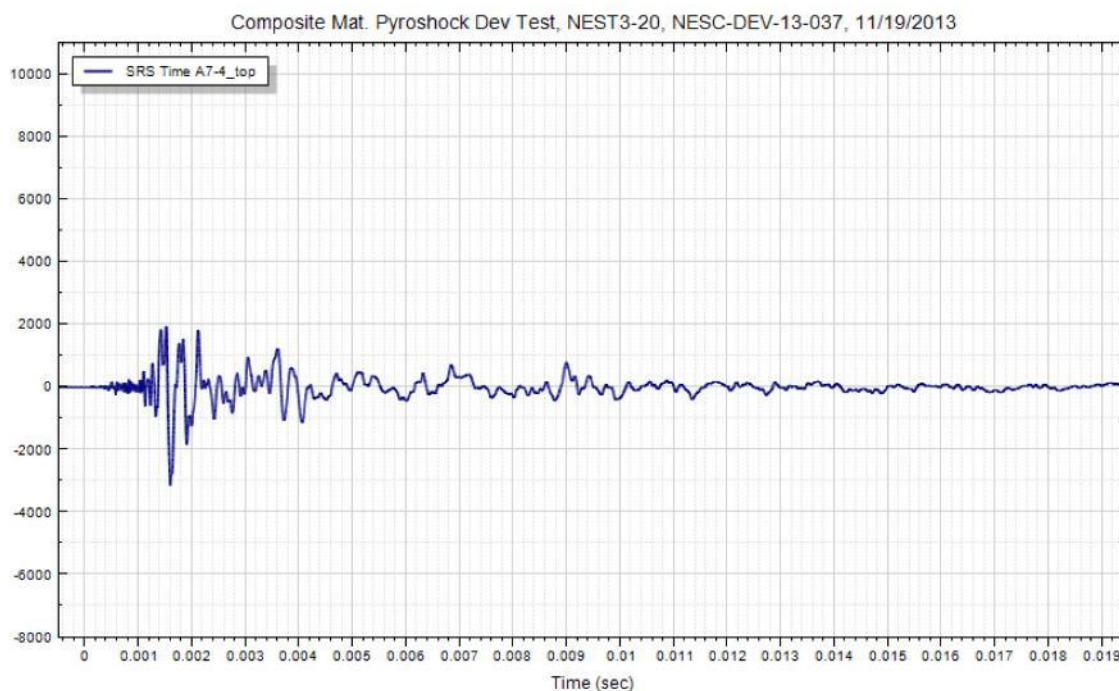
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
456 of 832





# NASA Engineering and Safety Center Technical Assessment Report

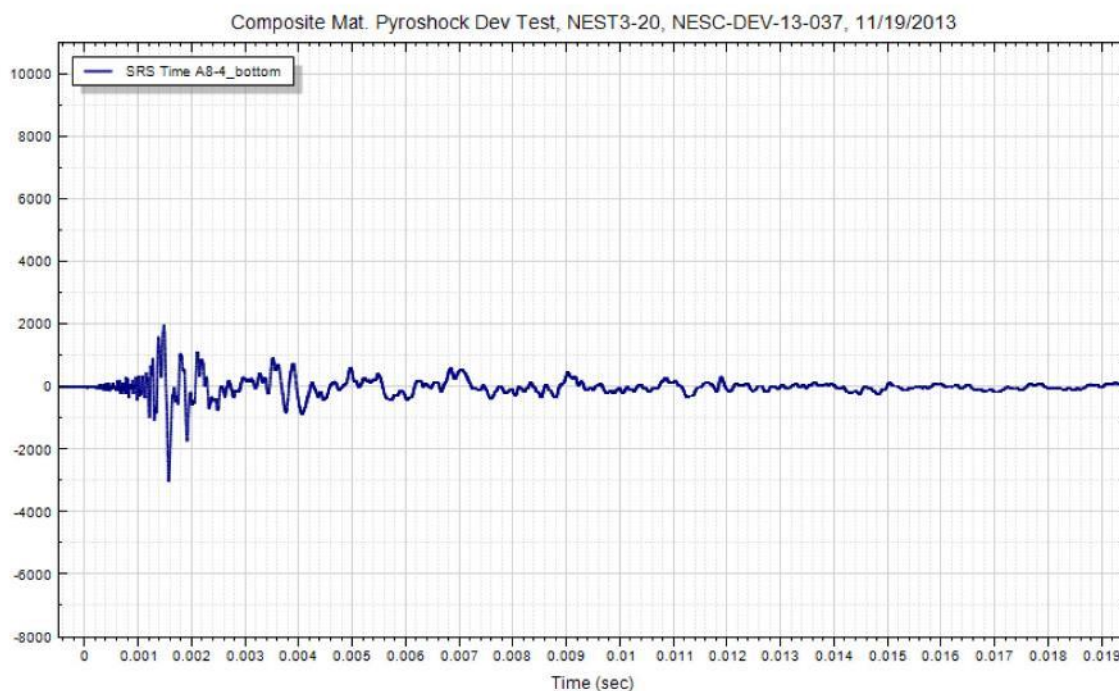
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
457 of 832





# NASA Engineering and Safety Center Technical Assessment Report

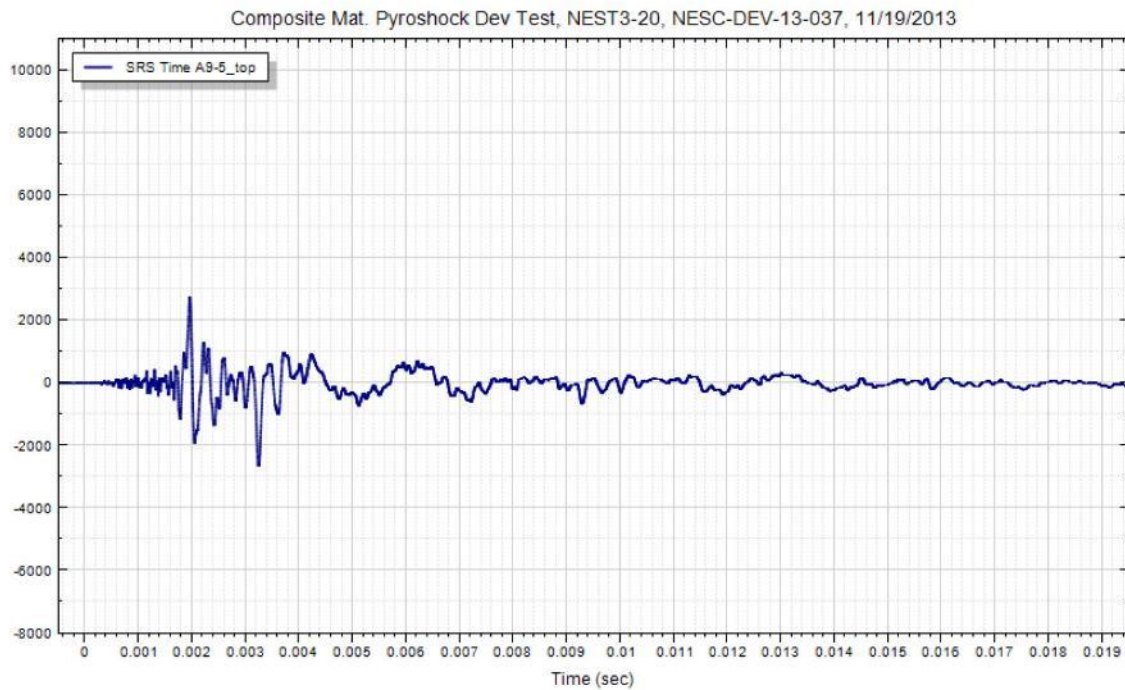
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
458 of 832





# NASA Engineering and Safety Center Technical Assessment Report

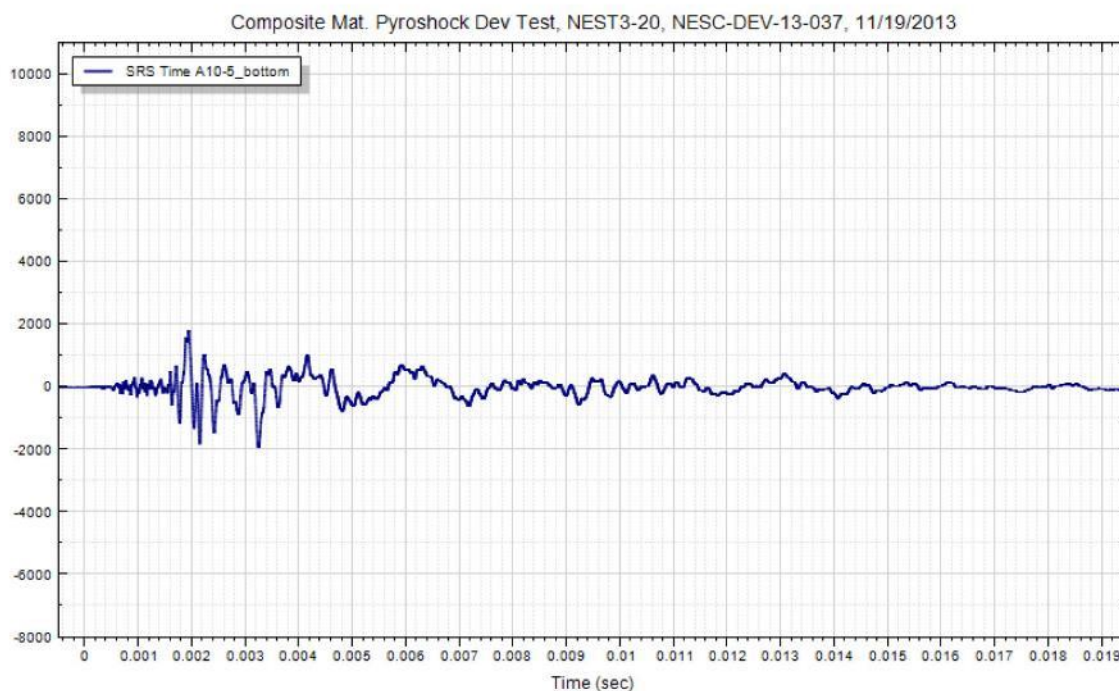
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
459 of 832





# NASA Engineering and Safety Center Technical Assessment Report

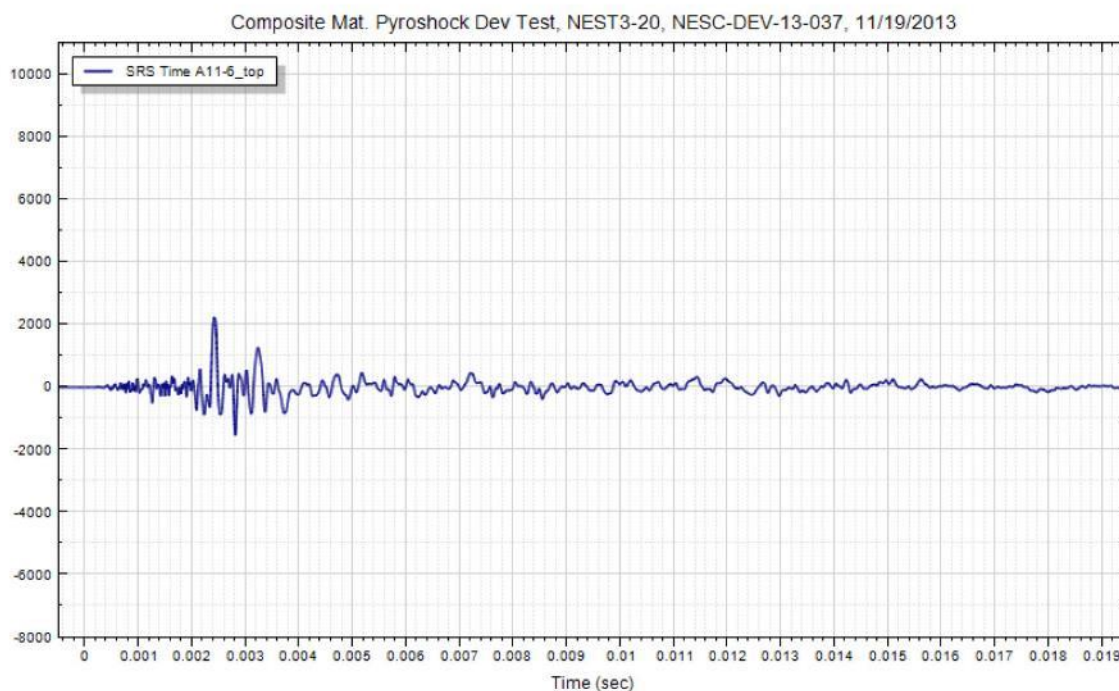
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
460 of 832







# NASA Engineering and Safety Center Technical Assessment Report

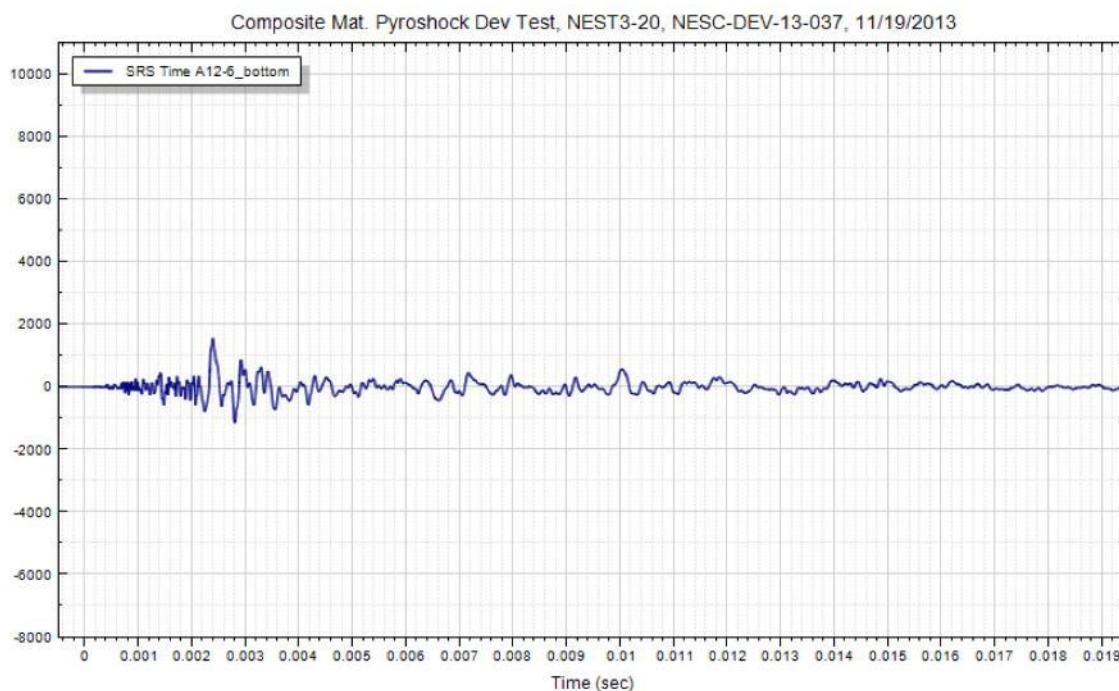
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
461 of 832





# NASA Engineering and Safety Center Technical Assessment Report

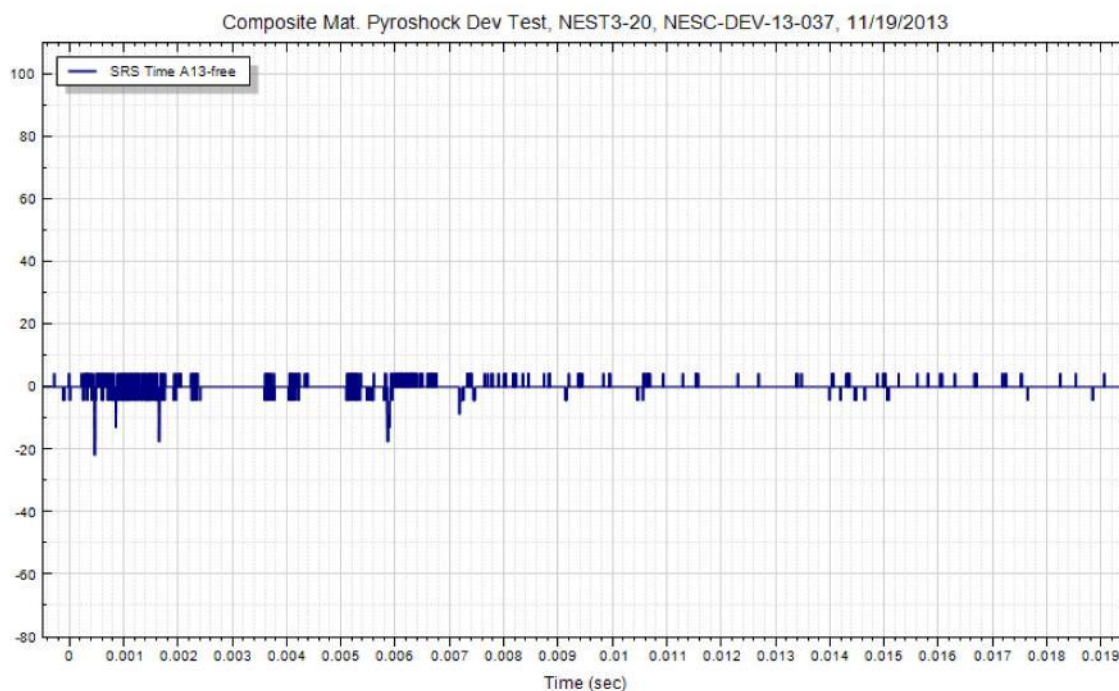
Document #:  
**NESC-RP-  
12-00783**


Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
462 of 832



	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 463 of 832	

**NESC-DEV-13-037**  
**Composite Materials**  
**Shock Test**  
  
**Test #3 Accelerometer Data**  
**Panel 0346A022**



# NASA Engineering and Safety Center Technical Assessment Report

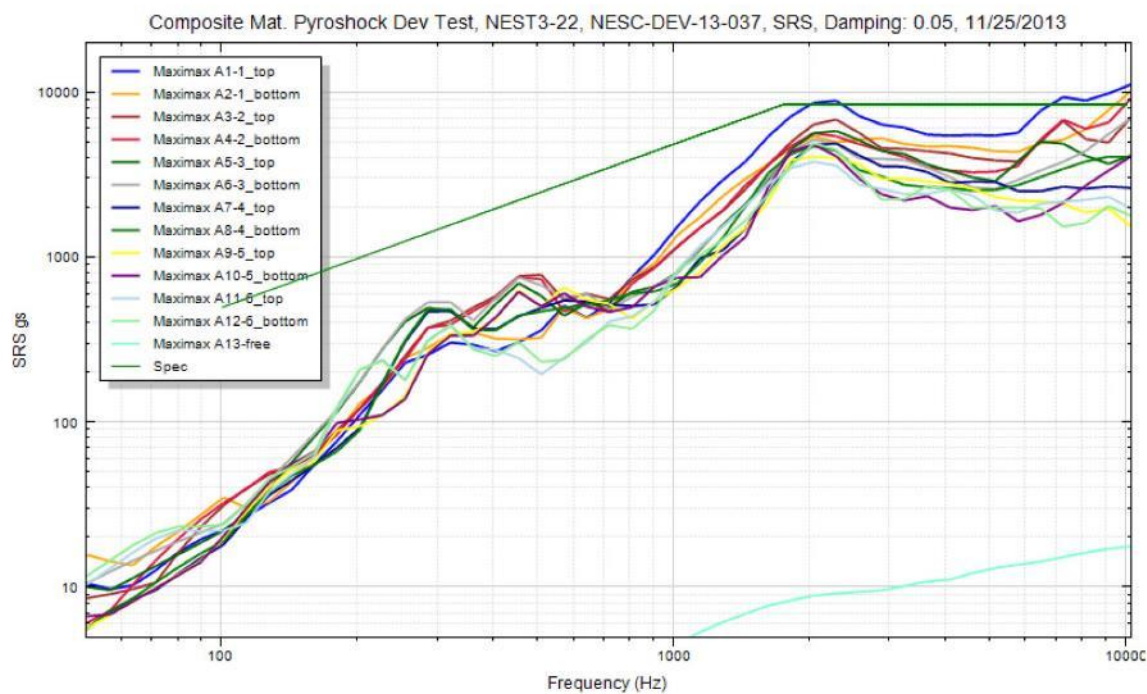
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
464 of 832





# NASA Engineering and Safety Center Technical Assessment Report

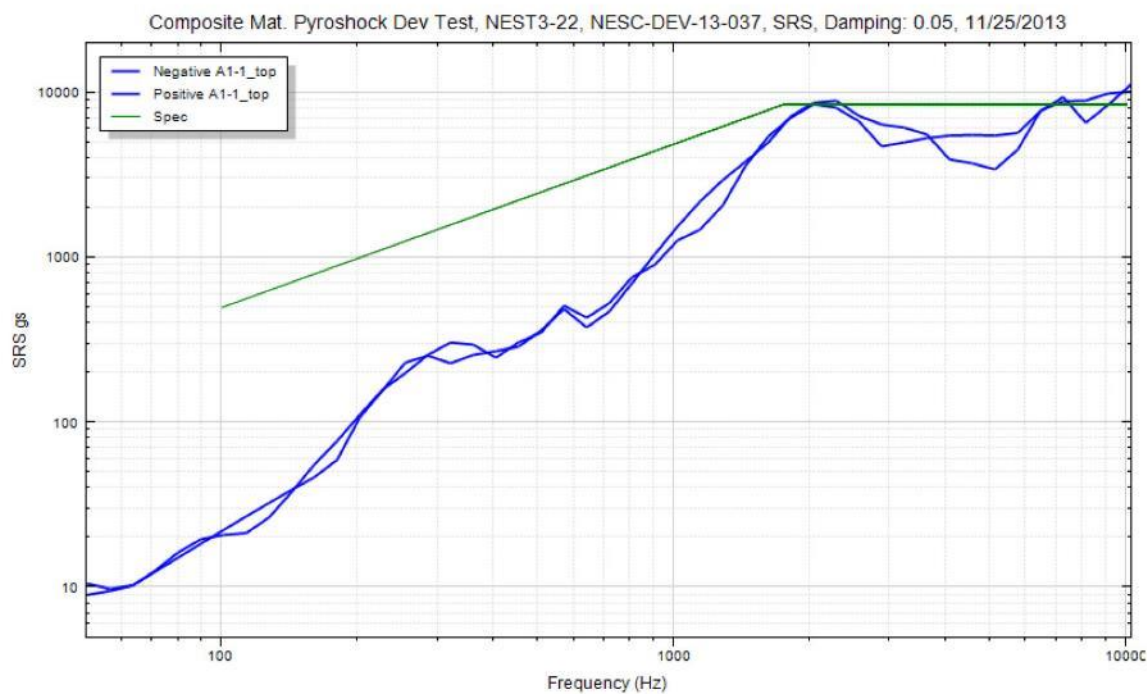
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
465 of 832





# NASA Engineering and Safety Center Technical Assessment Report

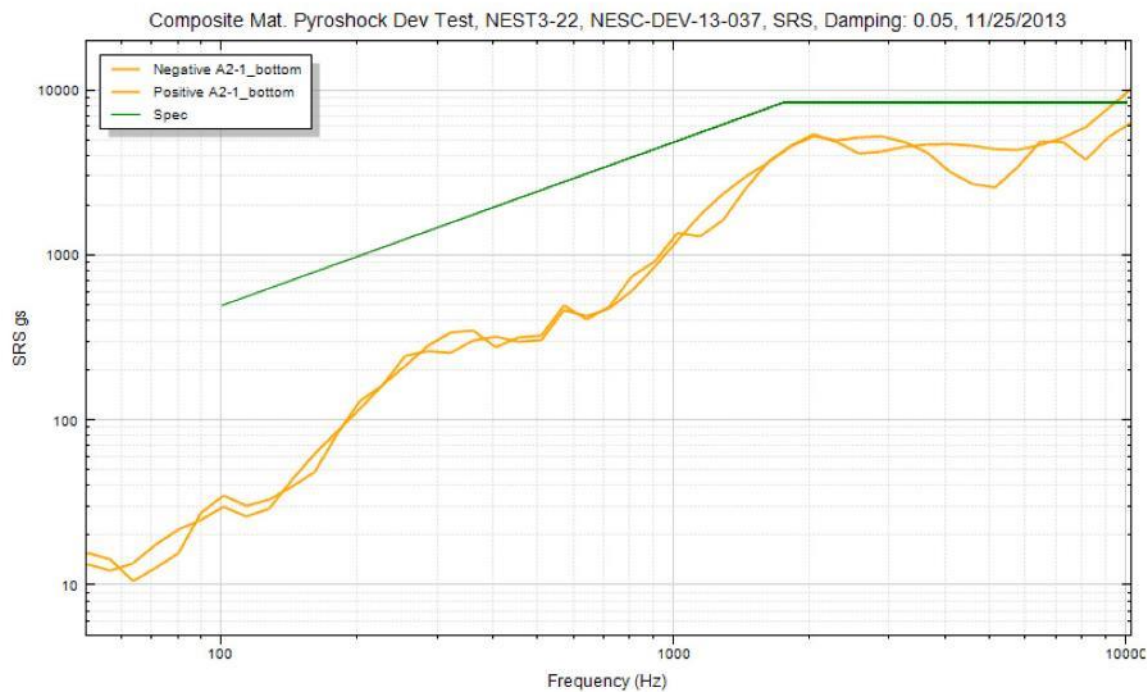
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
466 of 832





# NASA Engineering and Safety Center Technical Assessment Report

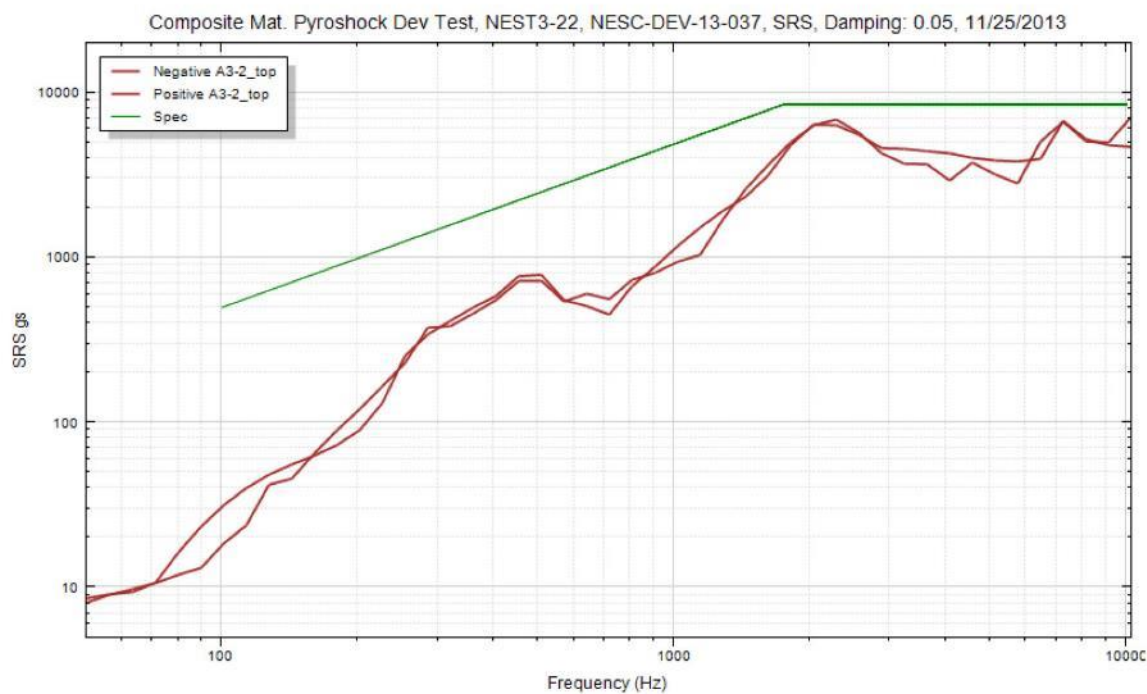
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
467 of 832





# NASA Engineering and Safety Center Technical Assessment Report

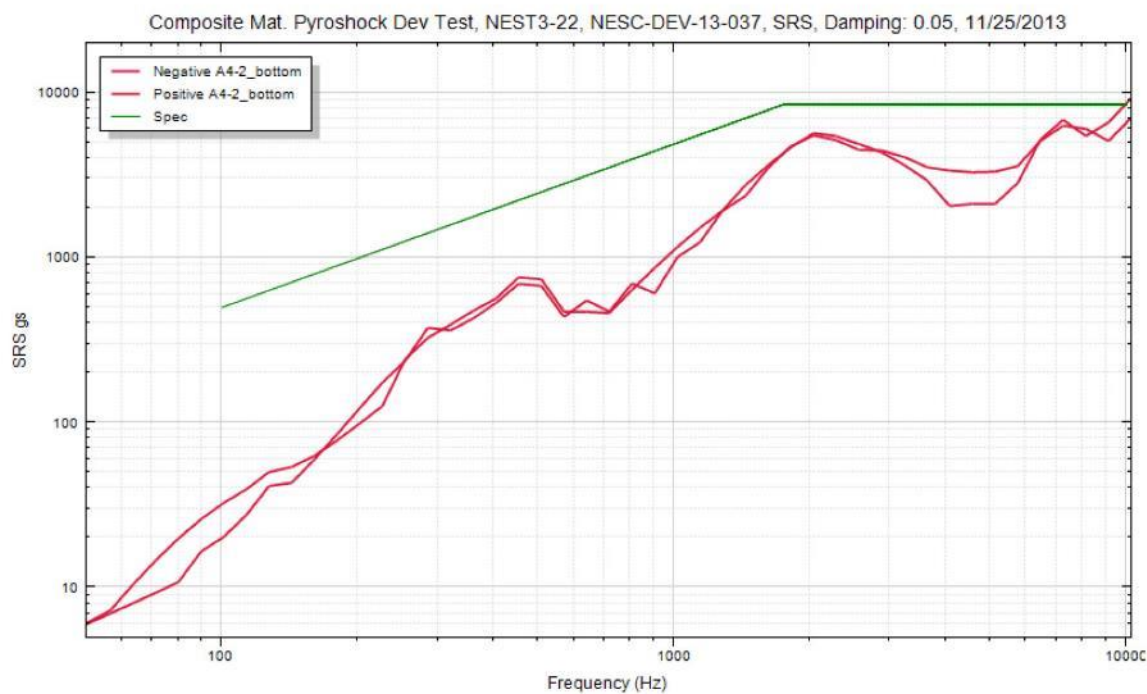
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
468 of 832







# NASA Engineering and Safety Center Technical Assessment Report

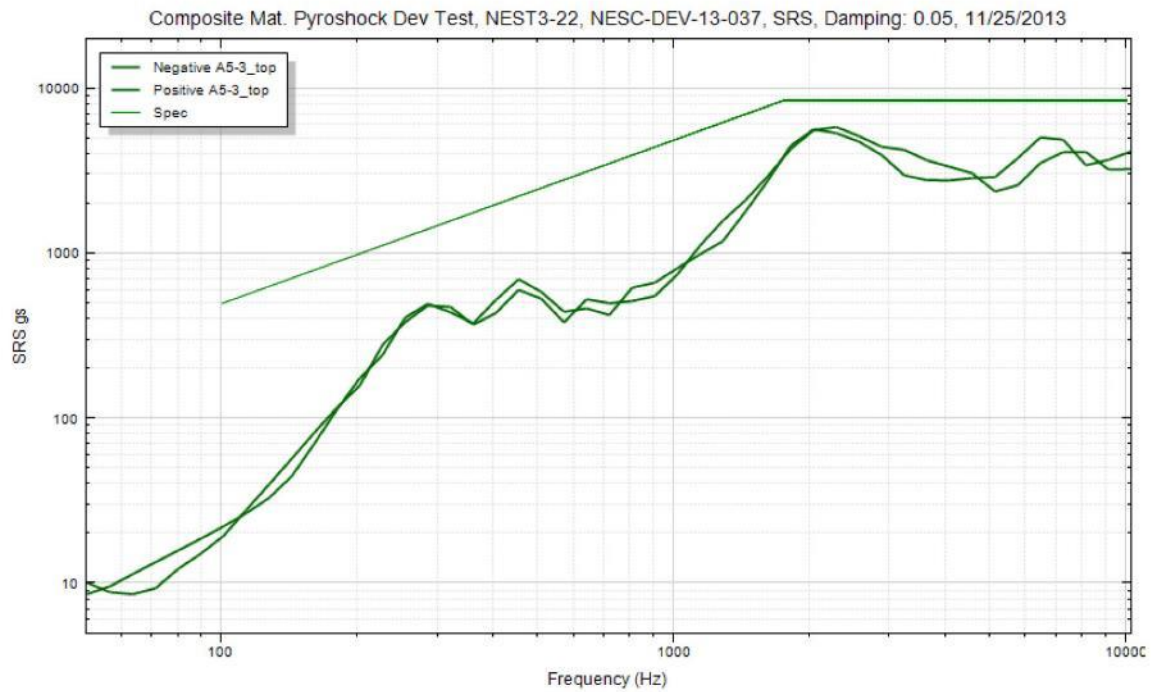
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
469 of 832





# NASA Engineering and Safety Center Technical Assessment Report

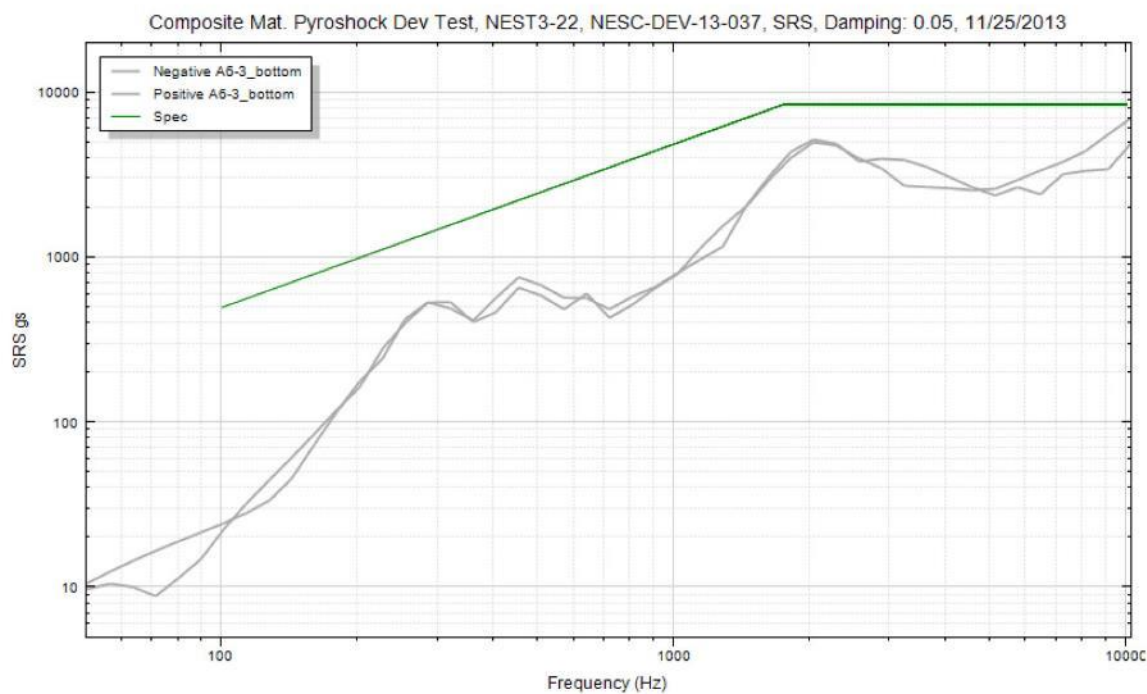
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
470 of 832





# NASA Engineering and Safety Center Technical Assessment Report

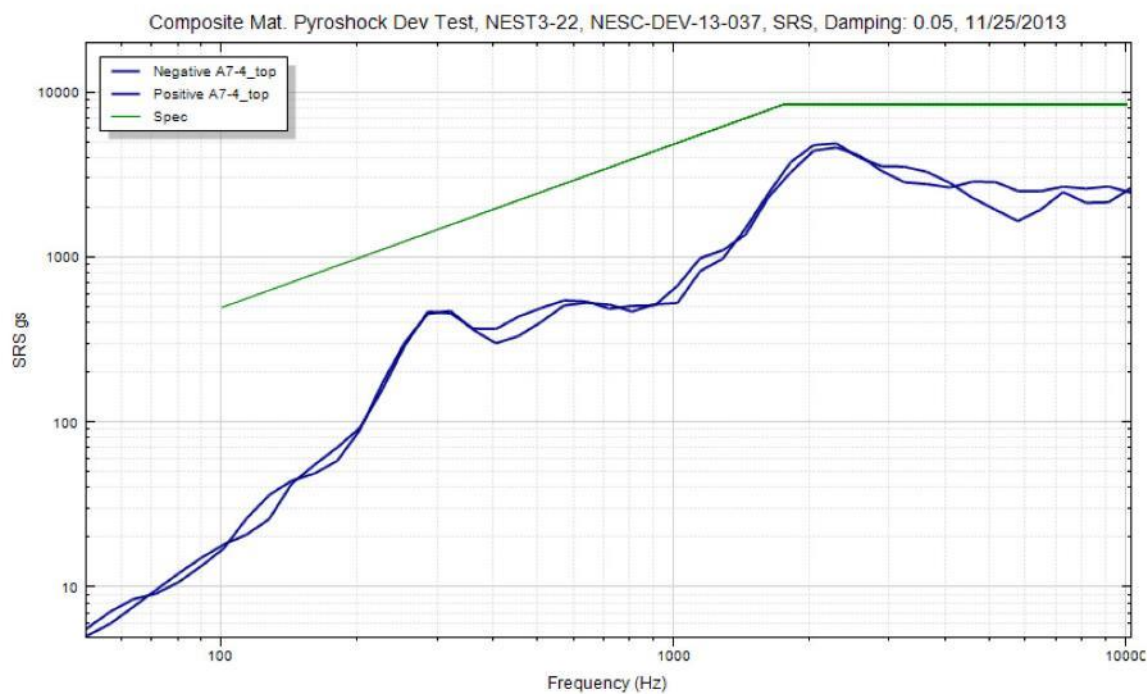
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
471 of 832





# NASA Engineering and Safety Center Technical Assessment Report

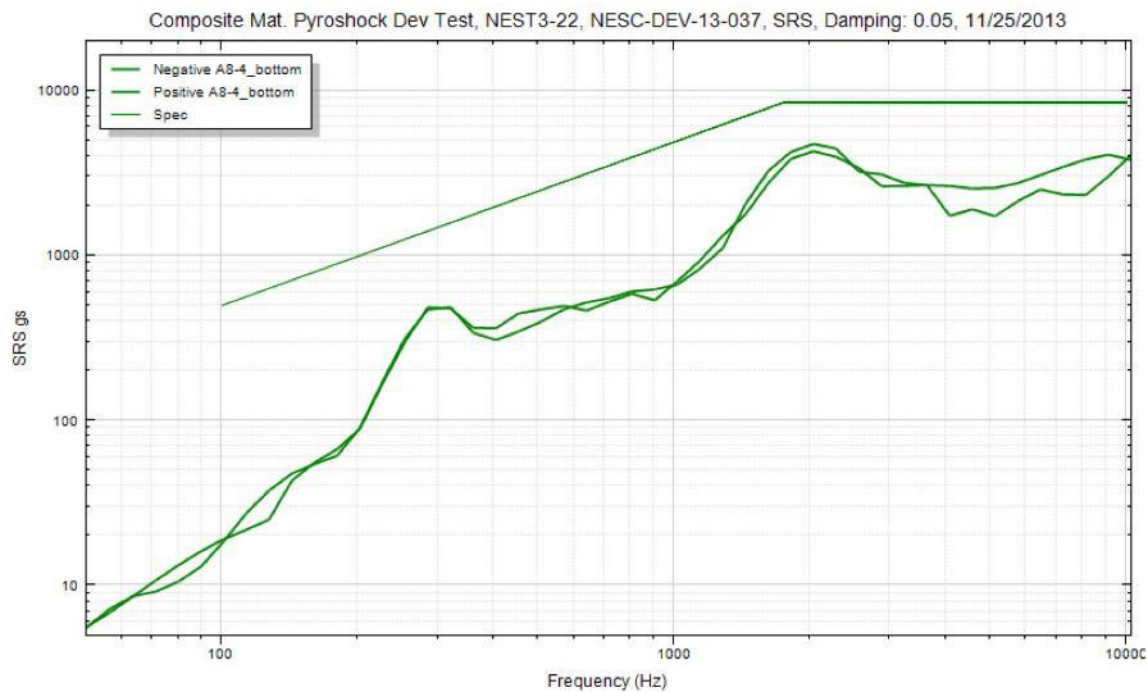
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
472 of 832





# NASA Engineering and Safety Center Technical Assessment Report

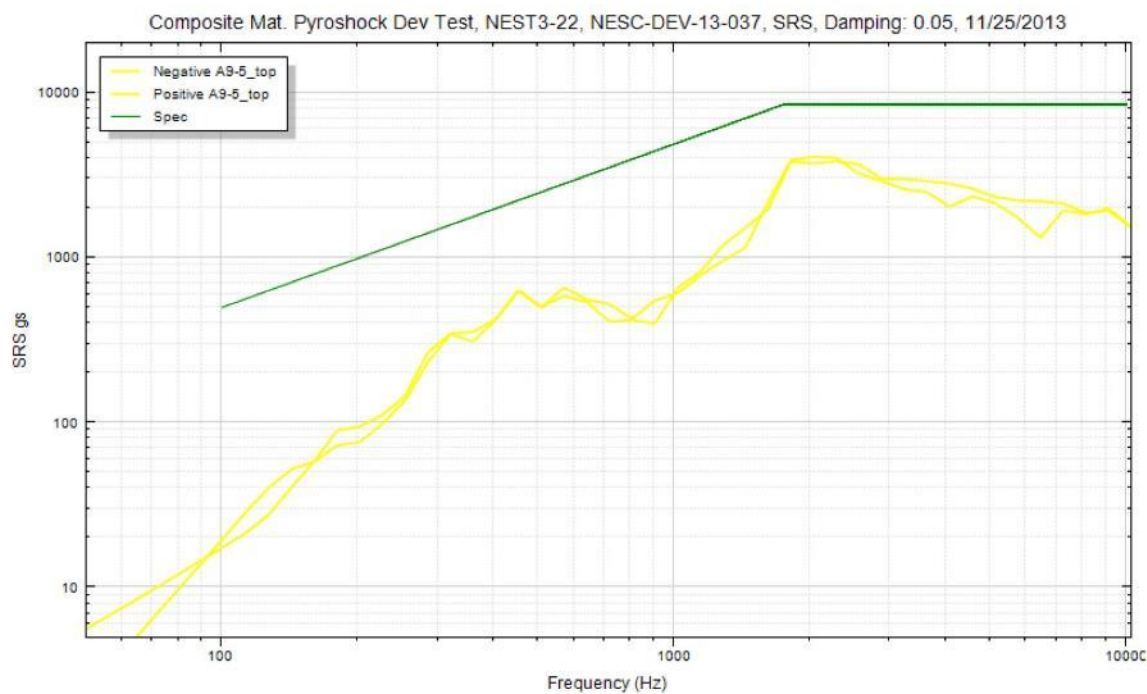
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
473 of 832





# NASA Engineering and Safety Center Technical Assessment Report

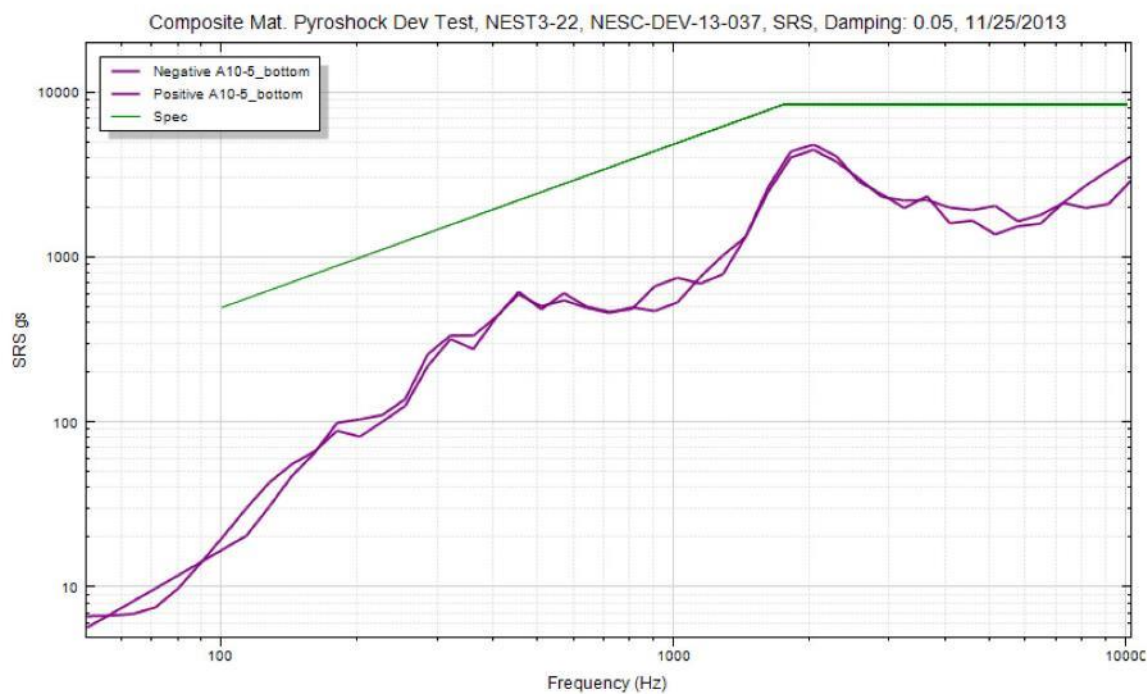
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
474 of 832





# NASA Engineering and Safety Center Technical Assessment Report

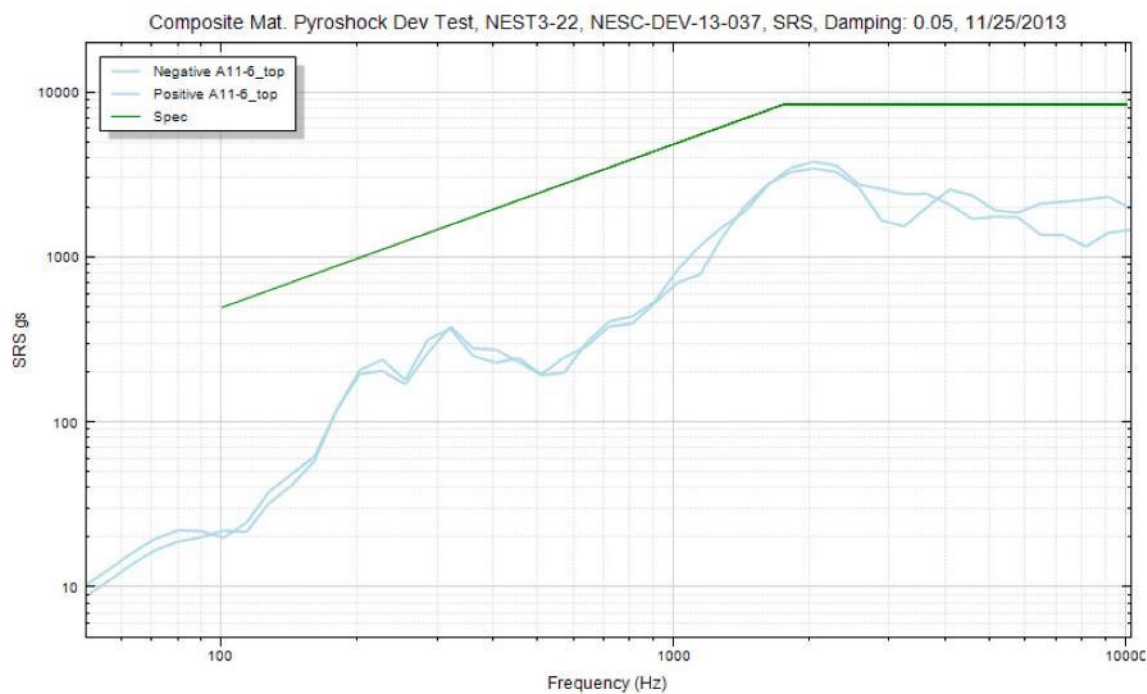
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
475 of 832





# NASA Engineering and Safety Center Technical Assessment Report

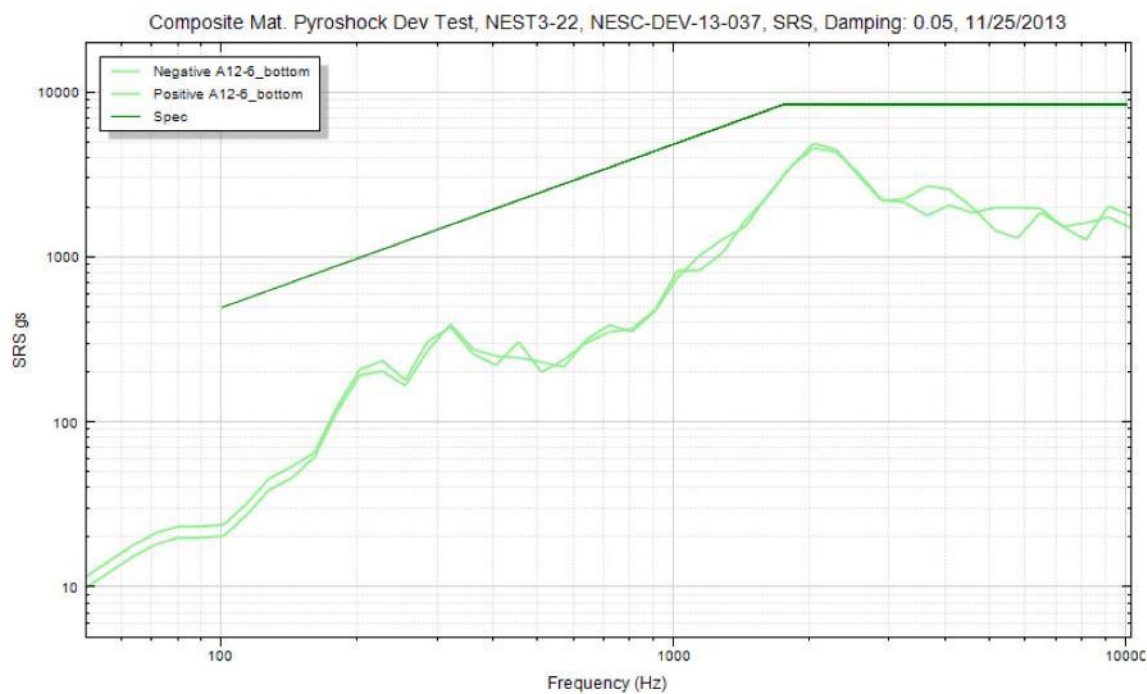
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
476 of 832







# NASA Engineering and Safety Center Technical Assessment Report

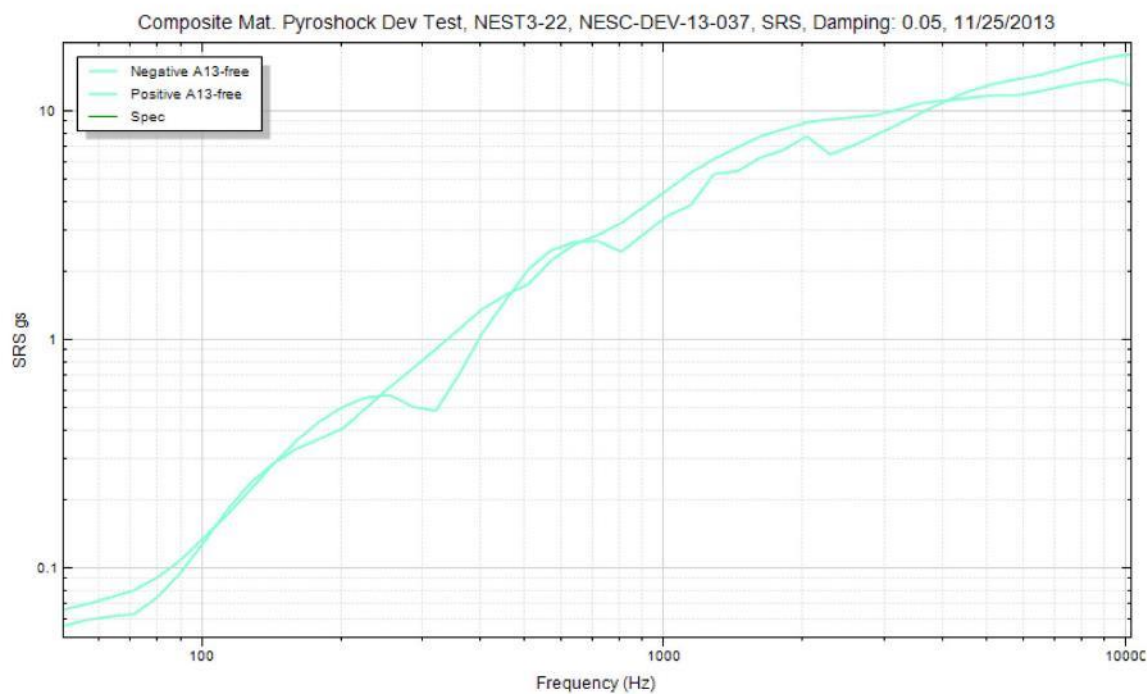
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
477 of 832





# NASA Engineering and Safety Center Technical Assessment Report

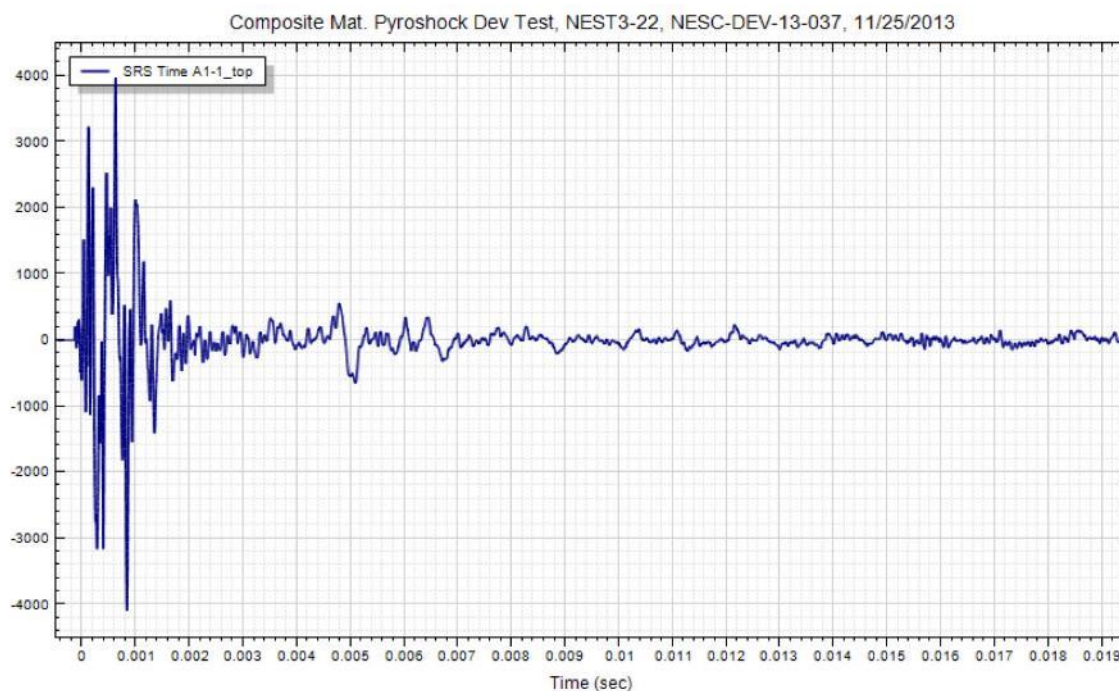
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
478 of 832





# NASA Engineering and Safety Center Technical Assessment Report

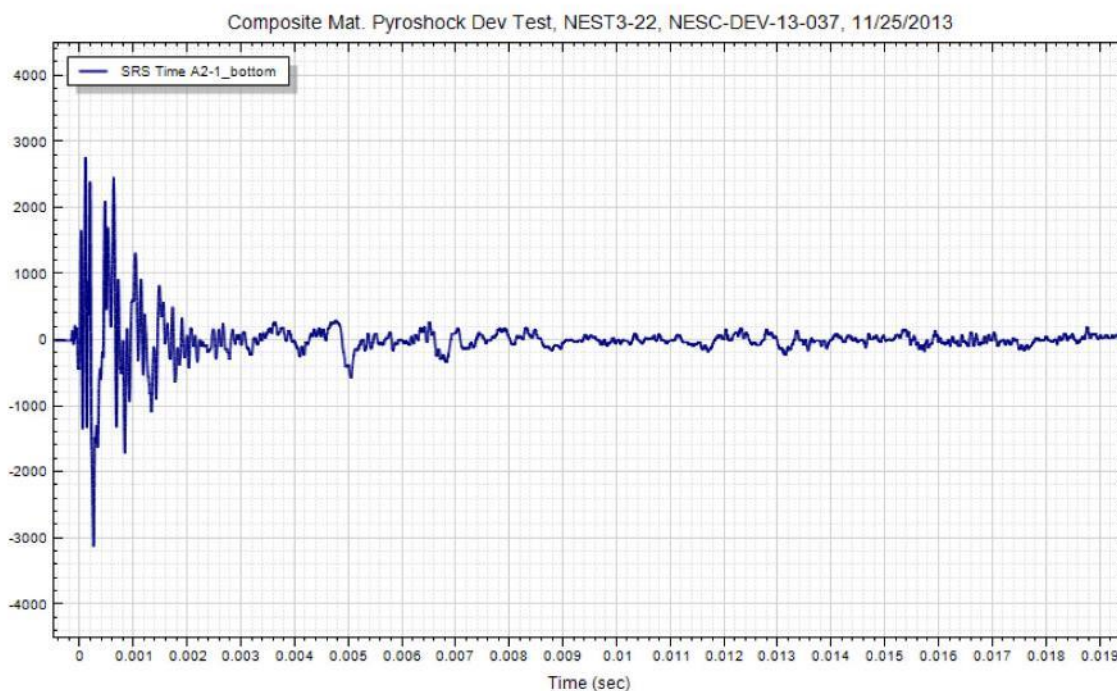
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
479 of 832





# NASA Engineering and Safety Center Technical Assessment Report

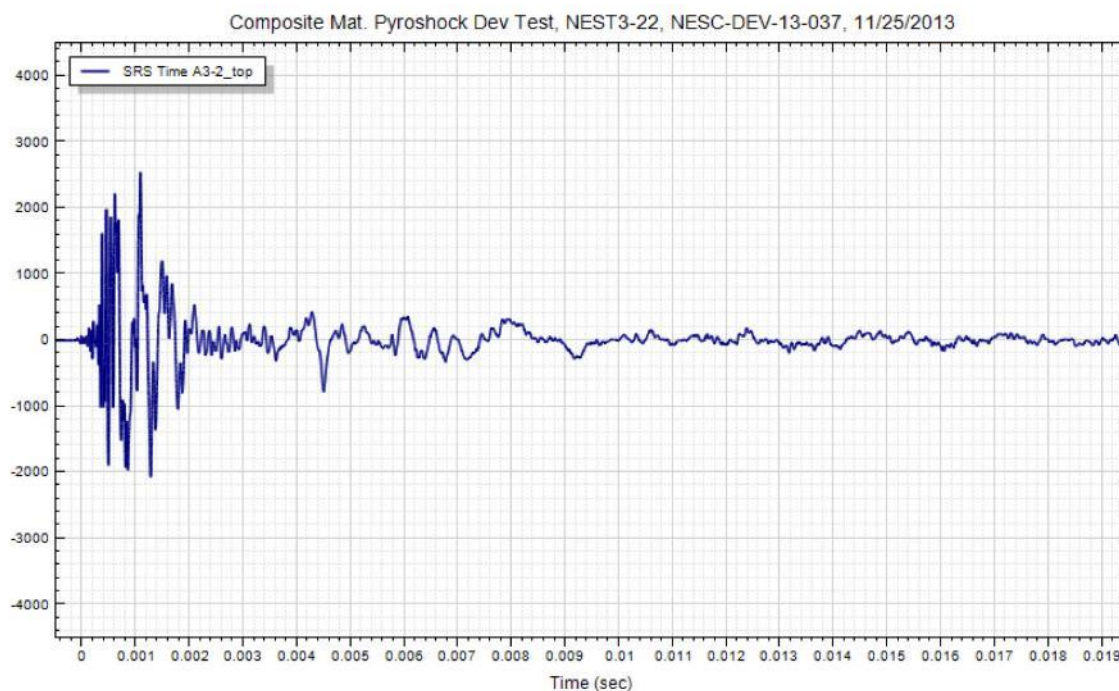
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
480 of 832





# NASA Engineering and Safety Center Technical Assessment Report

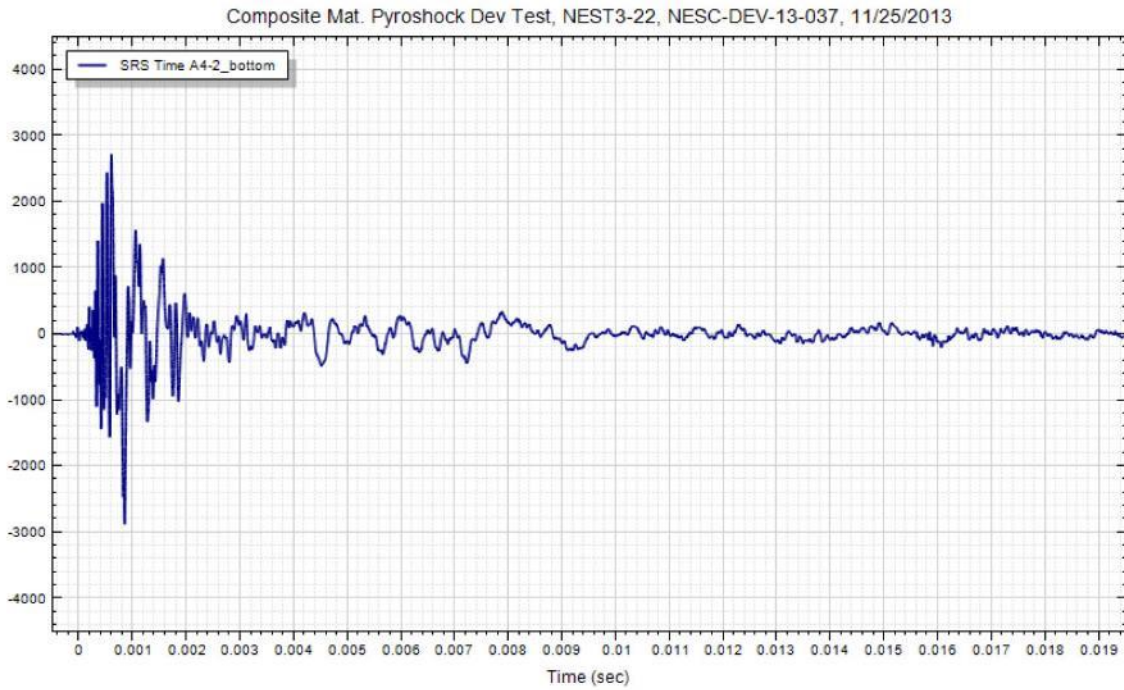
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
481 of 832





# NASA Engineering and Safety Center Technical Assessment Report

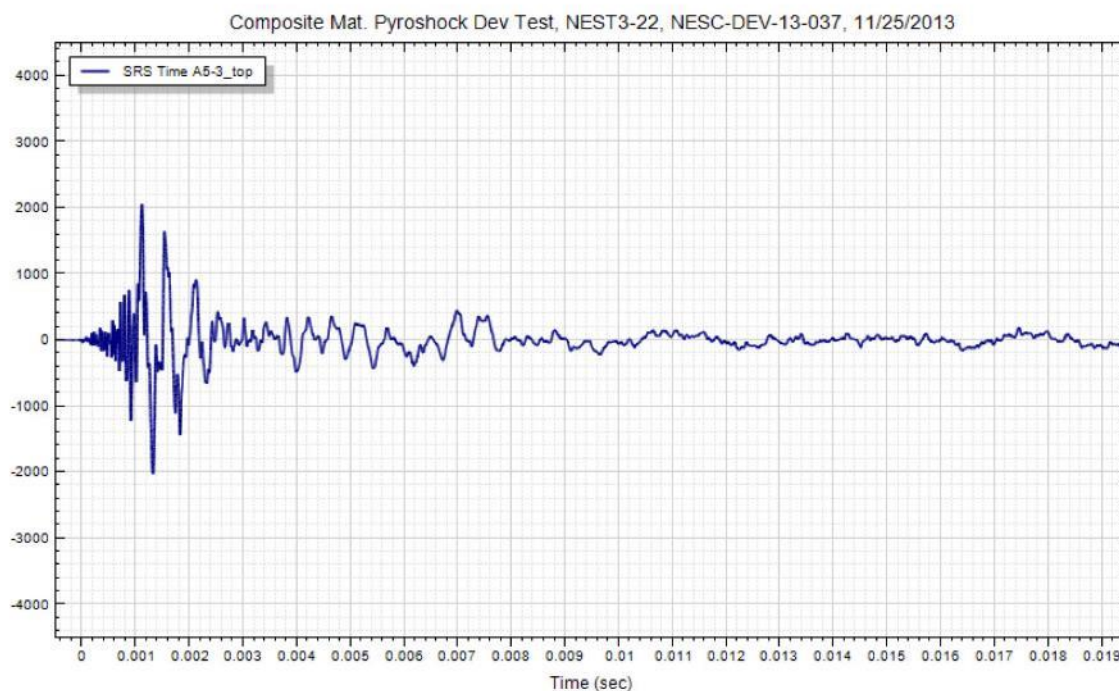
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
482 of 832





# NASA Engineering and Safety Center Technical Assessment Report

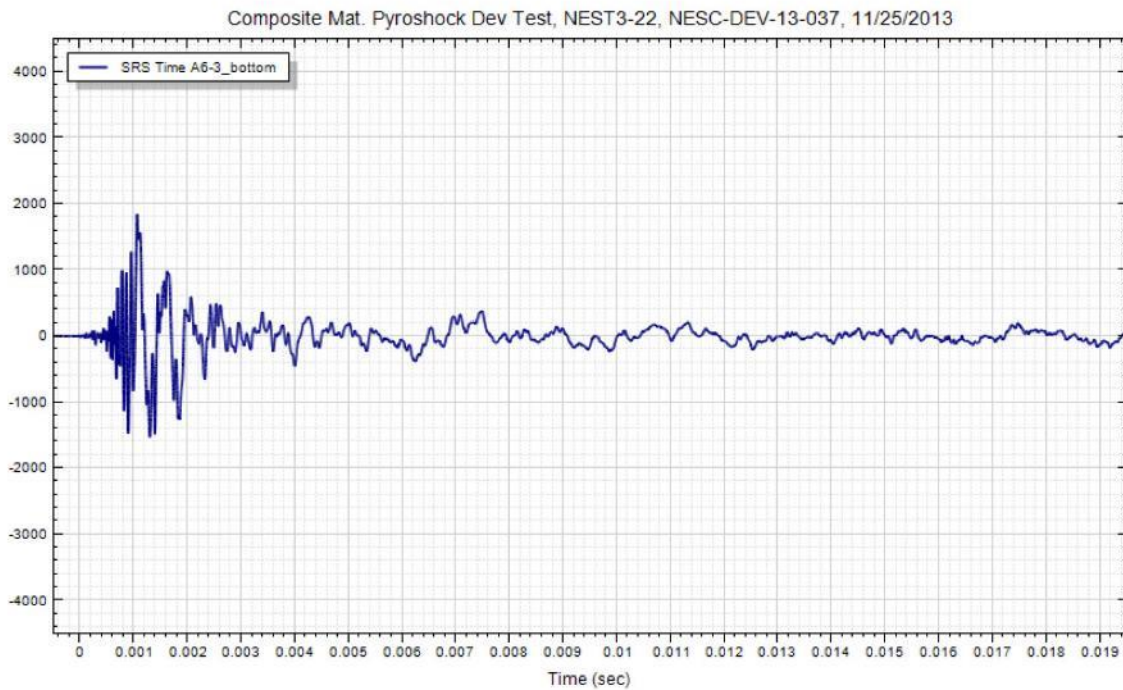
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
483 of 832





# NASA Engineering and Safety Center Technical Assessment Report

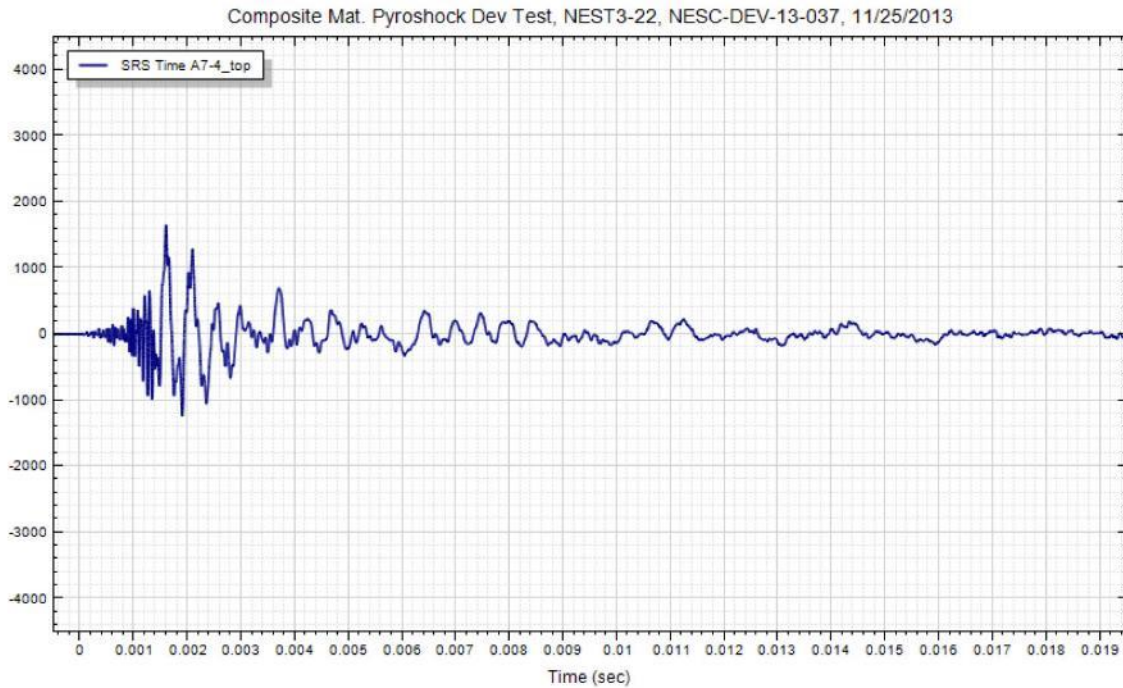
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
484 of 832







# NASA Engineering and Safety Center Technical Assessment Report

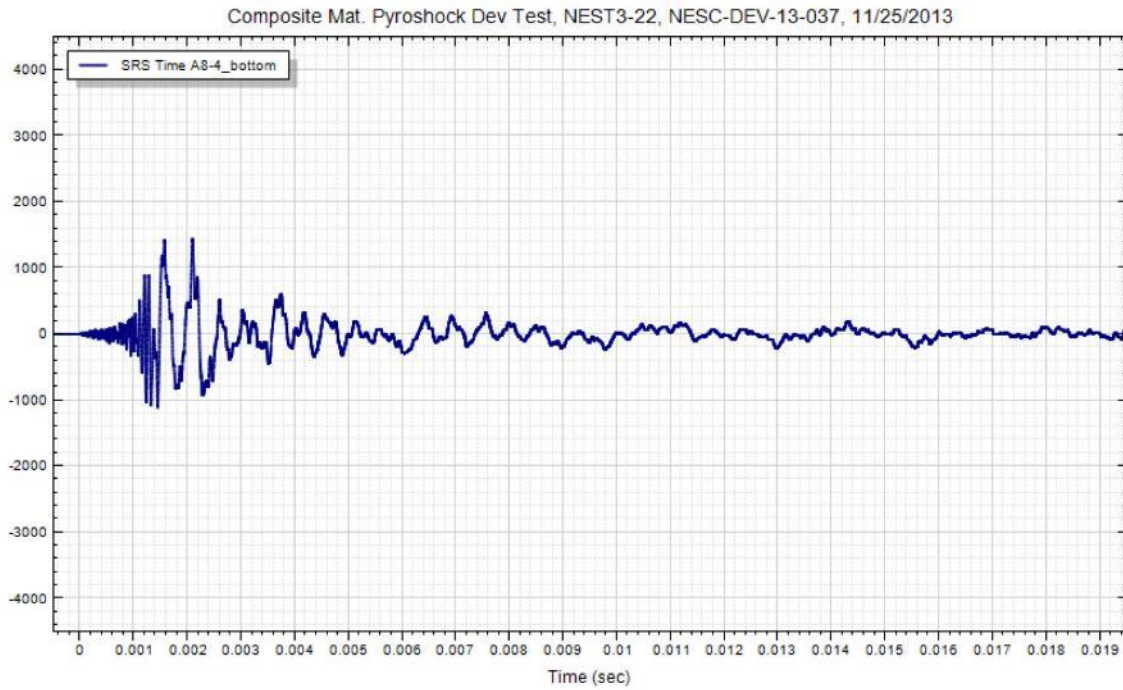
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
485 of 832





# NASA Engineering and Safety Center Technical Assessment Report

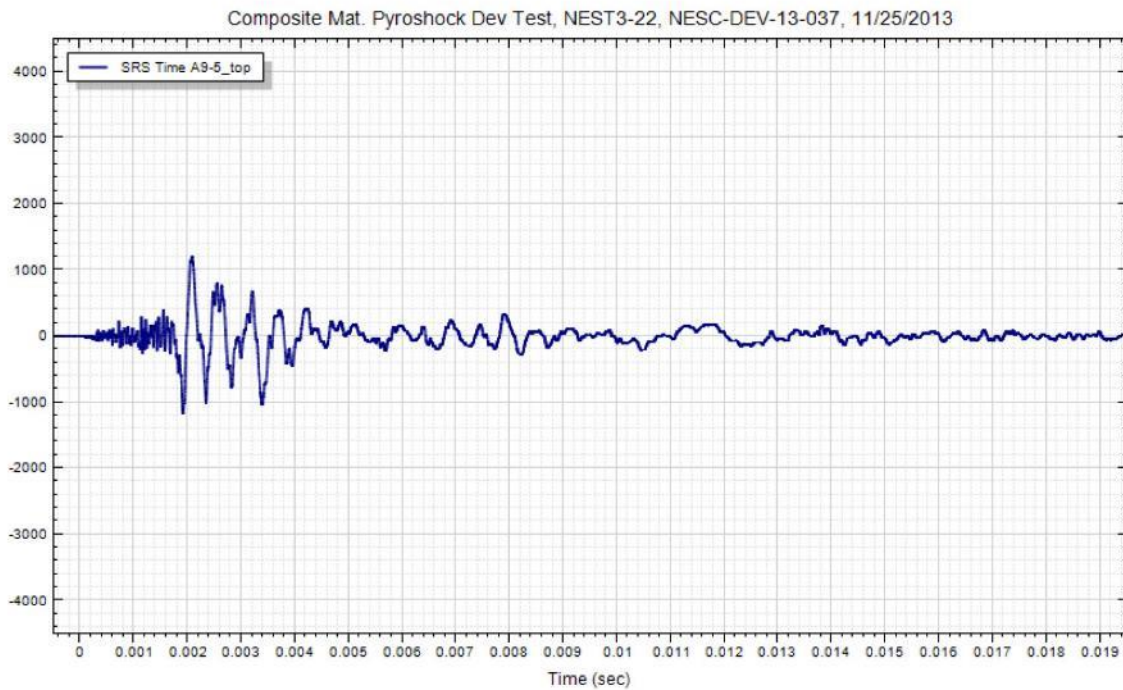
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
486 of 832





# NASA Engineering and Safety Center Technical Assessment Report

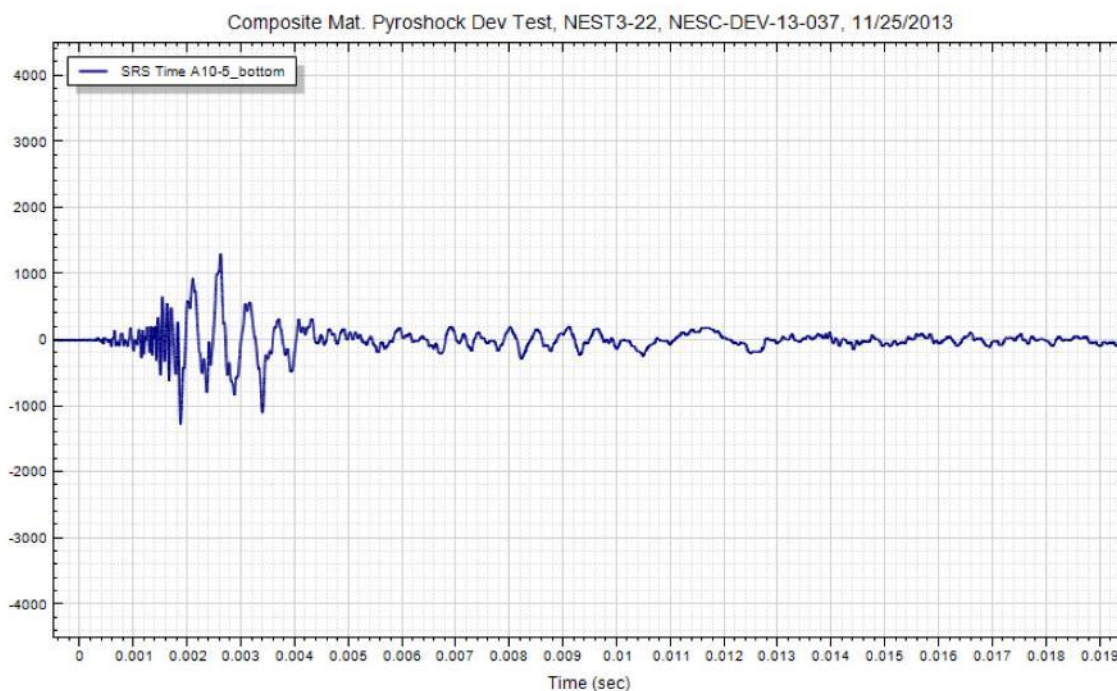
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
487 of 832





# NASA Engineering and Safety Center Technical Assessment Report

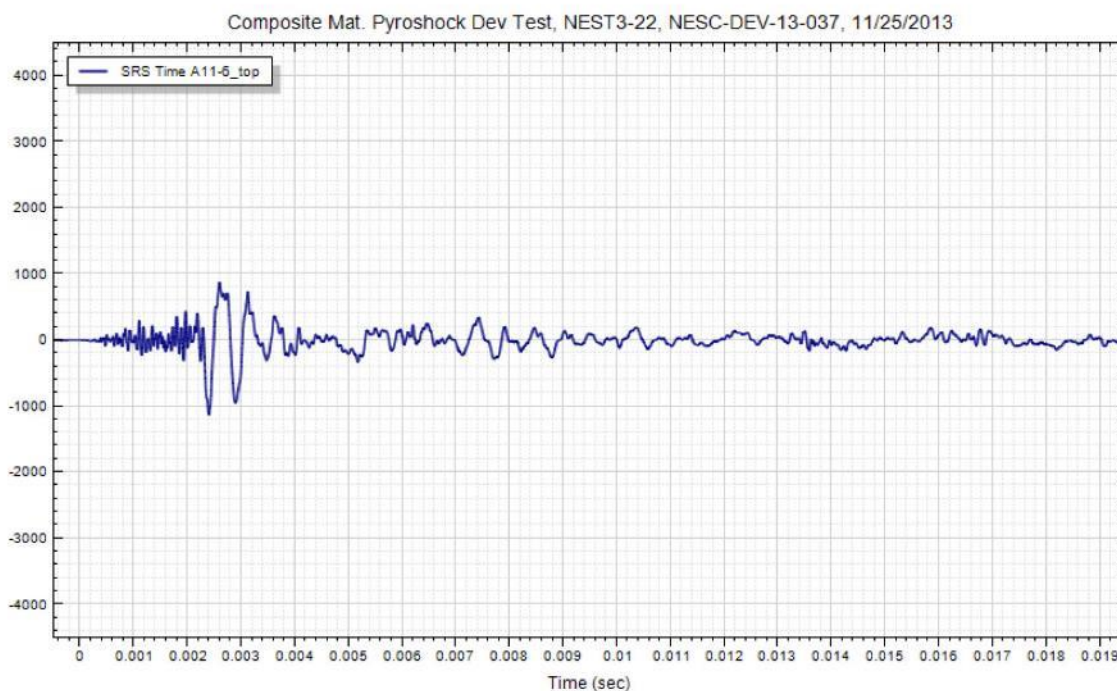
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
488 of 832





# NASA Engineering and Safety Center Technical Assessment Report

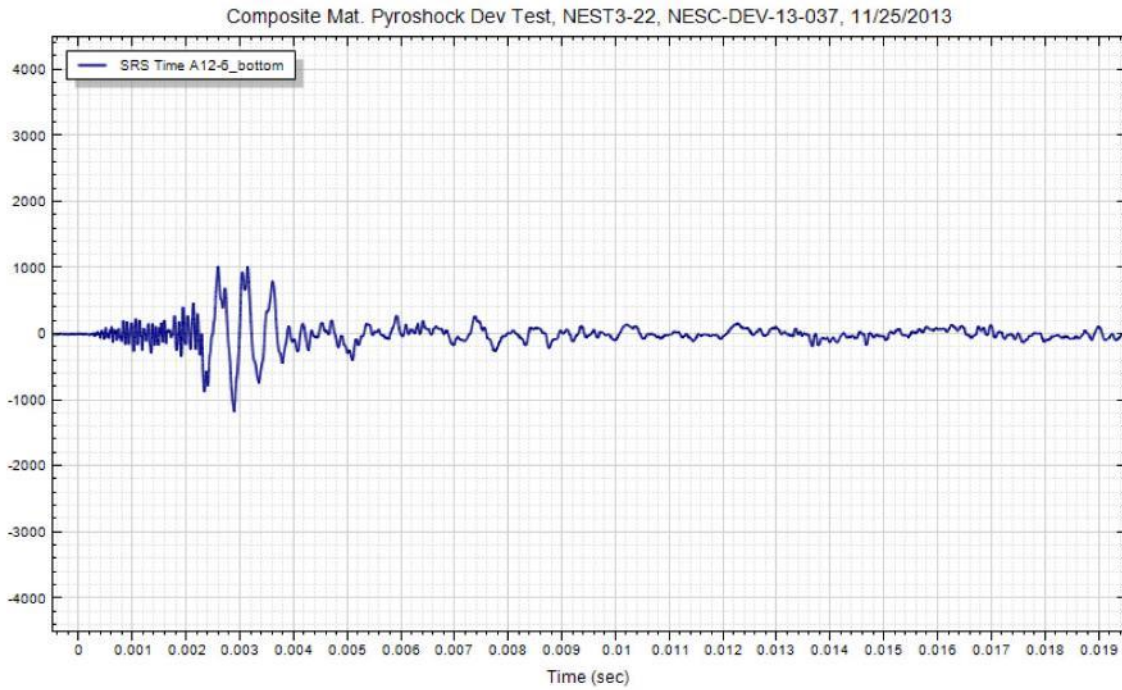
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
489 of 832





# NASA Engineering and Safety Center Technical Assessment Report

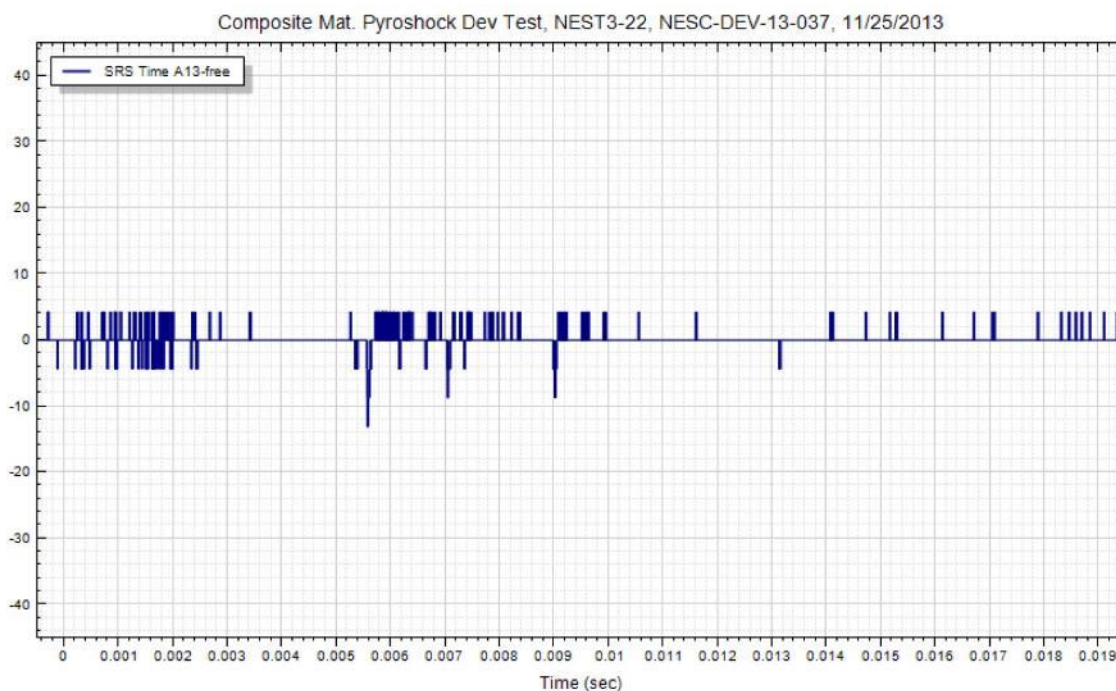
Document #:  
**NESC-RP-  
12-00783**


Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
490 of 832



	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 491 of 832	

**NESC-DEV-13-037**  
**Composite Materials**  
**Shock Test**  
  
**Test #4 Accelerometer Data**  
**Panel 0346A021**



# NASA Engineering and Safety Center Technical Assessment Report

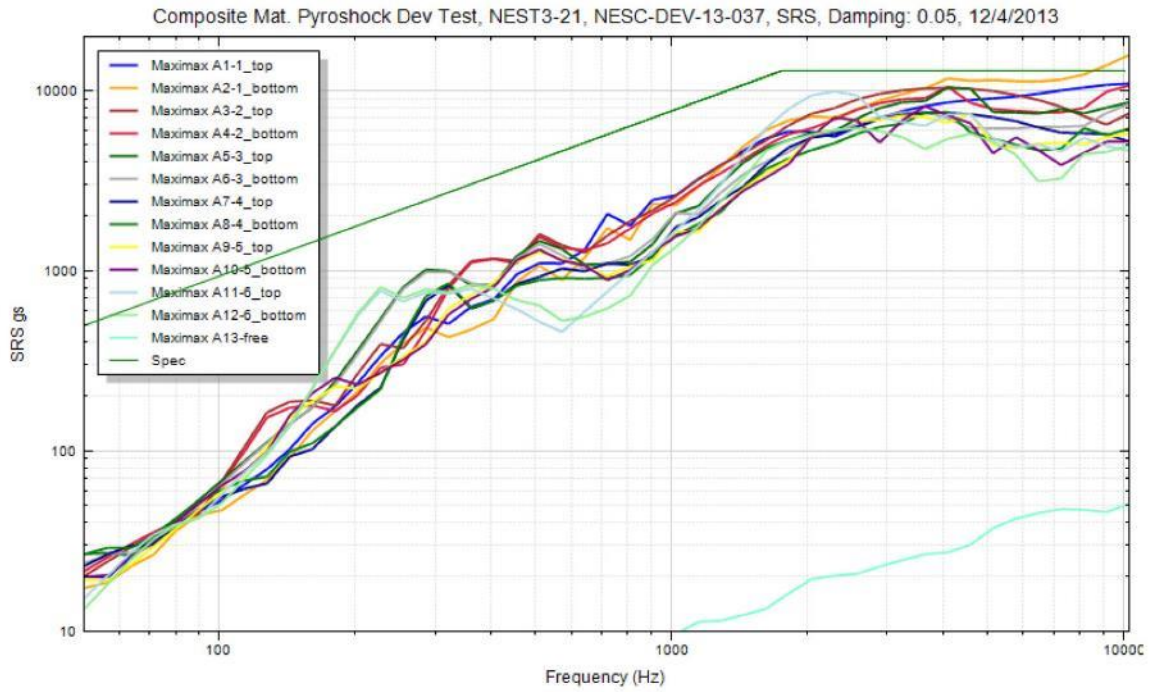
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
492 of 832







# NASA Engineering and Safety Center Technical Assessment Report

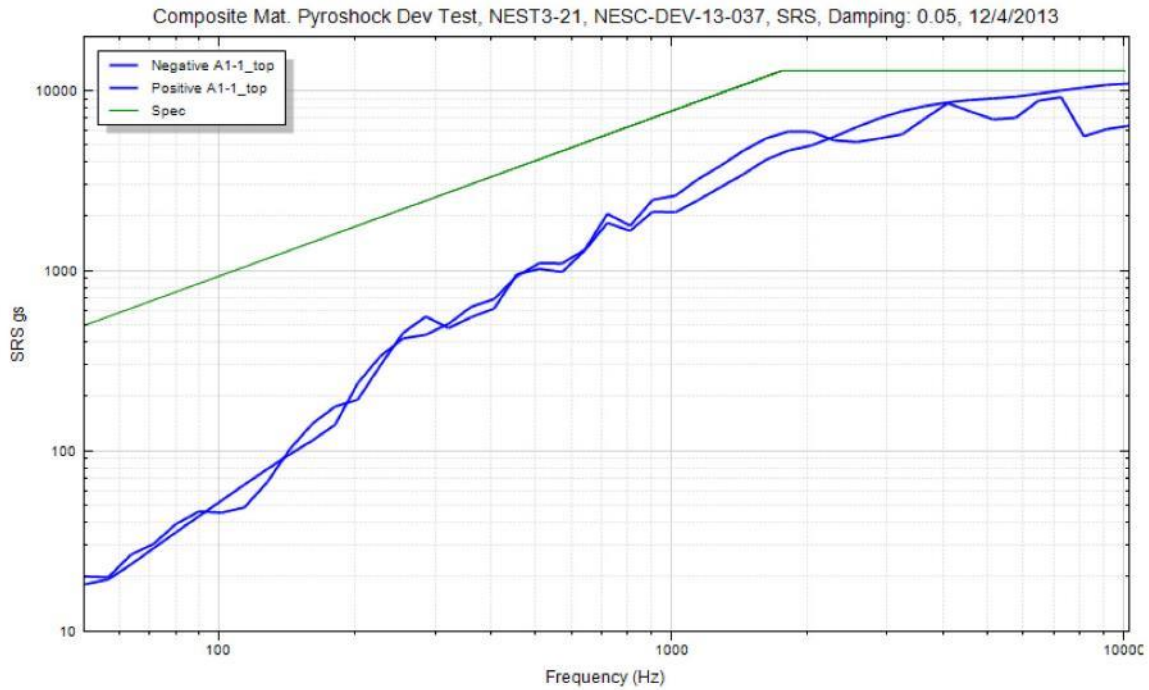
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
493 of 832





# NASA Engineering and Safety Center Technical Assessment Report

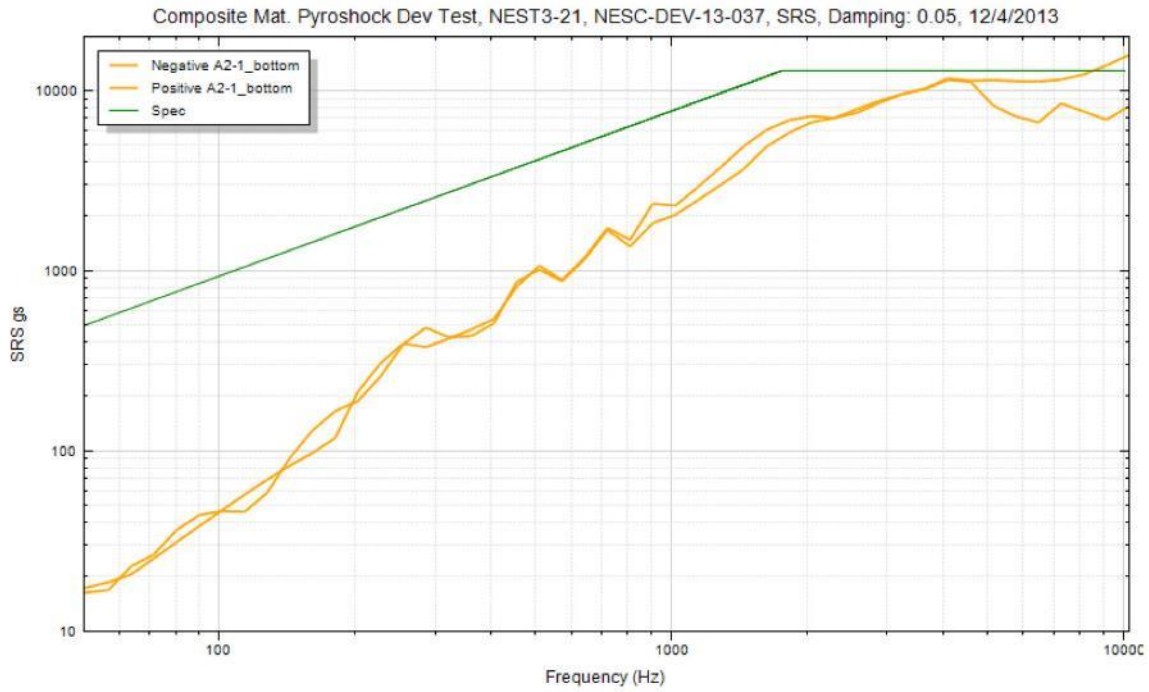
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
494 of 832





# NASA Engineering and Safety Center Technical Assessment Report

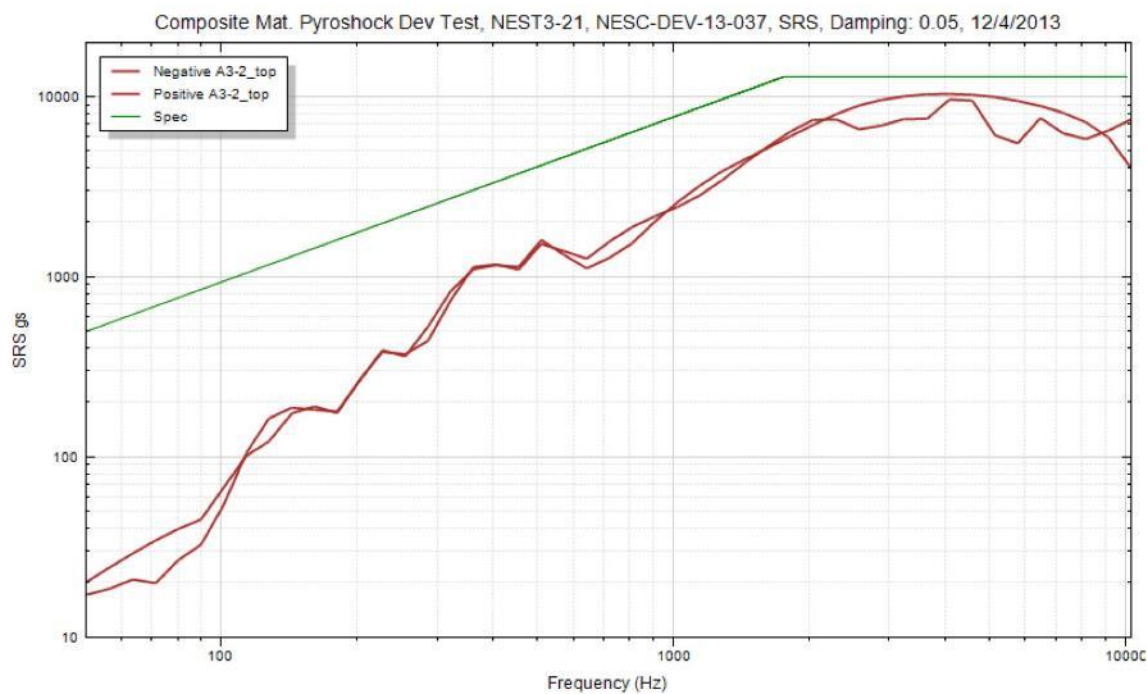
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
495 of 832





# NASA Engineering and Safety Center Technical Assessment Report

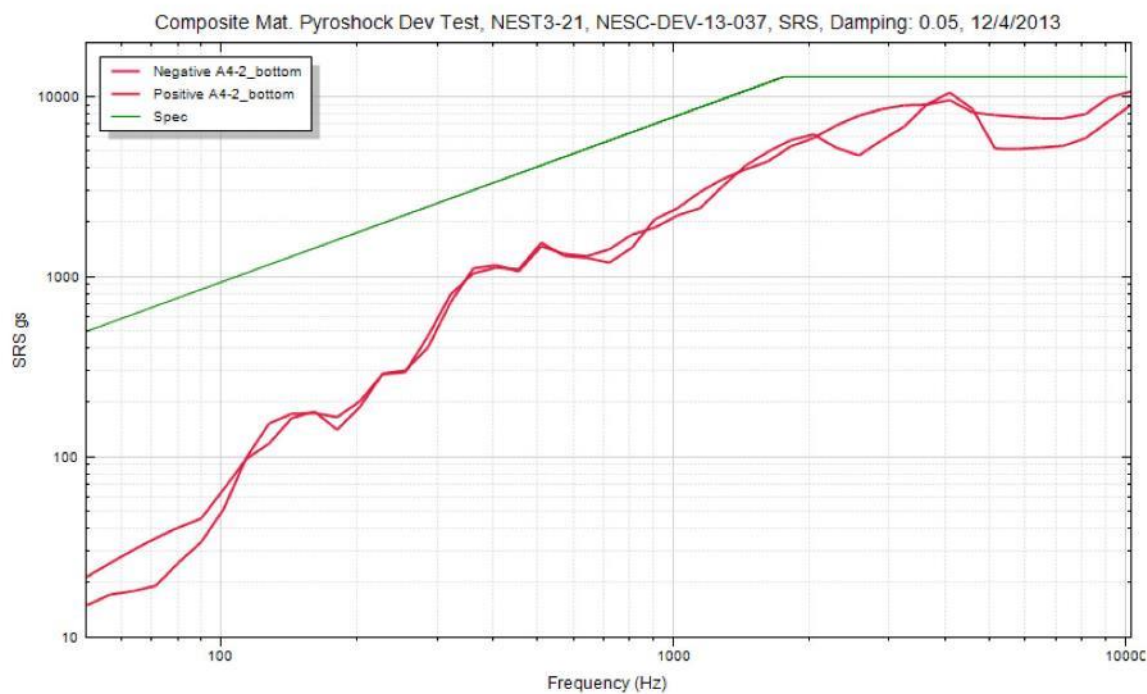
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
496 of 832





# NASA Engineering and Safety Center Technical Assessment Report

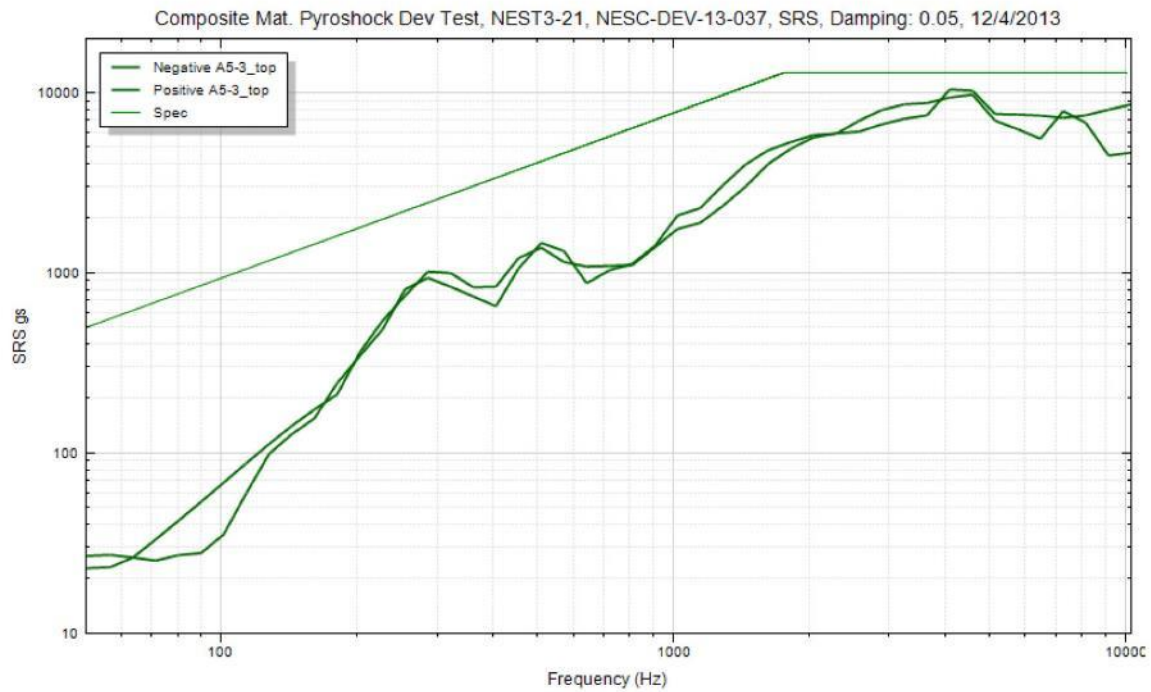
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
497 of 832





# NASA Engineering and Safety Center Technical Assessment Report

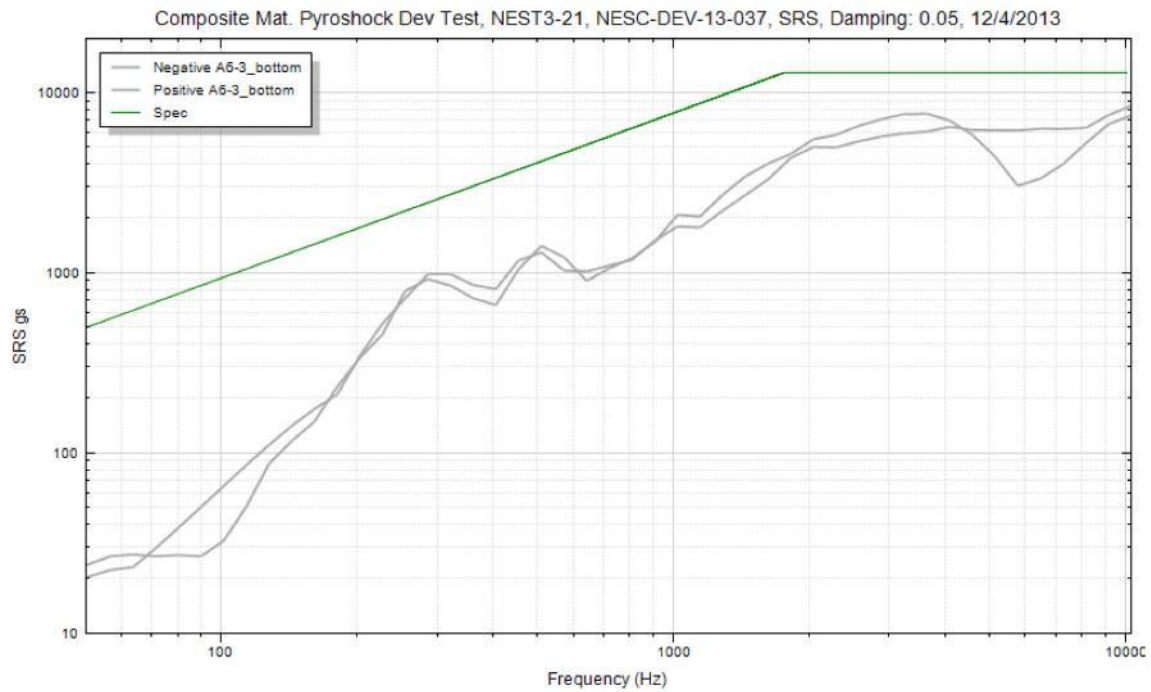
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
498 of 832





# NASA Engineering and Safety Center Technical Assessment Report

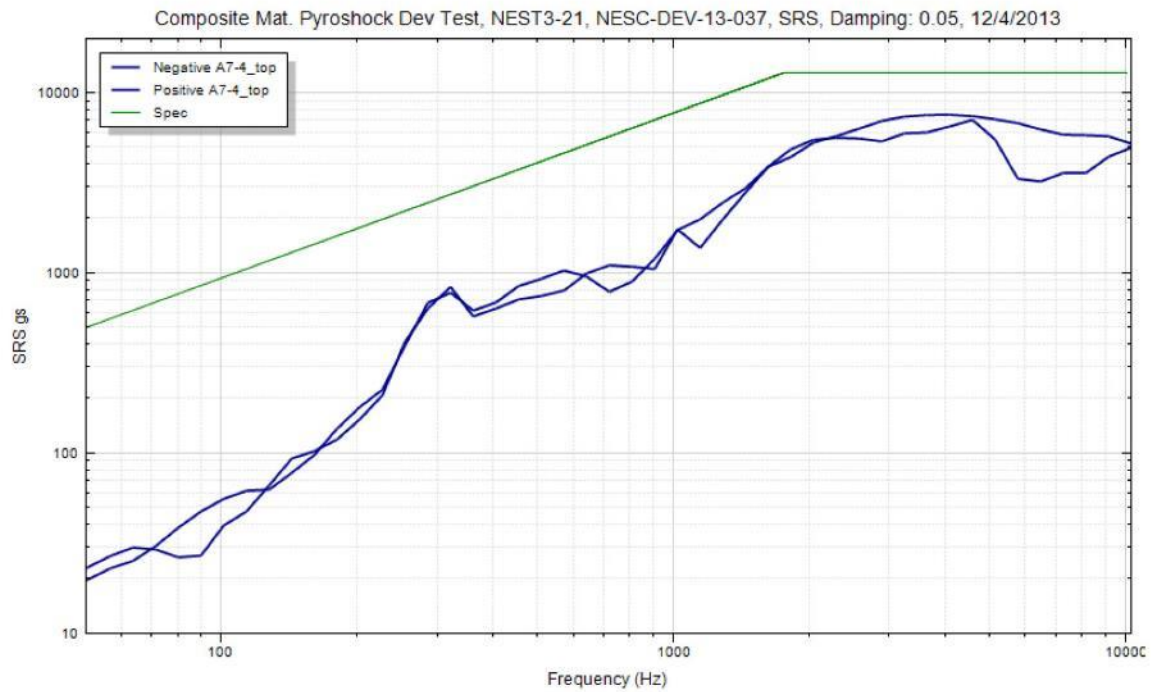
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
499 of 832





# NASA Engineering and Safety Center Technical Assessment Report

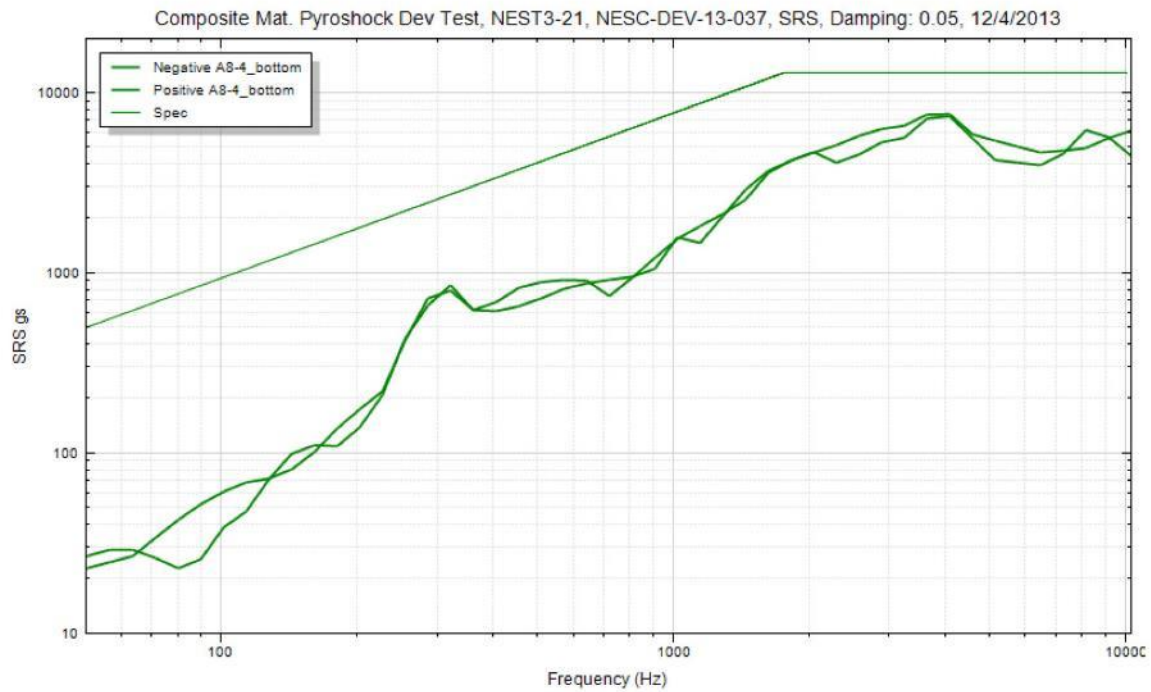
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
500 of 832







# NASA Engineering and Safety Center Technical Assessment Report

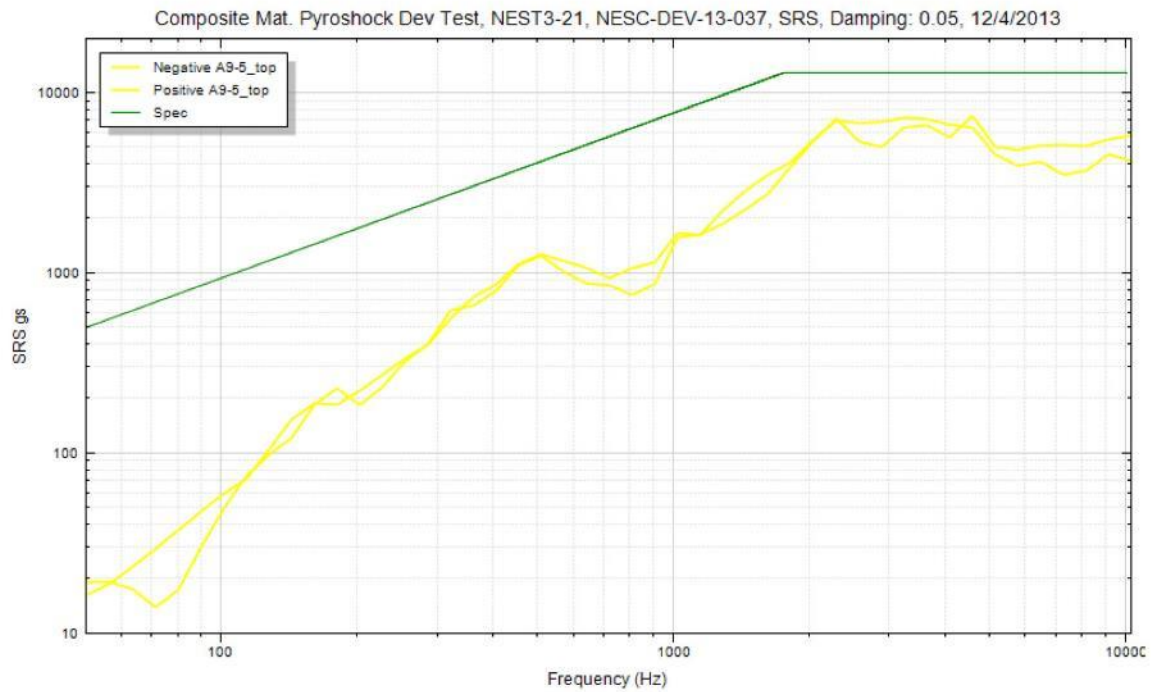
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
501 of 832





# NASA Engineering and Safety Center Technical Assessment Report

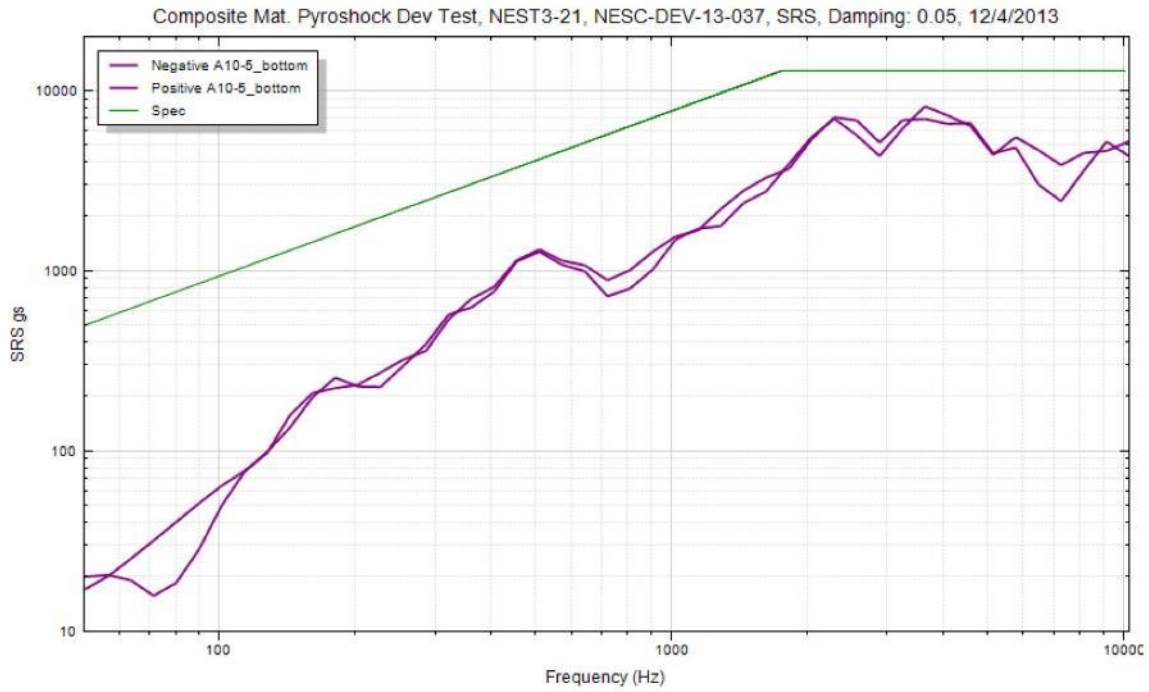
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
502 of 832





# NASA Engineering and Safety Center Technical Assessment Report

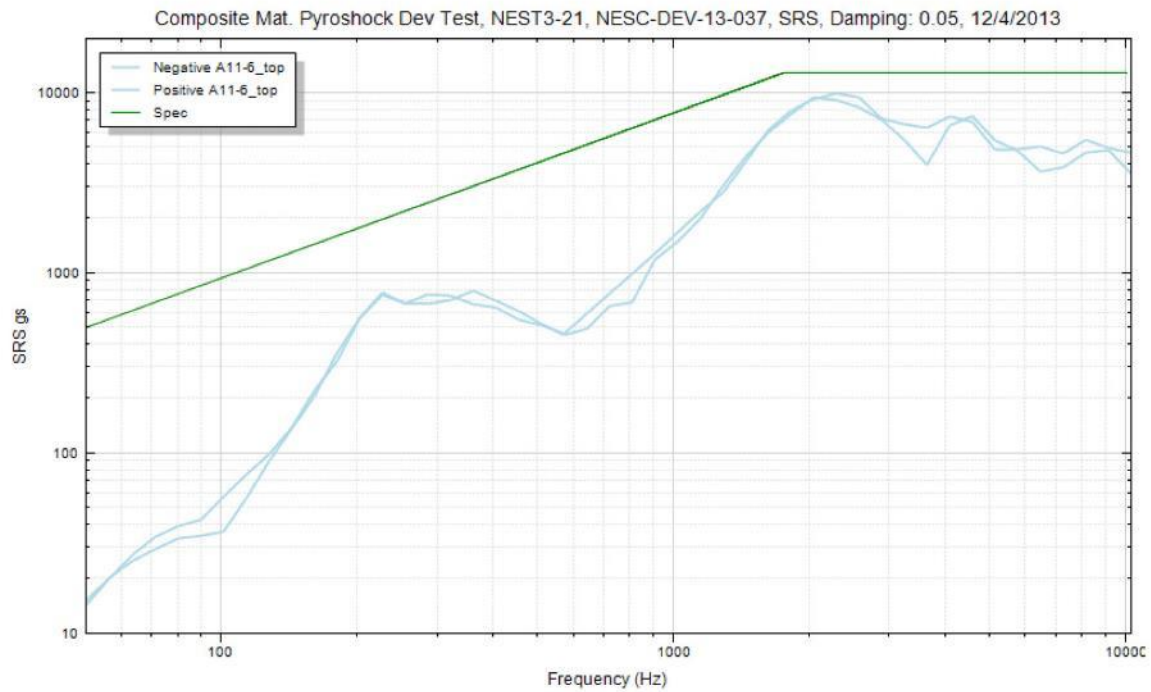
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
503 of 832





# NASA Engineering and Safety Center Technical Assessment Report

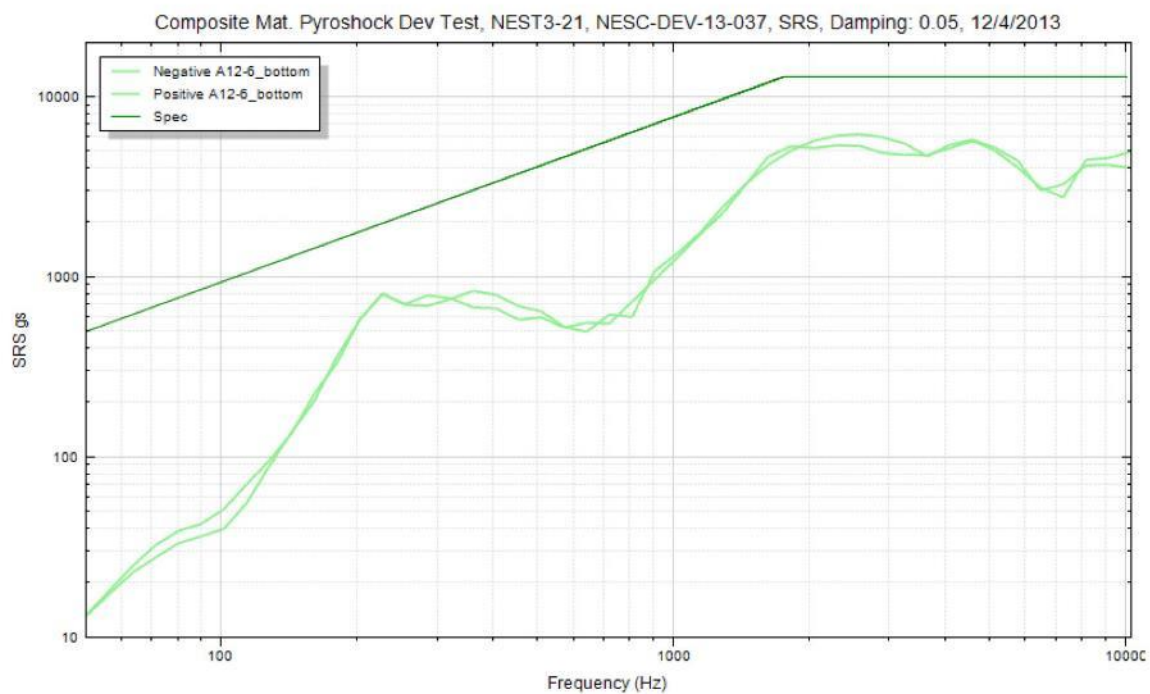
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
504 of 832





# NASA Engineering and Safety Center Technical Assessment Report

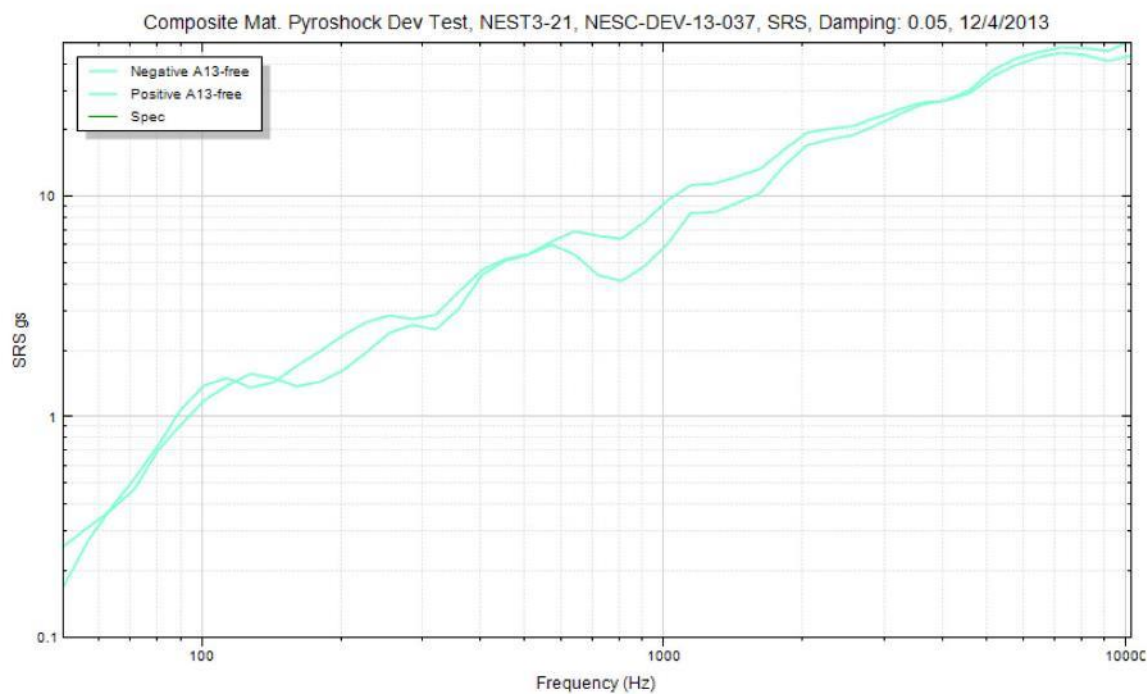
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
505 of 832





# NASA Engineering and Safety Center Technical Assessment Report

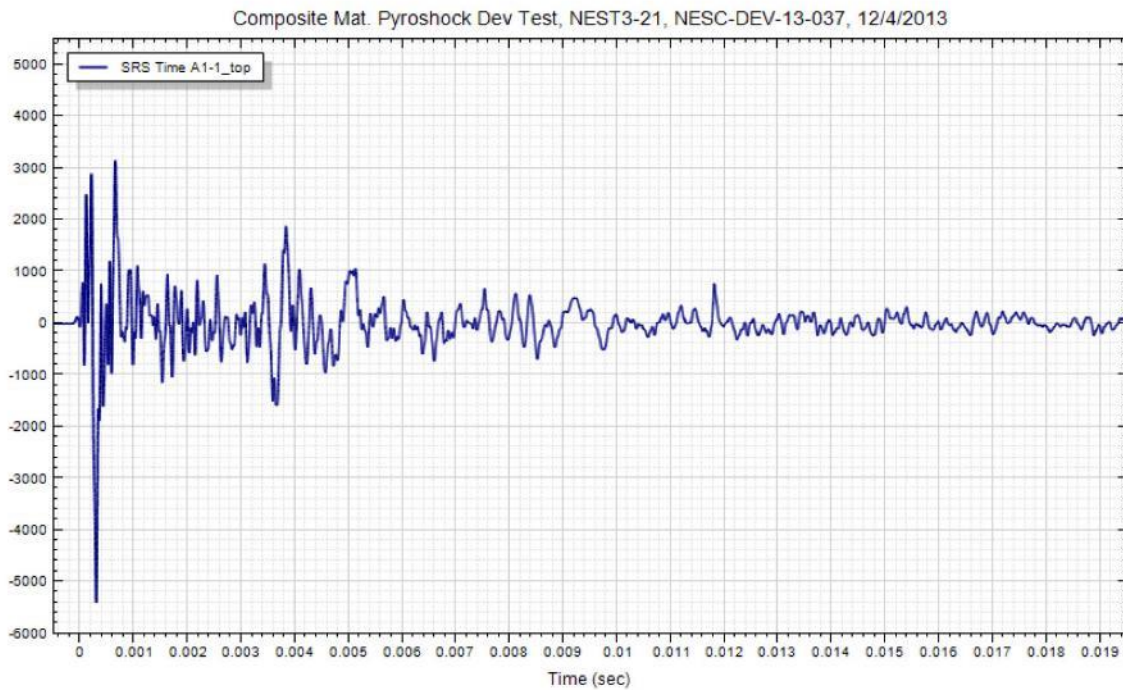
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
506 of 832





# NASA Engineering and Safety Center Technical Assessment Report

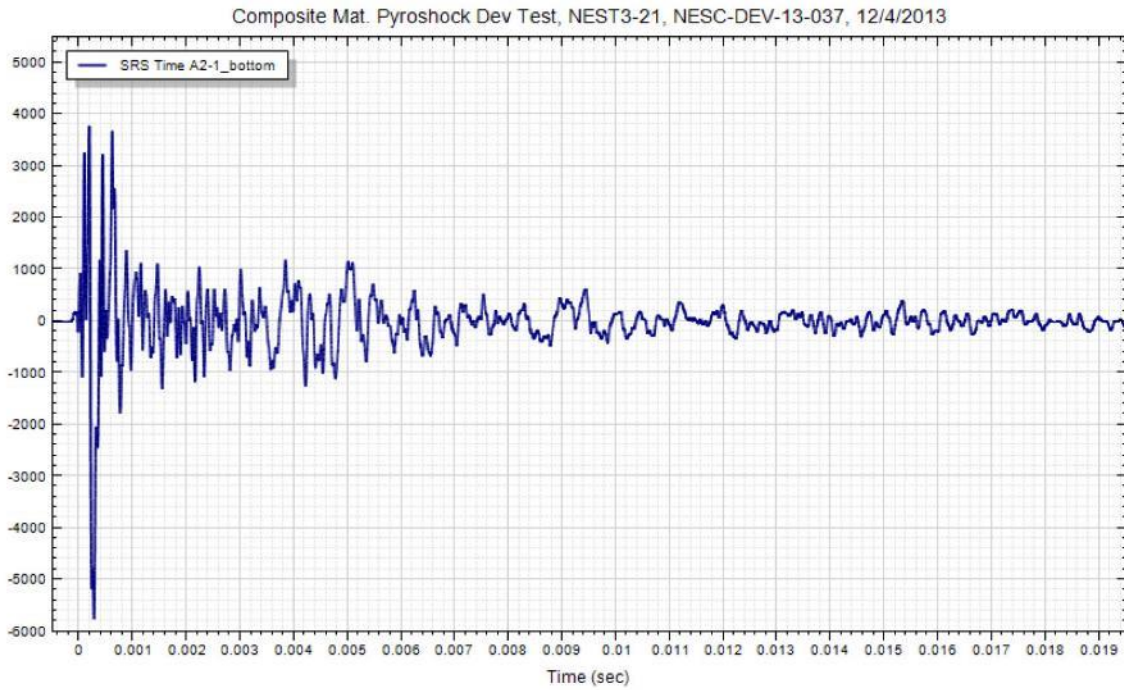
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
507 of 832





# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**

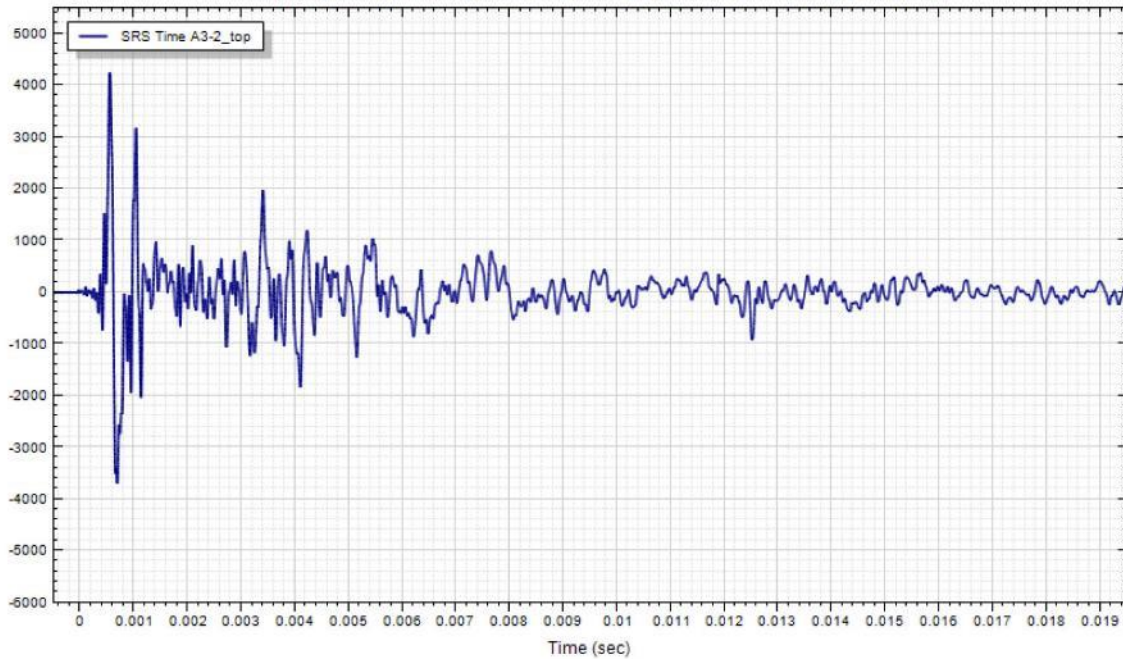
Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
508 of 832

Composite Mat. Pyroshock Dev Test, NEST3-21, NESC-DEV-13-037, 12/4/2013







# NASA Engineering and Safety Center Technical Assessment Report

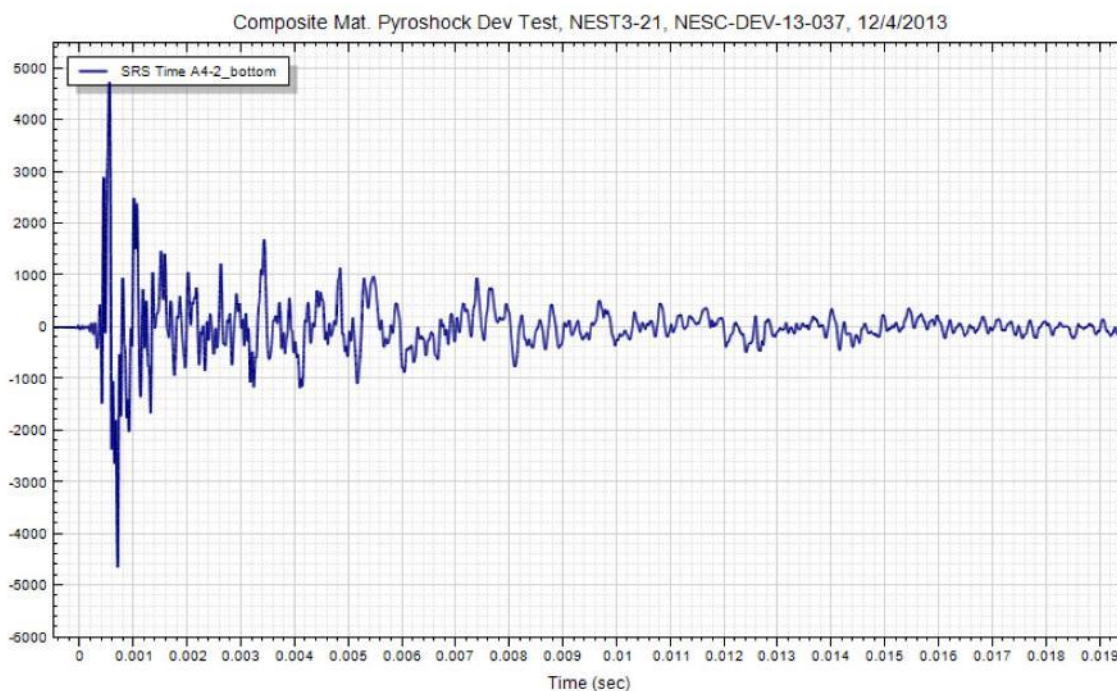
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
509 of 832





# NASA Engineering and Safety Center Technical Assessment Report

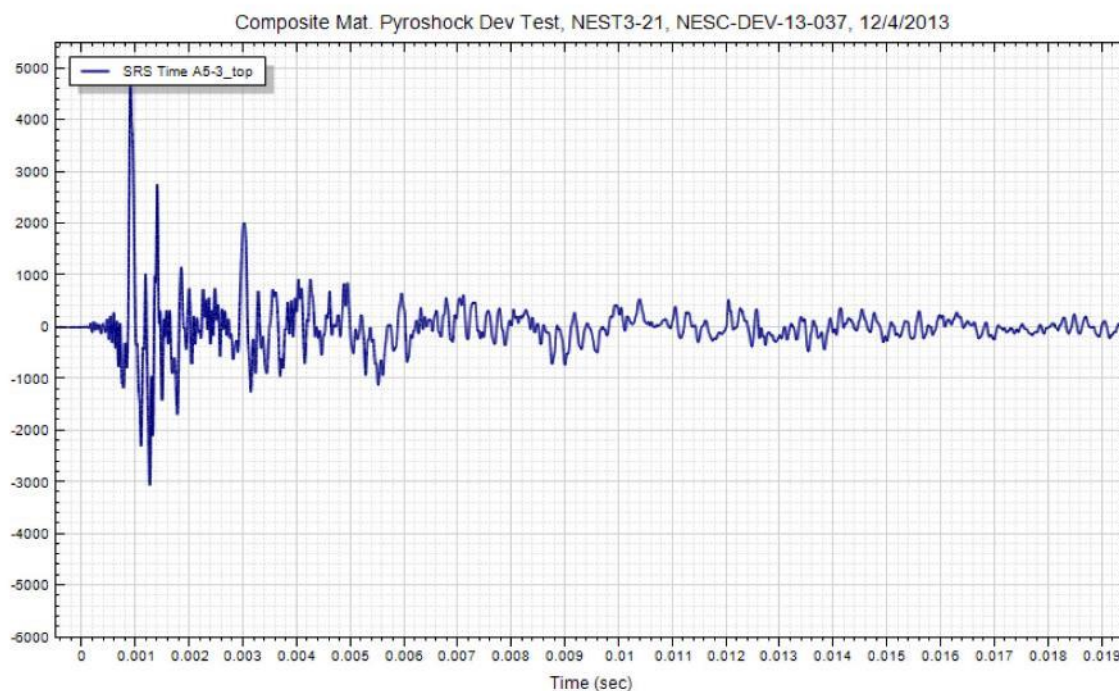
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
510 of 832





# NASA Engineering and Safety Center Technical Assessment Report

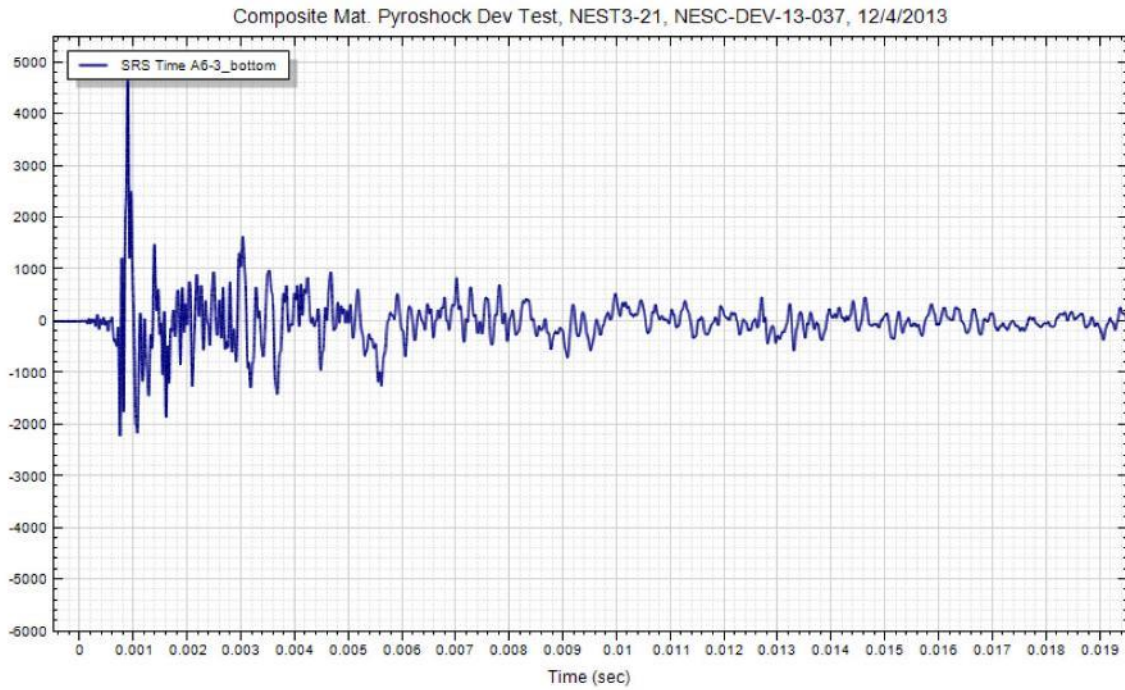
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
511 of 832





# NASA Engineering and Safety Center Technical Assessment Report

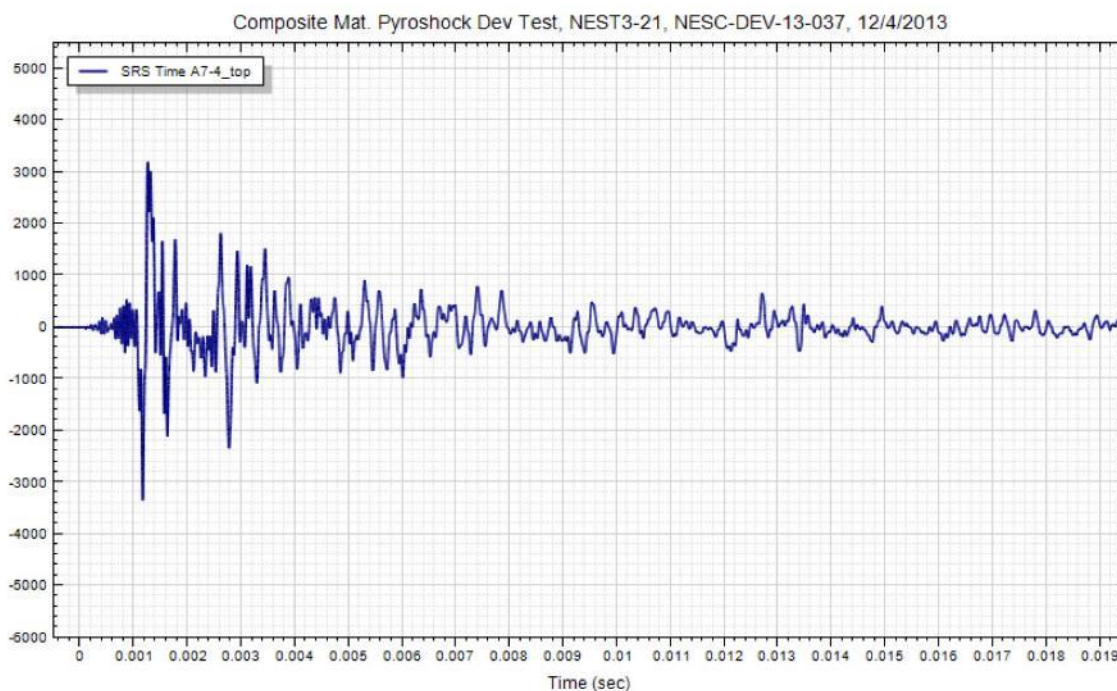
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
512 of 832





# NASA Engineering and Safety Center Technical Assessment Report

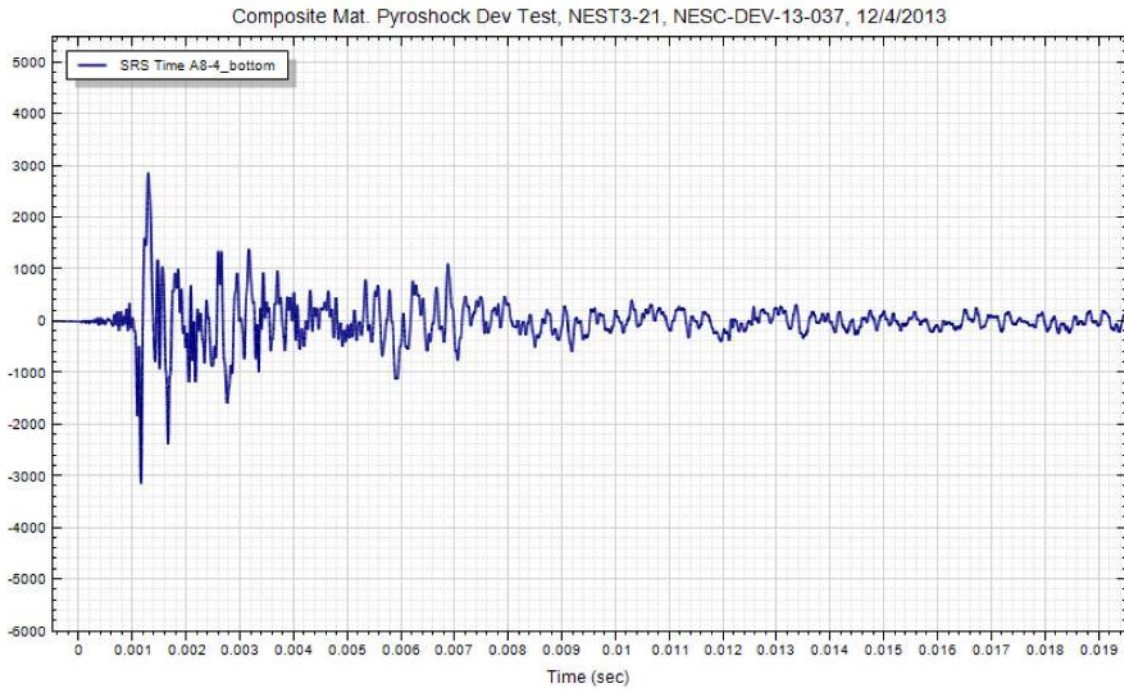
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
513 of 832





# NASA Engineering and Safety Center Technical Assessment Report

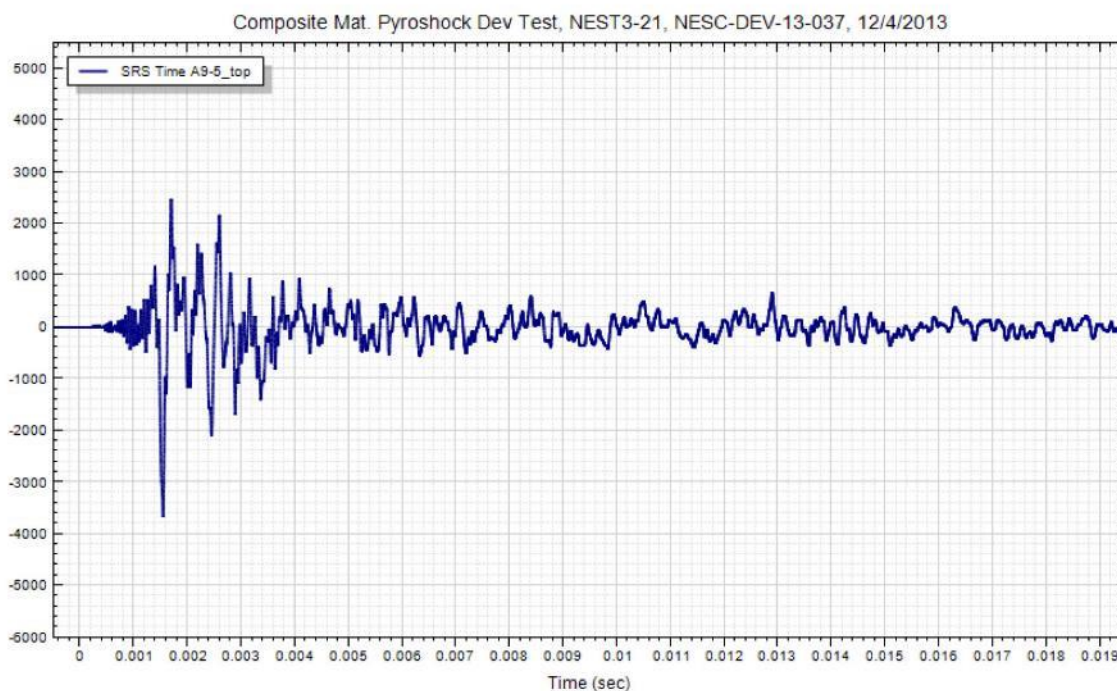
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
514 of 832





# NASA Engineering and Safety Center Technical Assessment Report

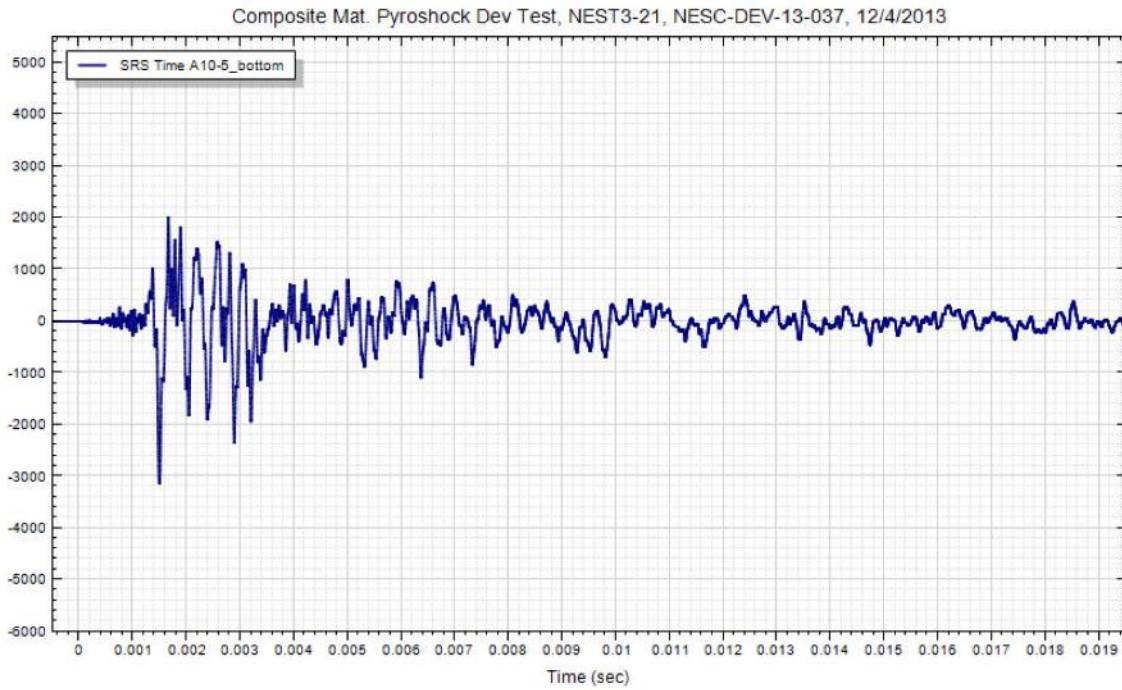
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
515 of 832





# NASA Engineering and Safety Center Technical Assessment Report

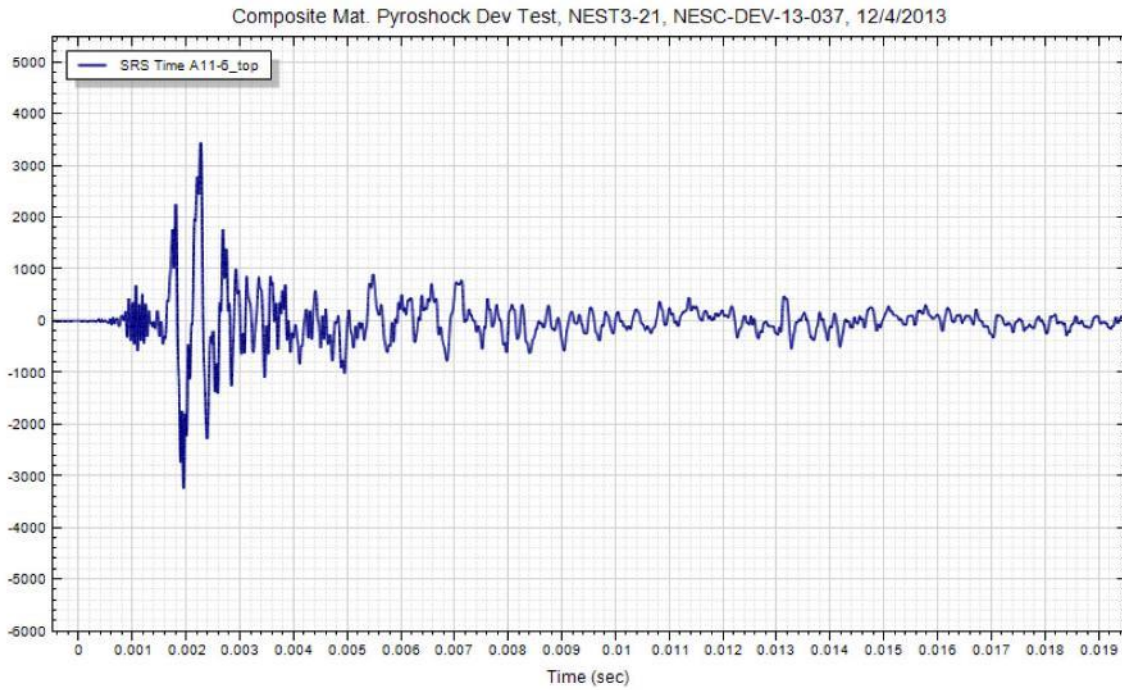
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
516 of 832







# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**

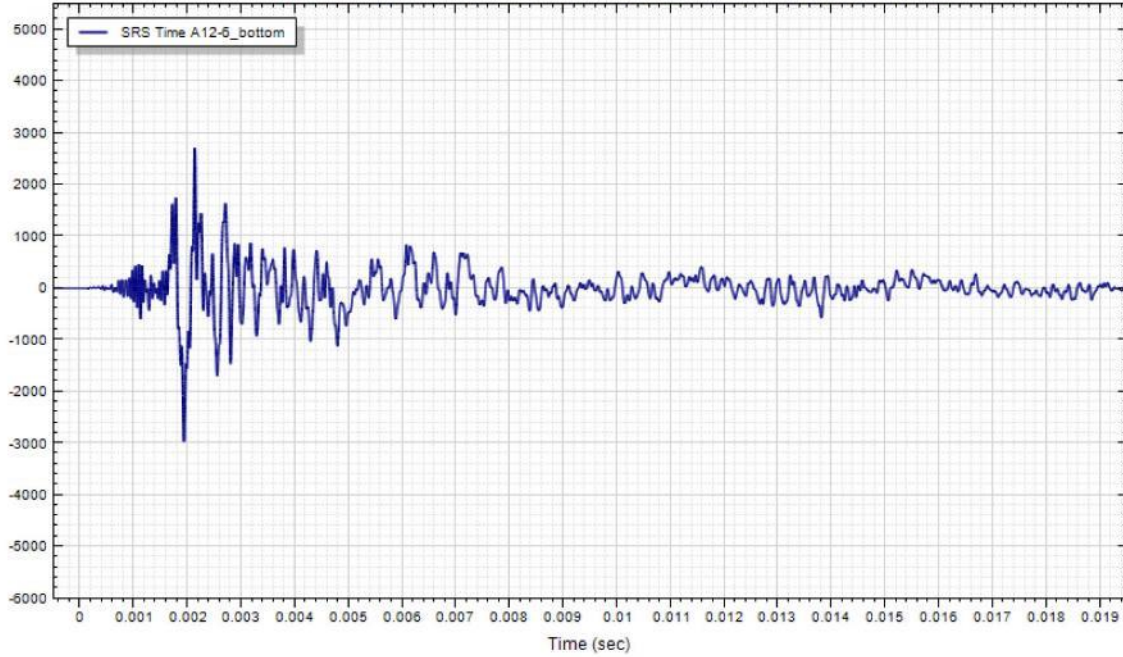
Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
517 of 832

Composite Mat. Pyroshock Dev Test, NEST3-21, NESC-DEV-13-037, 12/4/2013





# NASA Engineering and Safety Center Technical Assessment Report

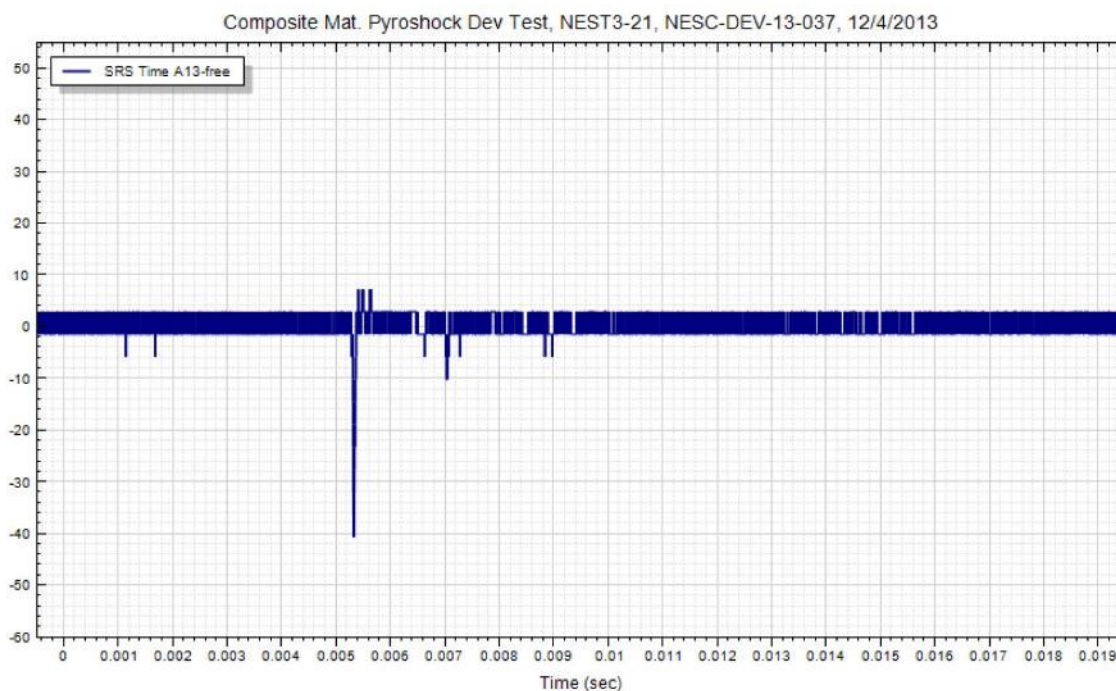
Document #:  
**NESC-RP-  
12-00783**


Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
518 of 832



	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 519 of 832	

**NESC-DEV-13-037**  
**Composite Materials**  
**Shock Test**  
  
**Test #5 Accelerometer Data**  
**Panel 0320A004**



# NASA Engineering and Safety Center Technical Assessment Report

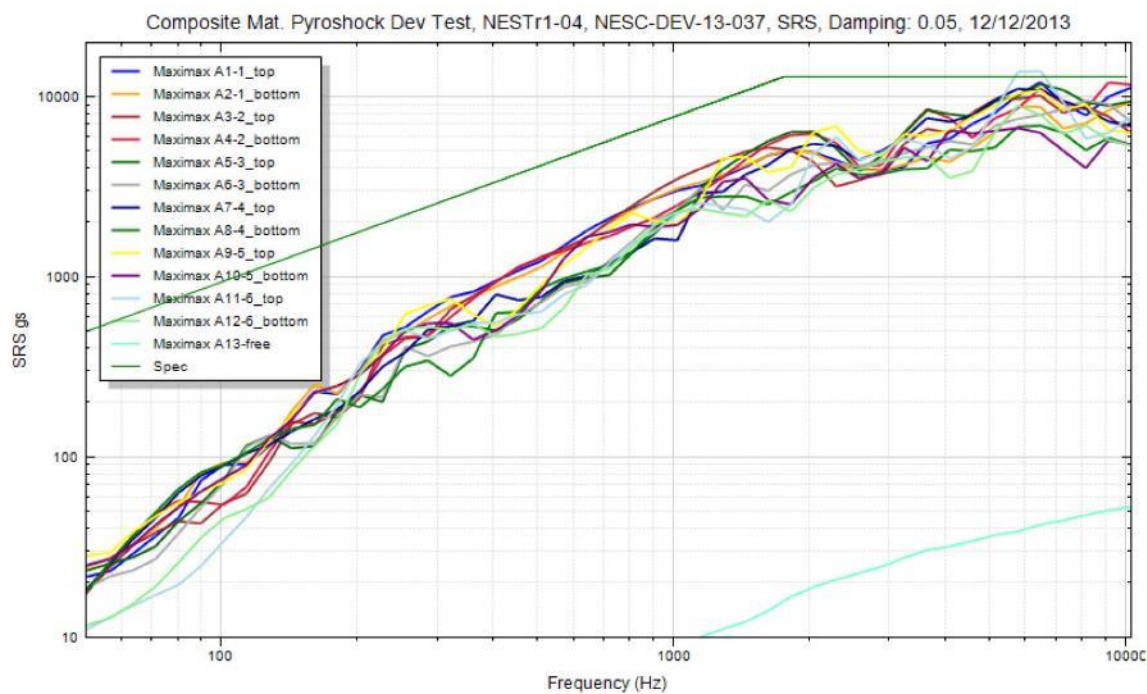
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
520 of 832





# NASA Engineering and Safety Center Technical Assessment Report

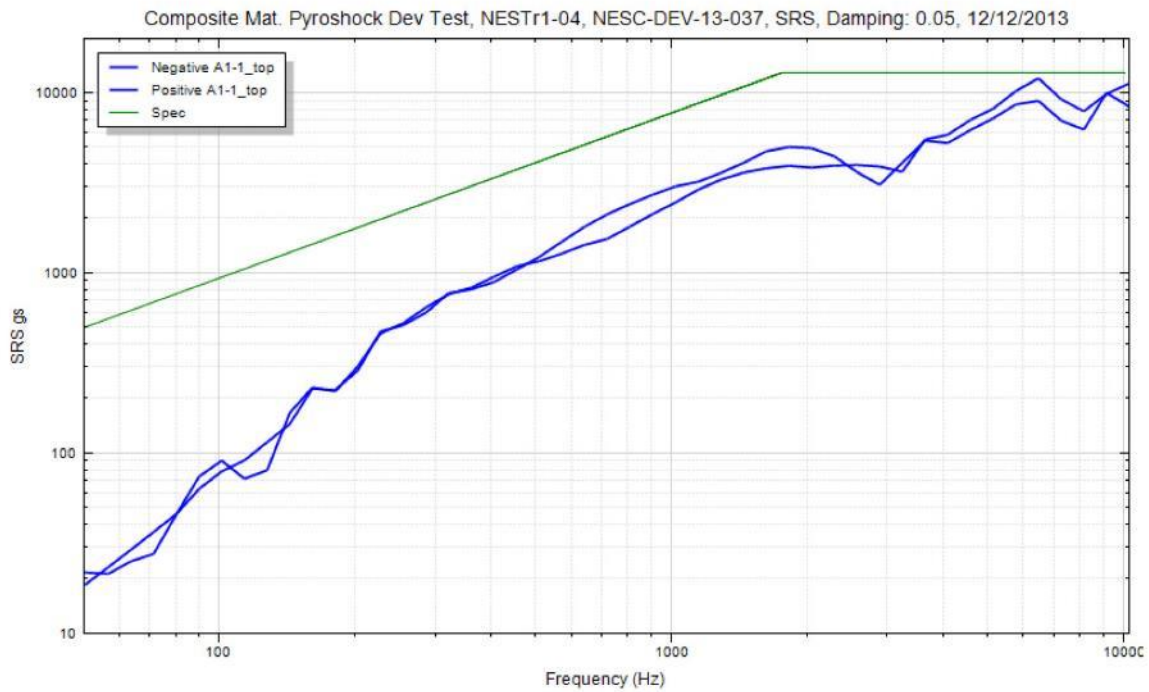
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
521 of 832





# NASA Engineering and Safety Center Technical Assessment Report

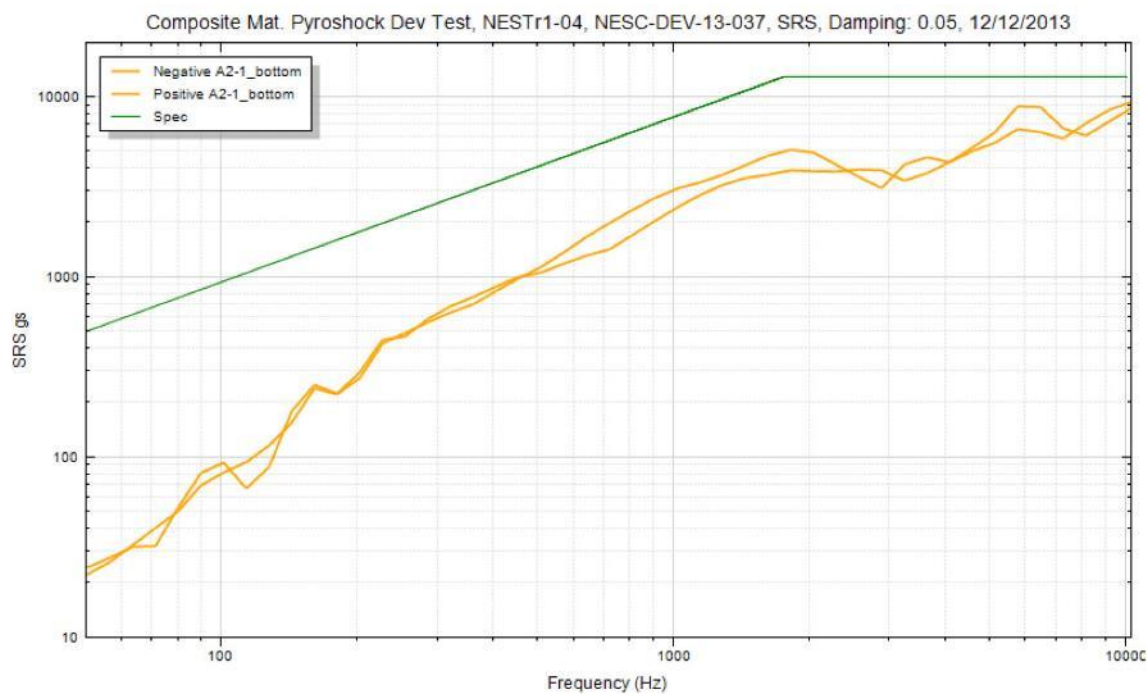
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
522 of 832





# NASA Engineering and Safety Center Technical Assessment Report

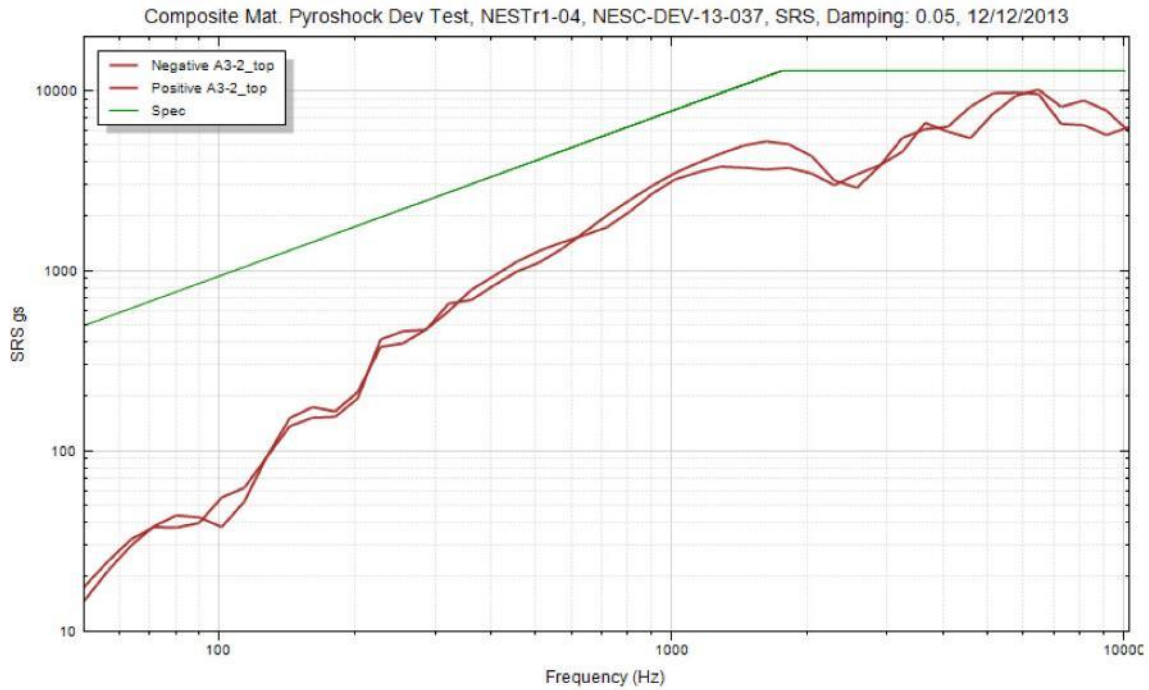
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
523 of 832





# NASA Engineering and Safety Center Technical Assessment Report

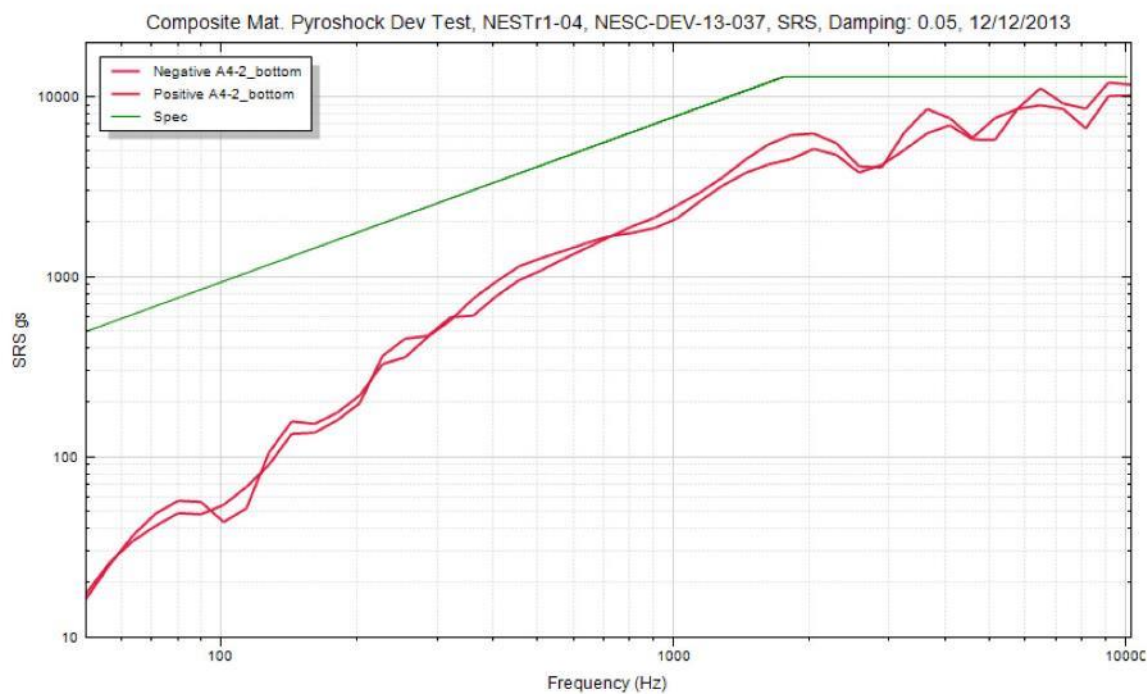
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
524 of 832







# NASA Engineering and Safety Center Technical Assessment Report

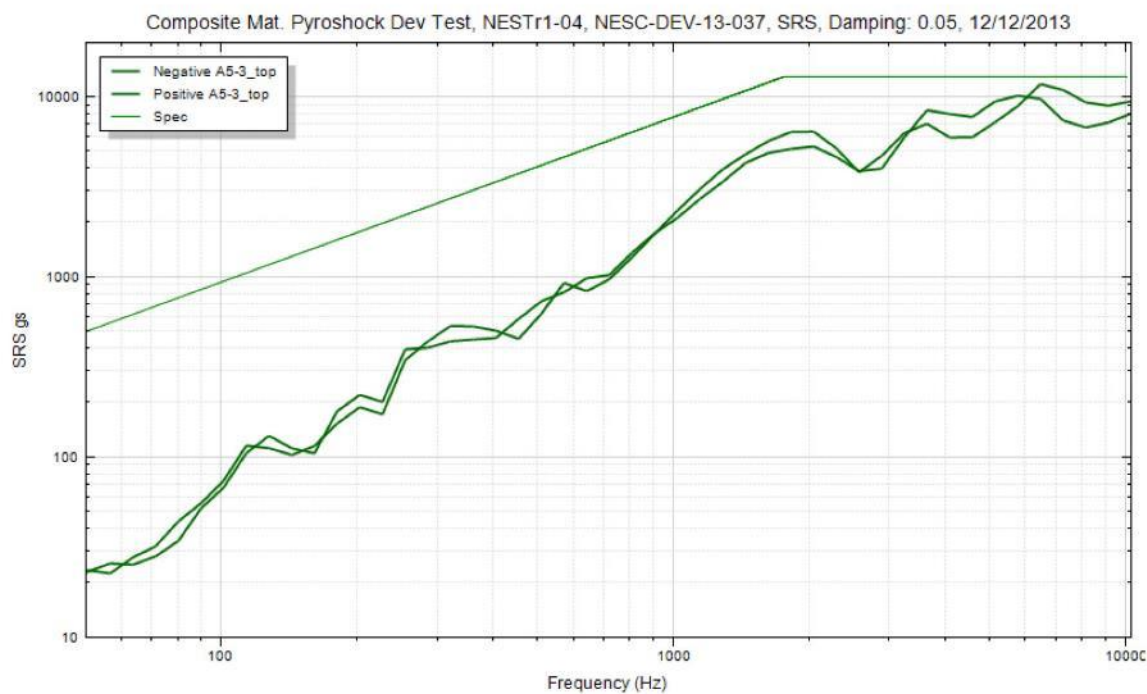
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
525 of 832





# NASA Engineering and Safety Center Technical Assessment Report

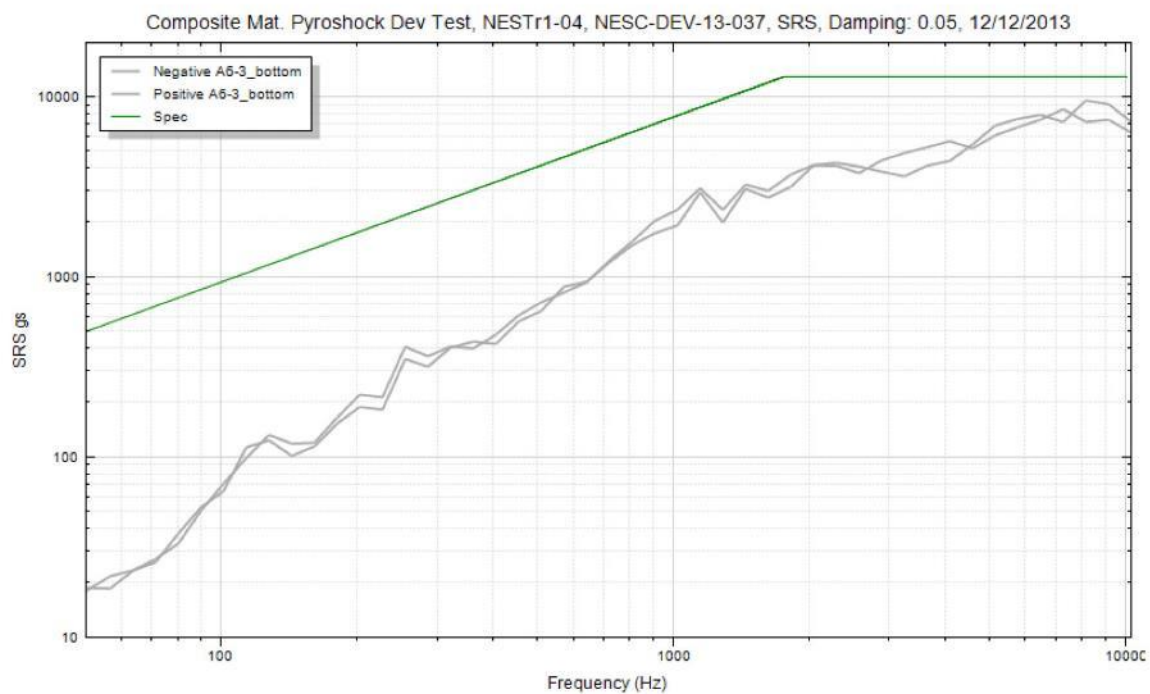
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
526 of 832





# NASA Engineering and Safety Center Technical Assessment Report

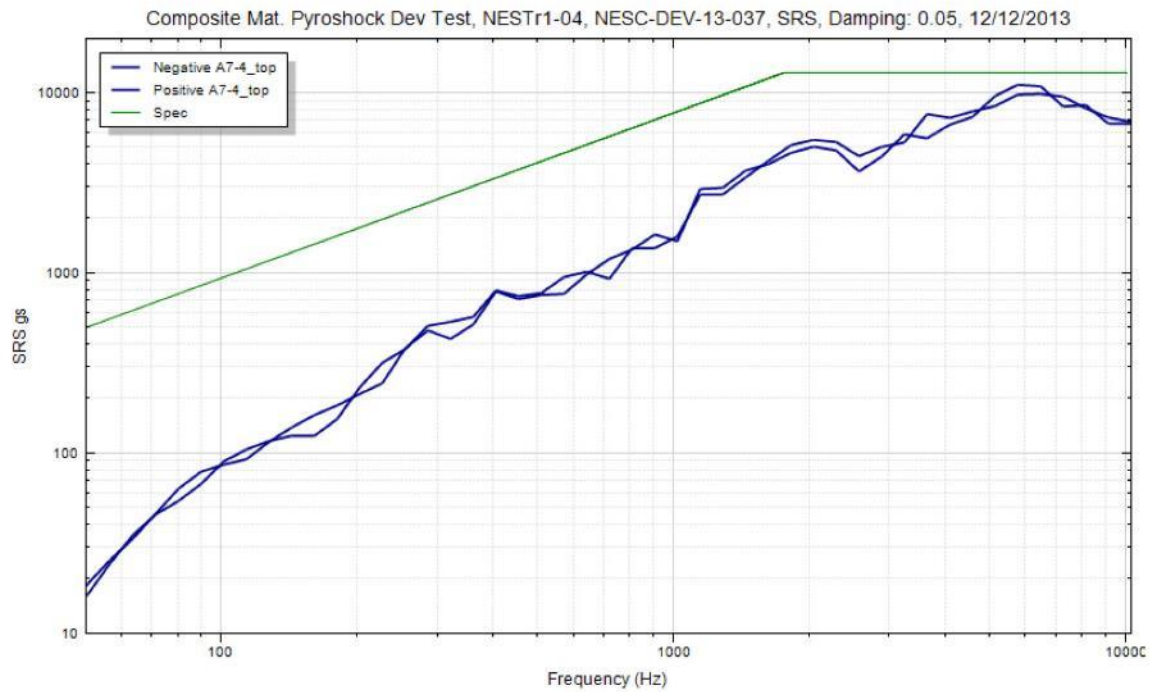
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
527 of 832





# NASA Engineering and Safety Center Technical Assessment Report

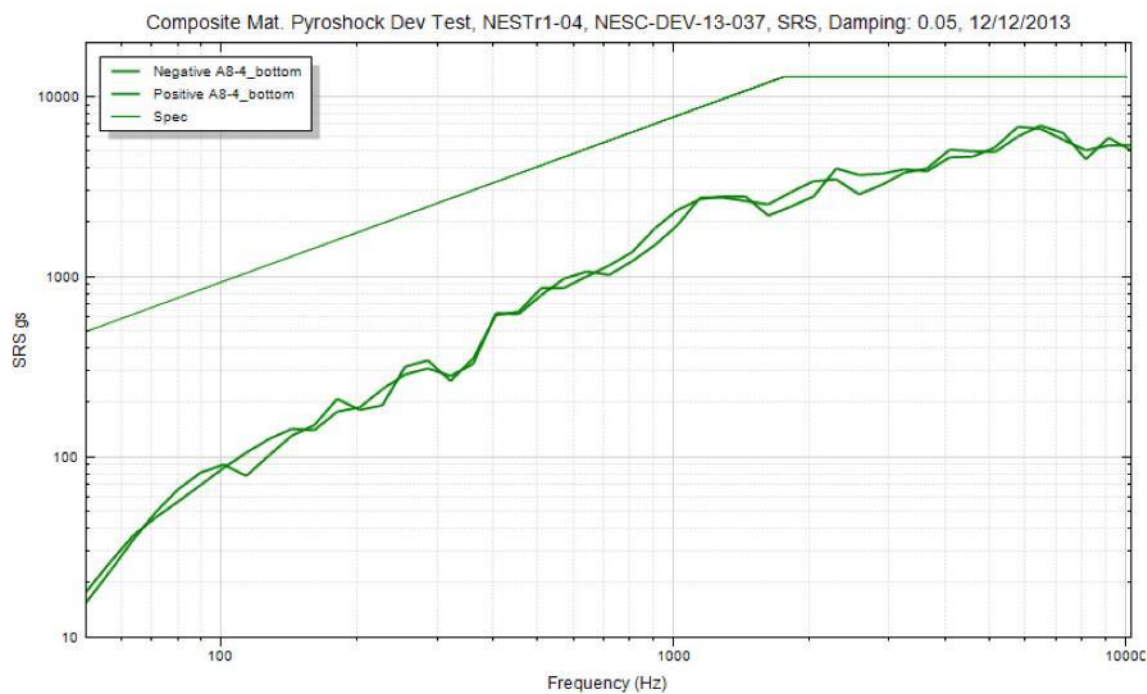
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
528 of 832





# NASA Engineering and Safety Center Technical Assessment Report

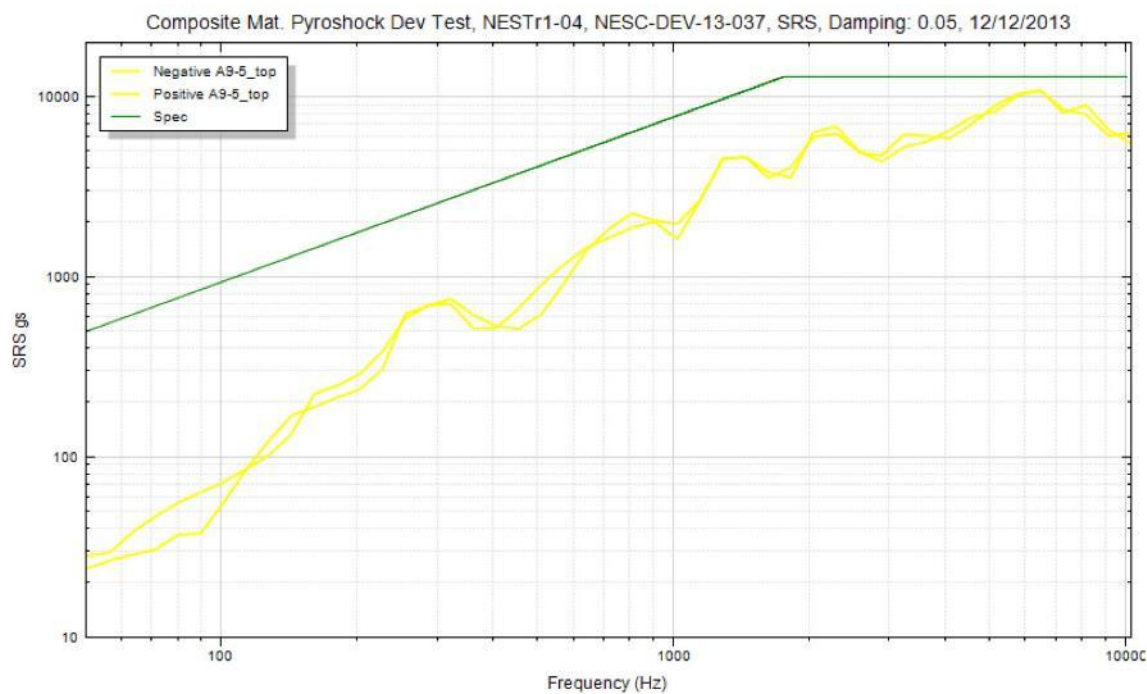
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
529 of 832





# NASA Engineering and Safety Center Technical Assessment Report

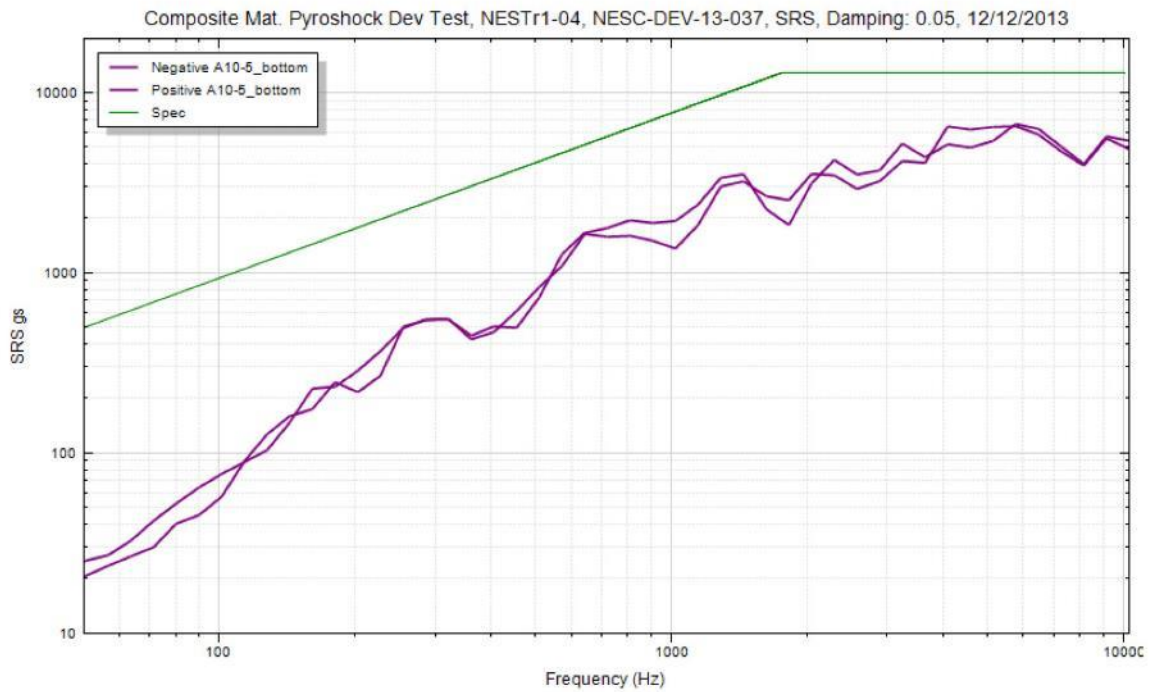
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
530 of 832





# NASA Engineering and Safety Center Technical Assessment Report

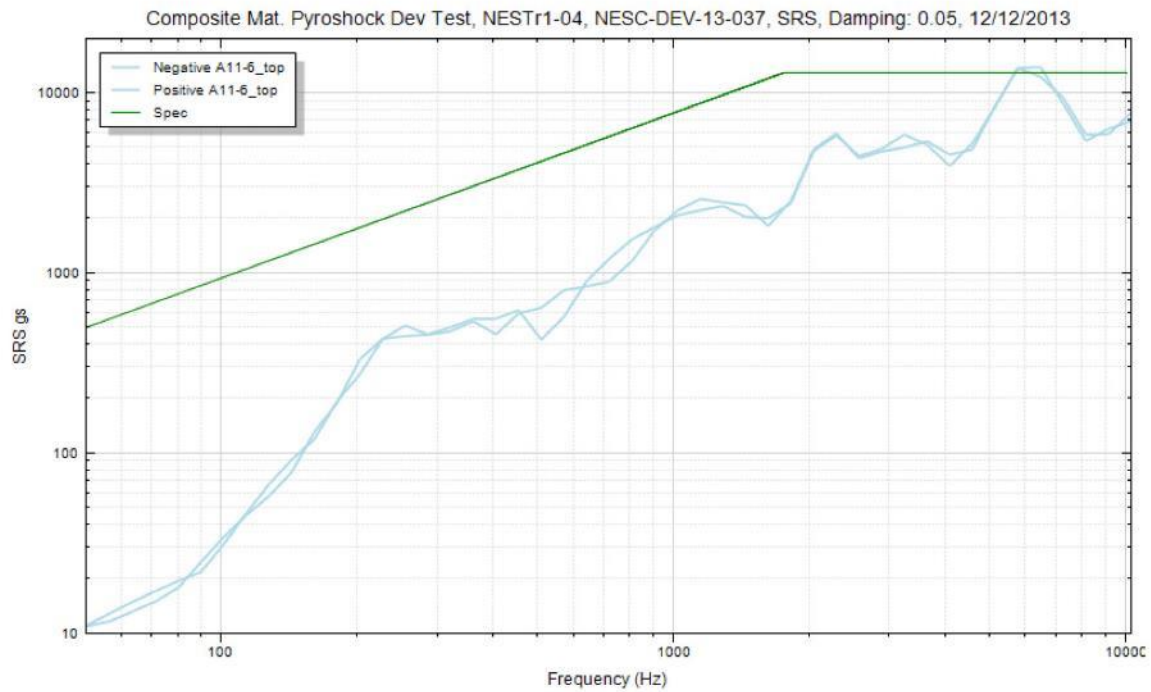
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
531 of 832





# NASA Engineering and Safety Center Technical Assessment Report

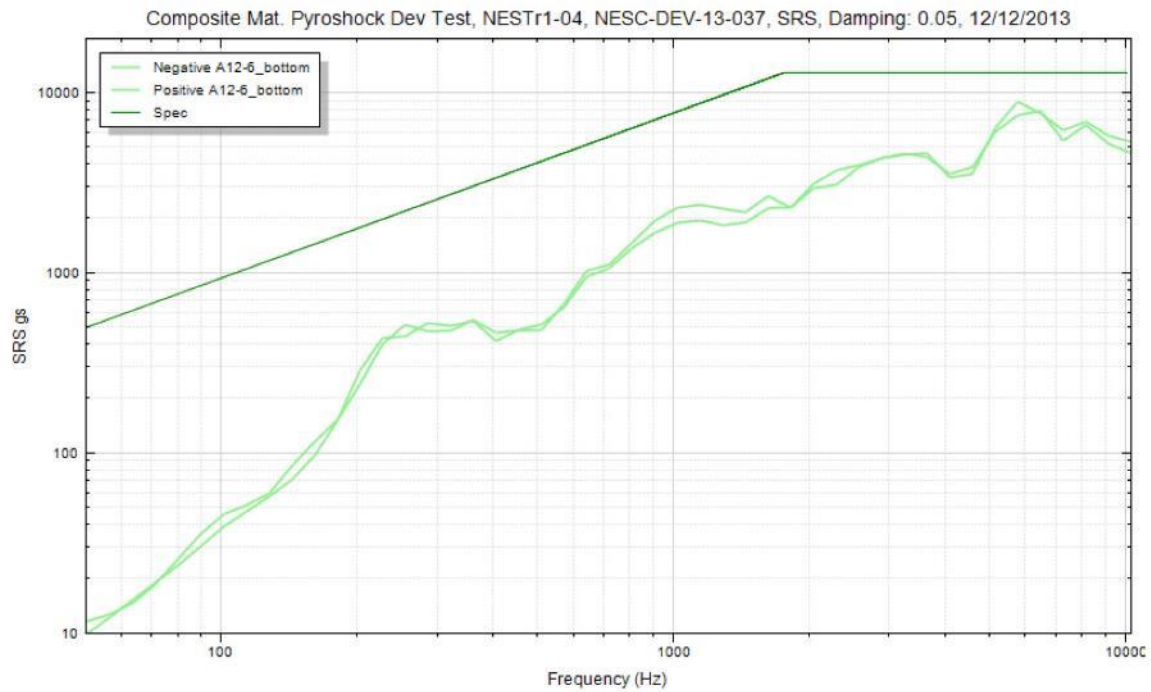
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
532 of 832







# NASA Engineering and Safety Center Technical Assessment Report

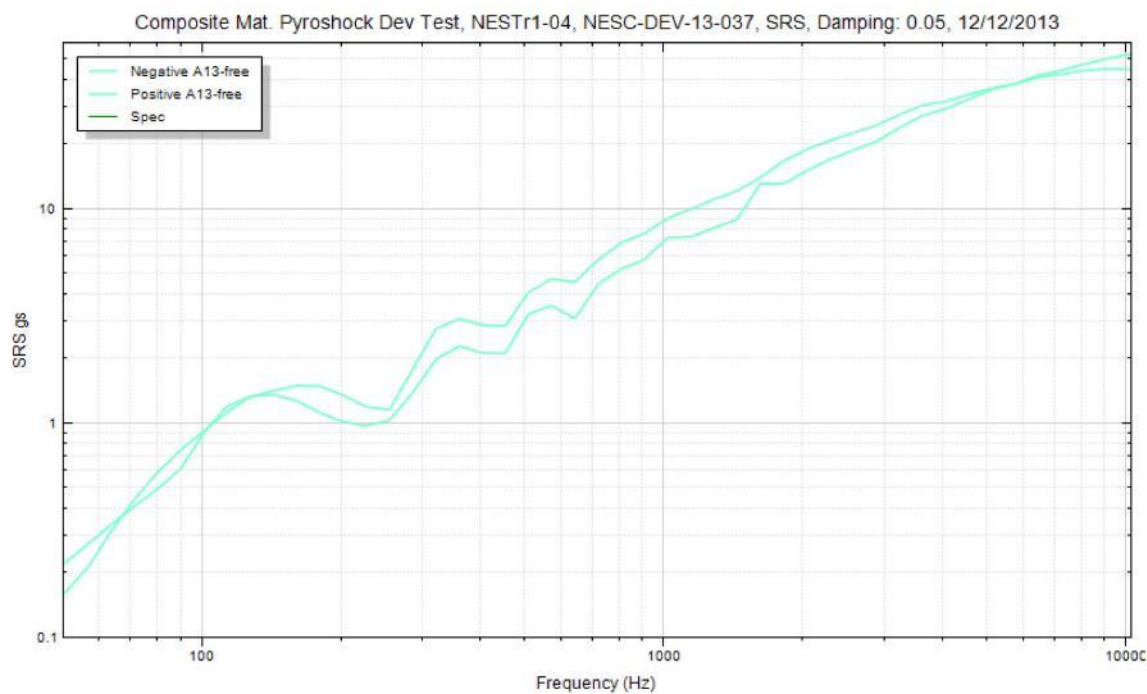
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
533 of 832





# NASA Engineering and Safety Center Technical Assessment Report

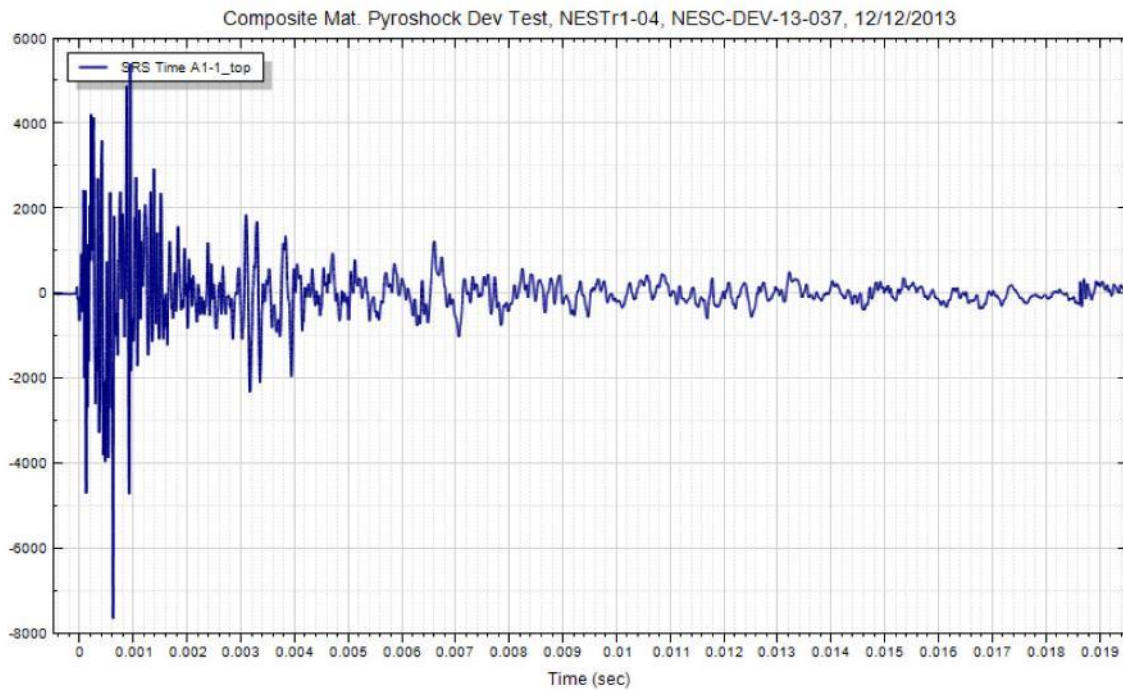
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
534 of 832





# NASA Engineering and Safety Center Technical Assessment Report

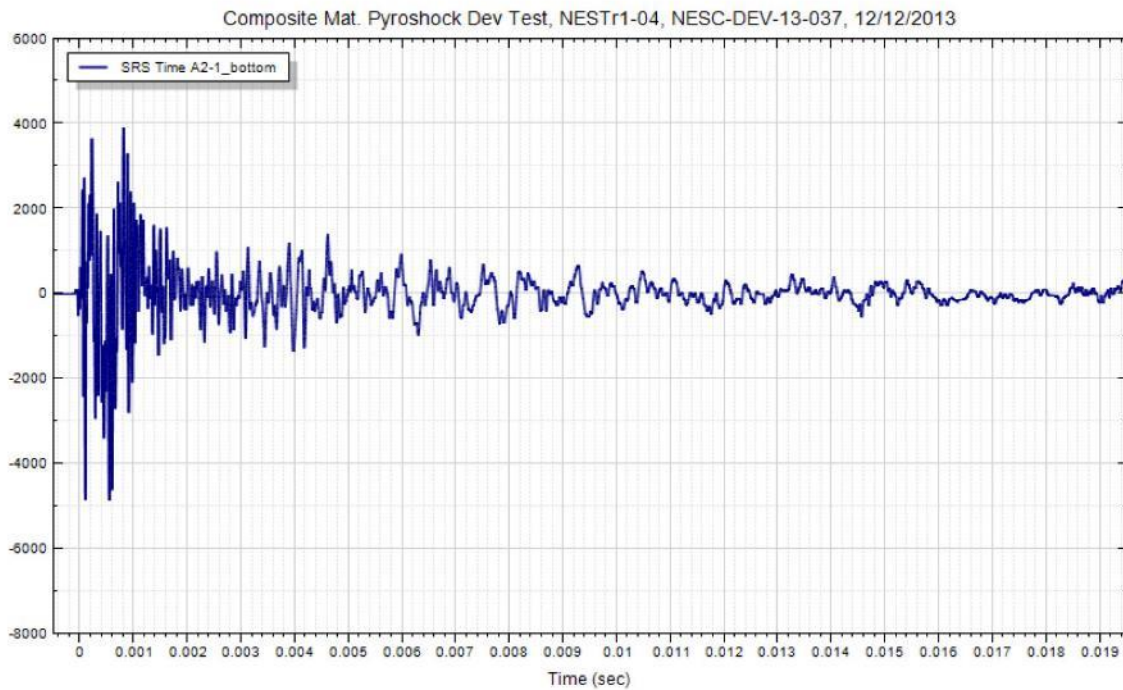
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
535 of 832





# NASA Engineering and Safety Center Technical Assessment Report

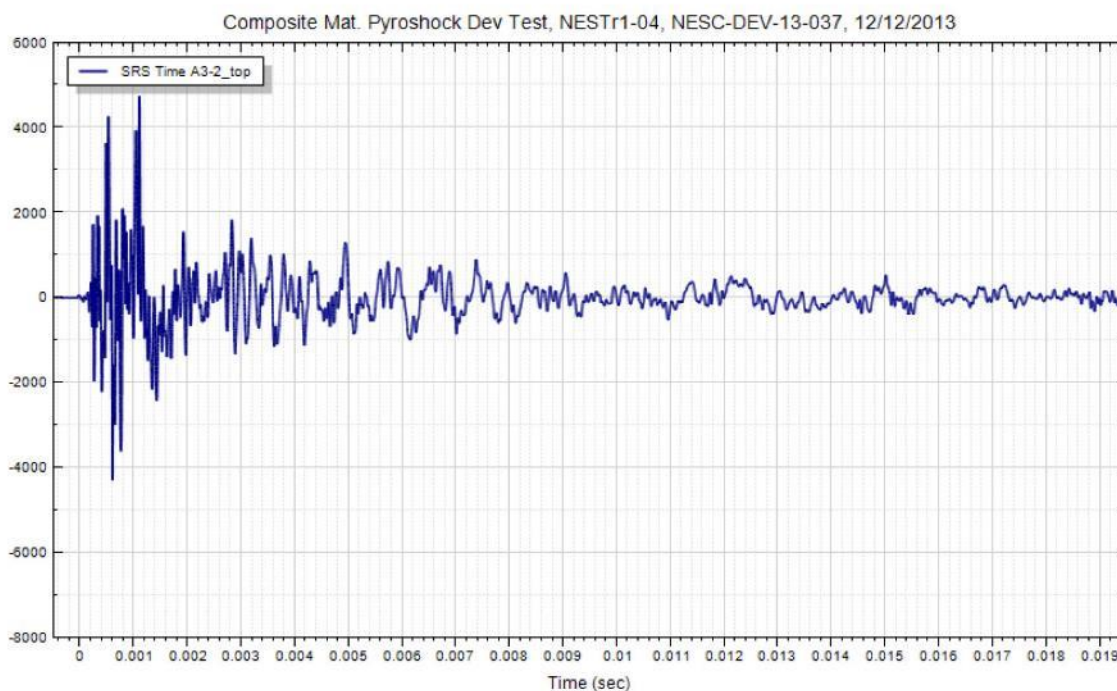
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
536 of 832





# NASA Engineering and Safety Center Technical Assessment Report

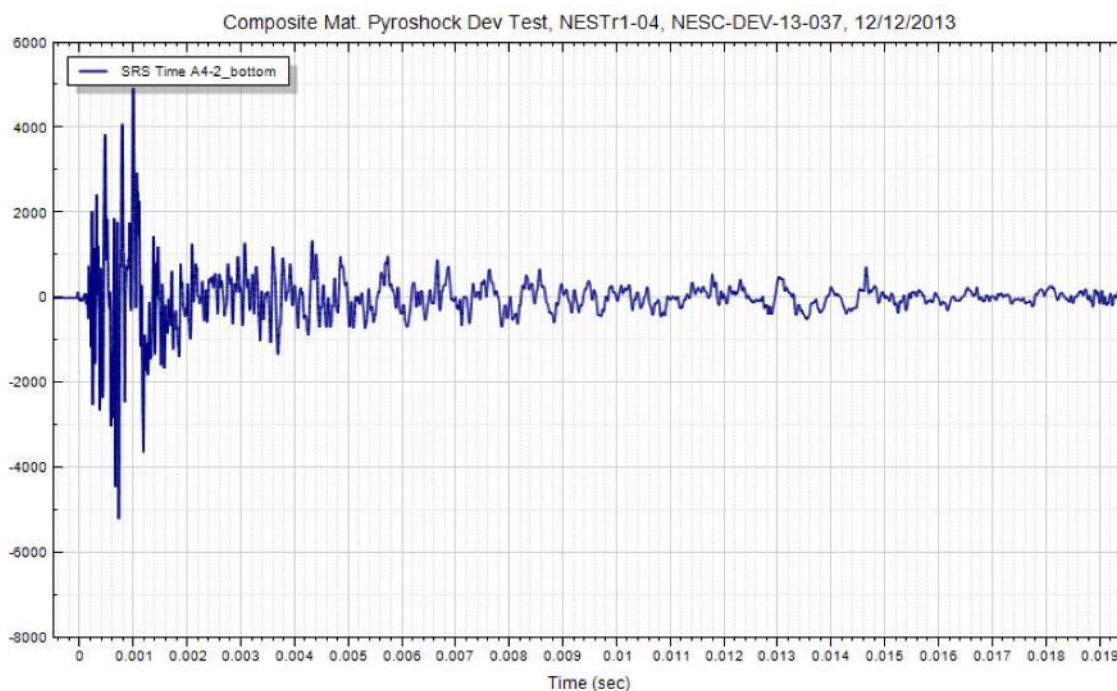
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
537 of 832





# NASA Engineering and Safety Center Technical Assessment Report

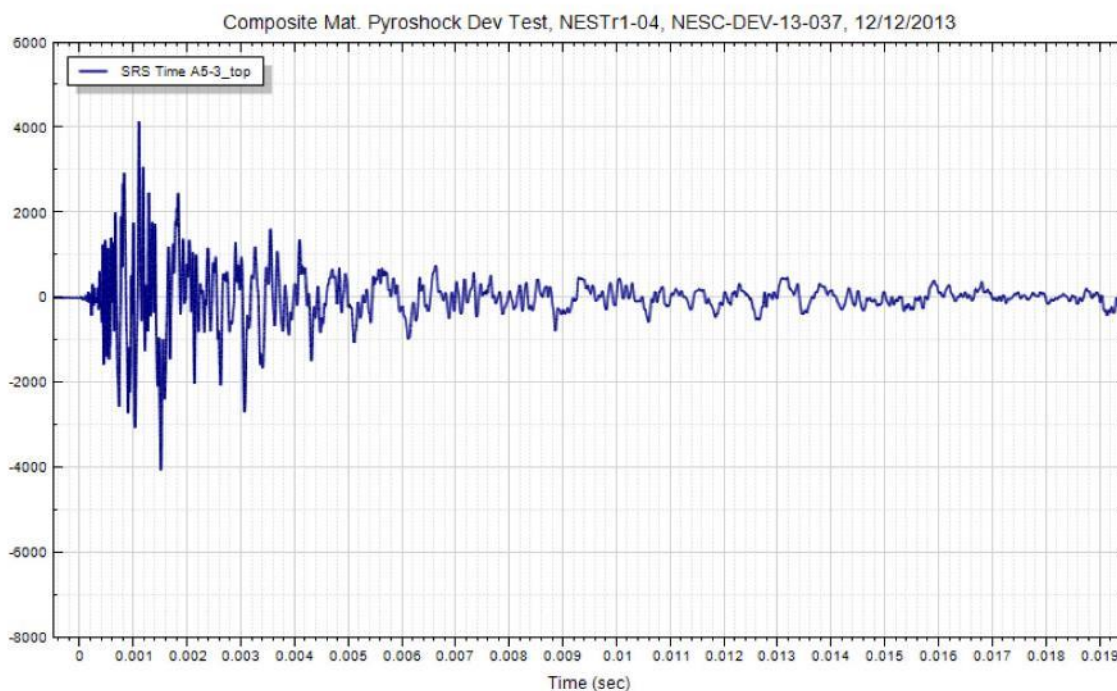
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
538 of 832





# NASA Engineering and Safety Center Technical Assessment Report

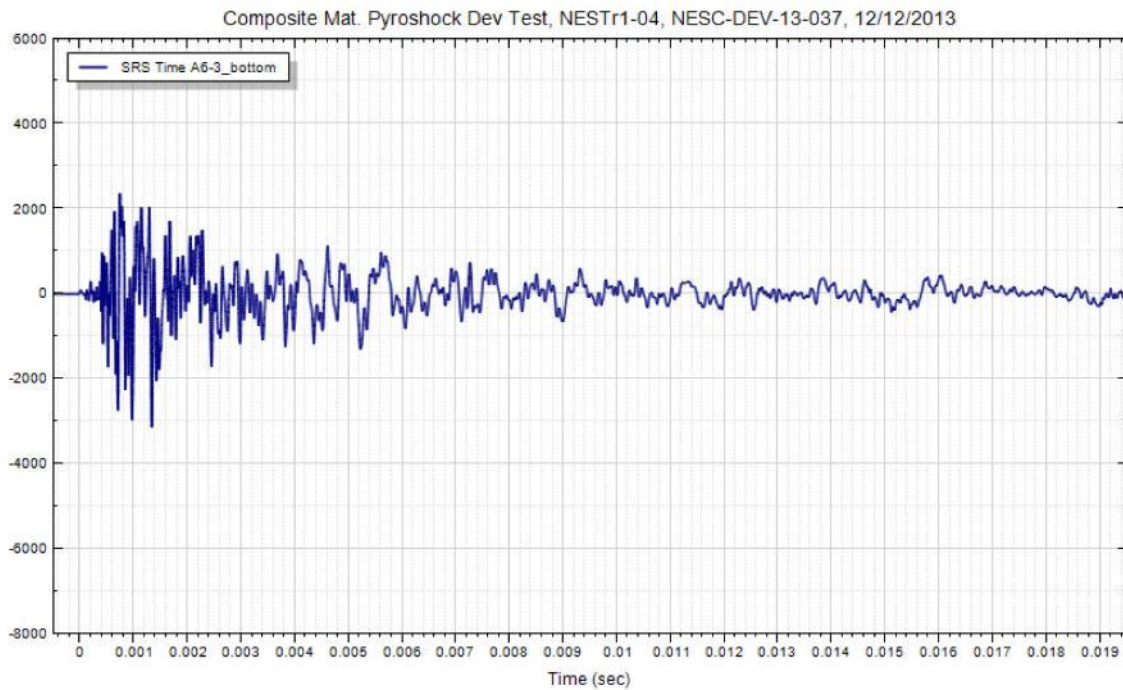
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
539 of 832





# NASA Engineering and Safety Center Technical Assessment Report

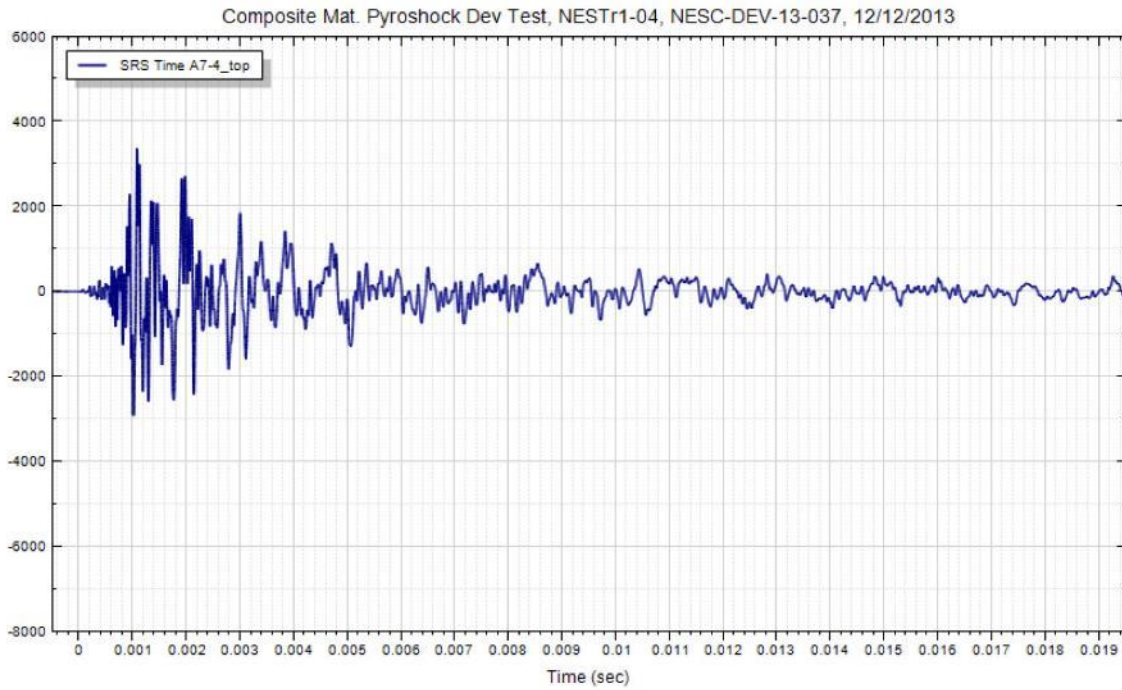
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
540 of 832







# NASA Engineering and Safety Center Technical Assessment Report

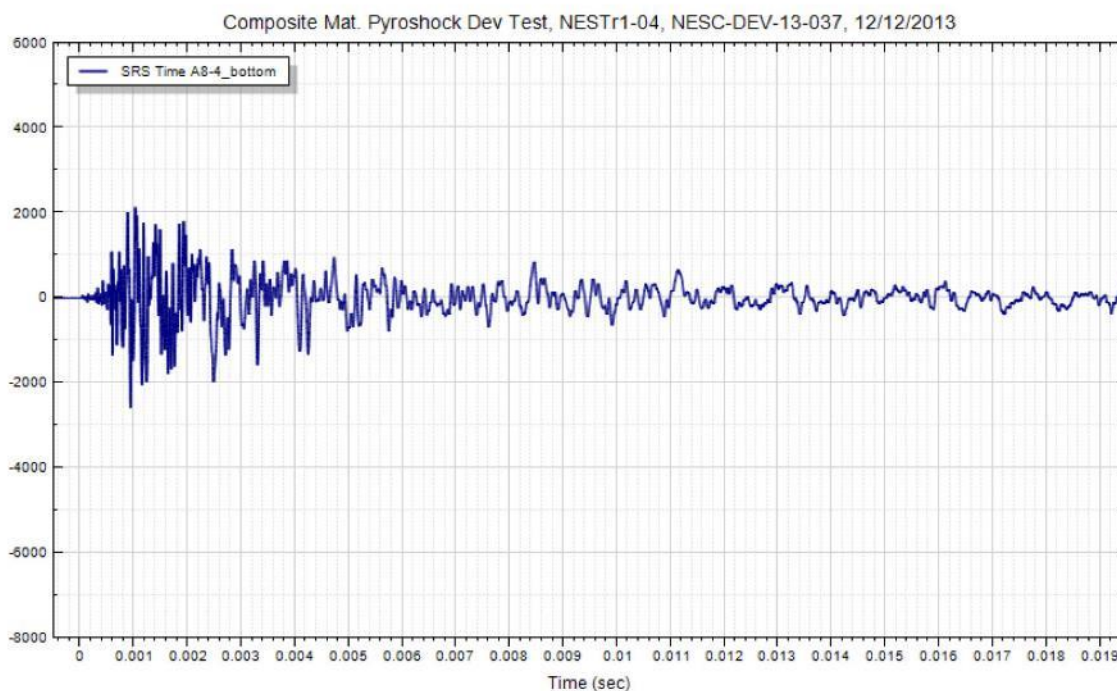
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
541 of 832





# NASA Engineering and Safety Center Technical Assessment Report

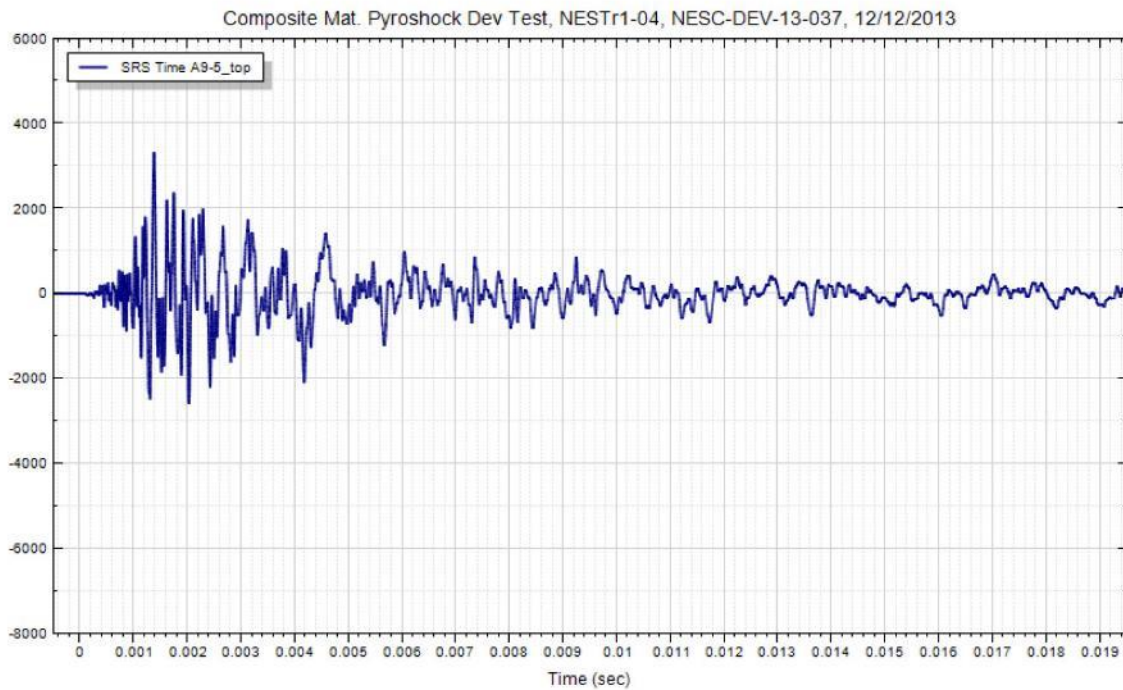
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
542 of 832





# NASA Engineering and Safety Center Technical Assessment Report

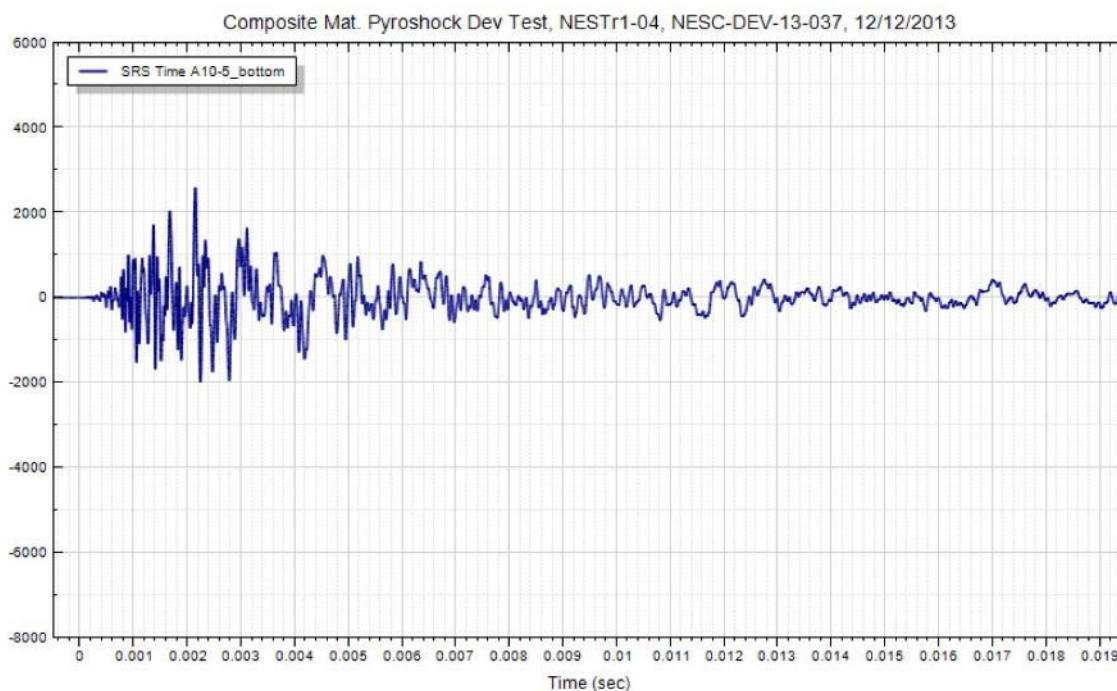
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
543 of 832





# NASA Engineering and Safety Center Technical Assessment Report

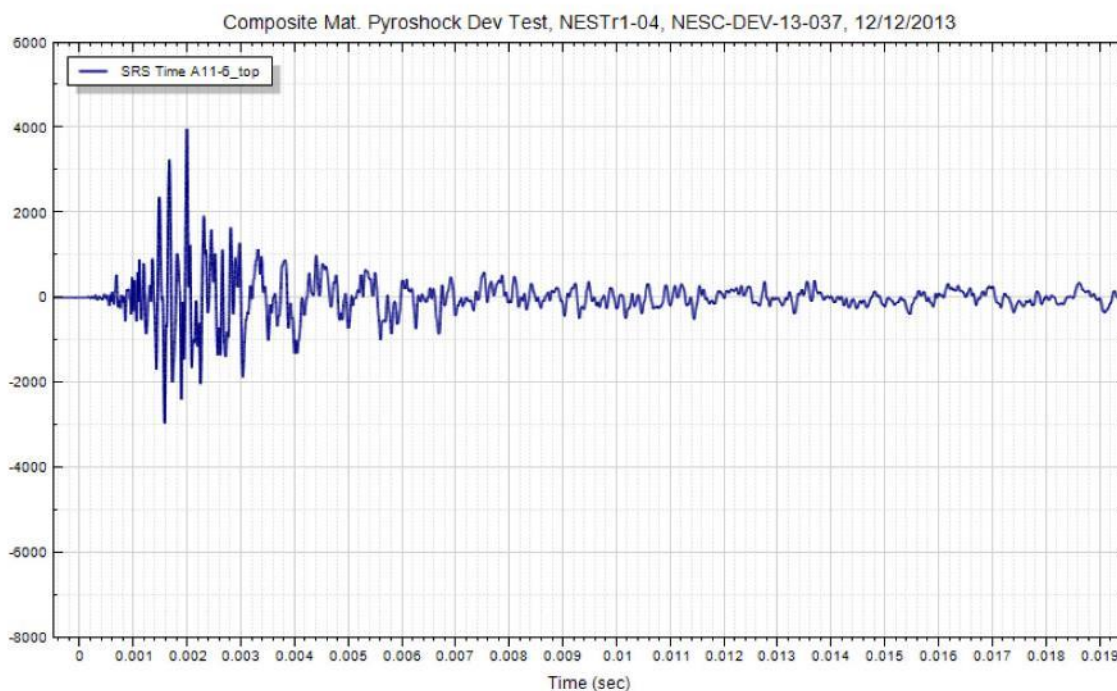
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
544 of 832





# NASA Engineering and Safety Center Technical Assessment Report

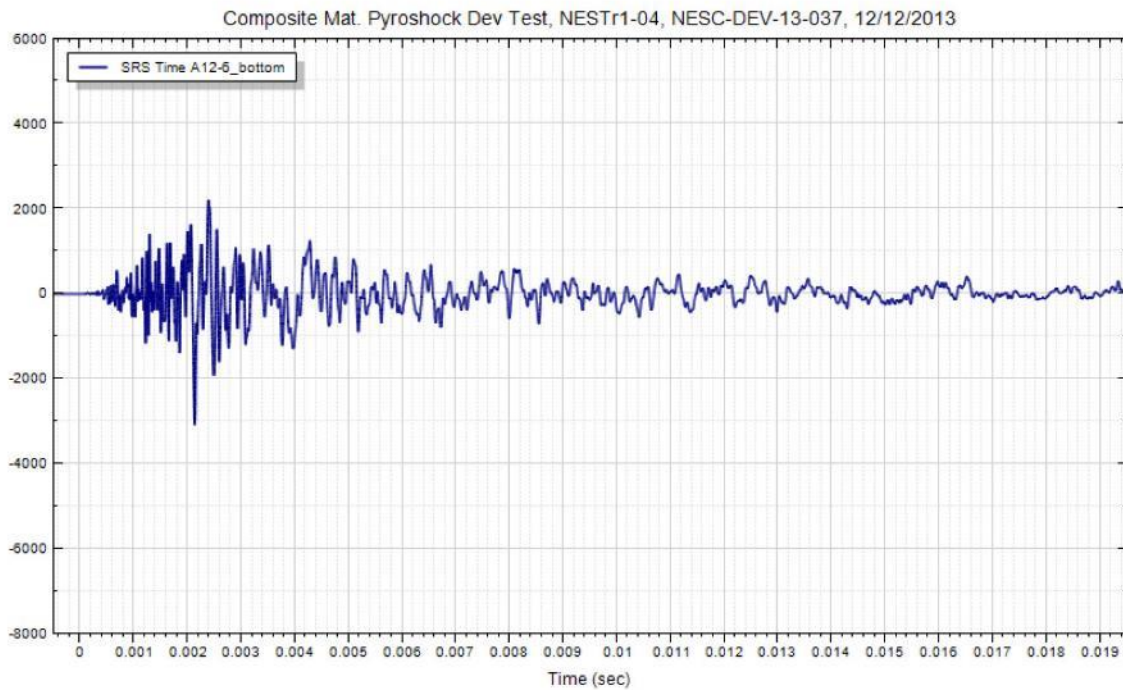
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
545 of 832





# NASA Engineering and Safety Center Technical Assessment Report

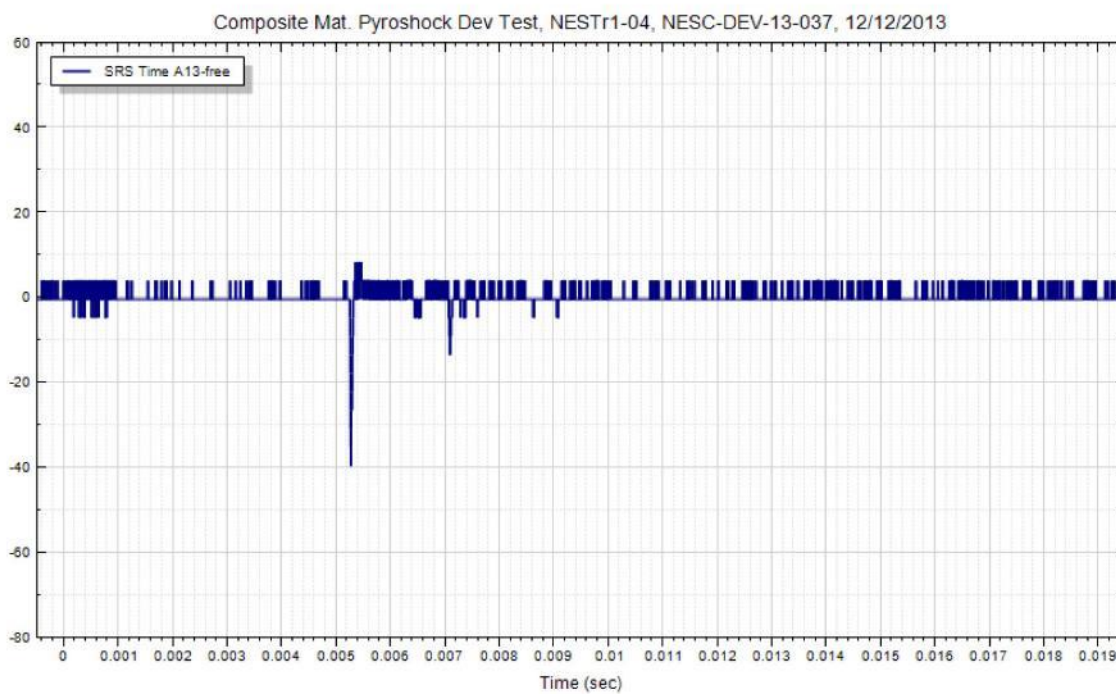
Document #:  
**NESC-RP-  
12-00783**


Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
546 of 832



	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 547 of 832	

**NESC-DEV-13-037**  
**Composite Materials**  
**Shock Test**  
  
**Test #6 Accelerometer Data**  
**Panel 0320A002**



# NASA Engineering and Safety Center Technical Assessment Report

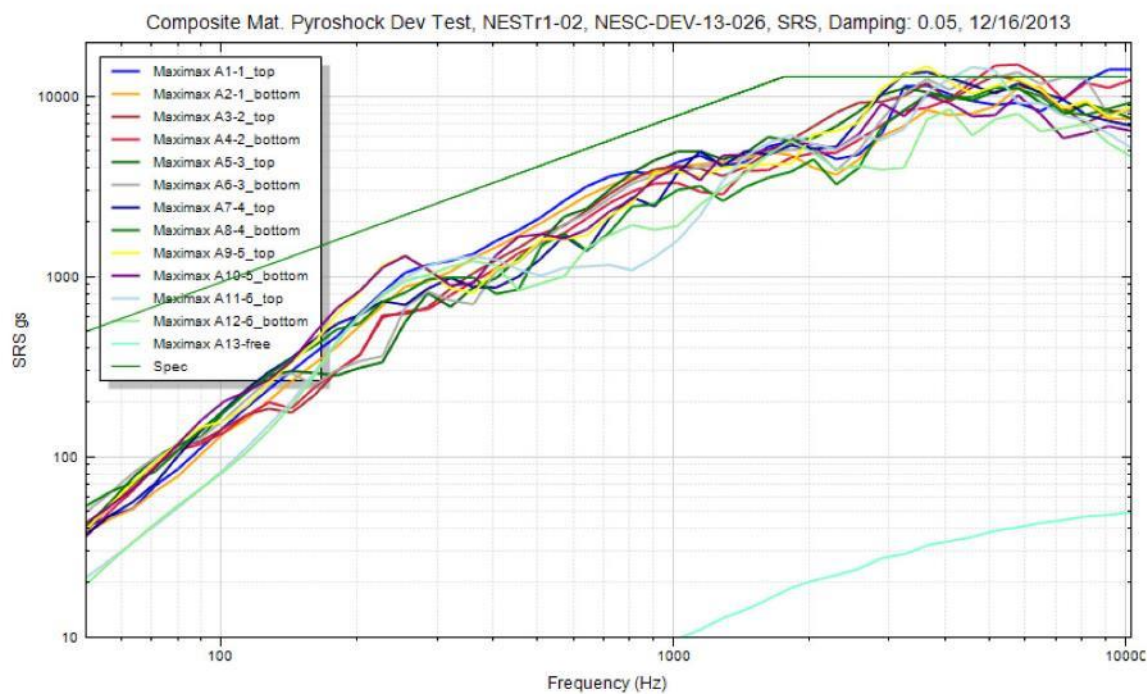
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
548 of 832







# NASA Engineering and Safety Center Technical Assessment Report

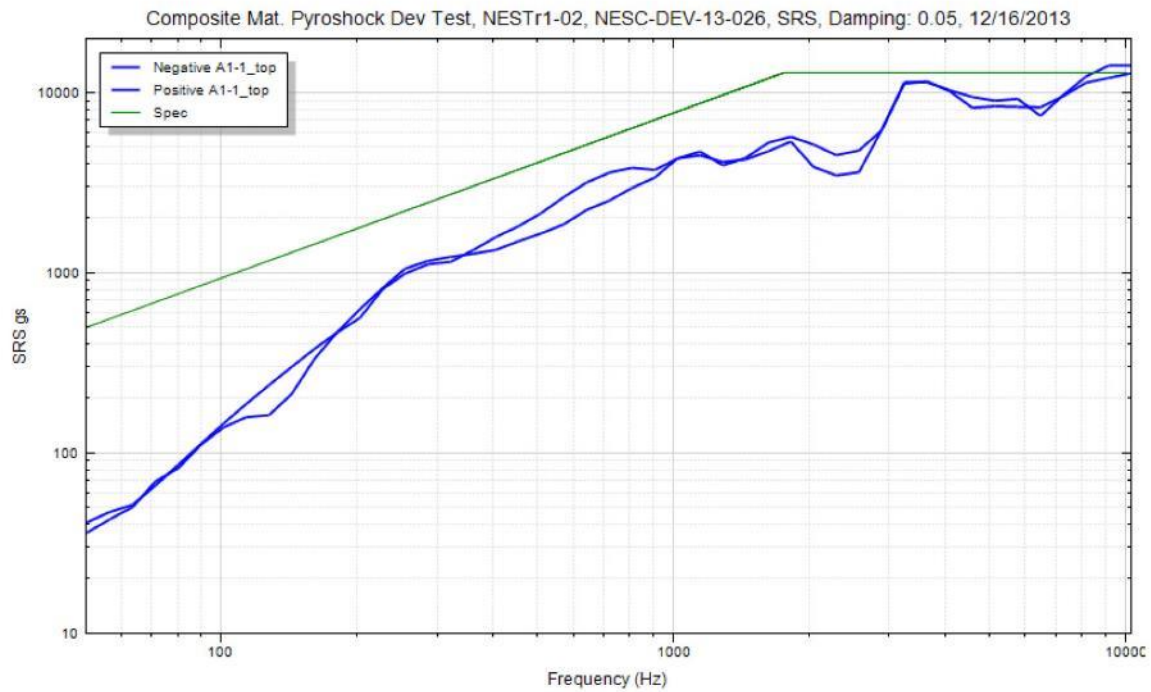
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
549 of 832





# NASA Engineering and Safety Center Technical Assessment Report

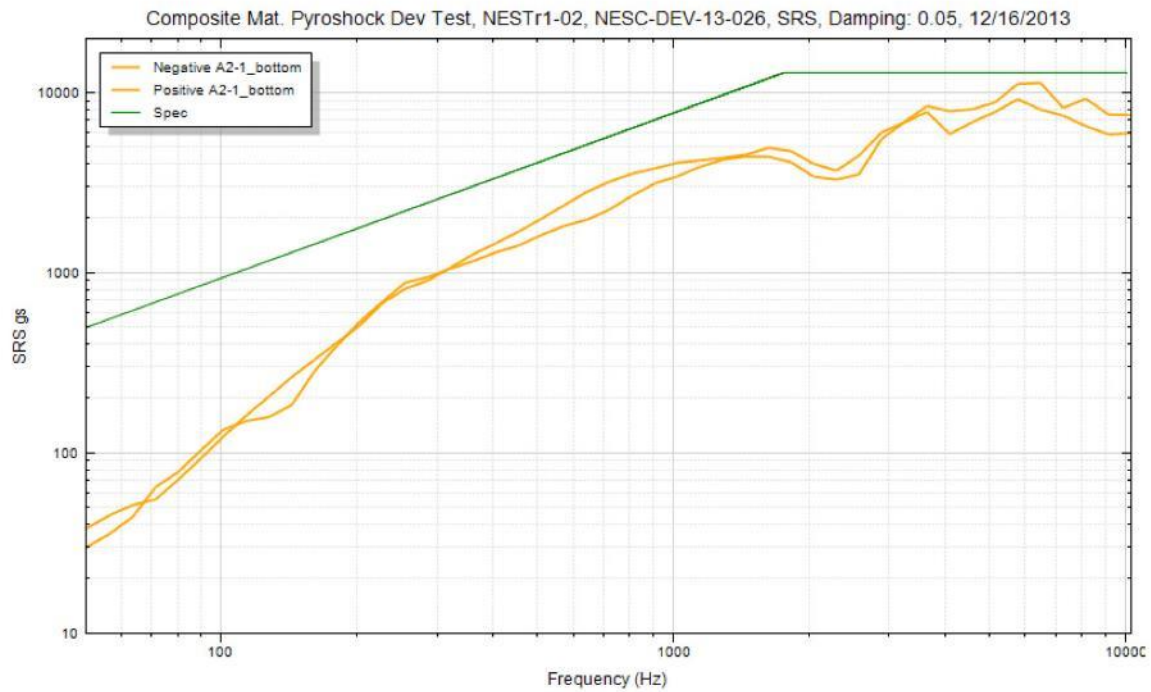
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
550 of 832





# NASA Engineering and Safety Center Technical Assessment Report

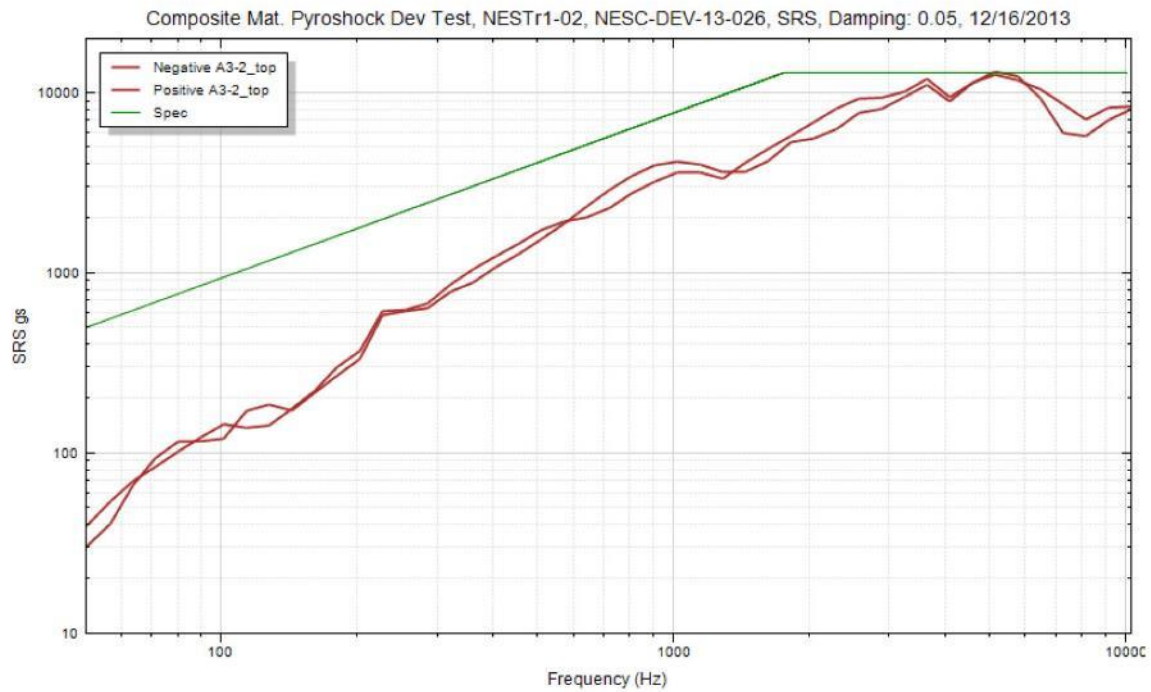
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
551 of 832





# NASA Engineering and Safety Center Technical Assessment Report

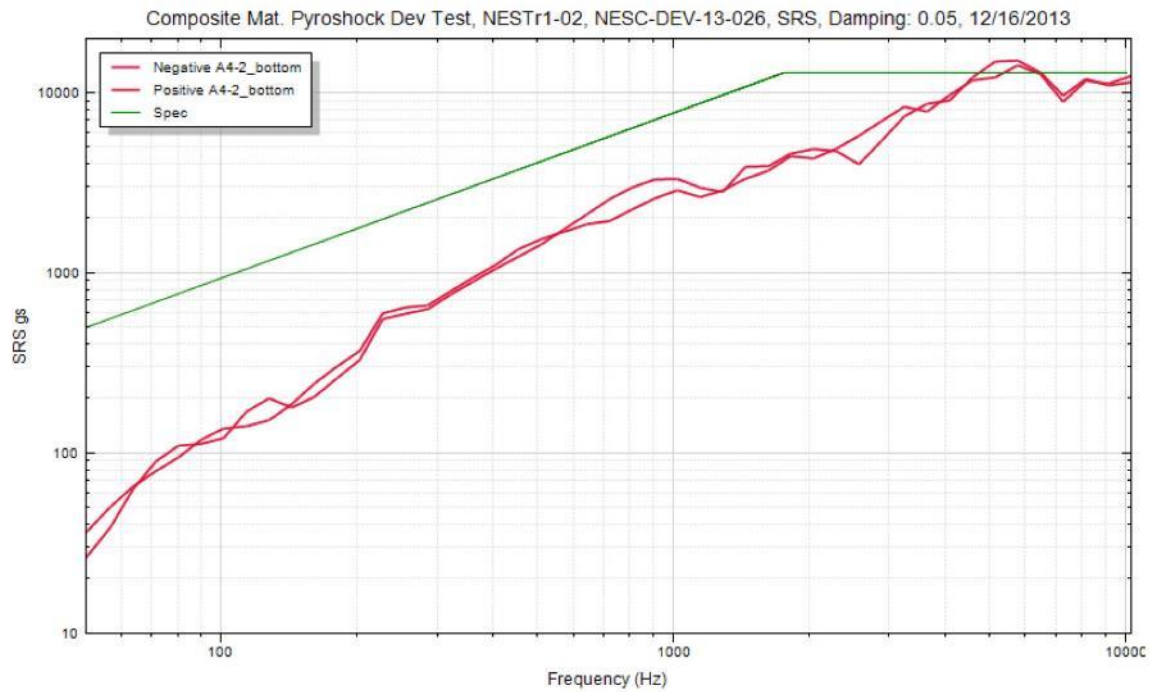
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
552 of 832





# NASA Engineering and Safety Center Technical Assessment Report

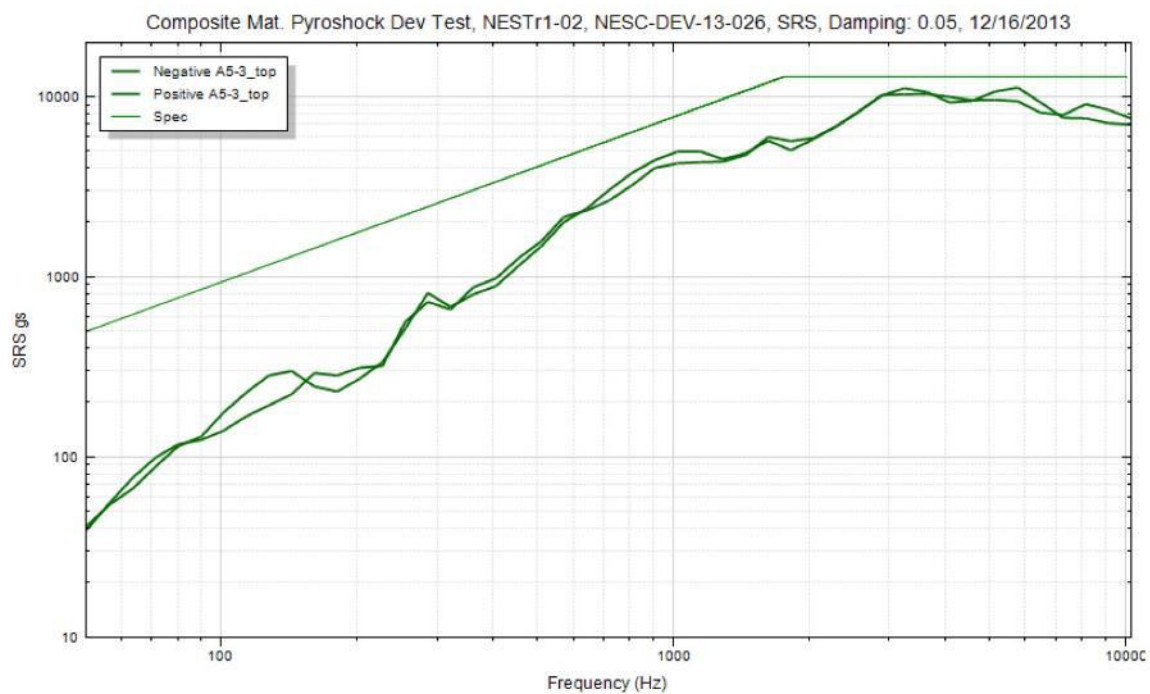
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
553 of 832





# NASA Engineering and Safety Center Technical Assessment Report

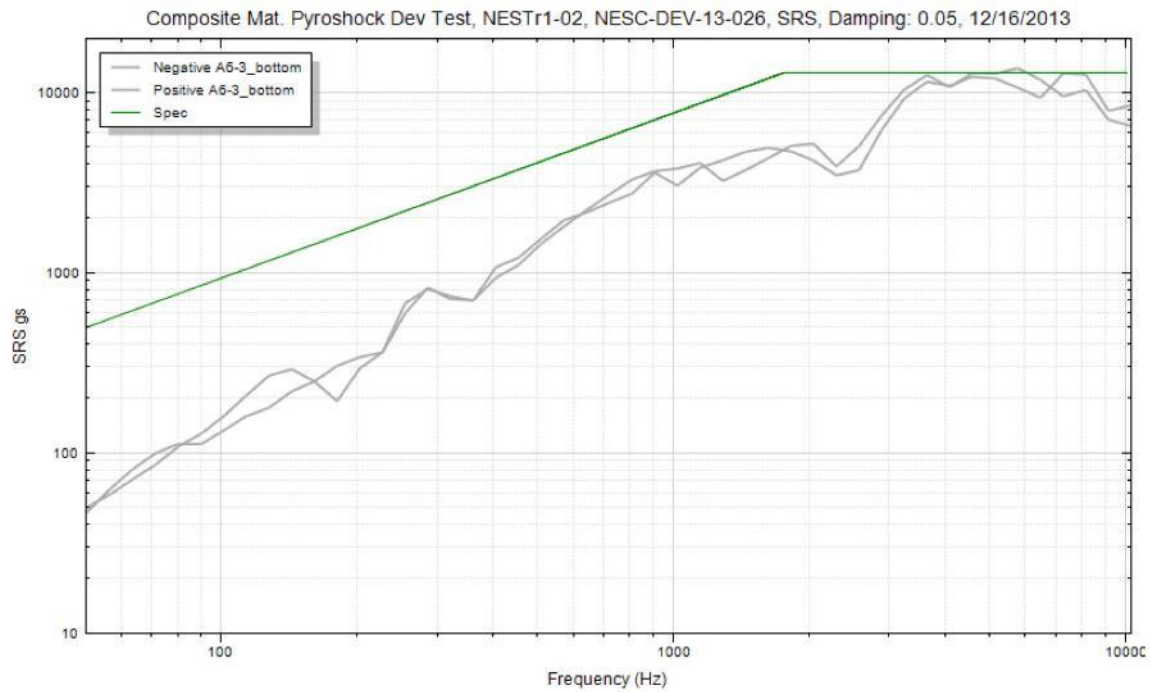
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
554 of 832





# NASA Engineering and Safety Center Technical Assessment Report

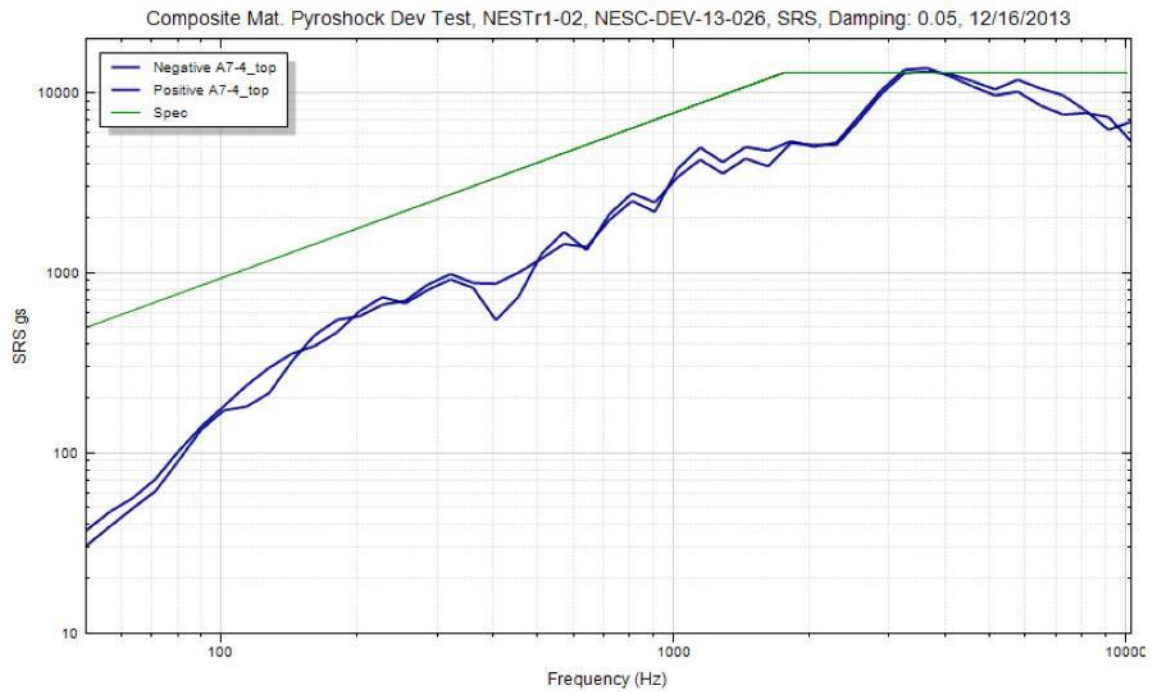
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
555 of 832





# NASA Engineering and Safety Center Technical Assessment Report

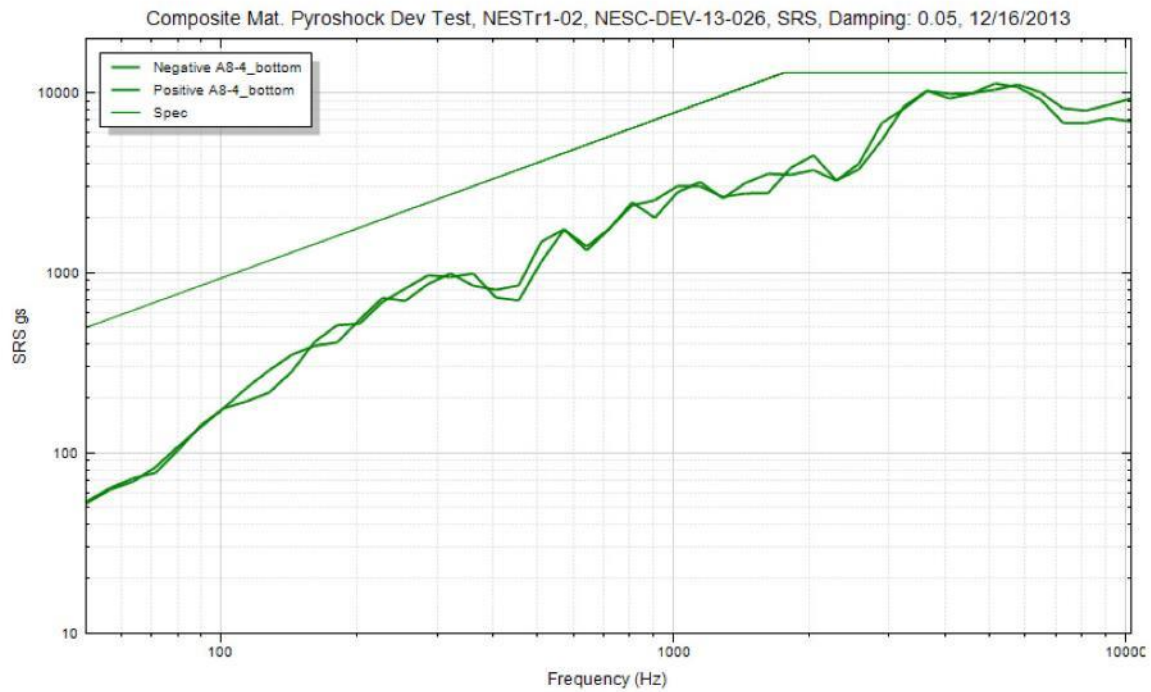
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
556 of 832







# NASA Engineering and Safety Center Technical Assessment Report

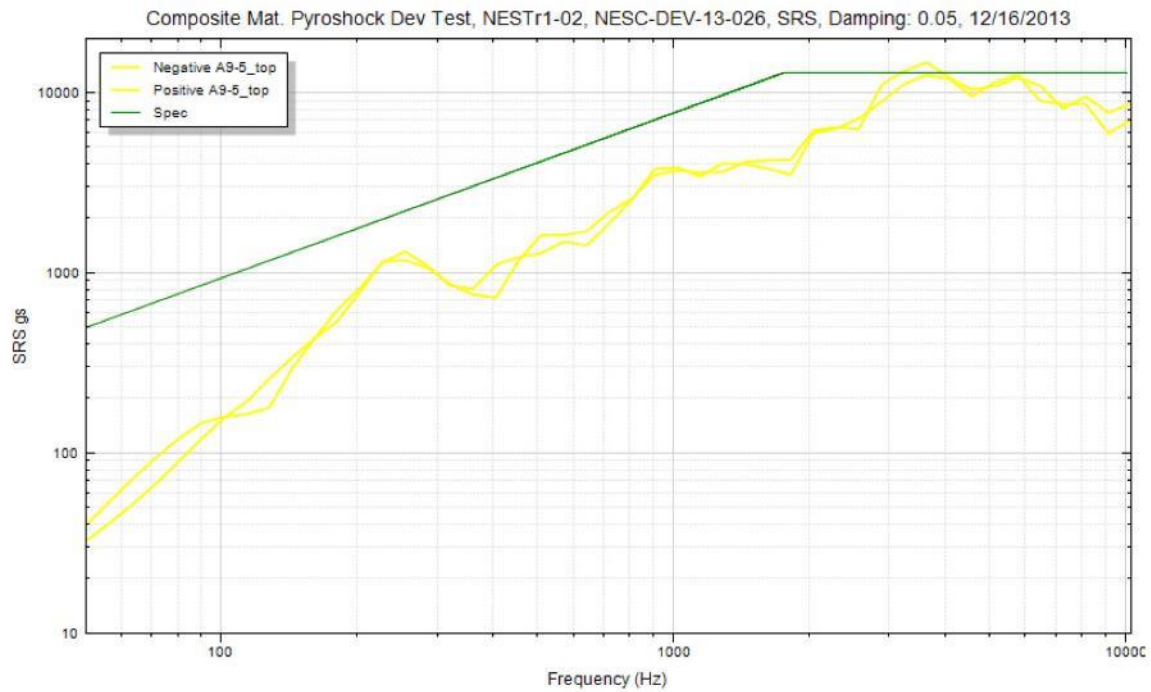
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
557 of 832





# NASA Engineering and Safety Center Technical Assessment Report

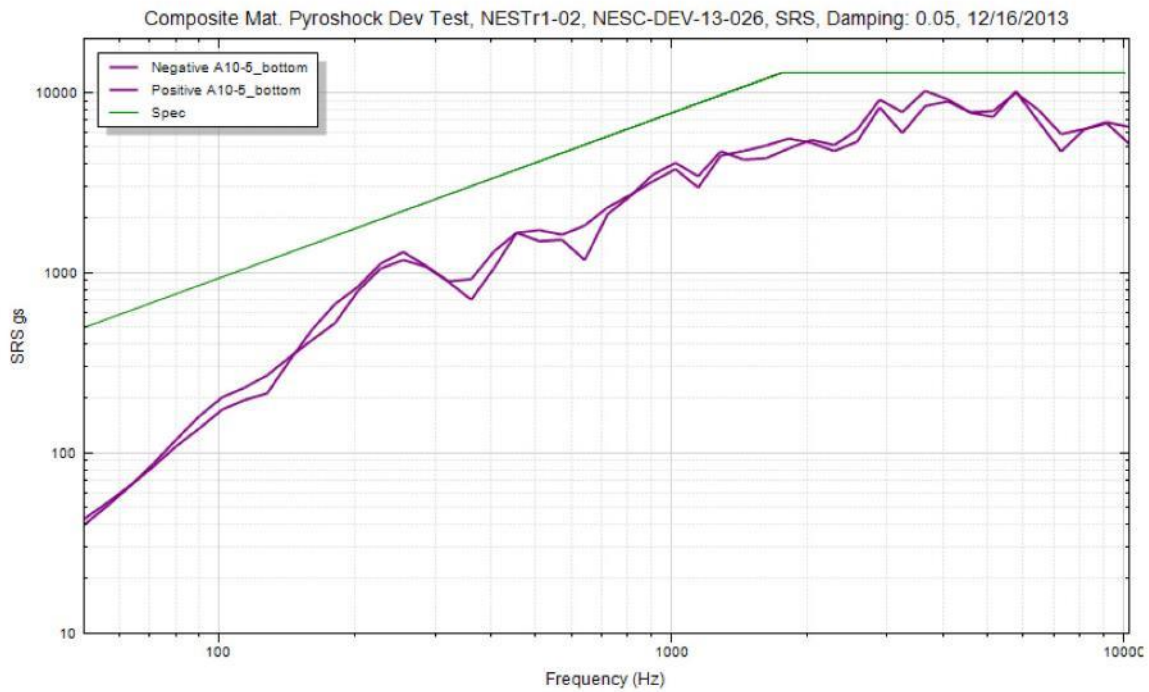
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
558 of 832





# NASA Engineering and Safety Center Technical Assessment Report

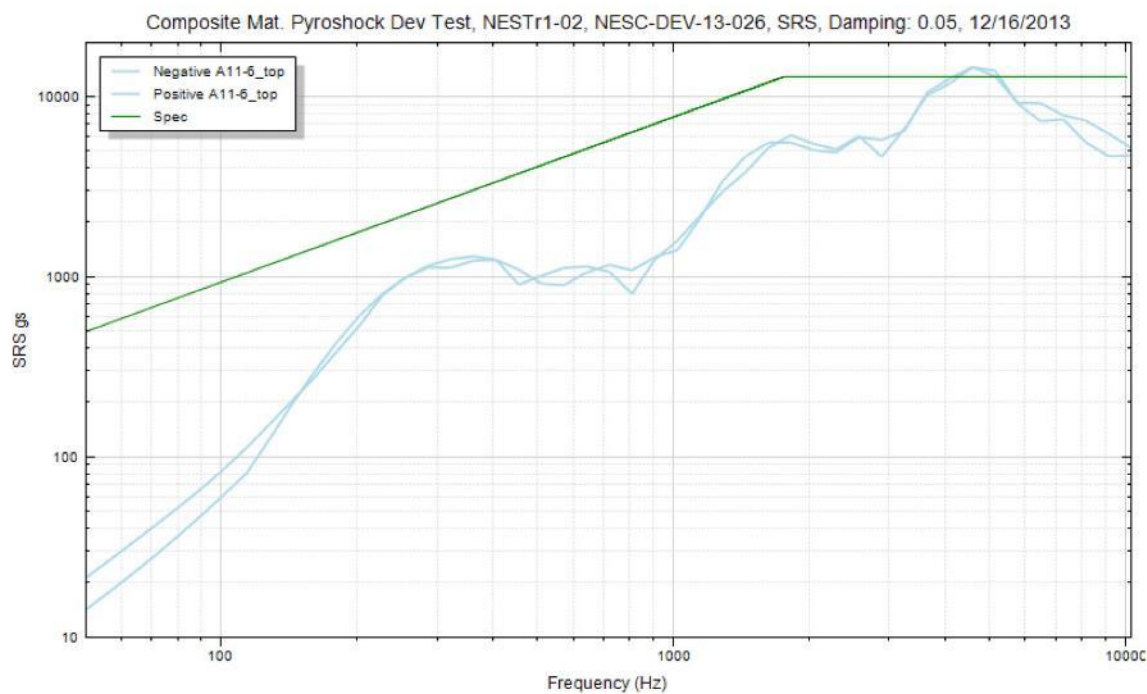
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
559 of 832





# NASA Engineering and Safety Center Technical Assessment Report

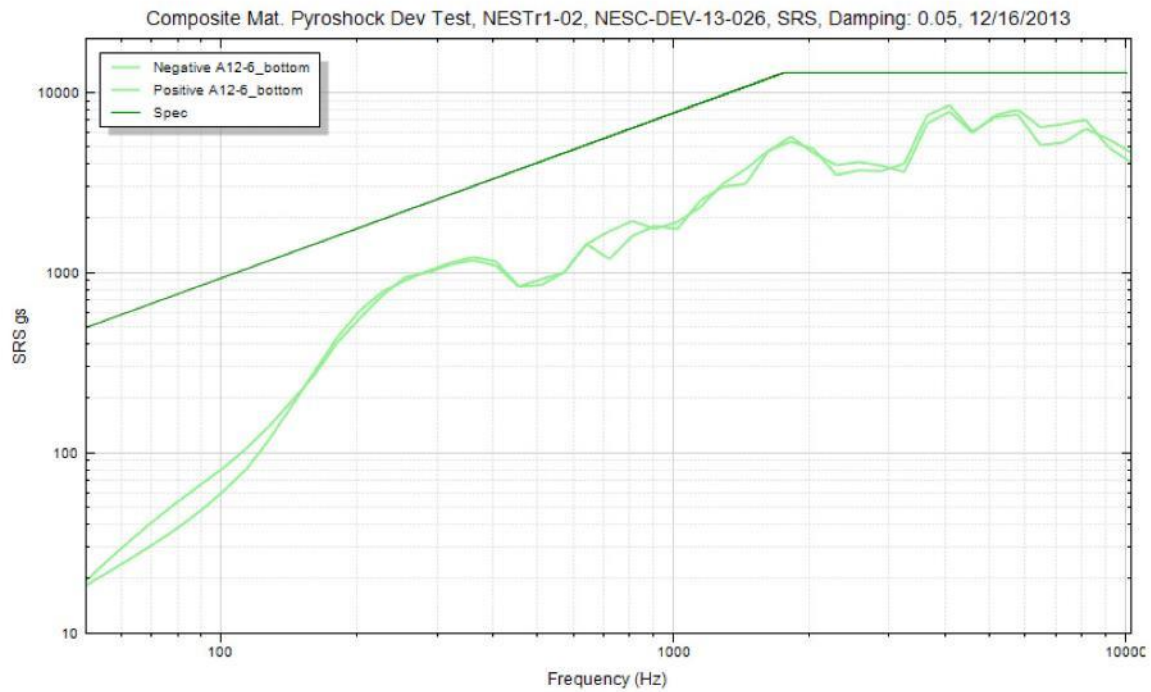
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
560 of 832





# NASA Engineering and Safety Center Technical Assessment Report

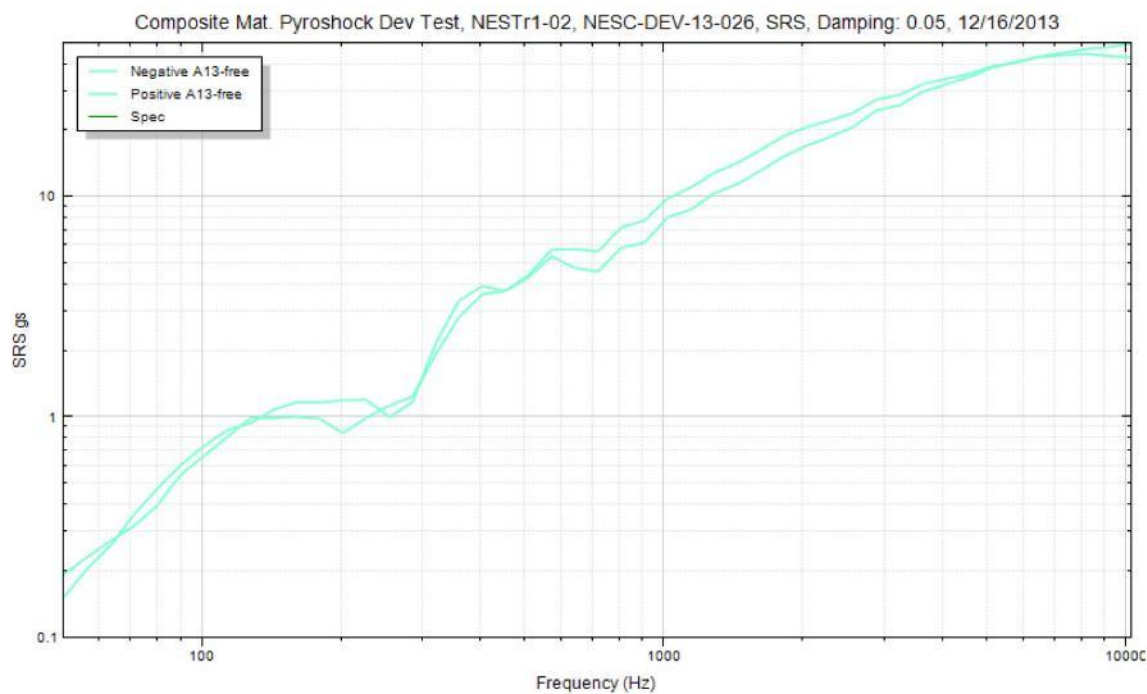
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
561 of 832





# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**

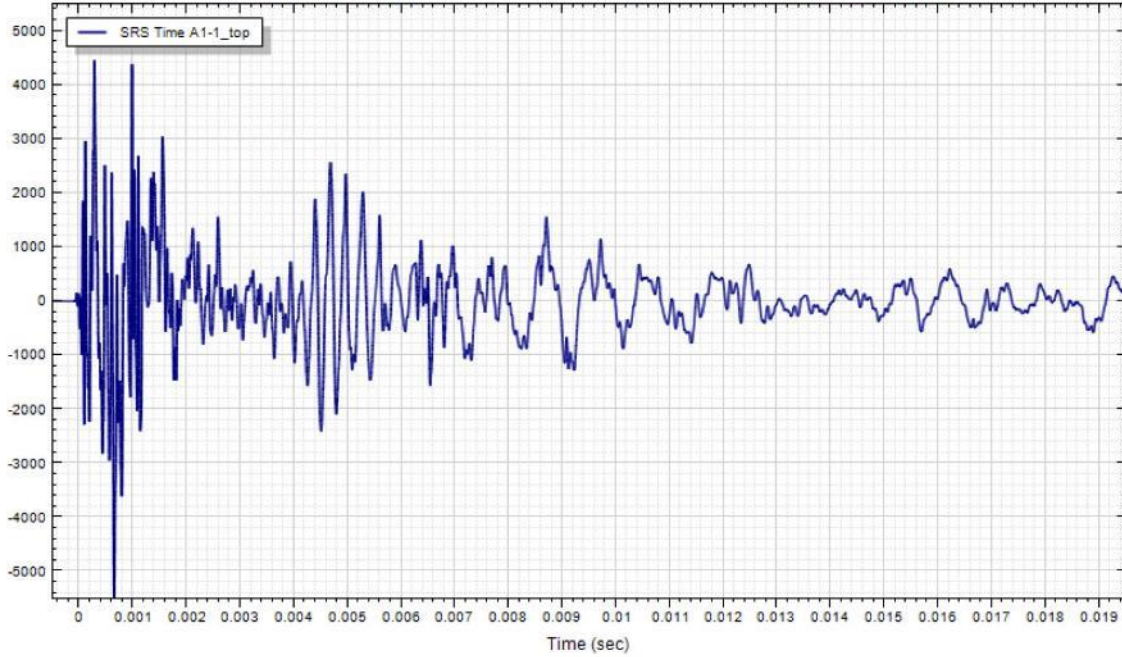
Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
562 of 832

Composite Mat. Pyroshock Dev Test, NESTr1-02, NESC-DEV-13-026, 12/16/2013





# NASA Engineering and Safety Center Technical Assessment Report

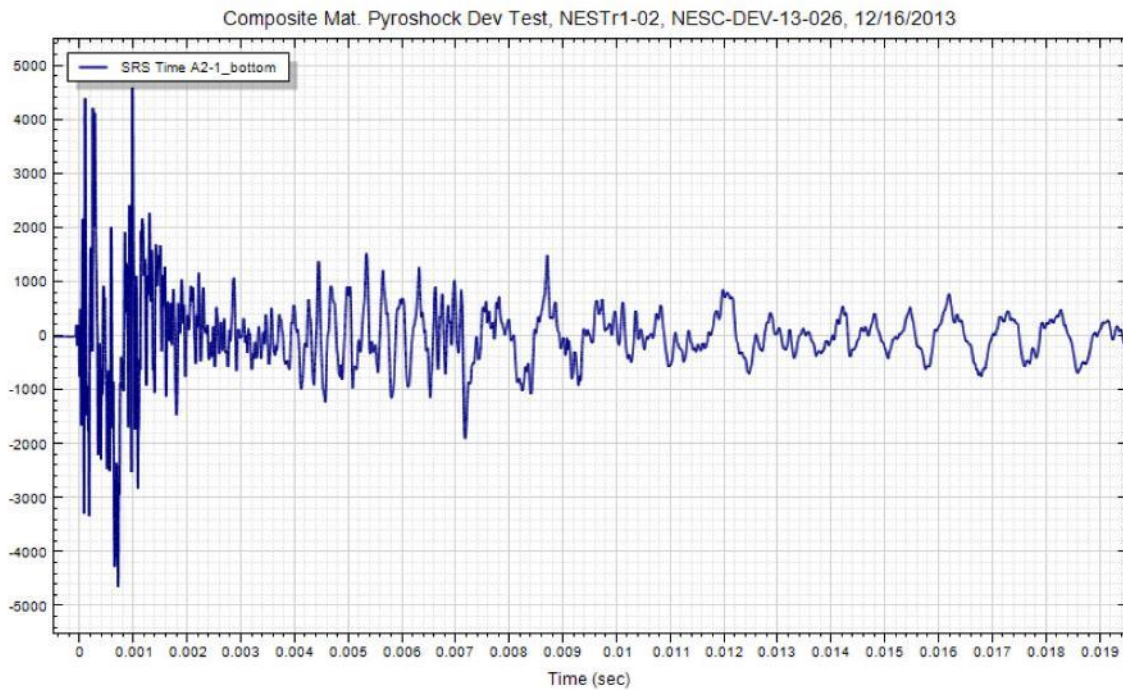
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
563 of 832





# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**

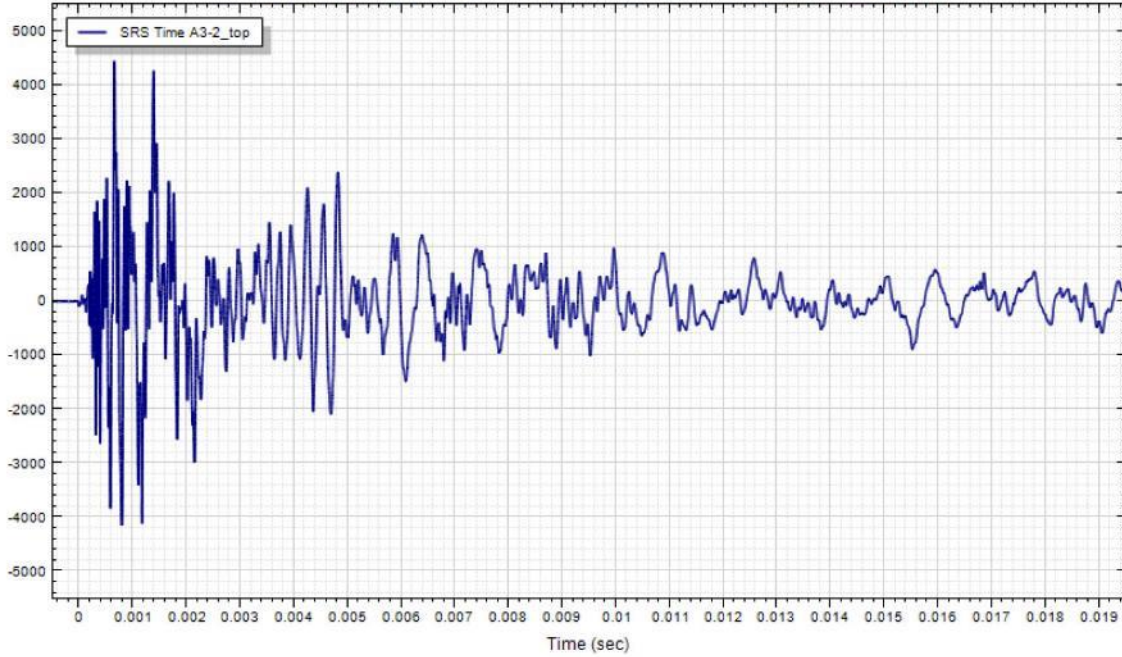
Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
564 of 832

Composite Mat. Pyroshock Dev Test, NESTr1-02, NESC-DEV-13-026, 12/16/2013







# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**

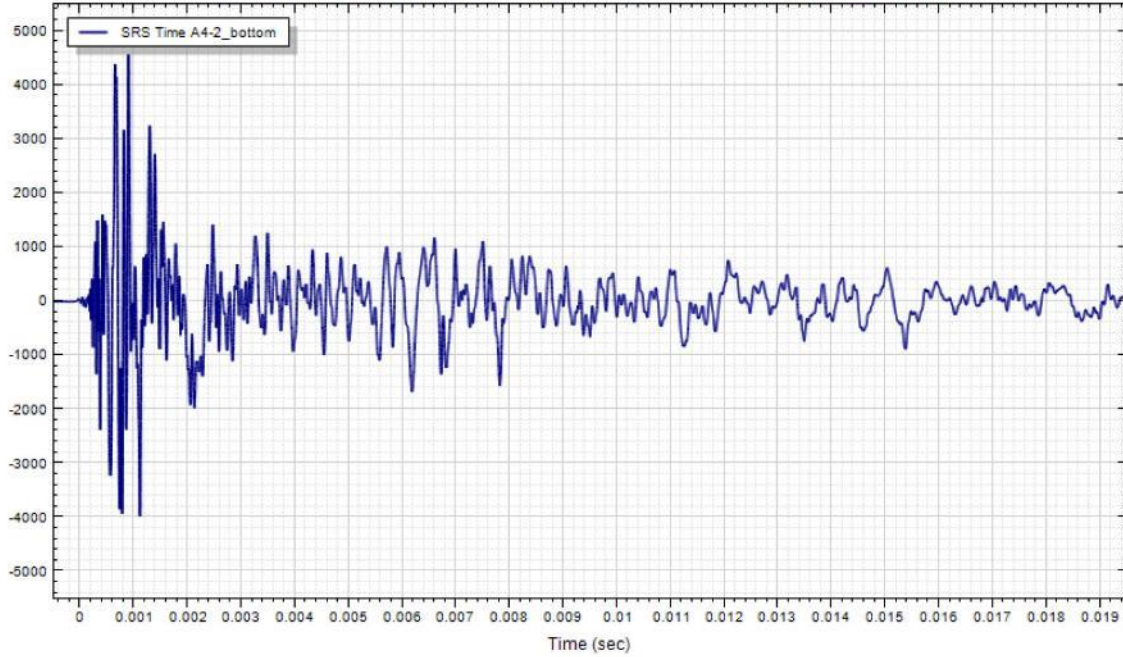
Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
565 of 832

Composite Mat. Pyroshock Dev Test, NESTr1-02, NESC-DEV-13-026, 12/16/2013





# NASA Engineering and Safety Center Technical Assessment Report

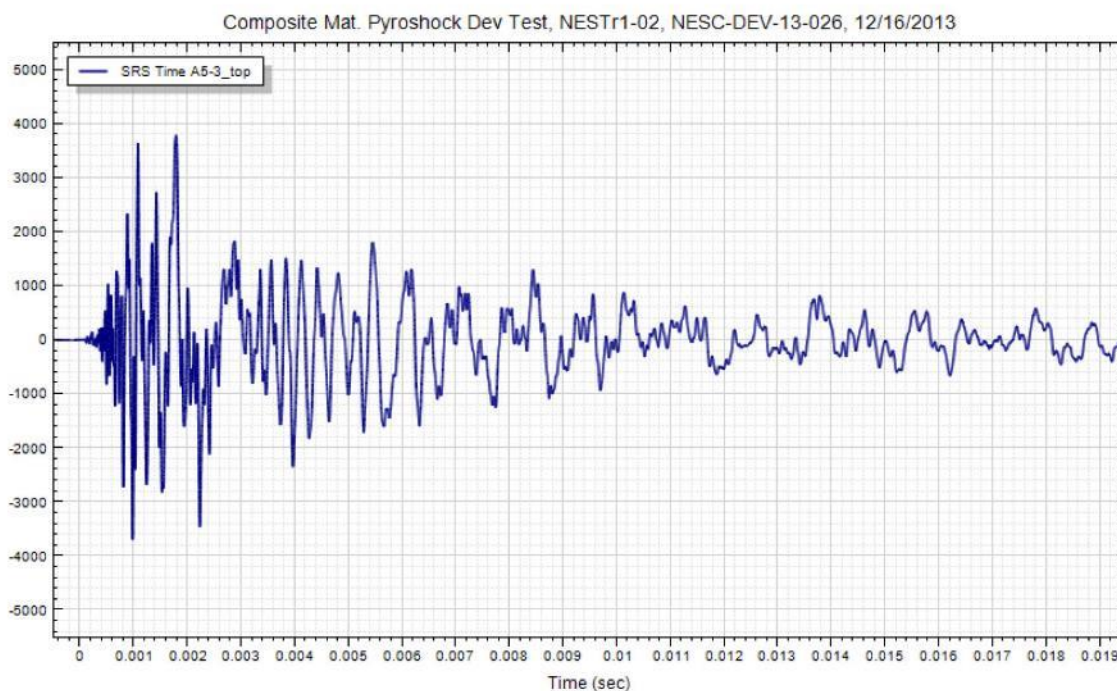
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
566 of 832





# NASA Engineering and Safety Center Technical Assessment Report

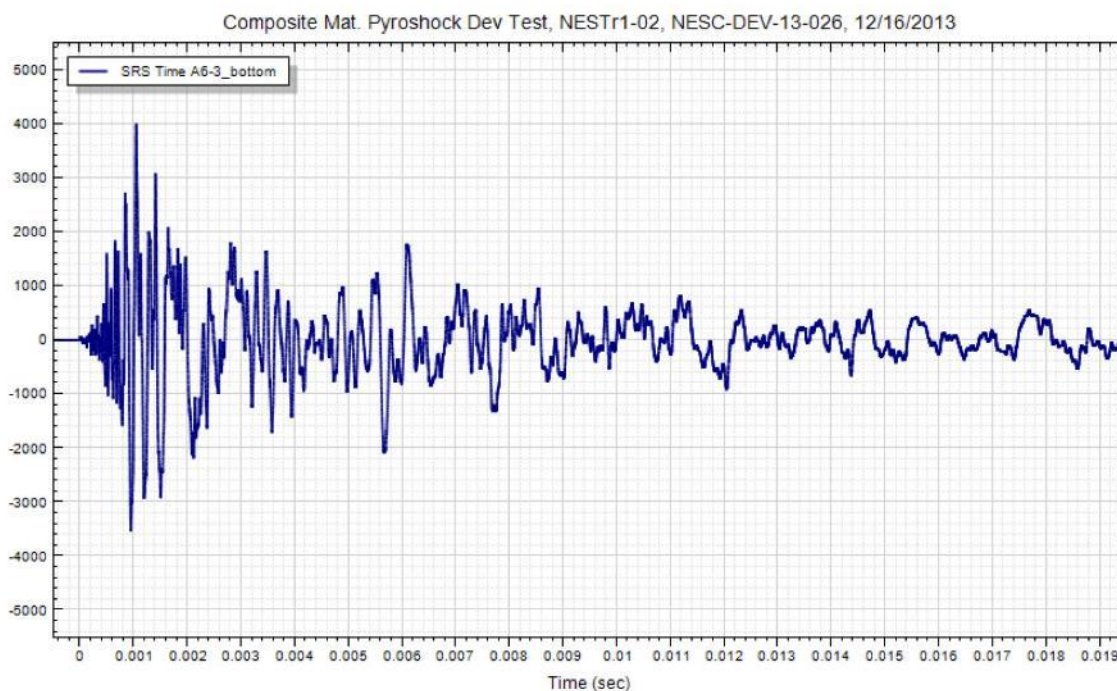
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
567 of 832





# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**

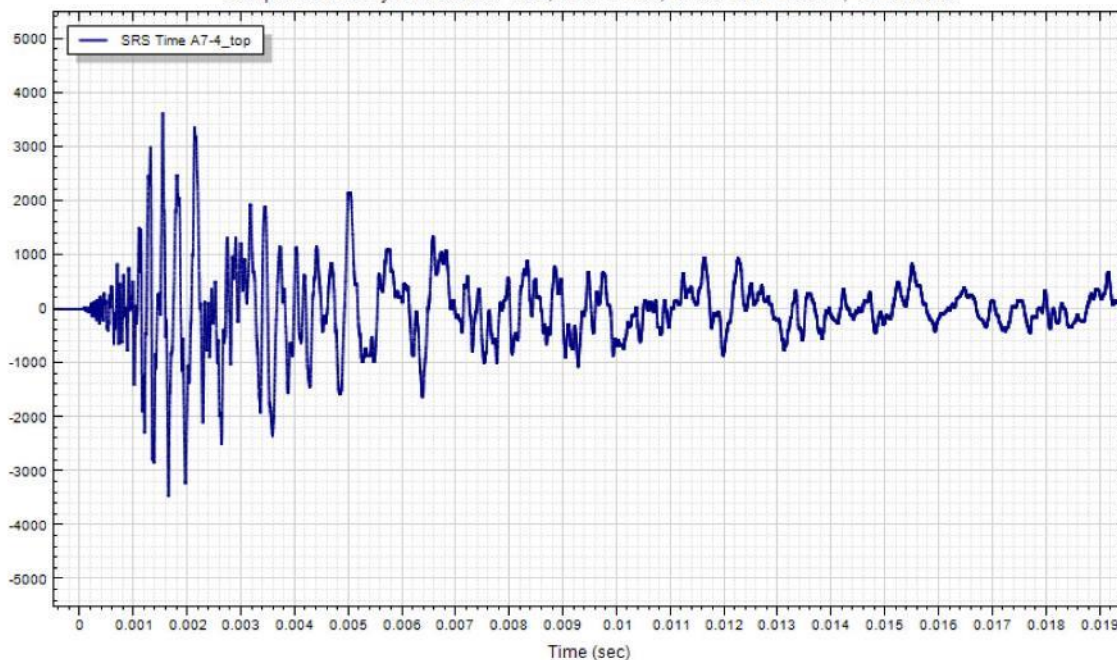
Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
568 of 832

Composite Mat. Pyroshock Dev Test, NESTr1-02, NESC-DEV-13-026, 12/16/2013





# NASA Engineering and Safety Center Technical Assessment Report

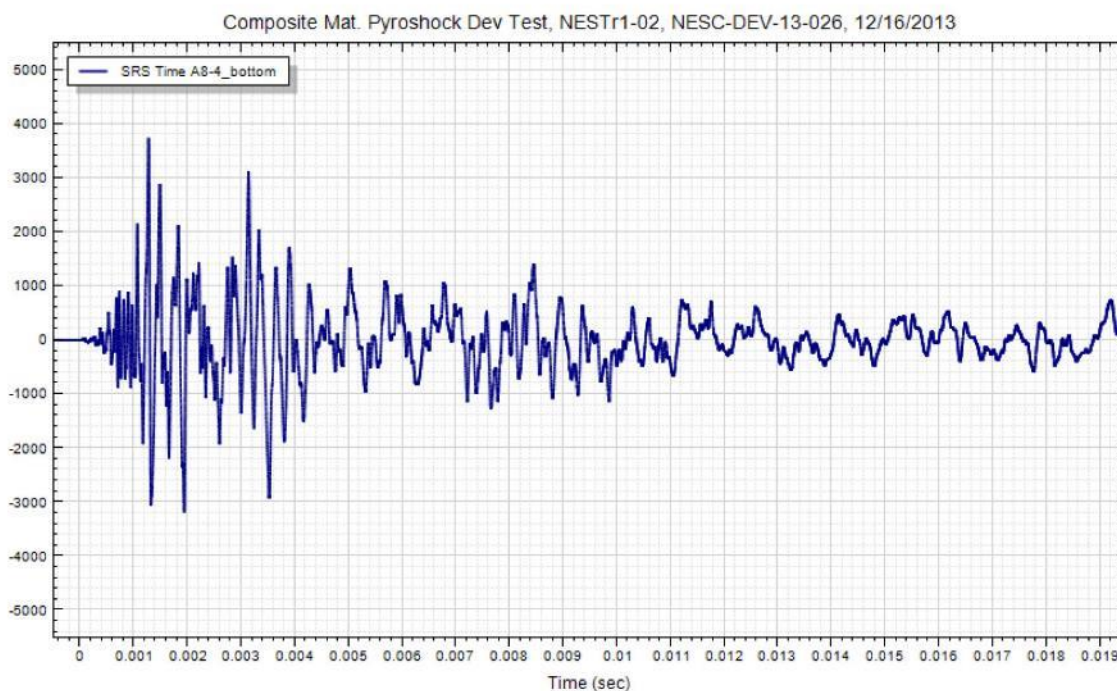
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
569 of 832





# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**

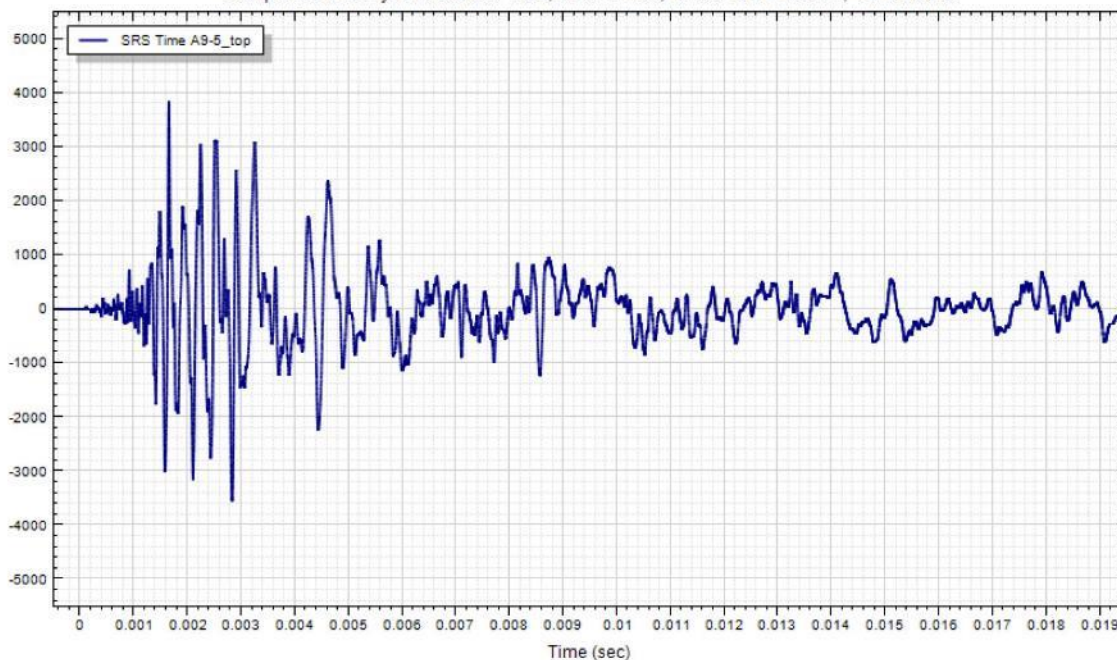
Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
570 of 832

Composite Mat. Pyroshock Dev Test, NESTr1-02, NESC-DEV-13-026, 12/16/2013





# NASA Engineering and Safety Center Technical Assessment Report

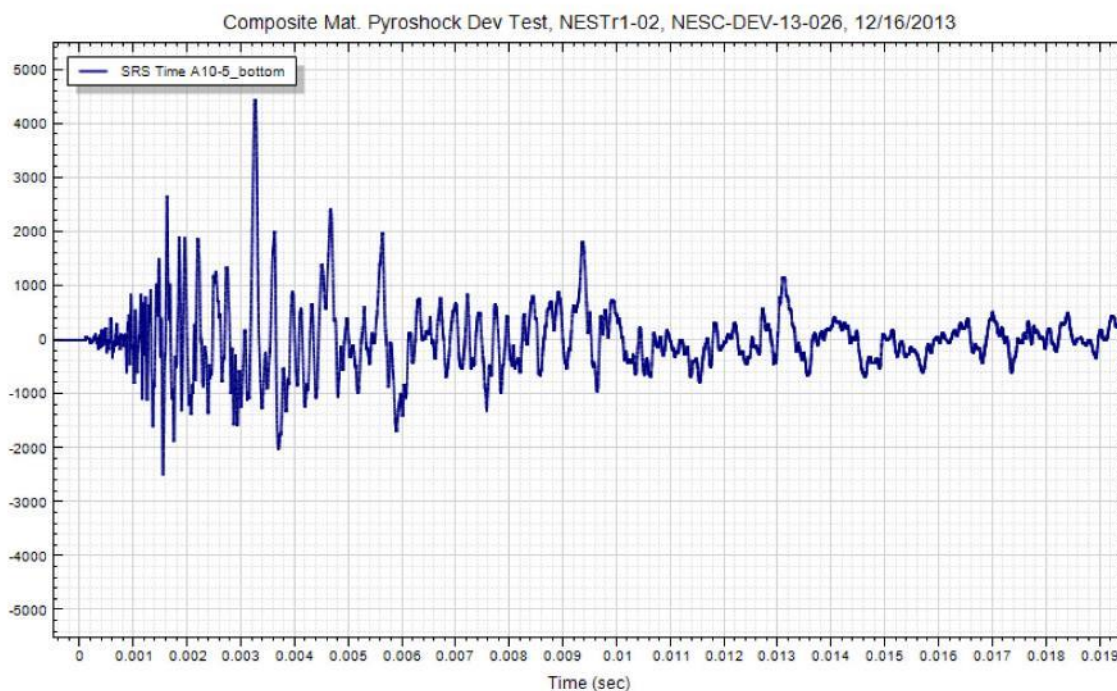
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
571 of 832





# NASA Engineering and Safety Center Technical Assessment Report

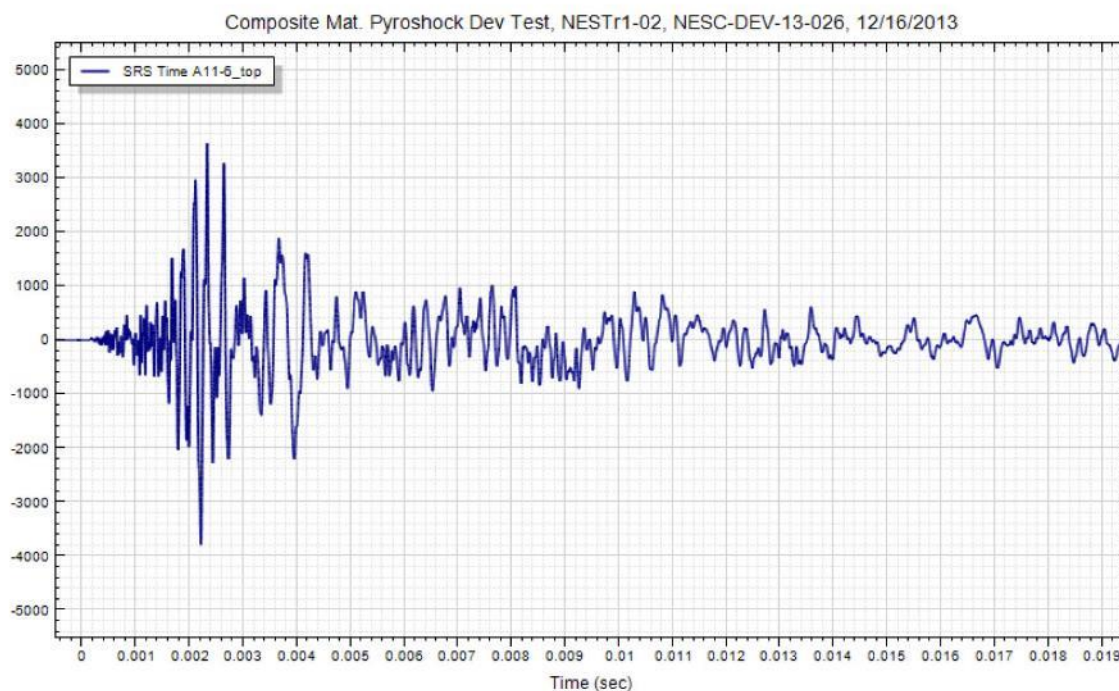
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
572 of 832







# NASA Engineering and Safety Center Technical Assessment Report

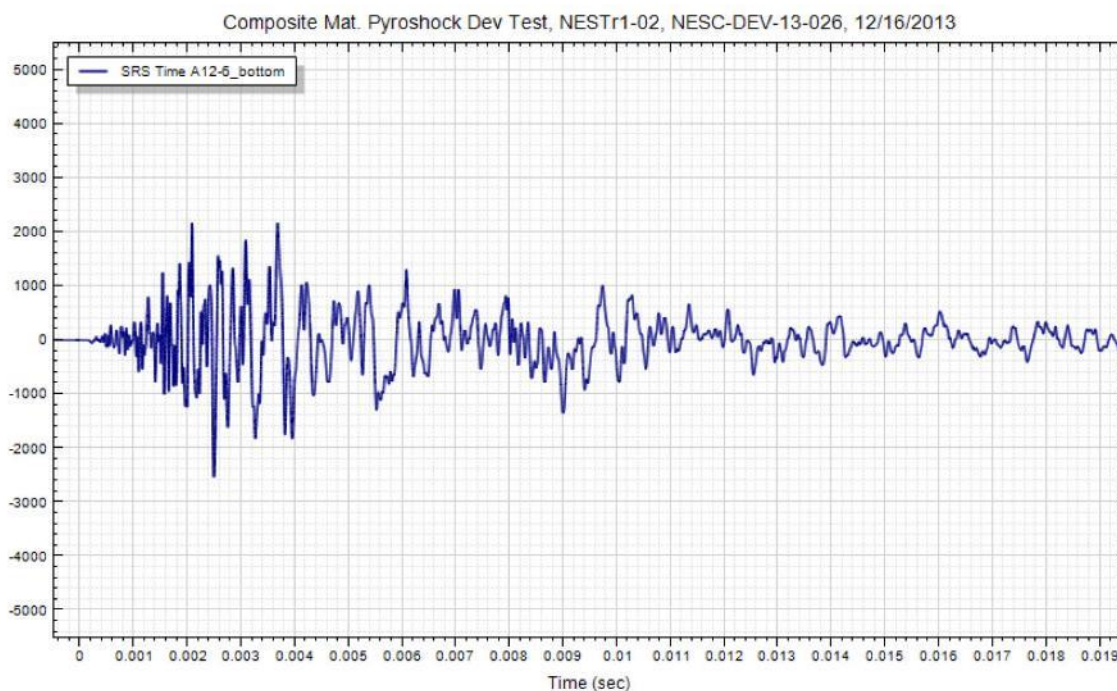
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
573 of 832





# NASA Engineering and Safety Center Technical Assessment Report

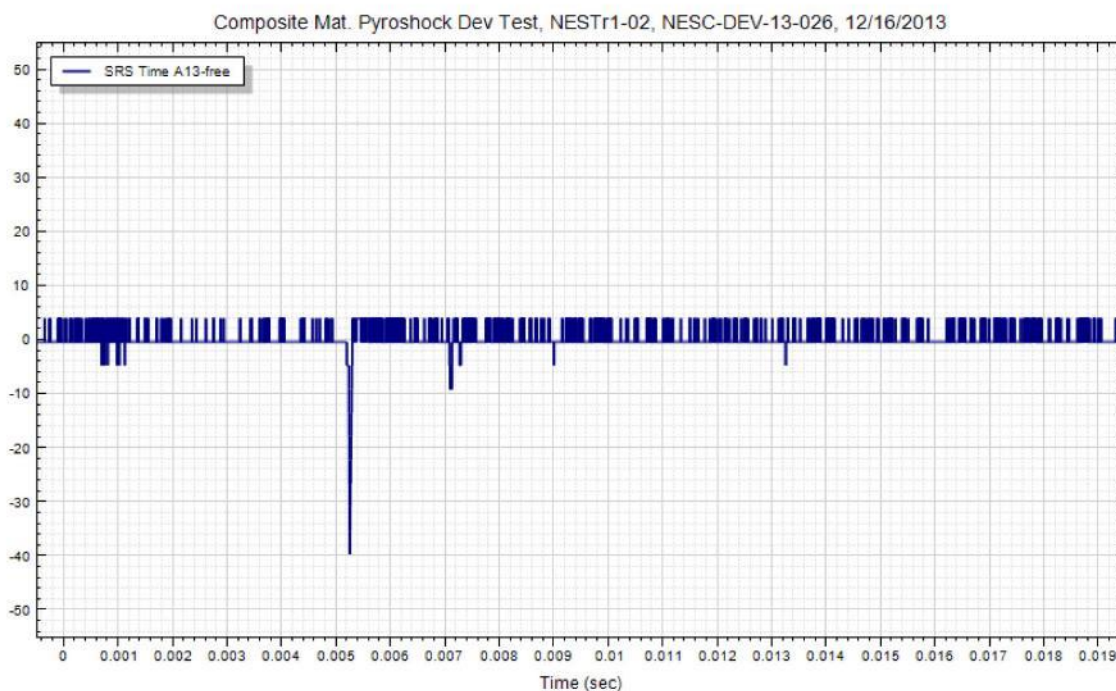
Document #:  
**NESC-RP-  
12-00783**


Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
574 of 832



	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 575 of 832	

**NESC-DEV-13-037**  
**Composite Materials**  
**Shock Test**  
  
**Test #7 Accelerometer Data**  
**Panel 0346A026**



# NASA Engineering and Safety Center Technical Assessment Report

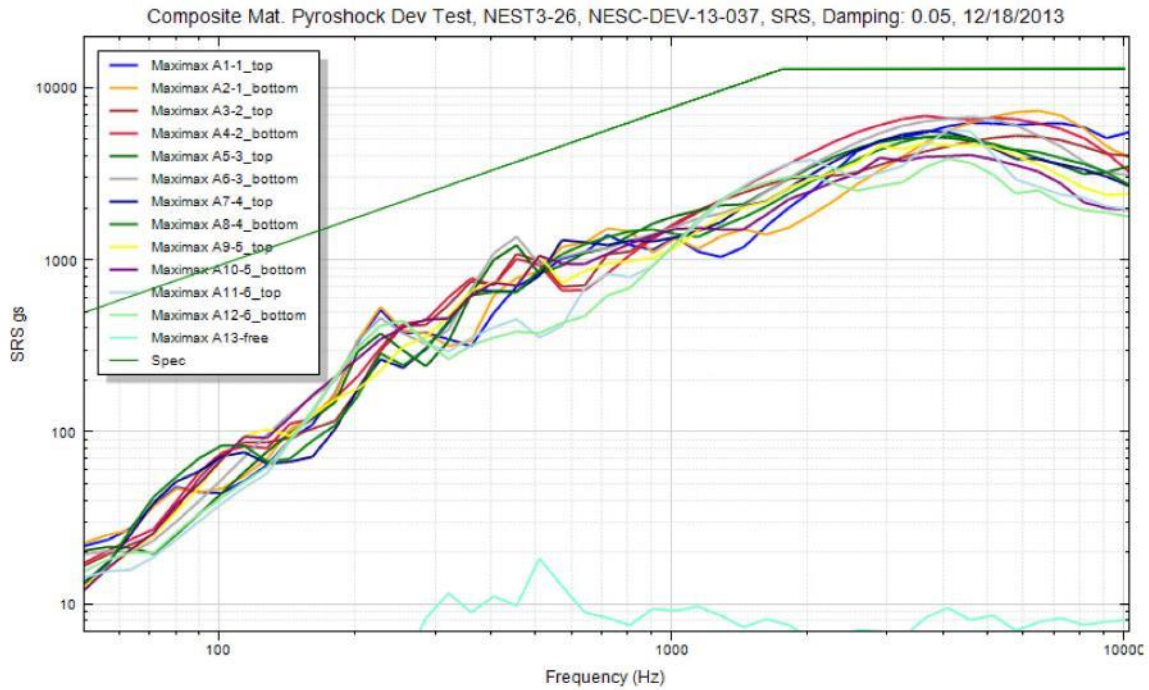
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
576 of 832





# NASA Engineering and Safety Center Technical Assessment Report

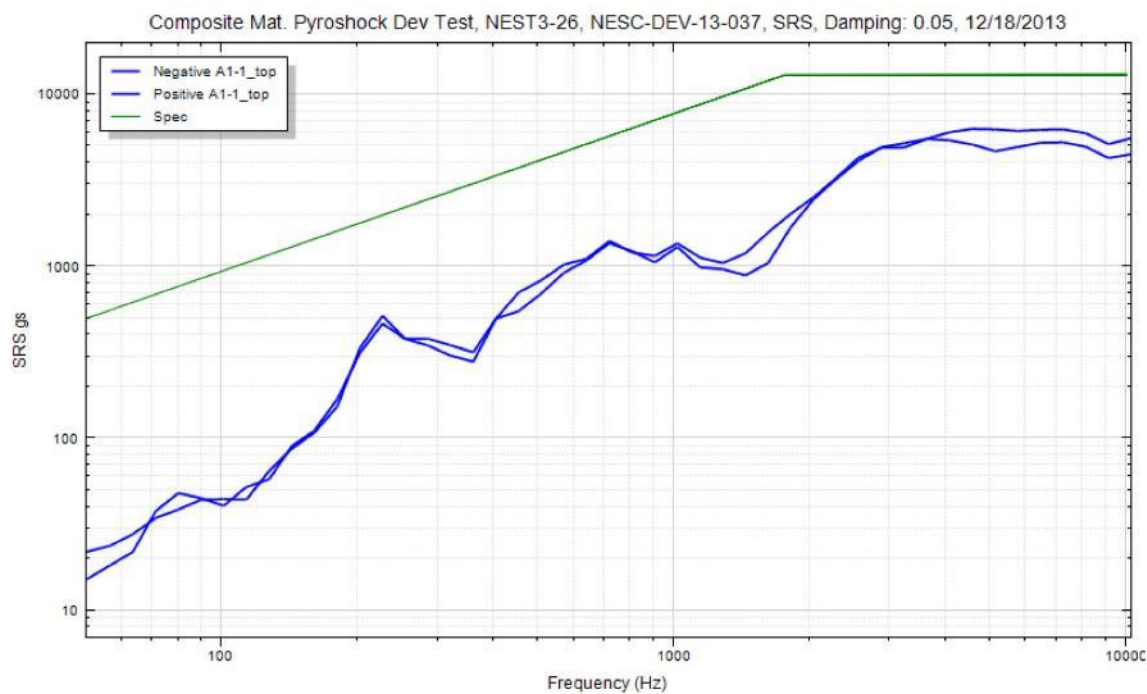
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
577 of 832





# NASA Engineering and Safety Center Technical Assessment Report

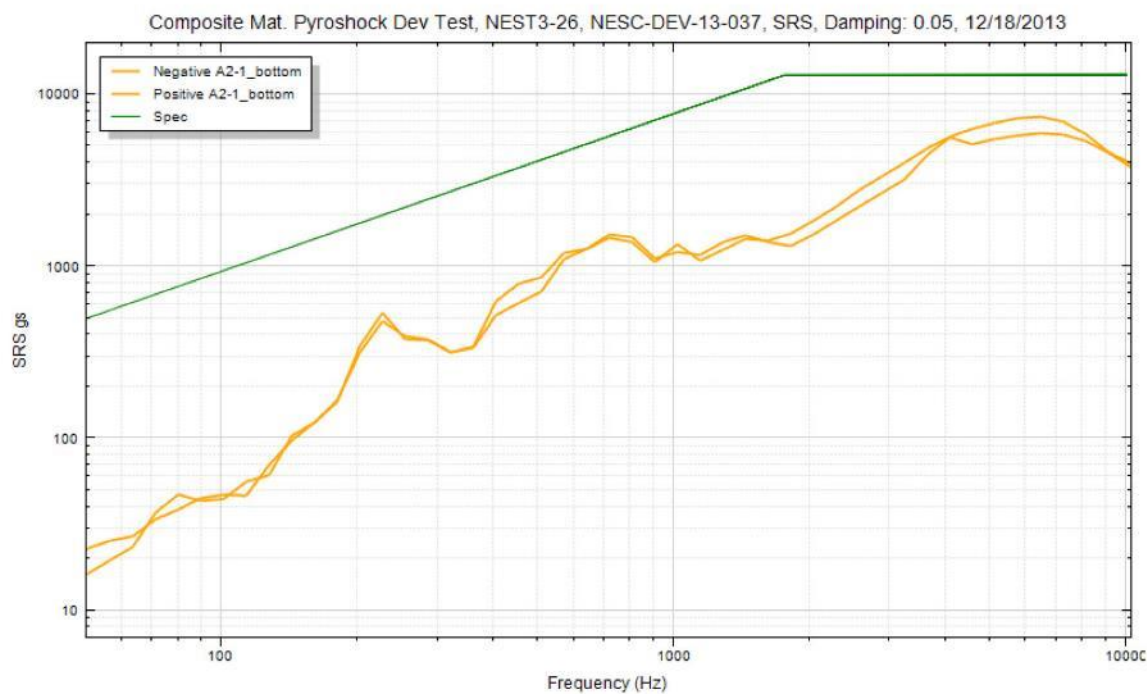
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
578 of 832





# NASA Engineering and Safety Center Technical Assessment Report

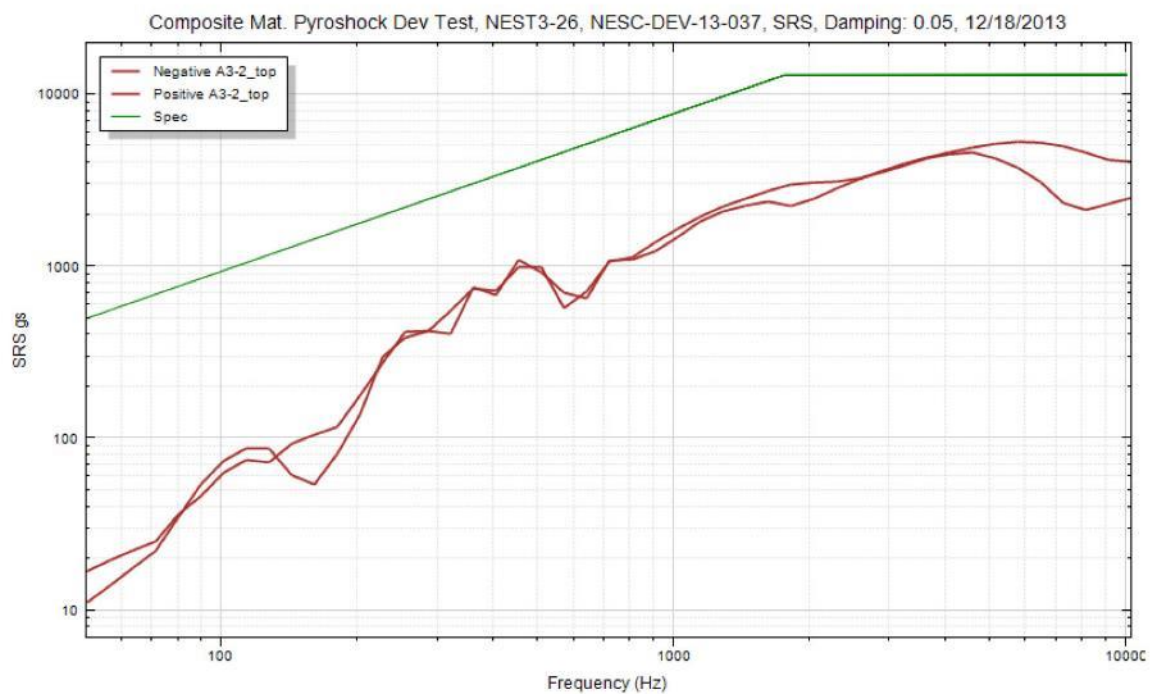
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
579 of 832





# NASA Engineering and Safety Center Technical Assessment Report

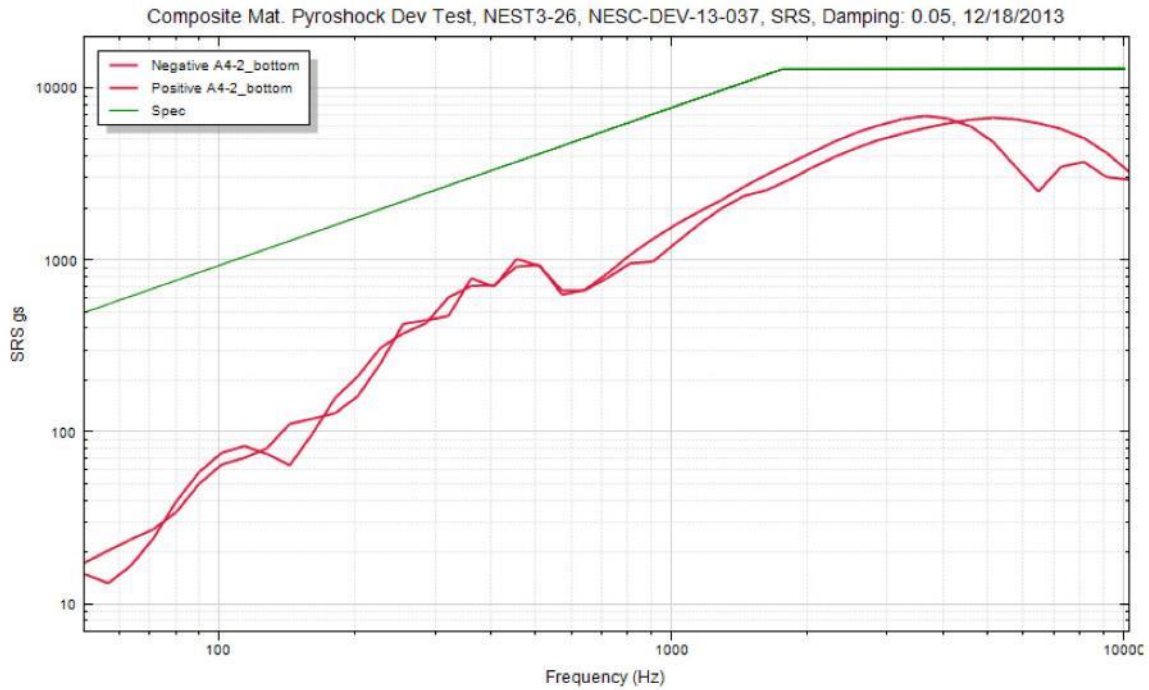
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
580 of 832







# NASA Engineering and Safety Center Technical Assessment Report

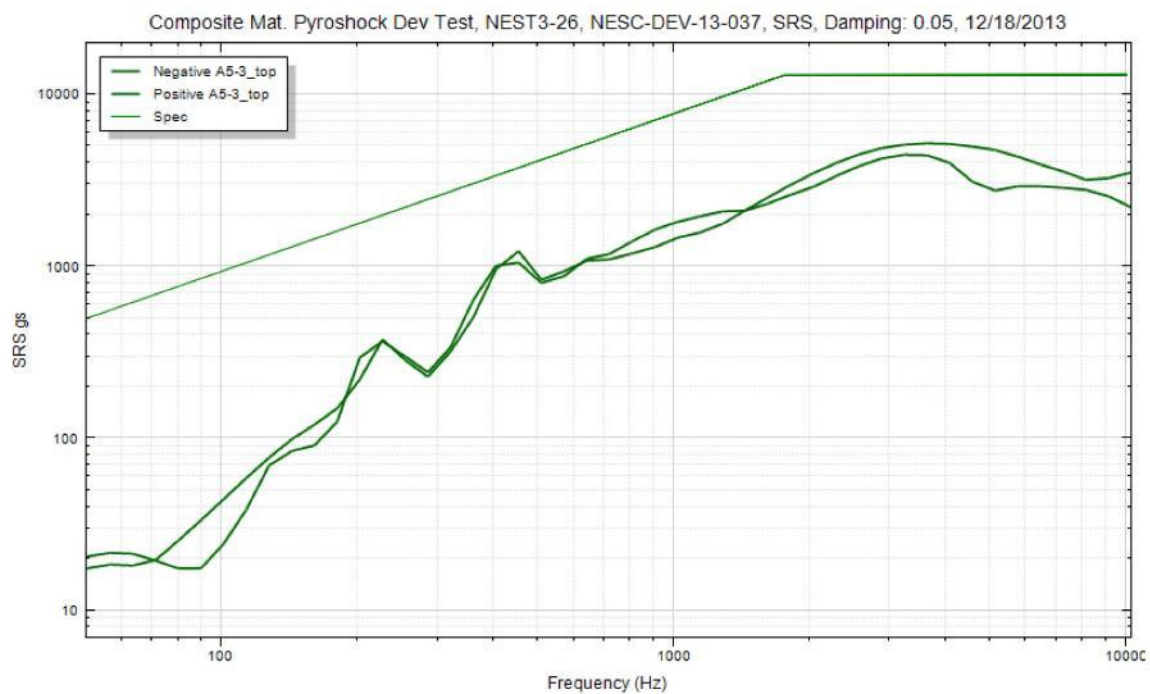
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
581 of 832





# NASA Engineering and Safety Center Technical Assessment Report

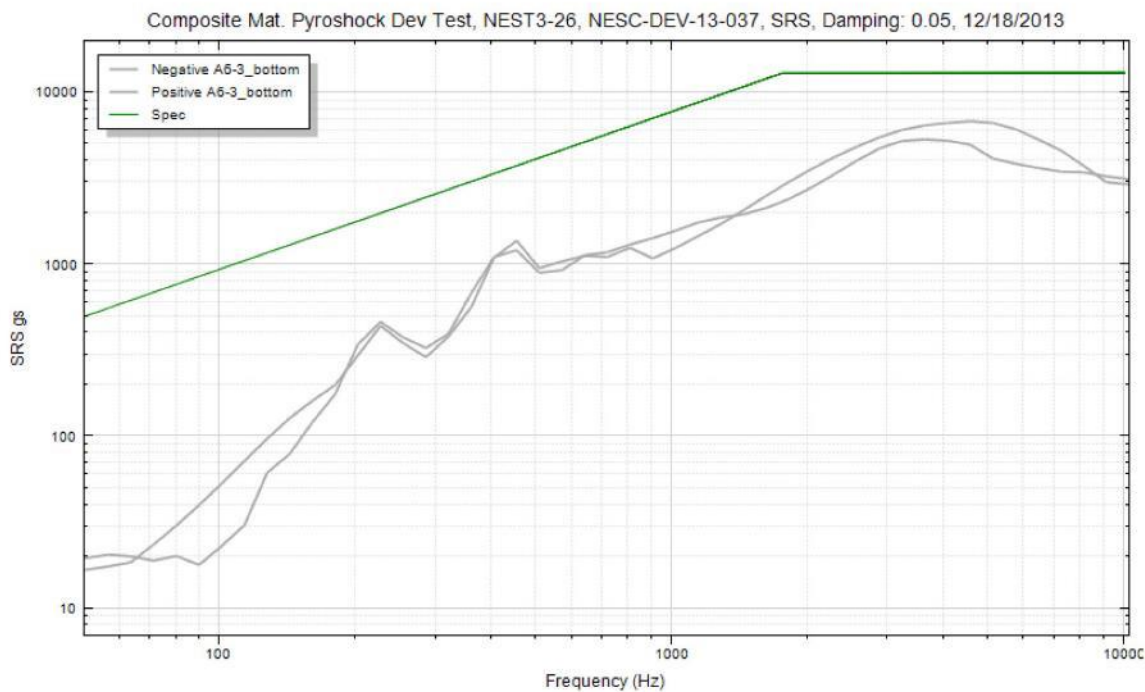
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
582 of 832





# NASA Engineering and Safety Center Technical Assessment Report

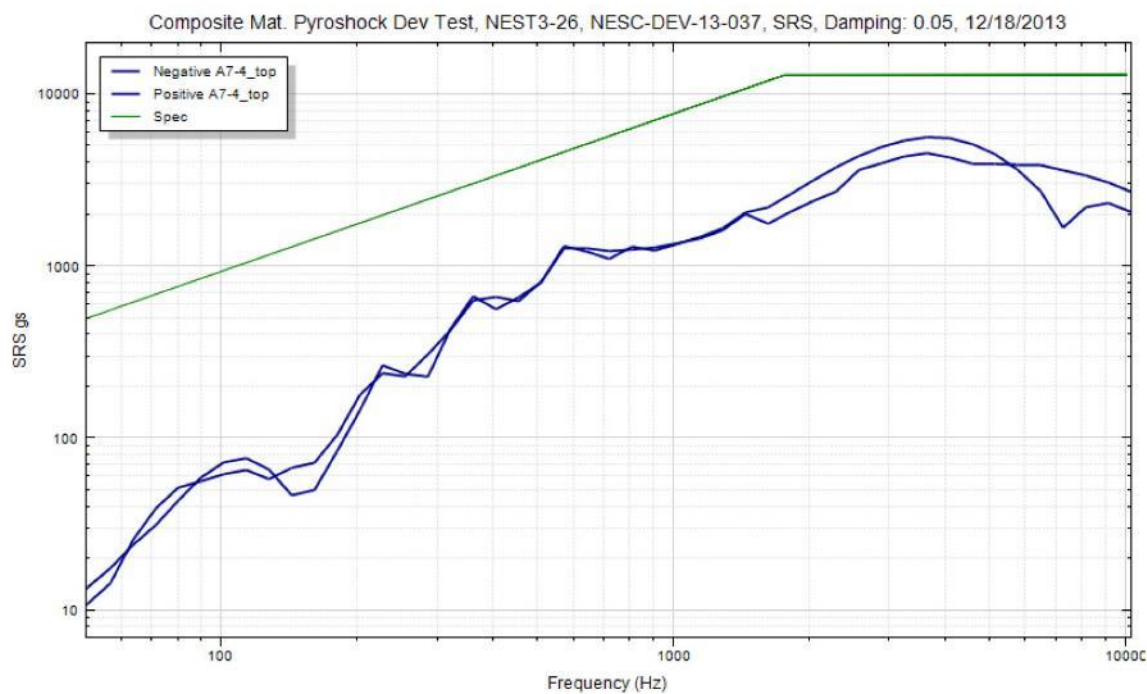
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
583 of 832





# NASA Engineering and Safety Center Technical Assessment Report

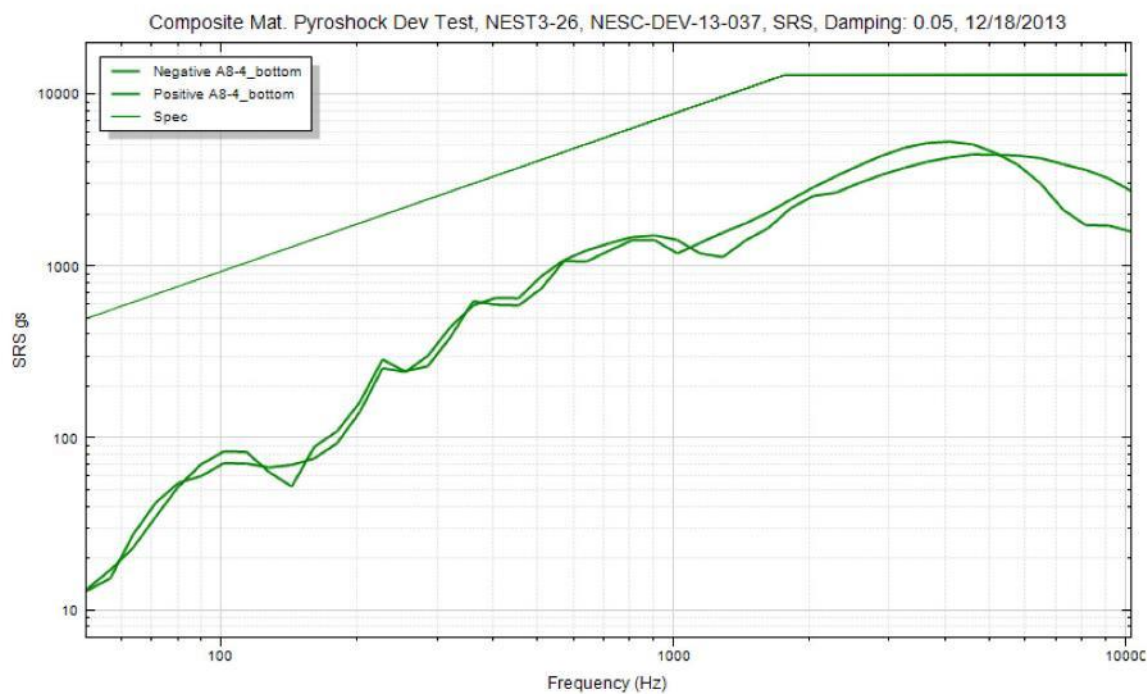
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
584 of 832





# NASA Engineering and Safety Center Technical Assessment Report

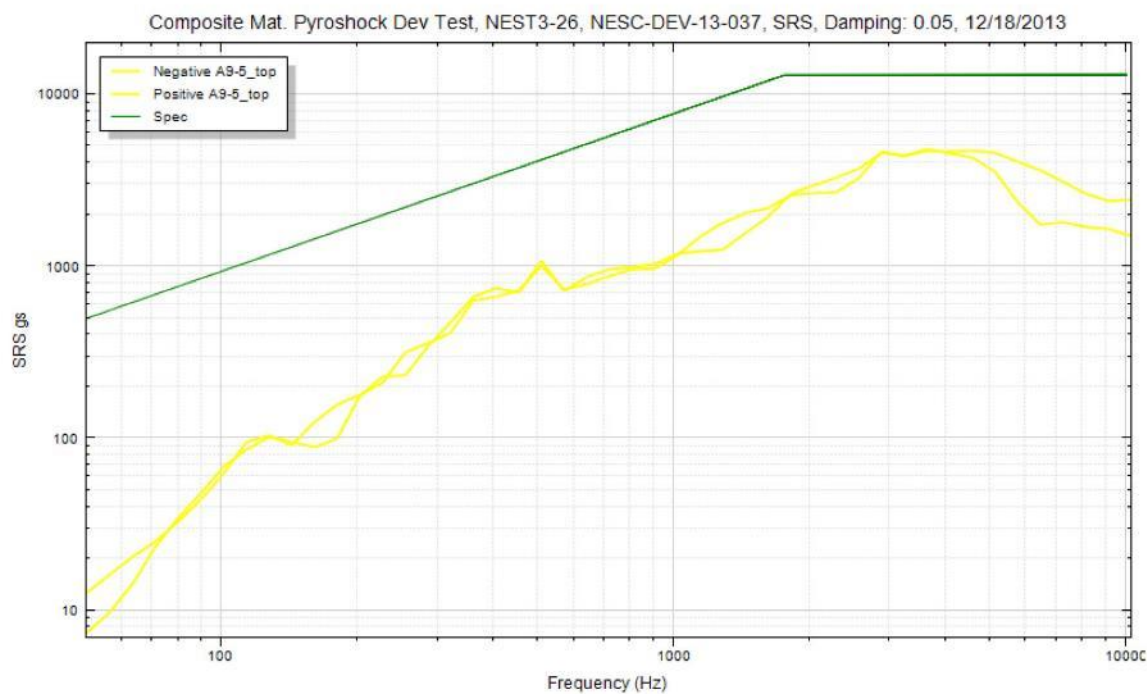
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
585 of 832





# NASA Engineering and Safety Center Technical Assessment Report

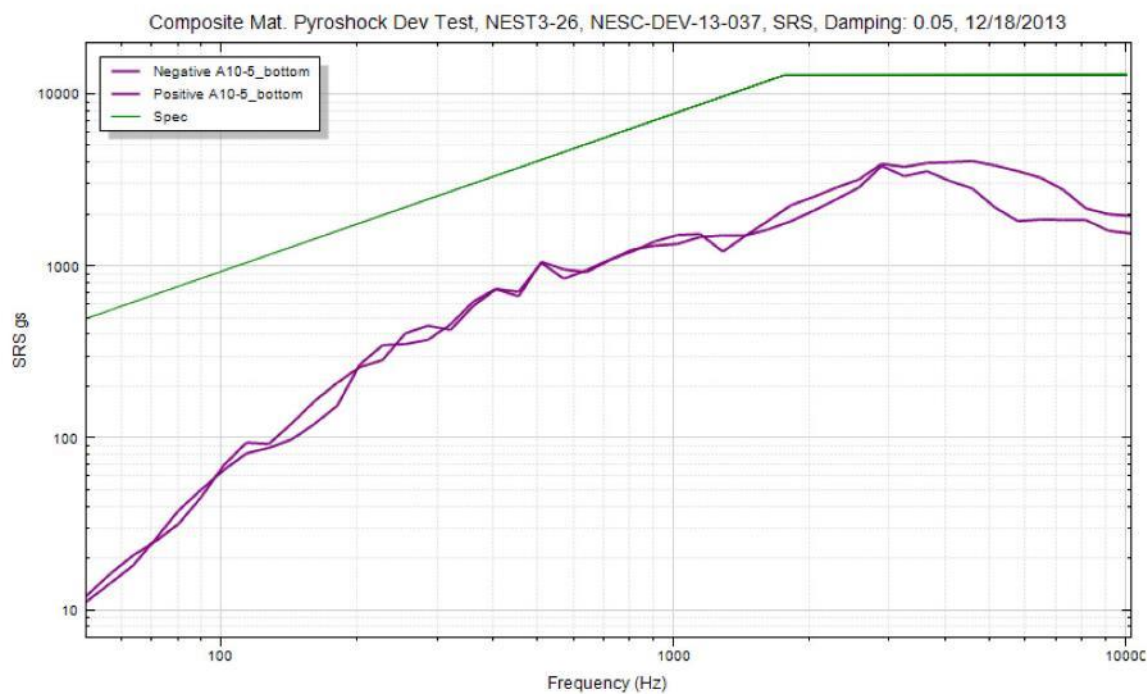
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
586 of 832





# NASA Engineering and Safety Center Technical Assessment Report

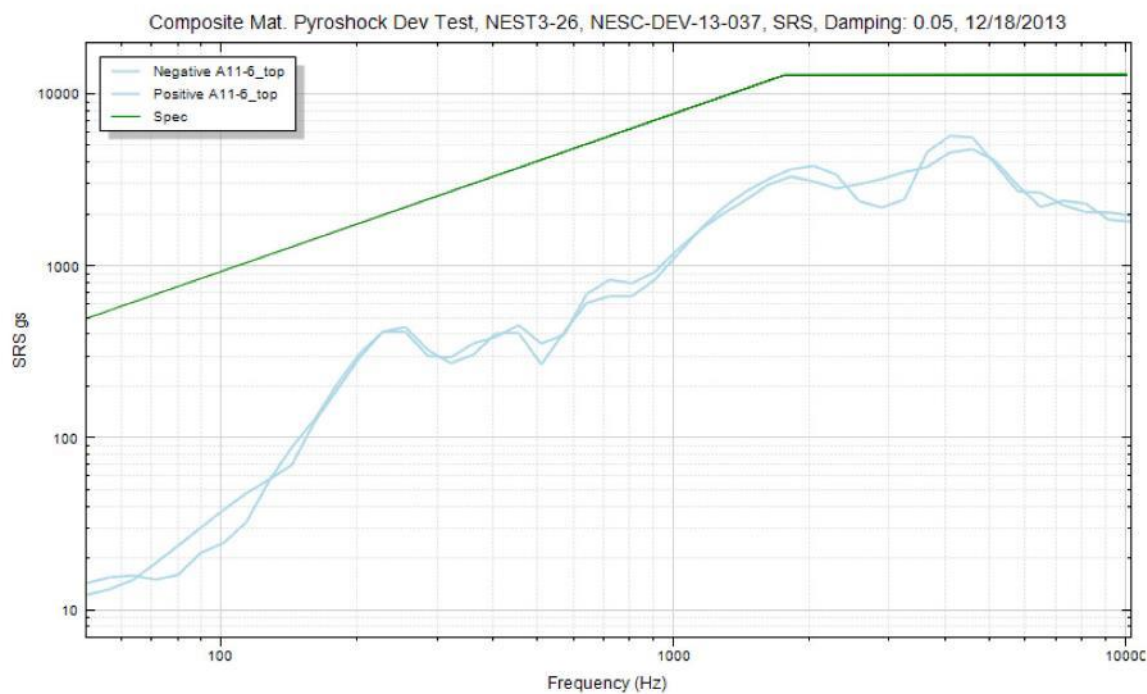
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
587 of 832





# NASA Engineering and Safety Center Technical Assessment Report

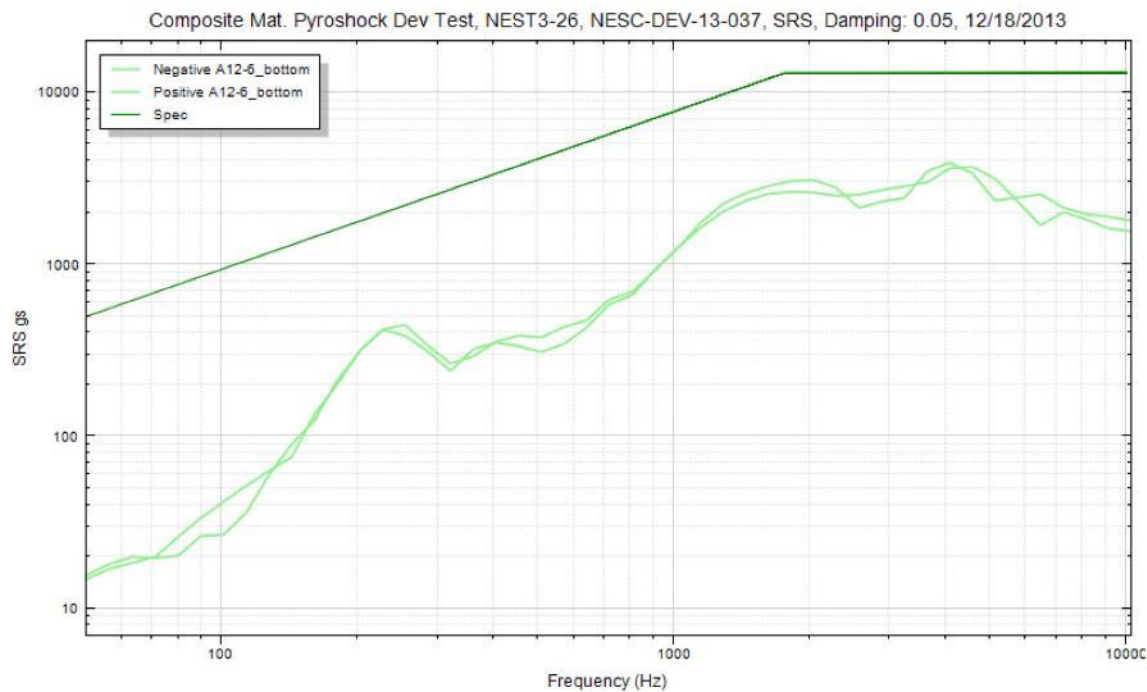
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
588 of 832







# NASA Engineering and Safety Center Technical Assessment Report

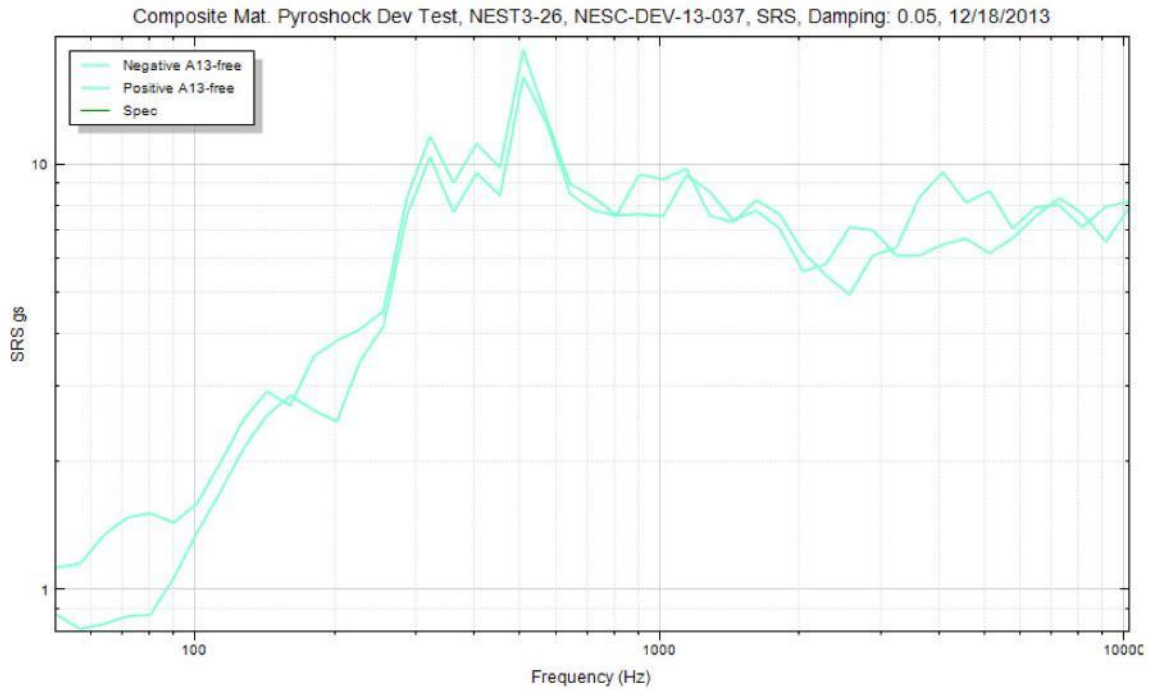
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
589 of 832





# NASA Engineering and Safety Center Technical Assessment Report

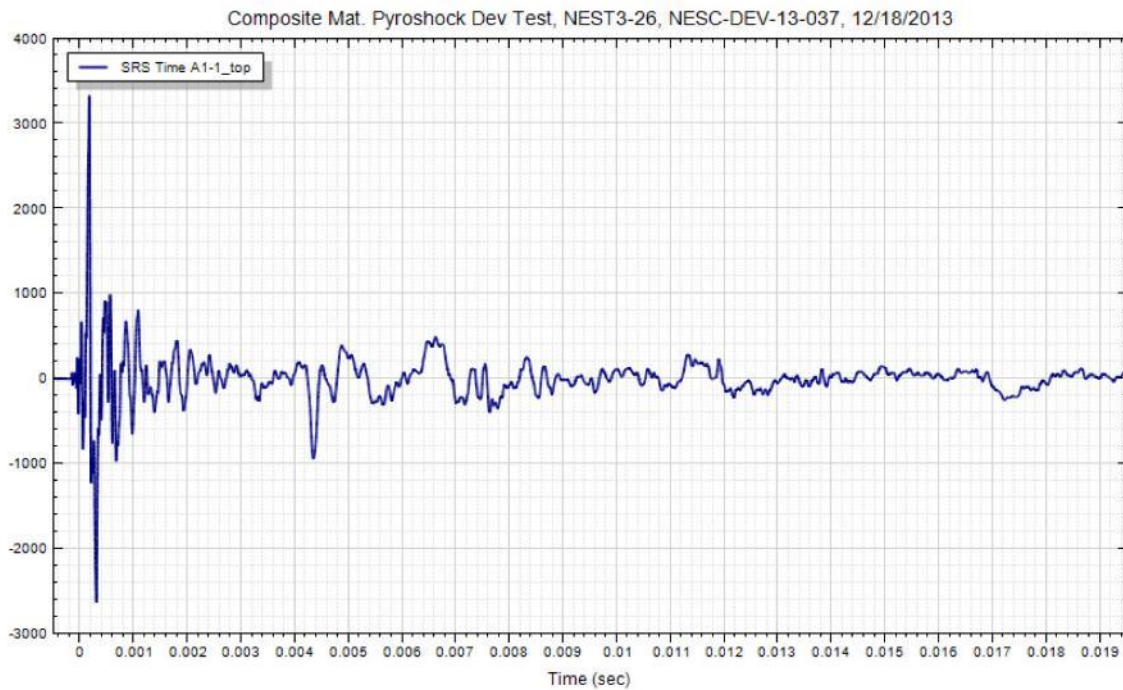
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
590 of 832





# NASA Engineering and Safety Center Technical Assessment Report

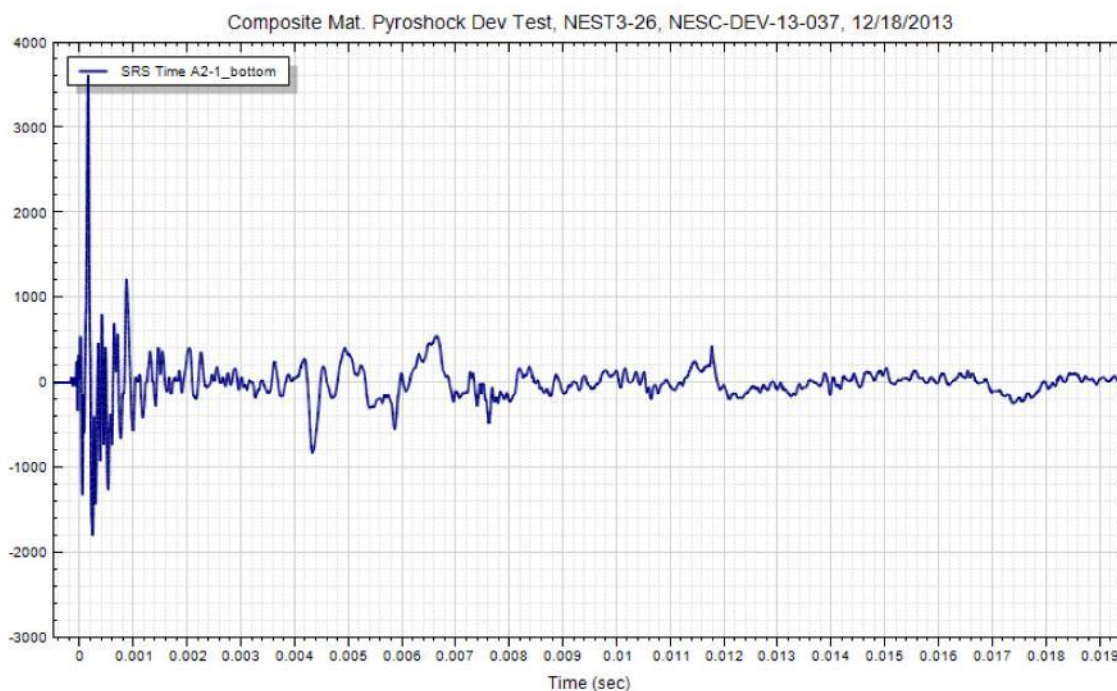
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
591 of 832





# NASA Engineering and Safety Center Technical Assessment Report

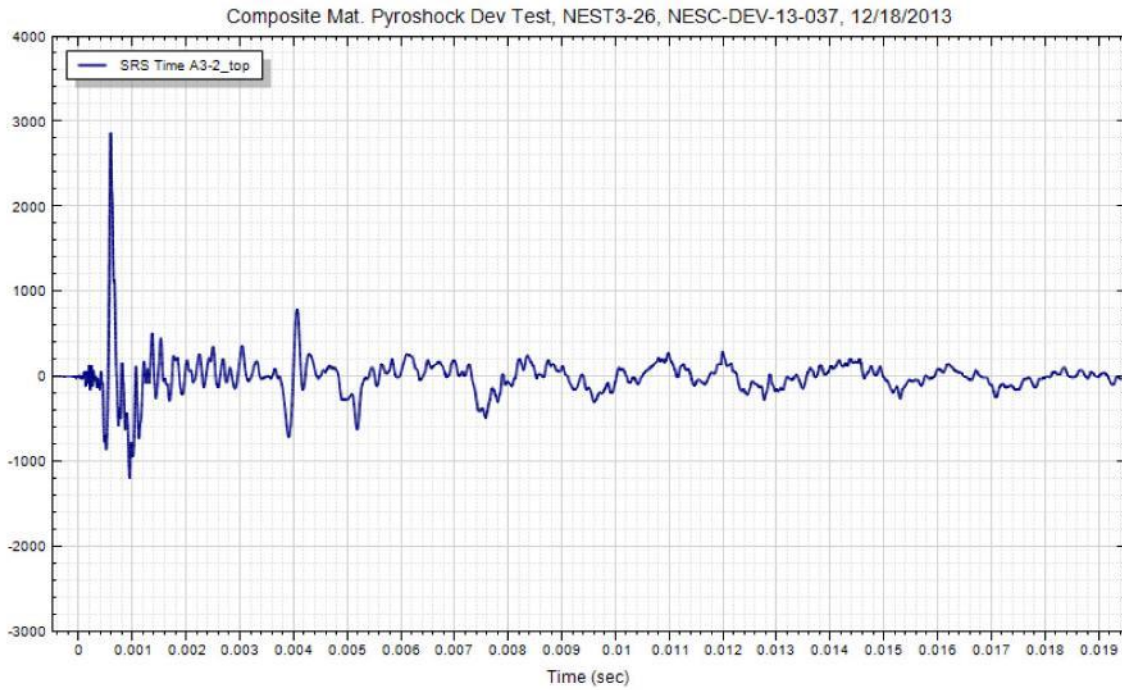
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
592 of 832





# NASA Engineering and Safety Center Technical Assessment Report

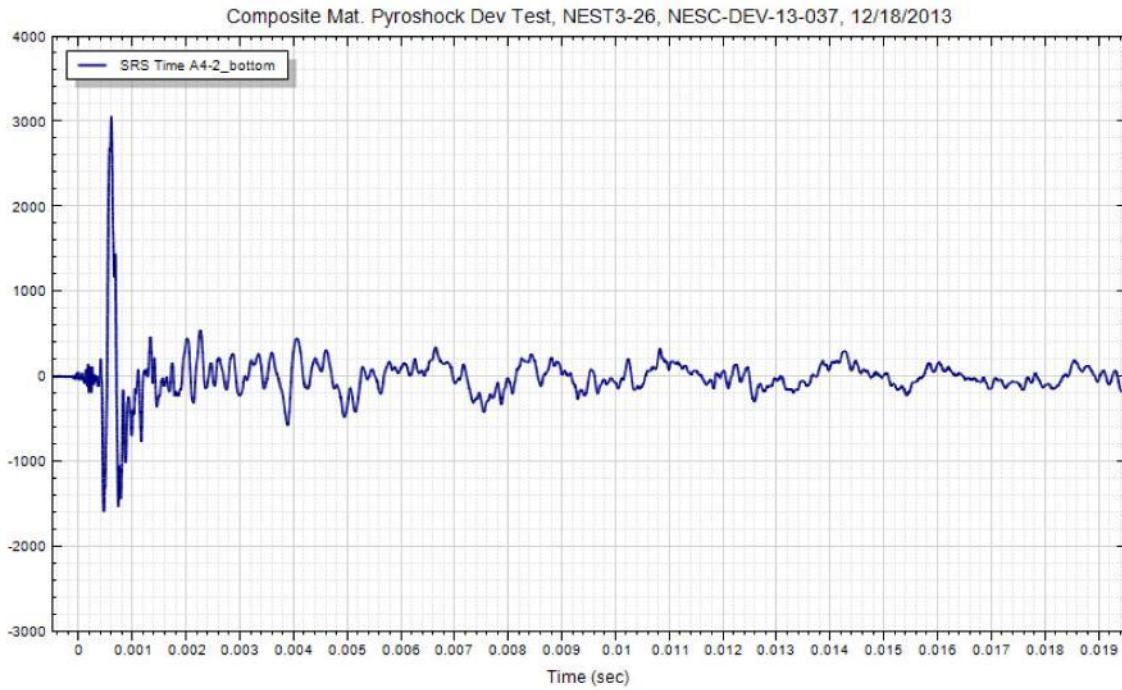
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
593 of 832





# NASA Engineering and Safety Center Technical Assessment Report

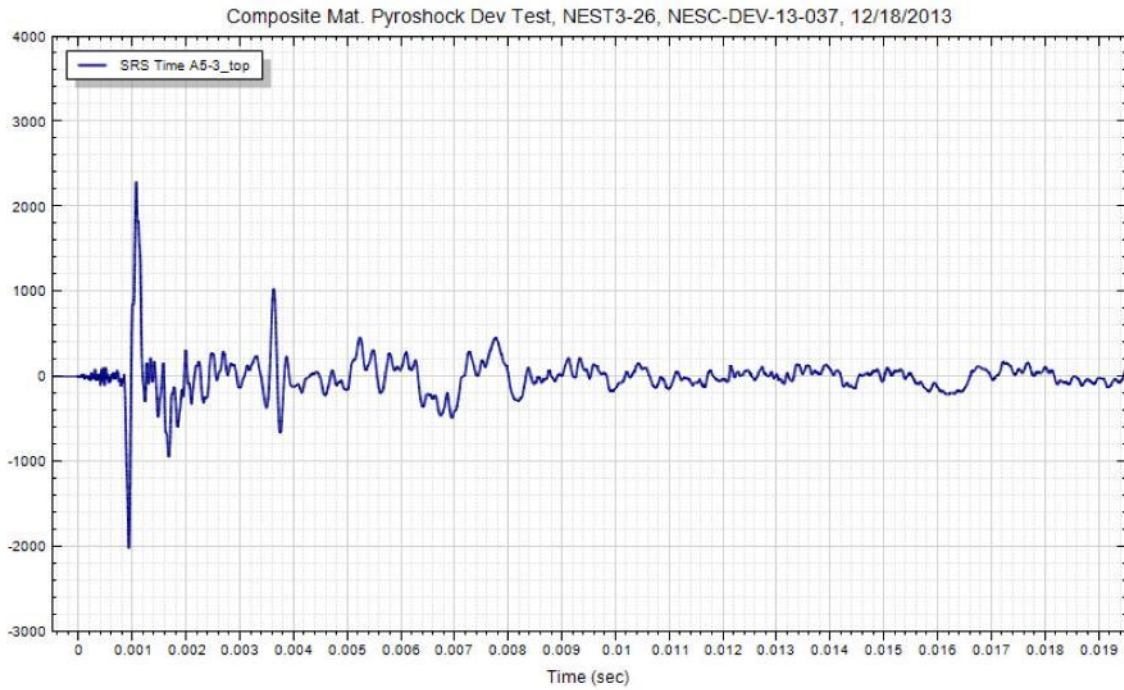
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
594 of 832





# NASA Engineering and Safety Center Technical Assessment Report

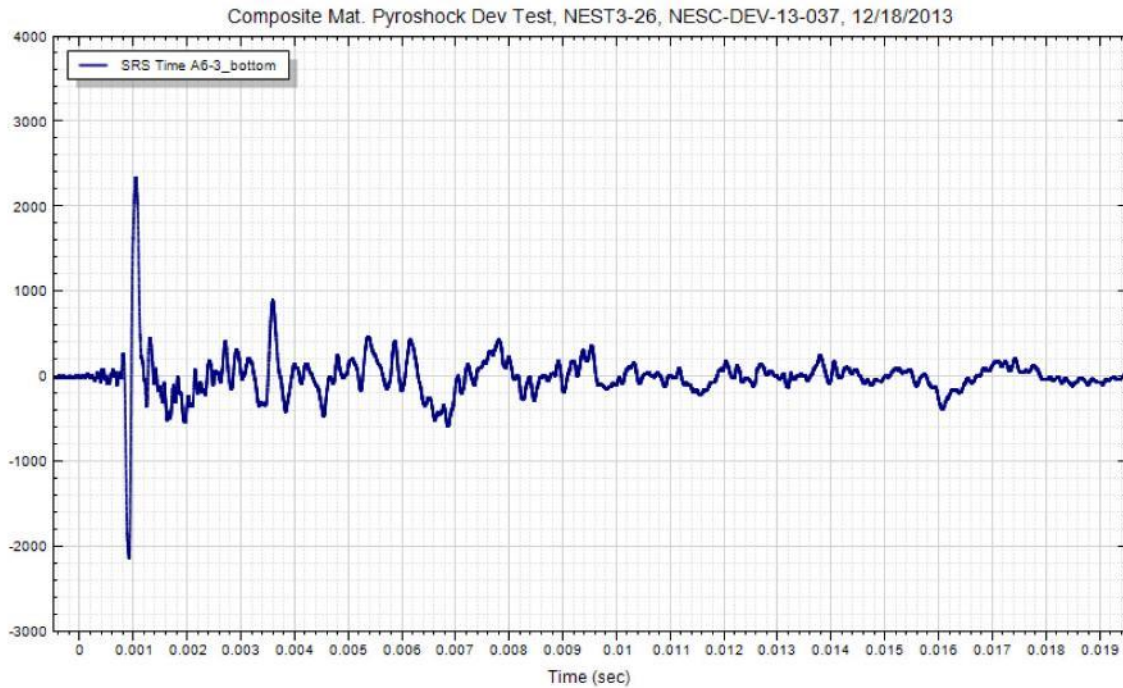
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
595 of 832





# NASA Engineering and Safety Center Technical Assessment Report

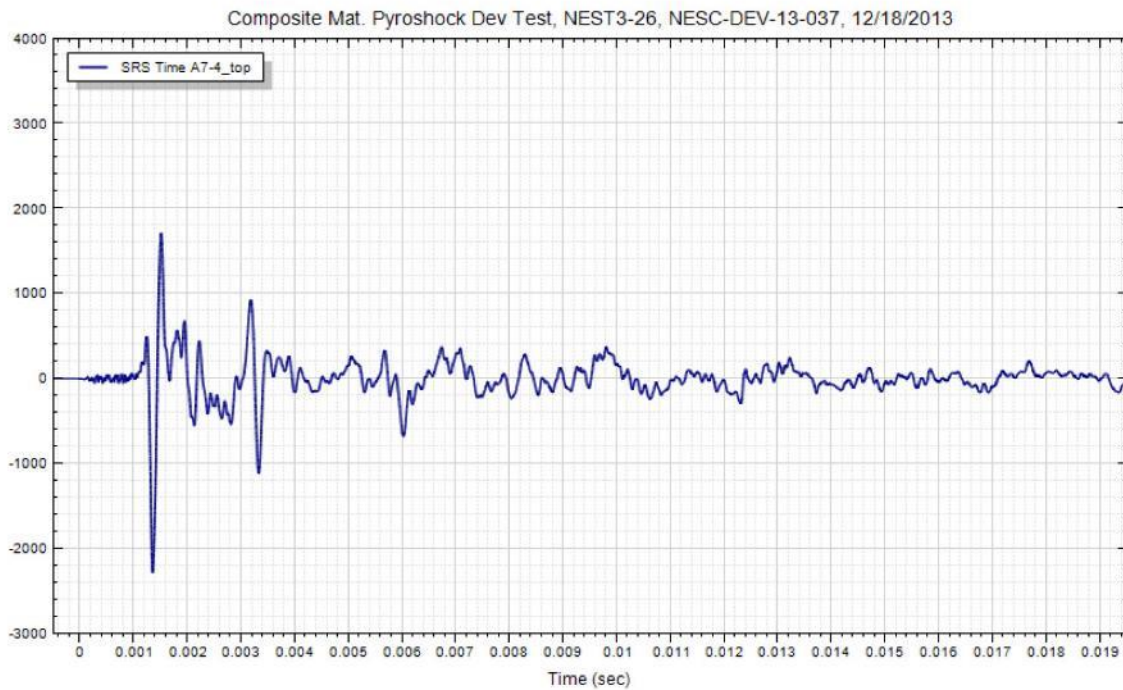
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
596 of 832







# NASA Engineering and Safety Center Technical Assessment Report

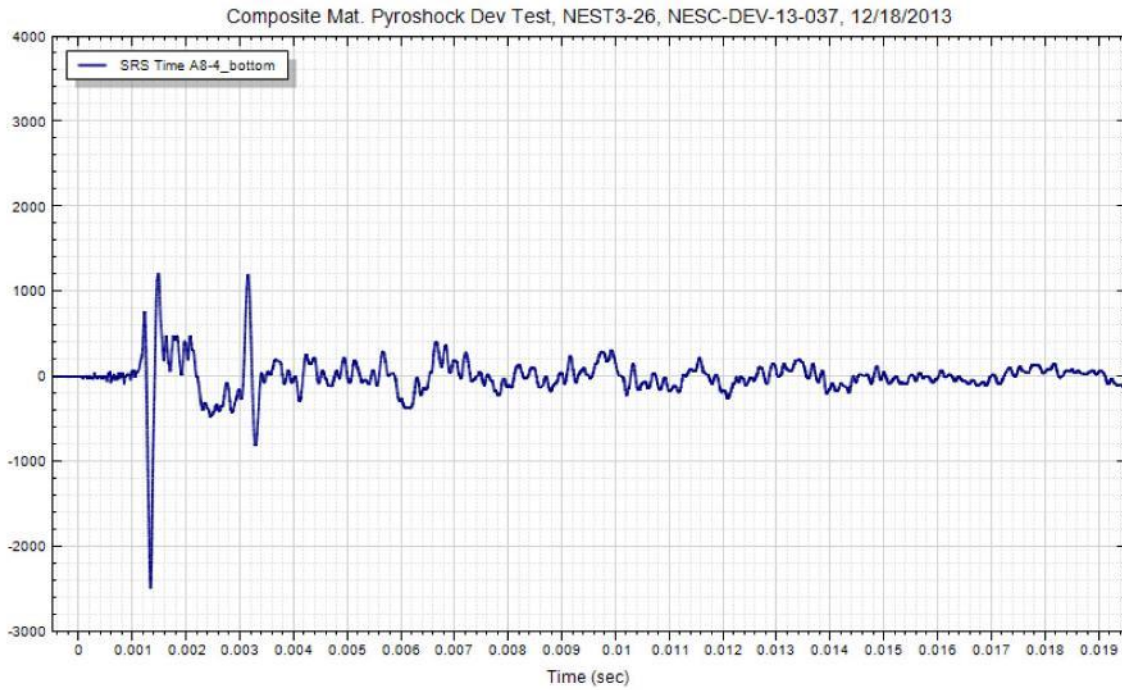
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
597 of 832





# NASA Engineering and Safety Center Technical Assessment Report

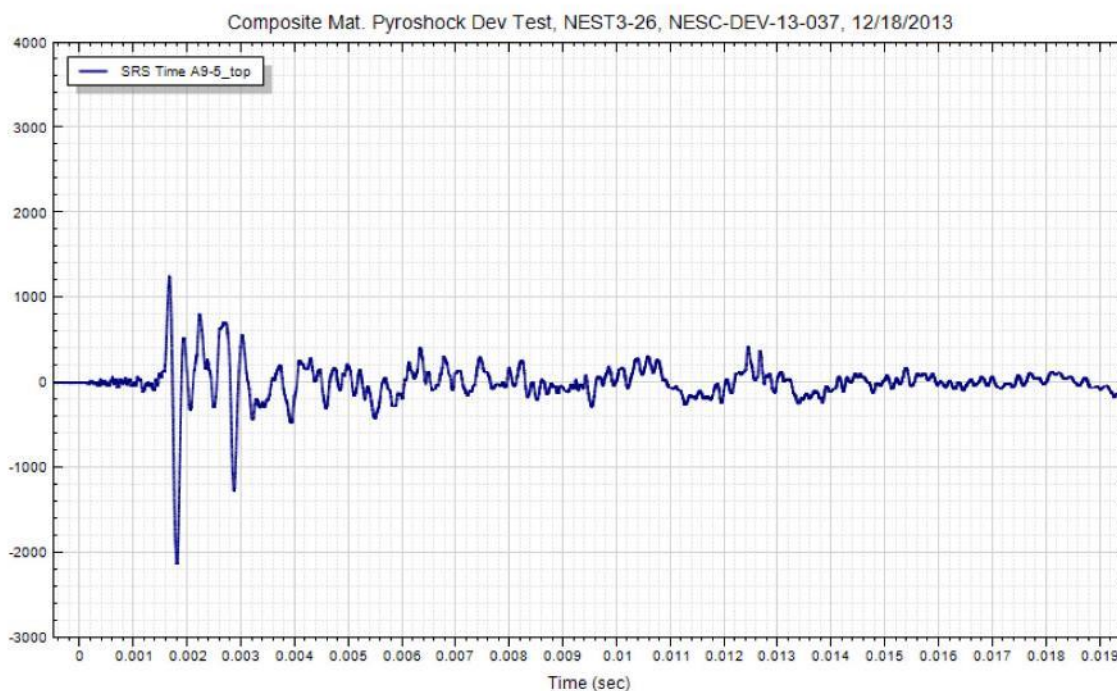
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
598 of 832





# NASA Engineering and Safety Center Technical Assessment Report

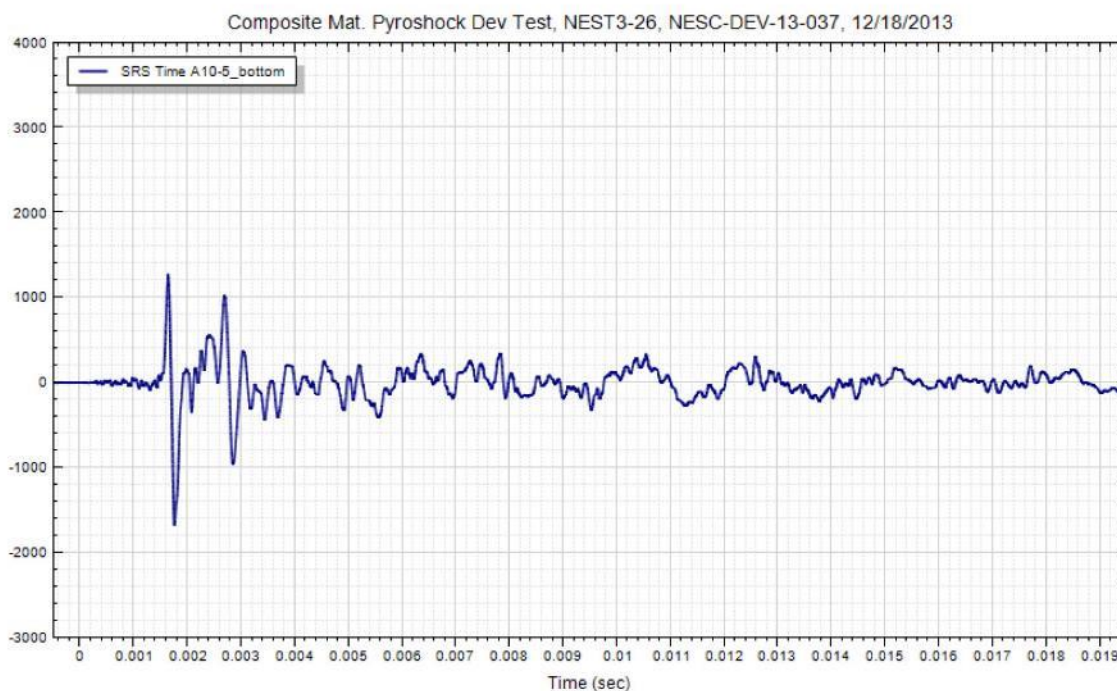
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
599 of 832





# NASA Engineering and Safety Center Technical Assessment Report

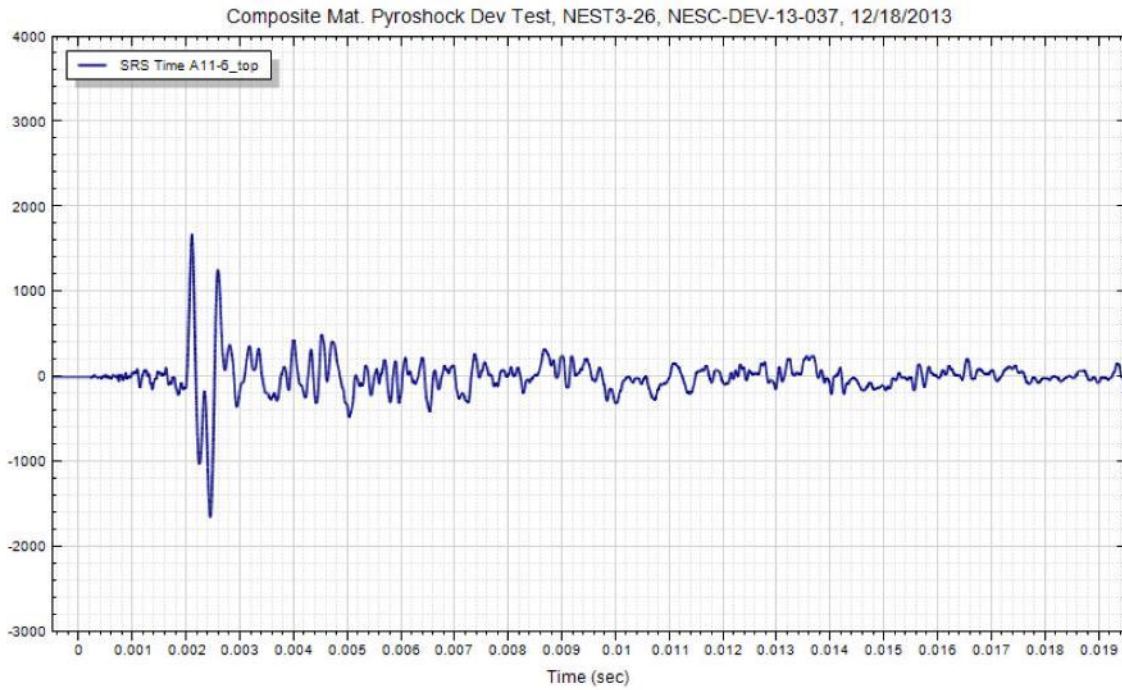
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
600 of 832





# NASA Engineering and Safety Center Technical Assessment Report

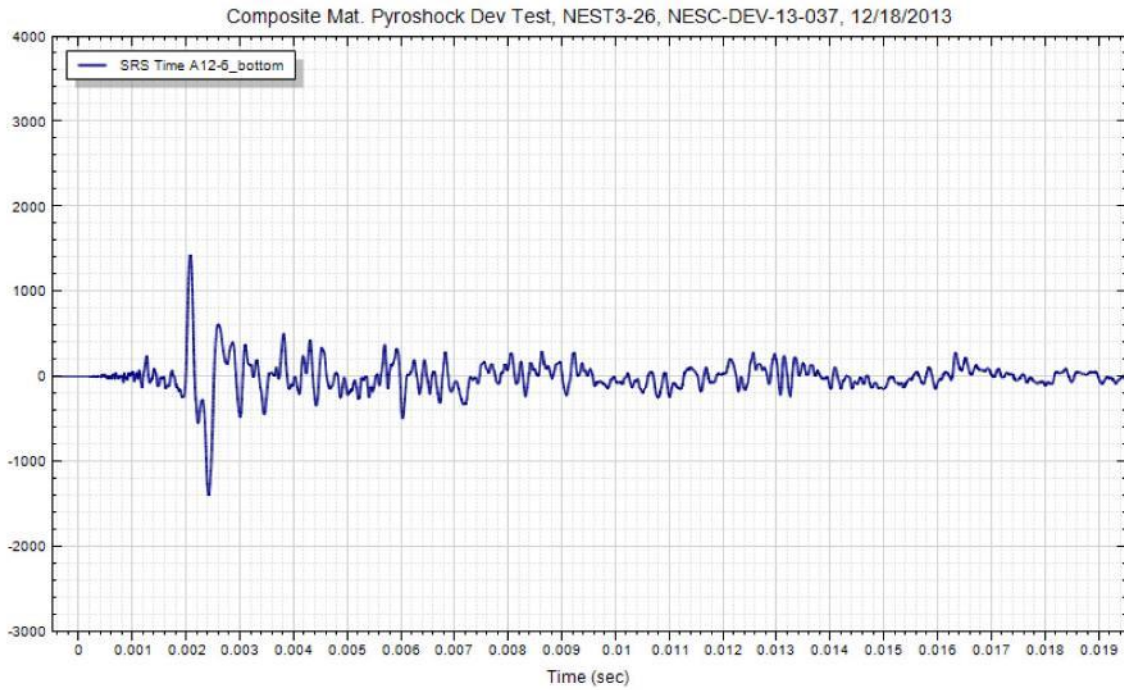
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
601 of 832





# NASA Engineering and Safety Center Technical Assessment Report

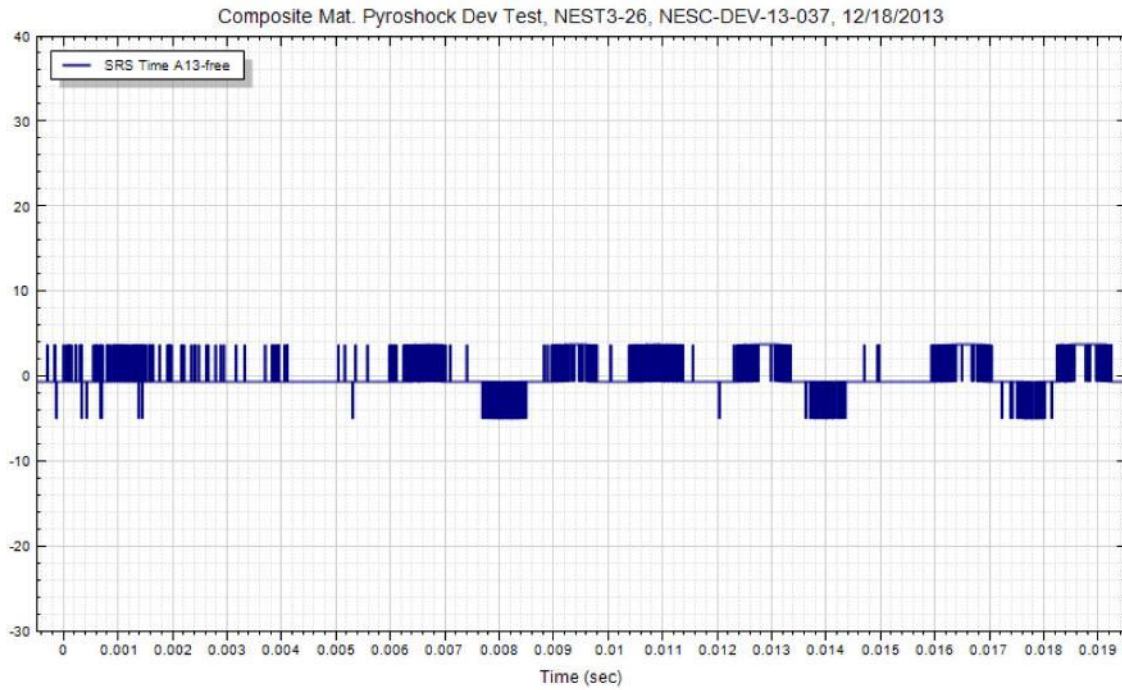
Document #:  
**NESC-RP-  
12-00783**


Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
602 of 832



	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 603 of 832	

**NESC-DEV-13-037**  
**Composite Materials**  
**Shock Test**  
  
**Test #8 Accelerometer Data**  
**Panel 0326A010**



# NASA Engineering and Safety Center Technical Assessment Report

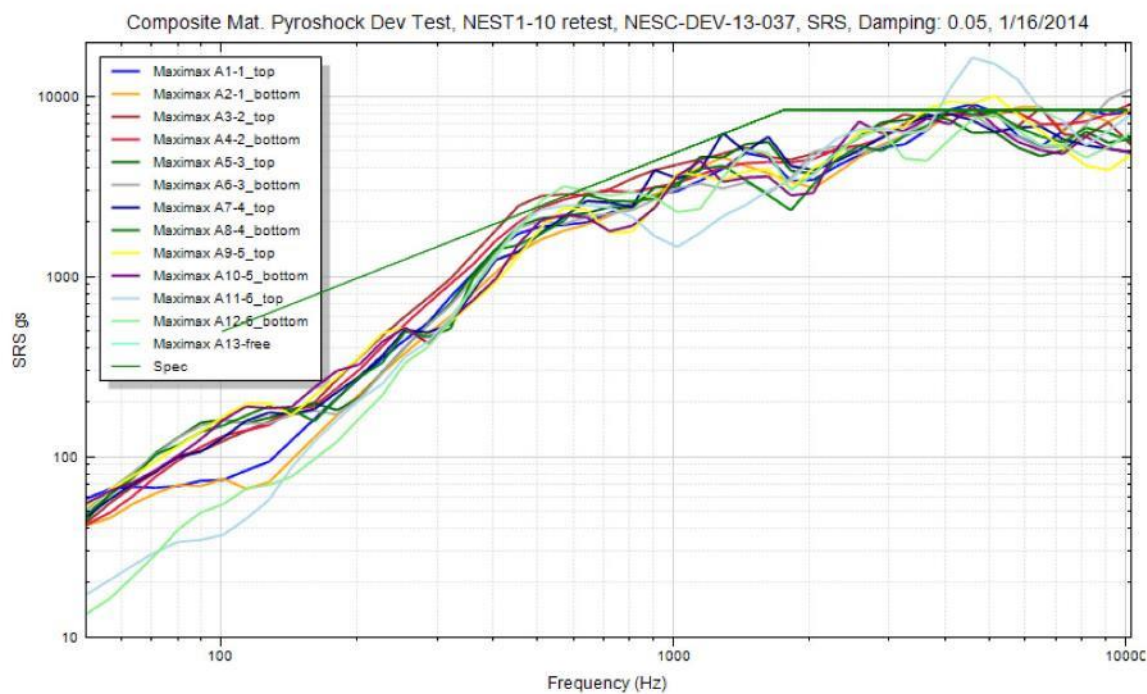
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
604 of 832







# NASA Engineering and Safety Center Technical Assessment Report

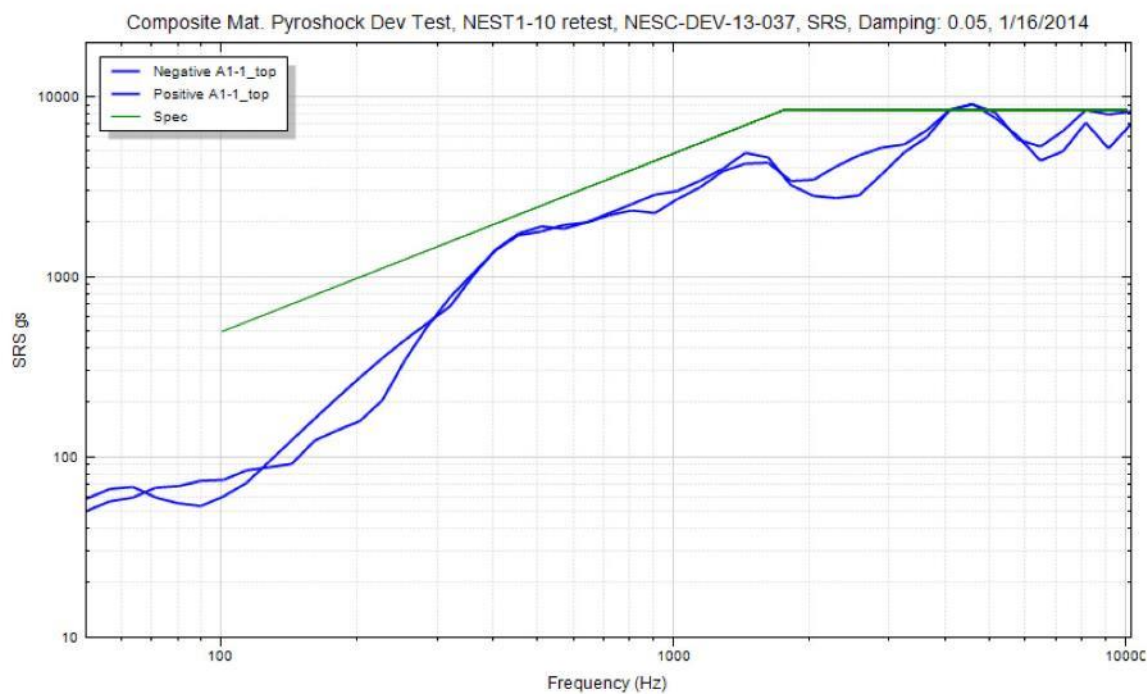
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
605 of 832





# NASA Engineering and Safety Center Technical Assessment Report

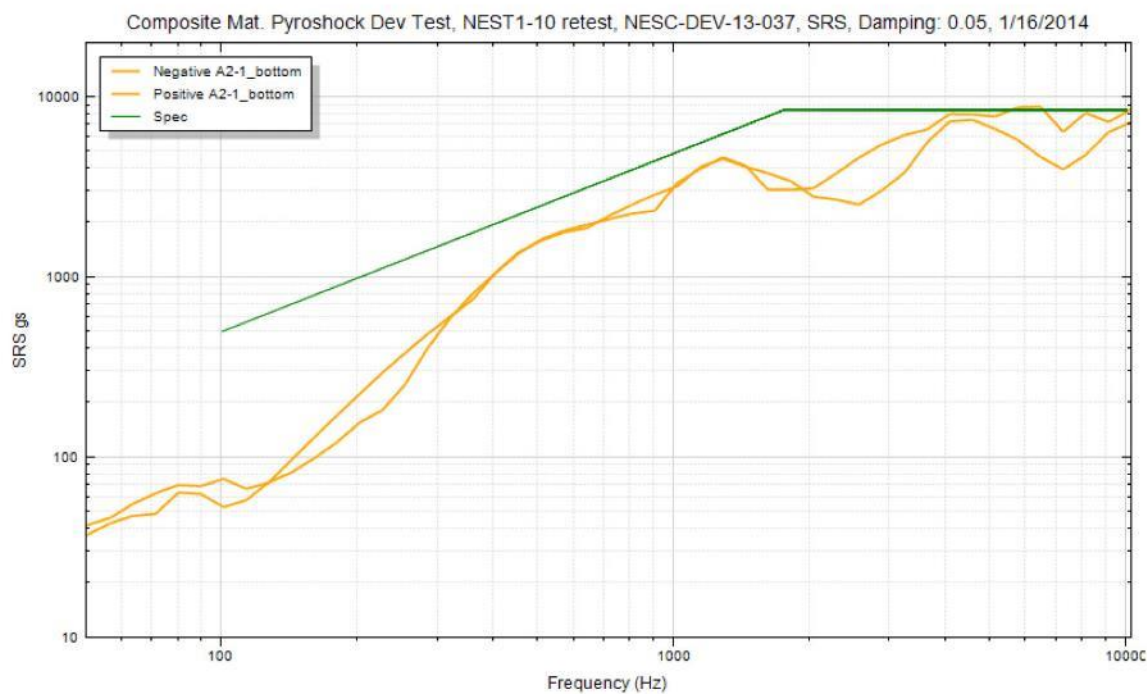
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
606 of 832





# NASA Engineering and Safety Center Technical Assessment Report

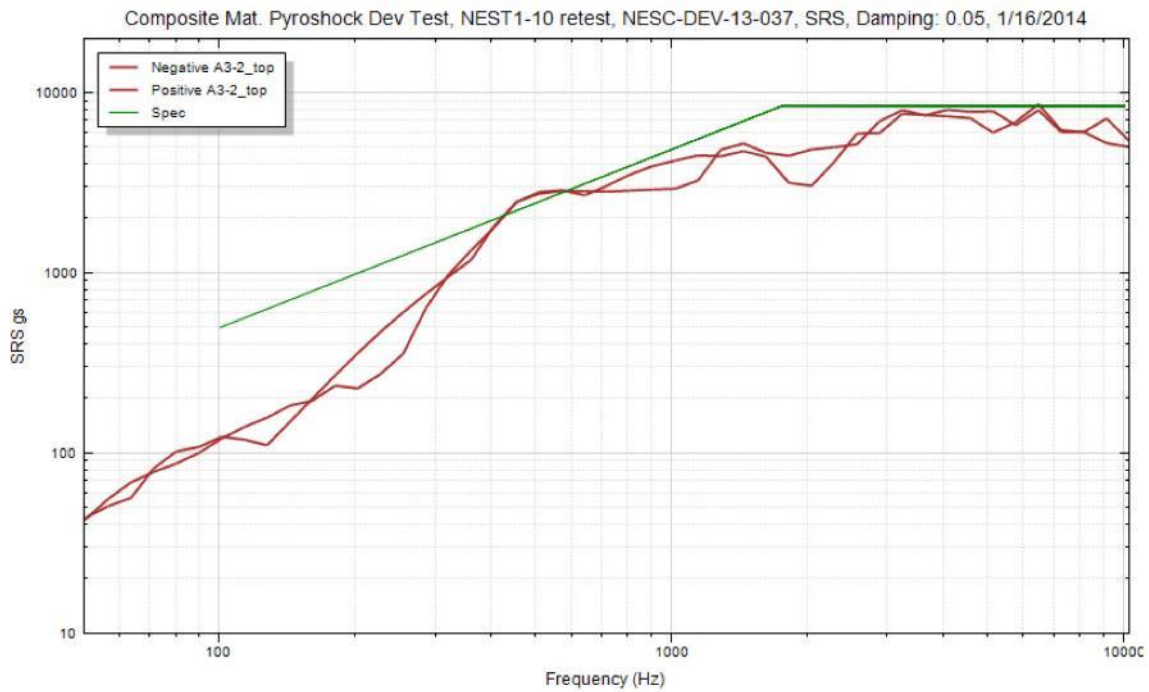
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
607 of 832





# NASA Engineering and Safety Center Technical Assessment Report

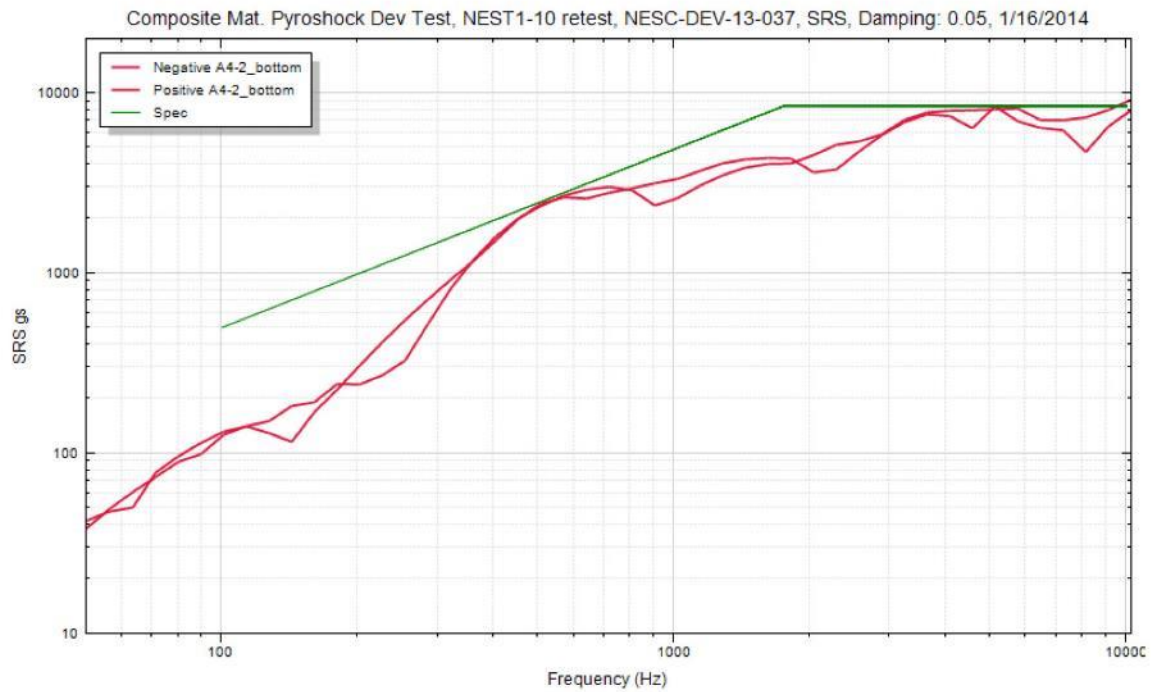
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
608 of 832





# NASA Engineering and Safety Center Technical Assessment Report

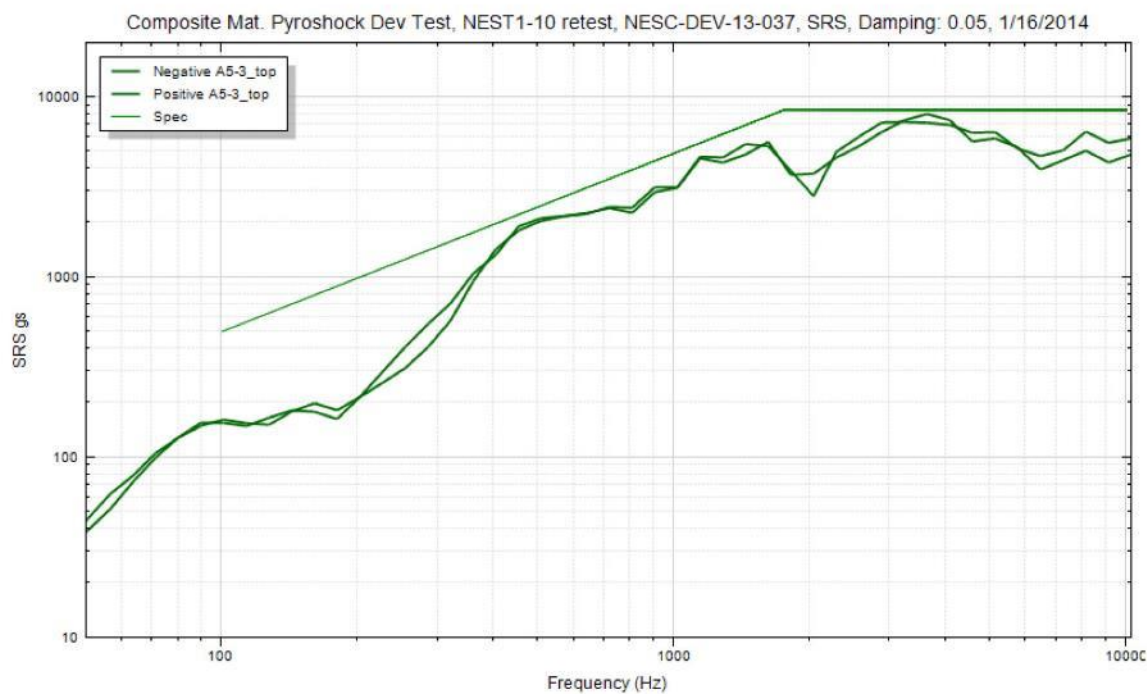
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
609 of 832





# NASA Engineering and Safety Center Technical Assessment Report

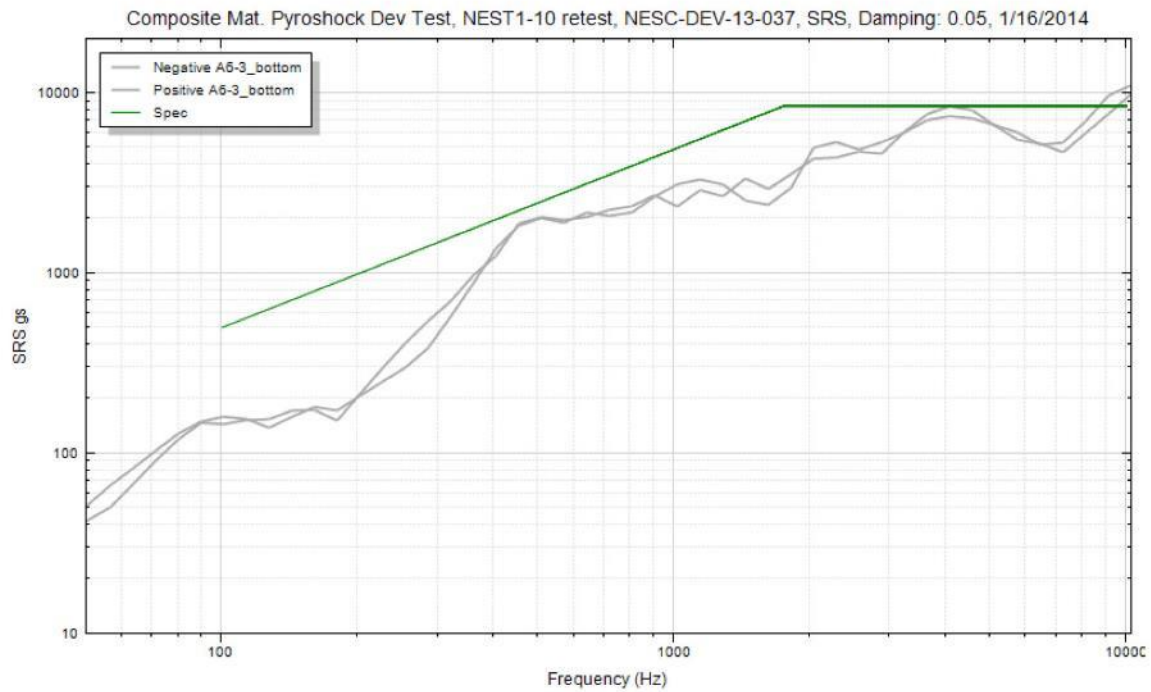
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
610 of 832





# NASA Engineering and Safety Center Technical Assessment Report

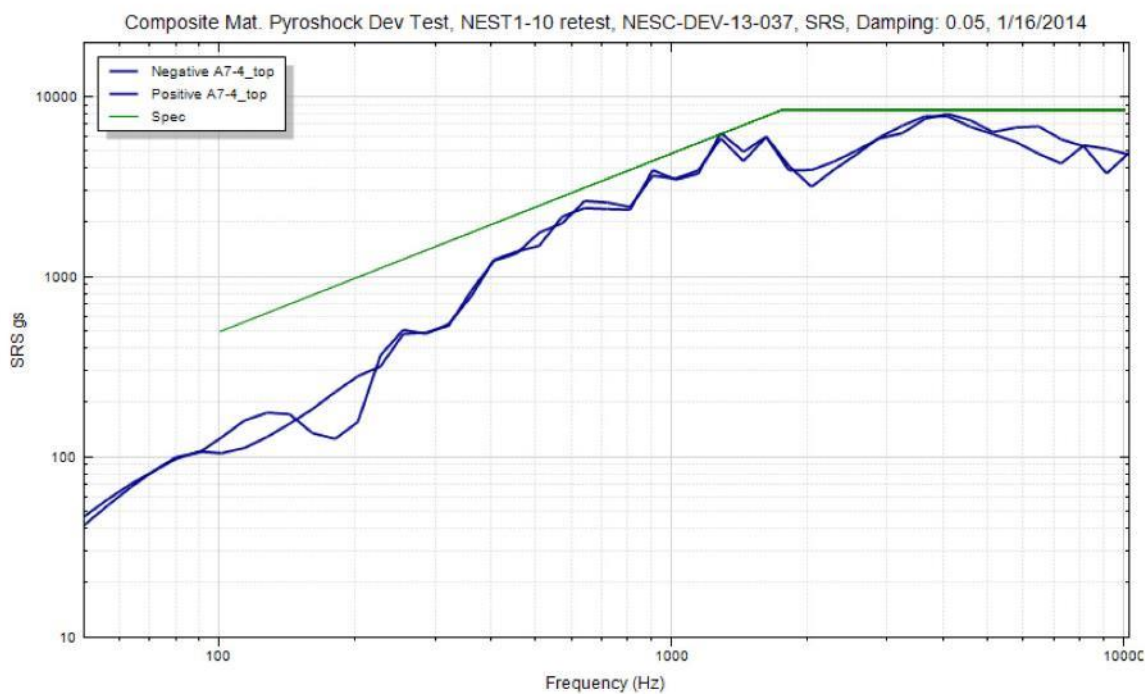
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
611 of 832





# NASA Engineering and Safety Center Technical Assessment Report

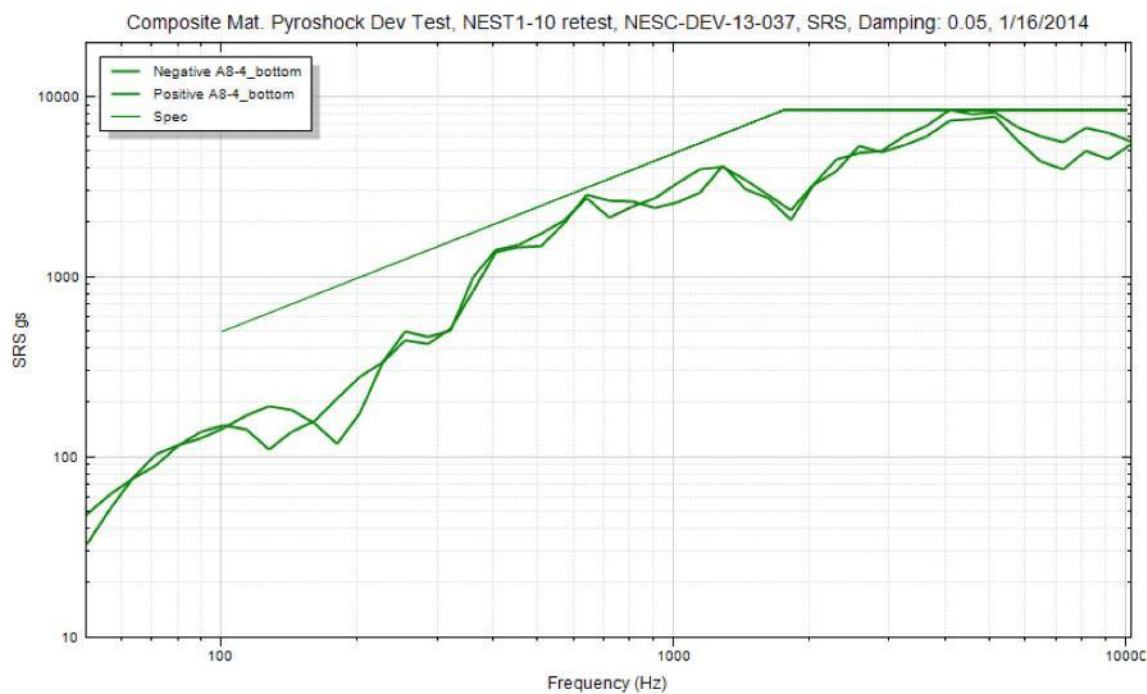
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
612 of 832







# NASA Engineering and Safety Center Technical Assessment Report

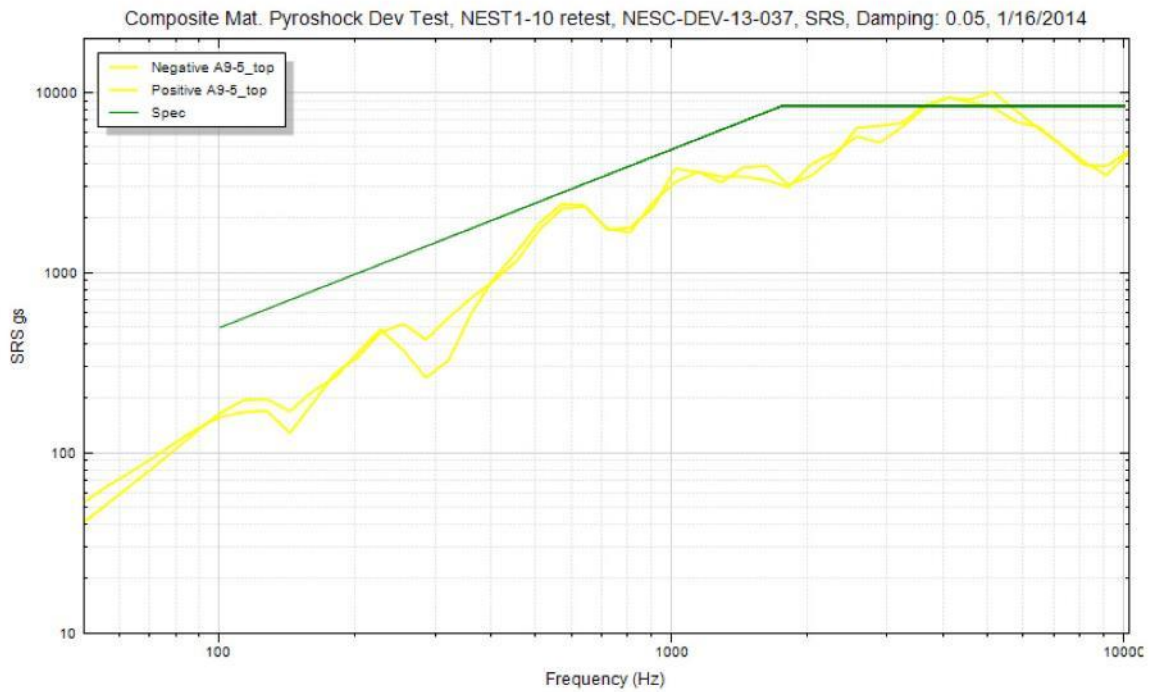
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
613 of 832





# NASA Engineering and Safety Center Technical Assessment Report

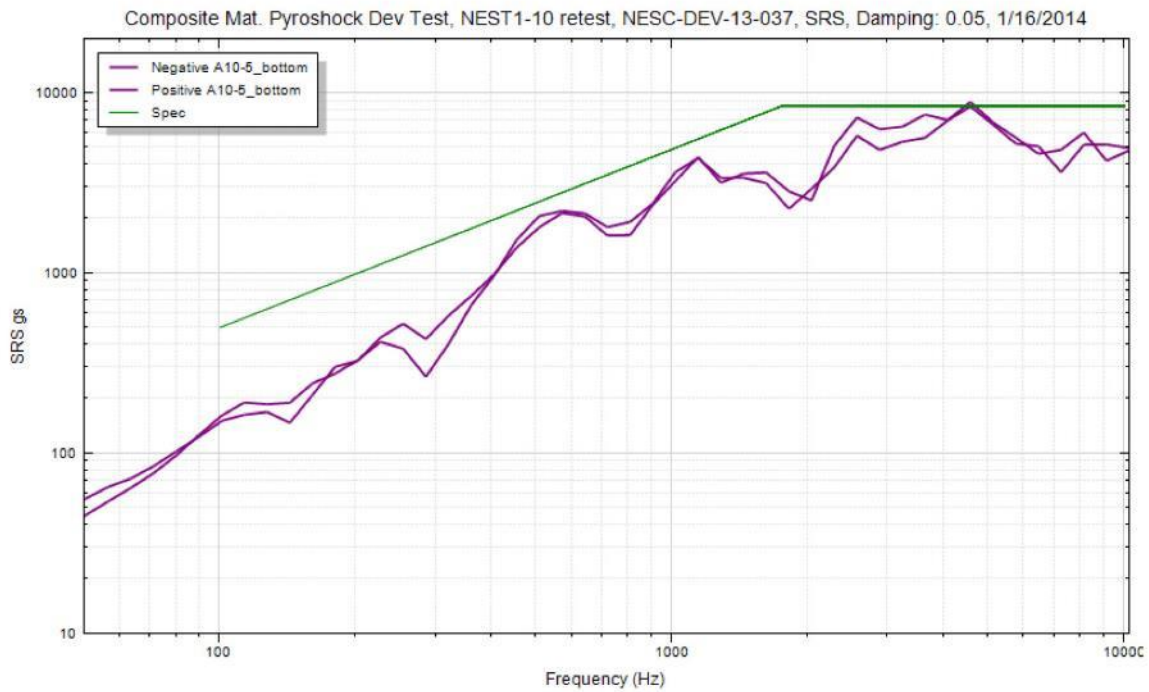
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
614 of 832





# NASA Engineering and Safety Center Technical Assessment Report

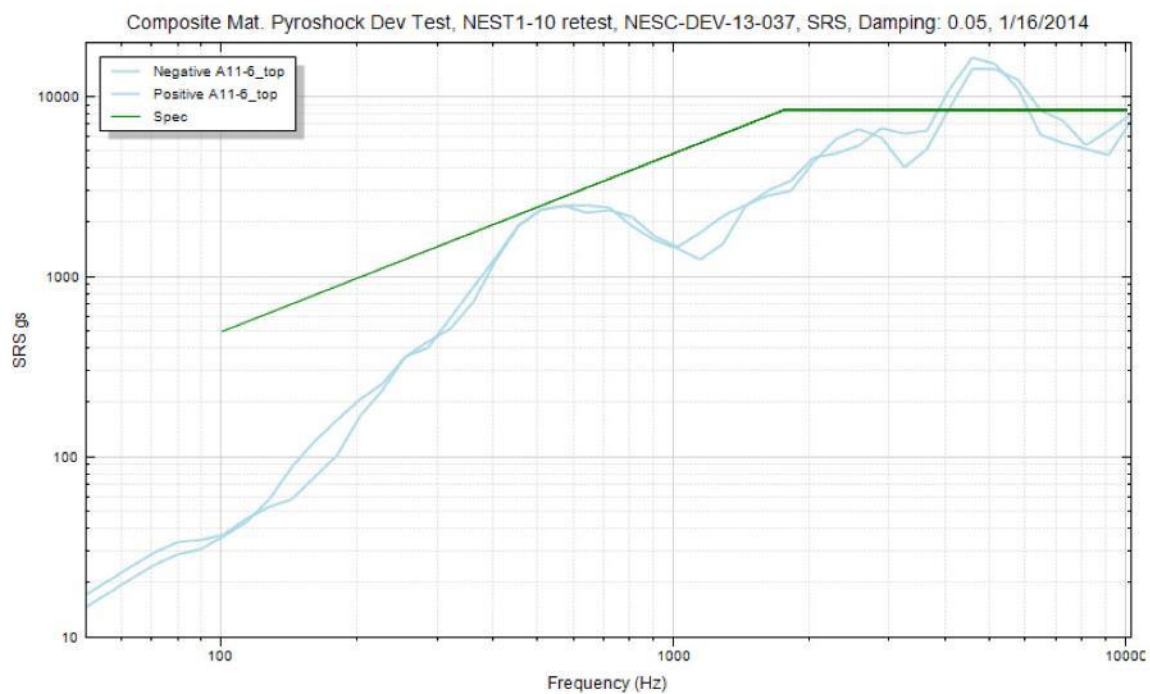
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
615 of 832





# NASA Engineering and Safety Center Technical Assessment Report

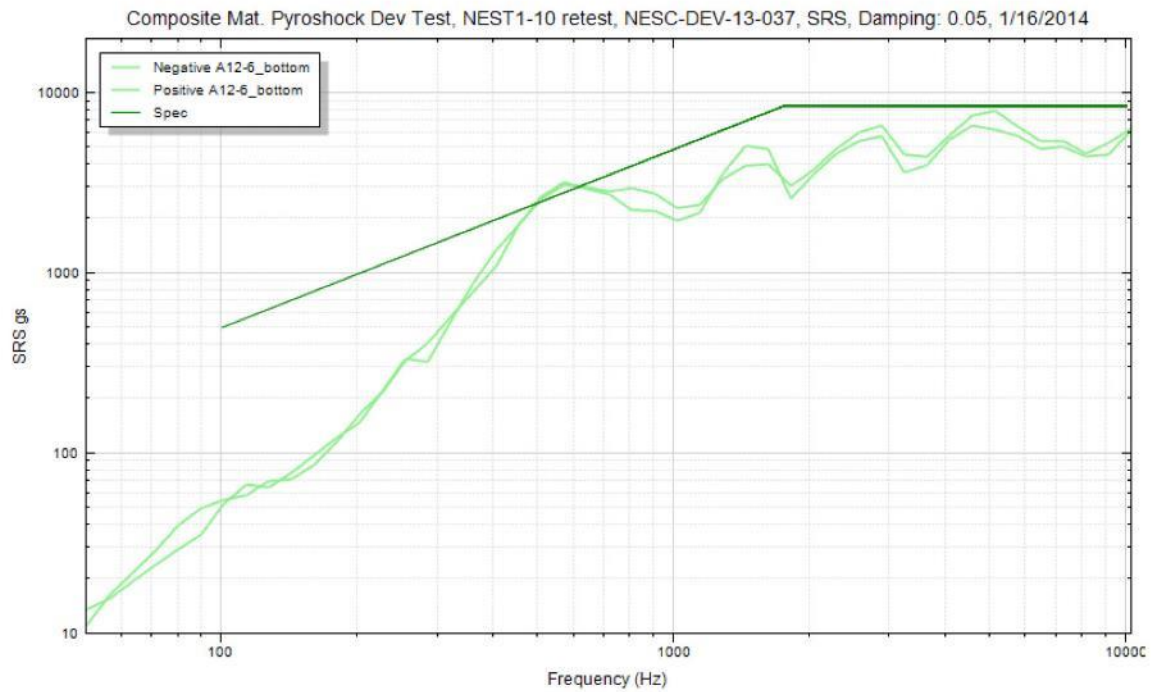
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
616 of 832





# NASA Engineering and Safety Center Technical Assessment Report

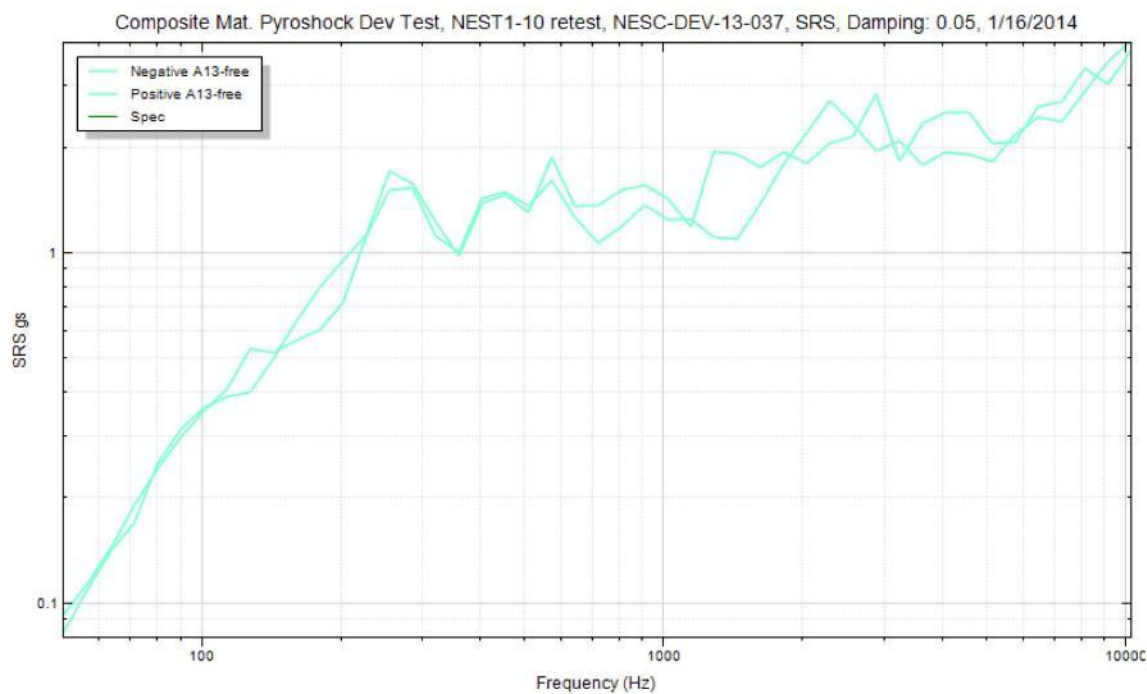
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
617 of 832





# NASA Engineering and Safety Center Technical Assessment Report

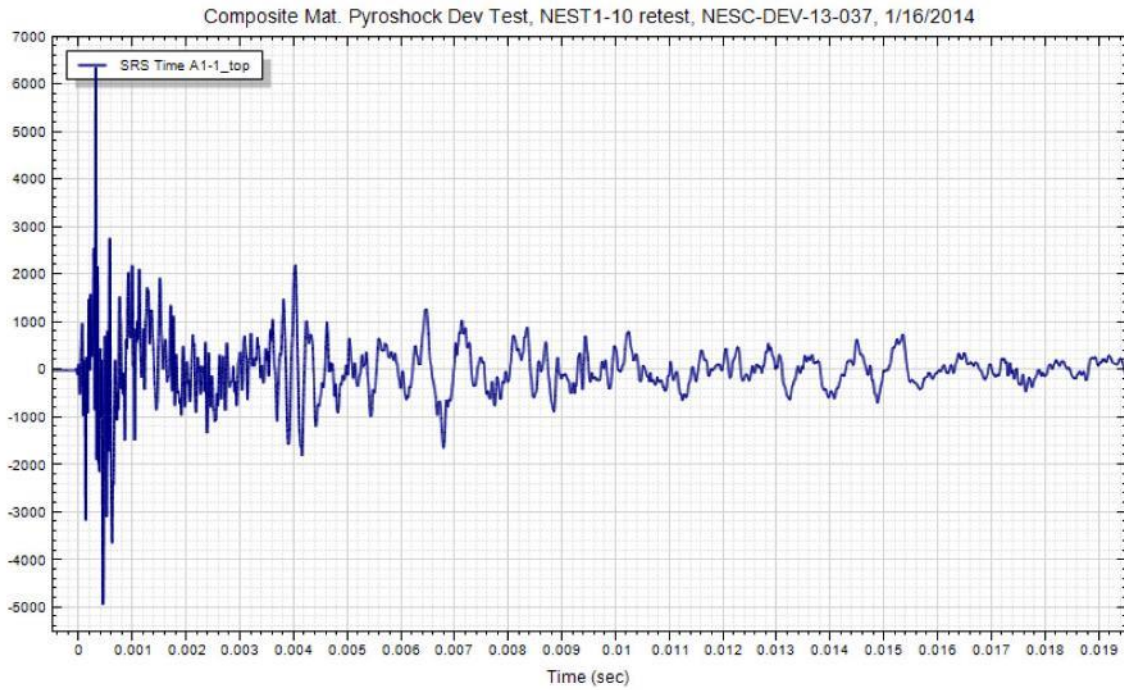
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
618 of 832





# NASA Engineering and Safety Center Technical Assessment Report

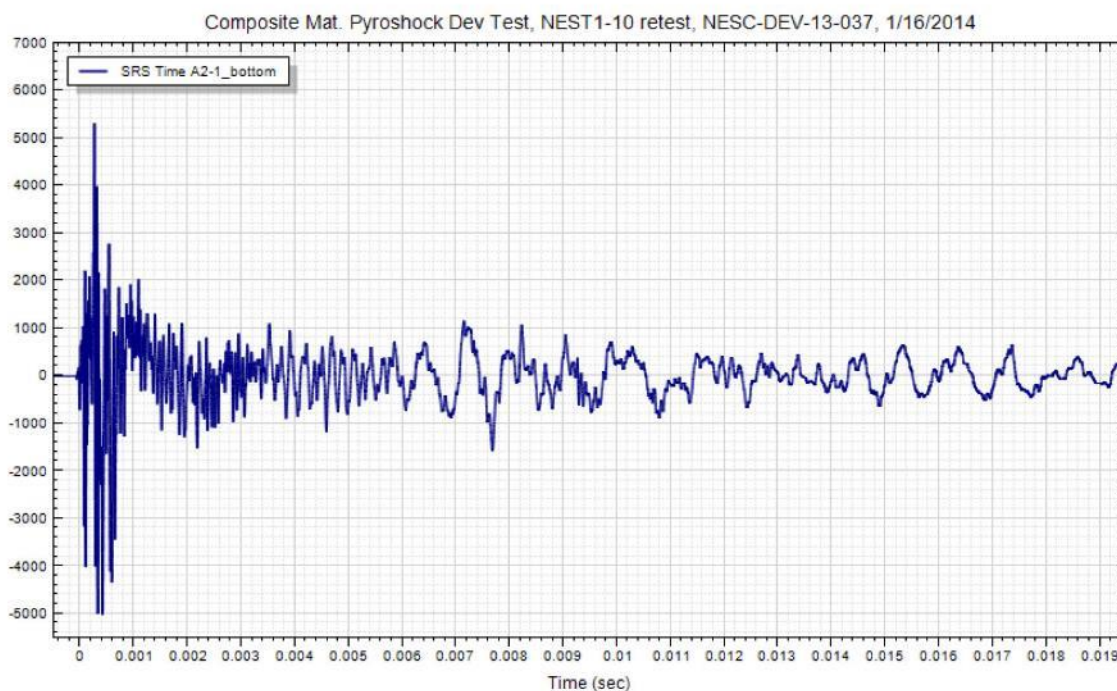
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
619 of 832





# NASA Engineering and Safety Center Technical Assessment Report

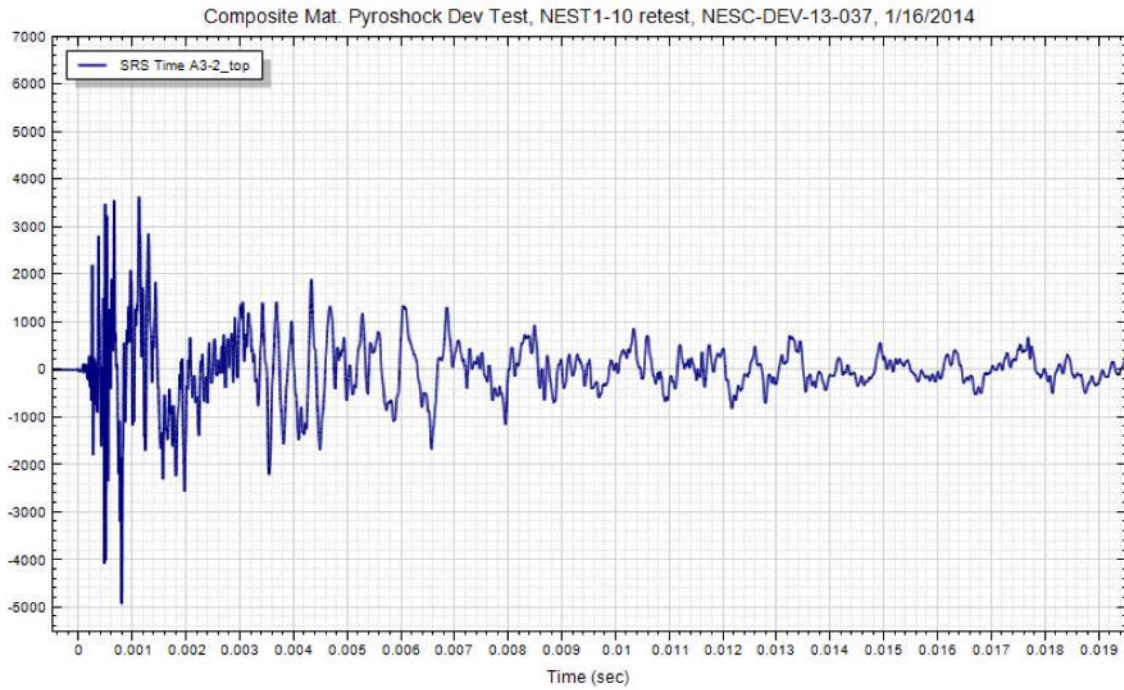
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
620 of 832



306 of 518





# NASA Engineering and Safety Center Technical Assessment Report

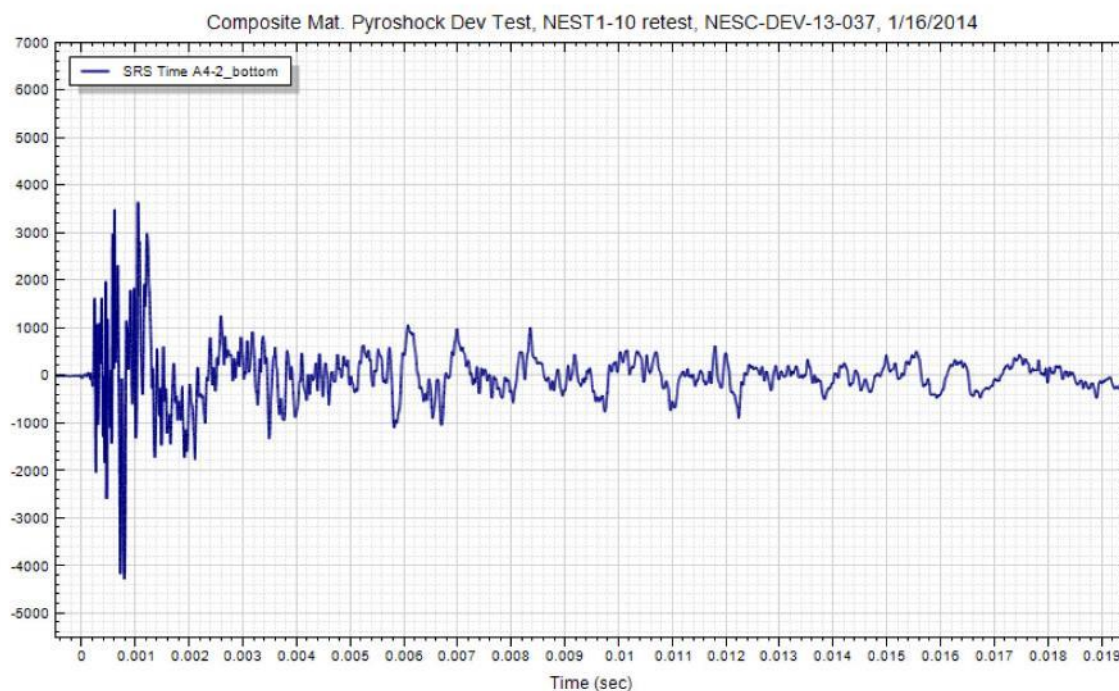
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
621 of 832





# NASA Engineering and Safety Center Technical Assessment Report

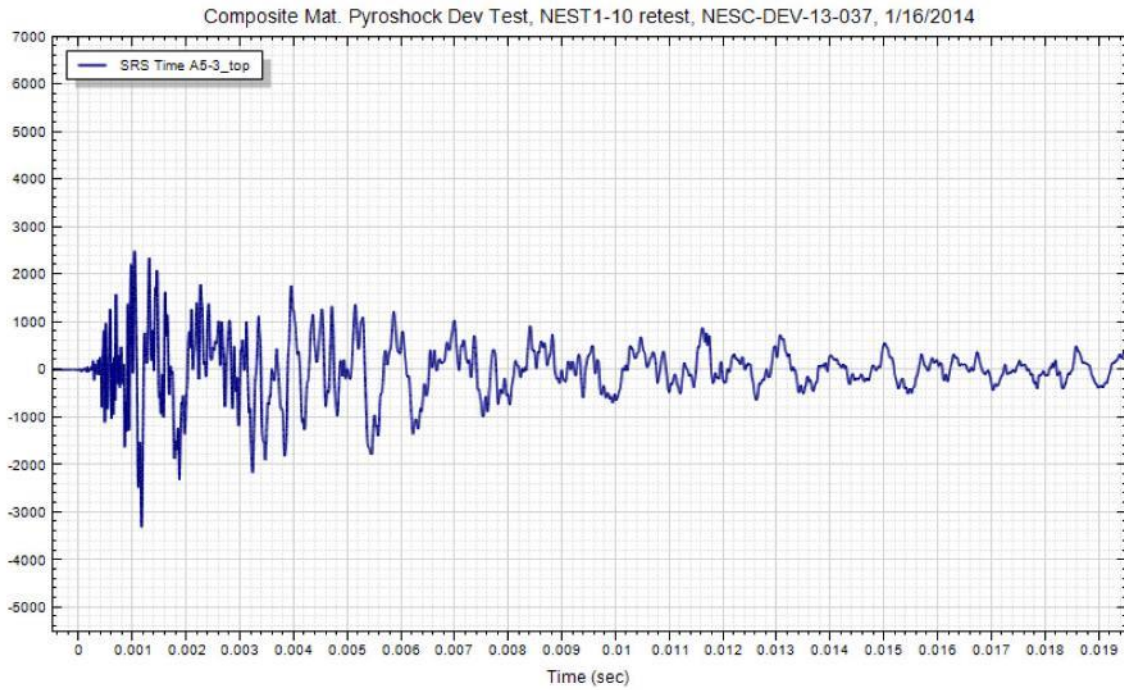
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
622 of 832





# NASA Engineering and Safety Center Technical Assessment Report

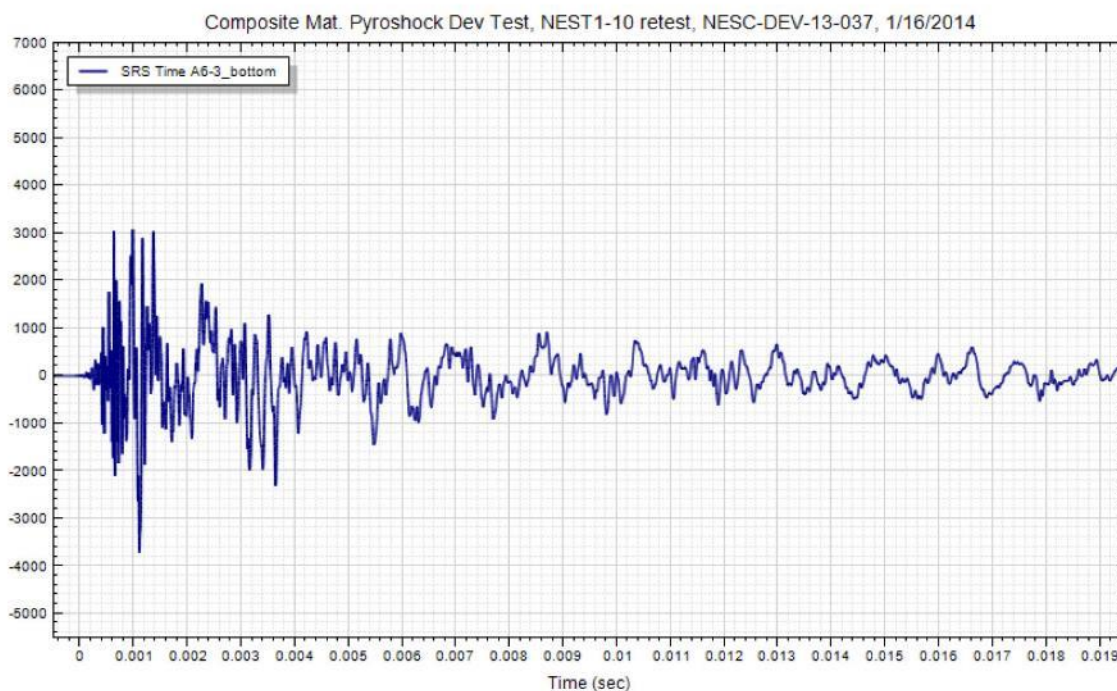
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
623 of 832





# NASA Engineering and Safety Center Technical Assessment Report

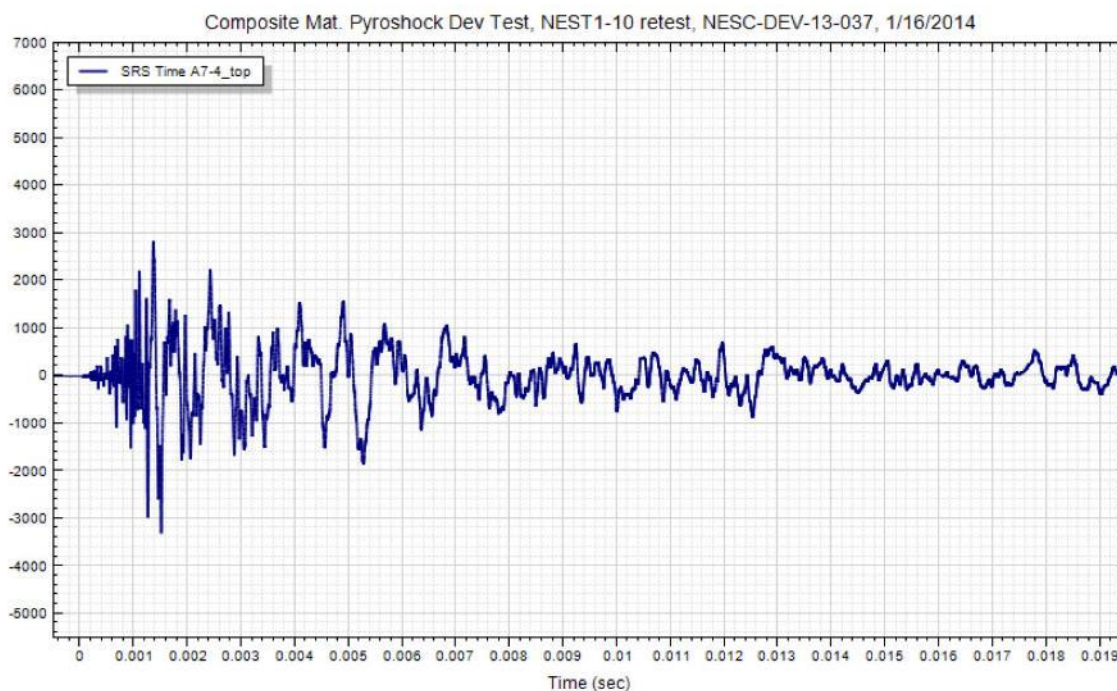
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
624 of 832





# NASA Engineering and Safety Center Technical Assessment Report

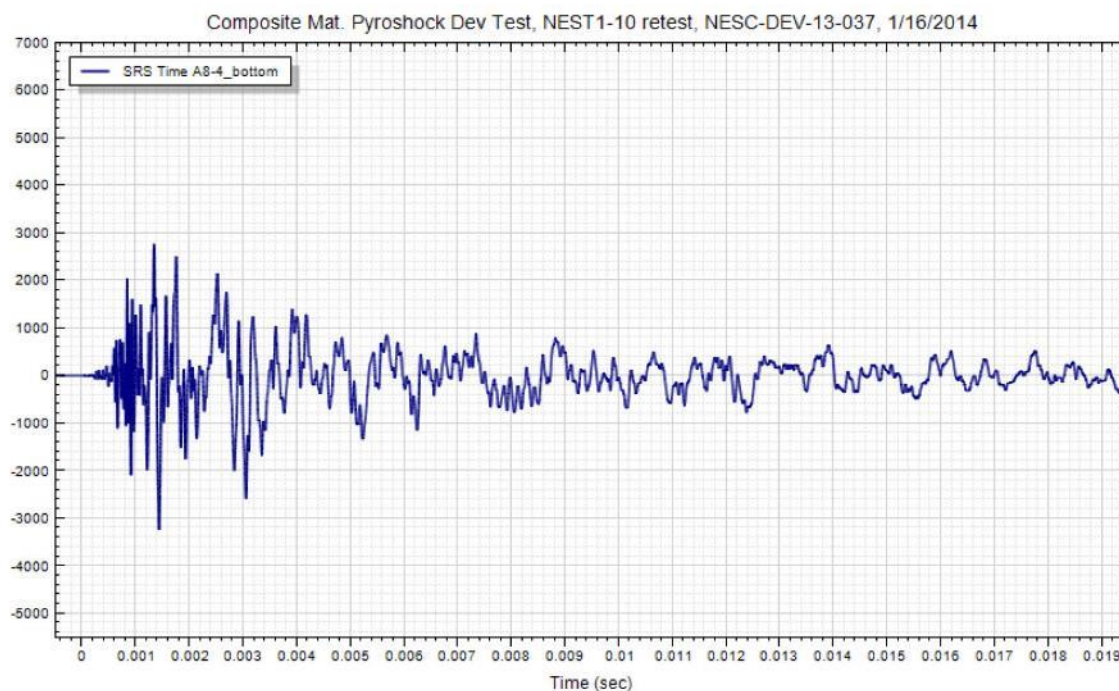
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
625 of 832





# NASA Engineering and Safety Center Technical Assessment Report

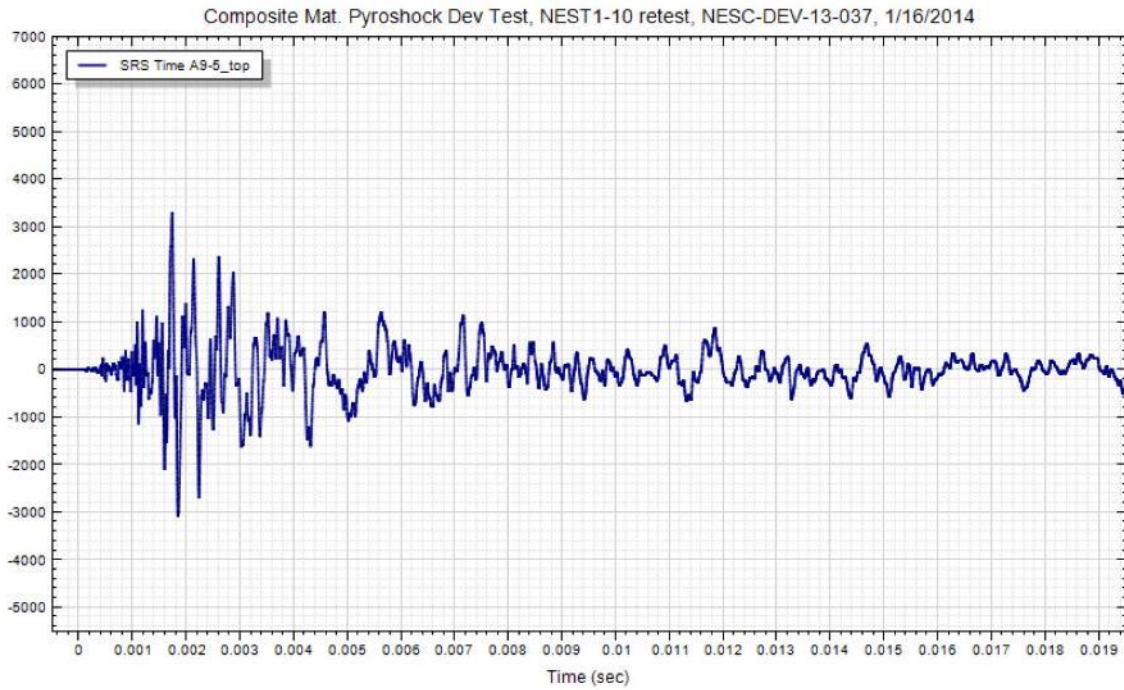
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
626 of 832





# NASA Engineering and Safety Center Technical Assessment Report

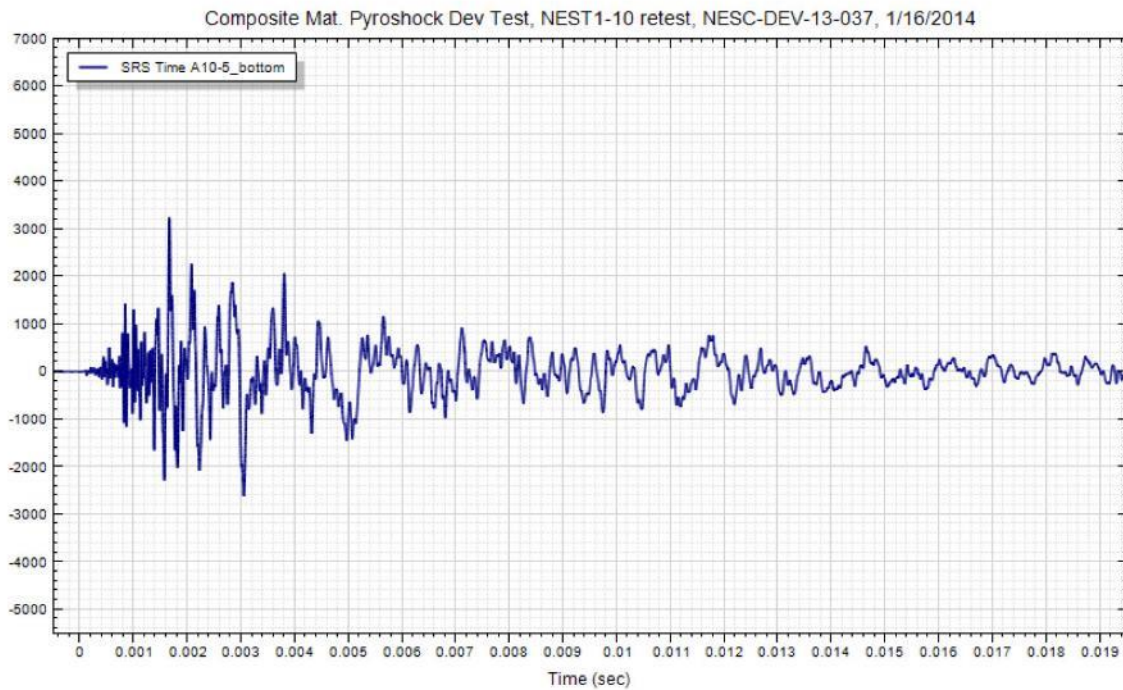
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
627 of 832





# NASA Engineering and Safety Center Technical Assessment Report

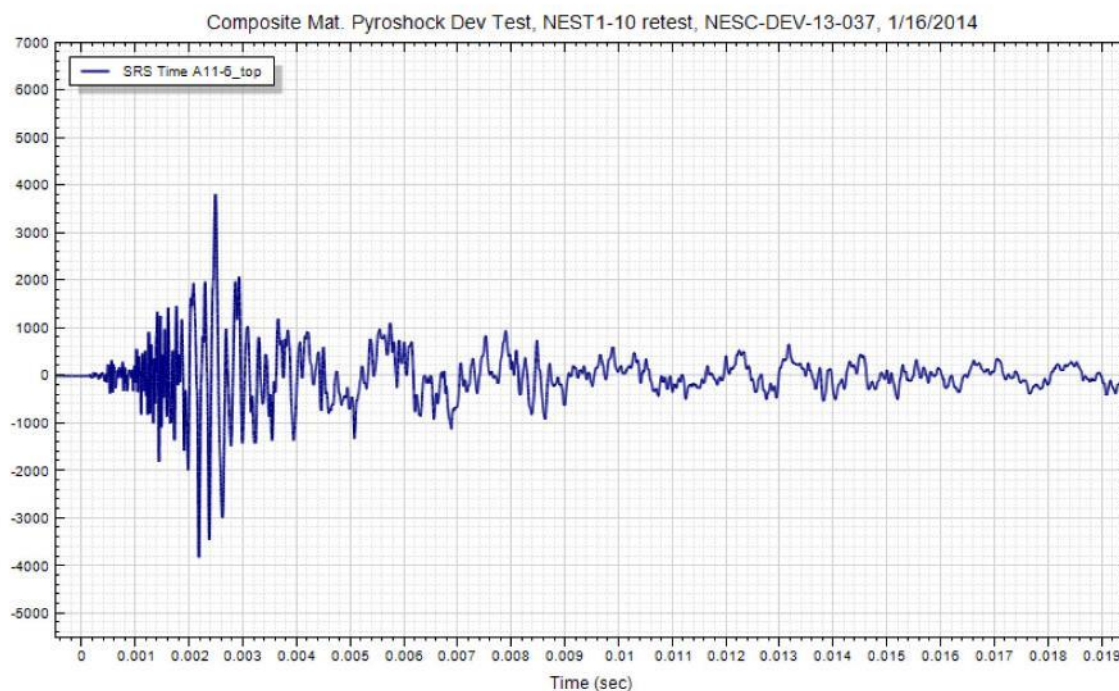
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
628 of 832







# NASA Engineering and Safety Center Technical Assessment Report

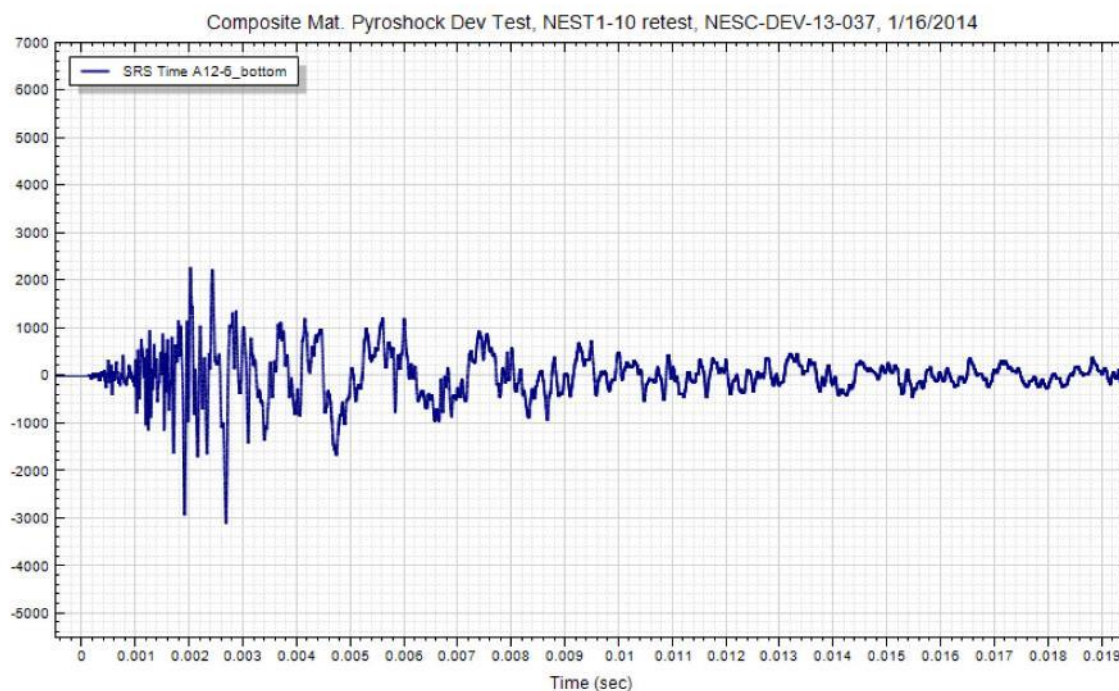
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
629 of 832





# NASA Engineering and Safety Center Technical Assessment Report

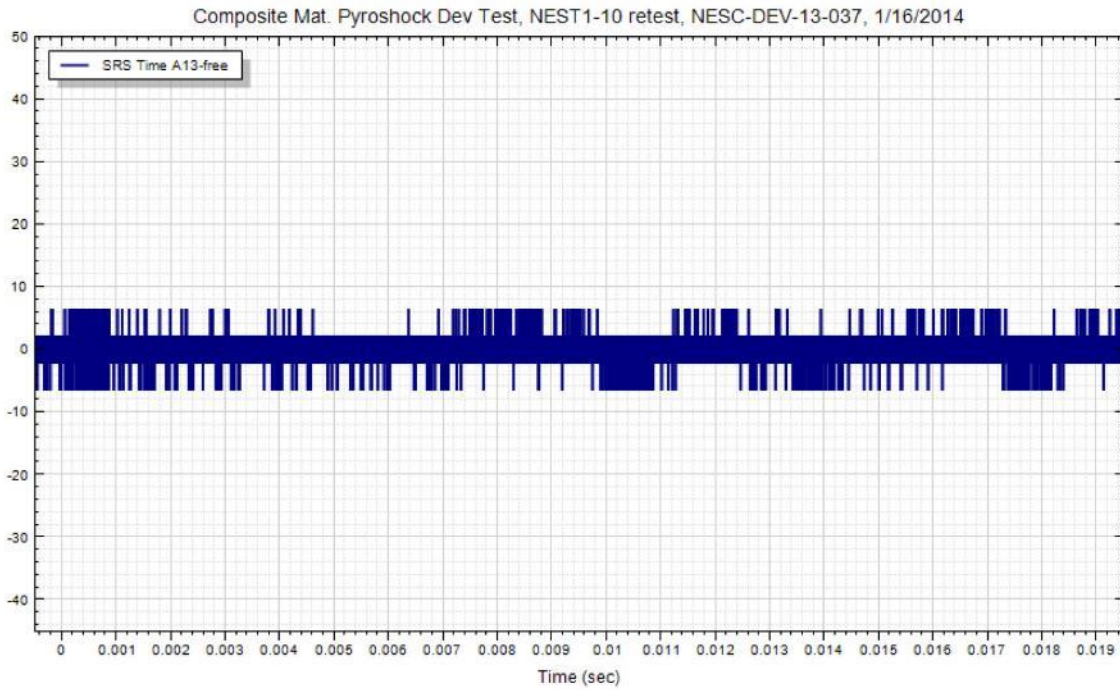
Document #:  
**NESC-RP-  
12-00783**


Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
630 of 832



	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 631 of 832	

**NESC-DEV-13-037**  
**Composite Materials**  
**Shock Test**  
  
**Test #9 Accelerometer Data**  
**Panel 0326A009**



# NASA Engineering and Safety Center Technical Assessment Report

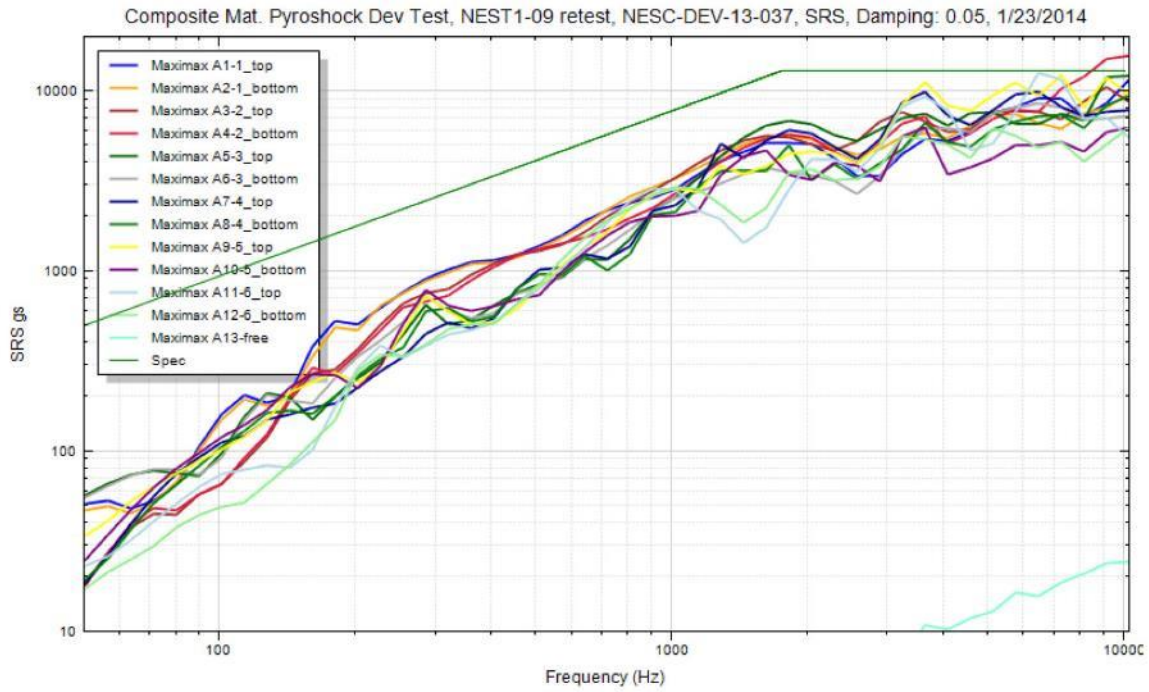
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
632 of 832





# NASA Engineering and Safety Center Technical Assessment Report

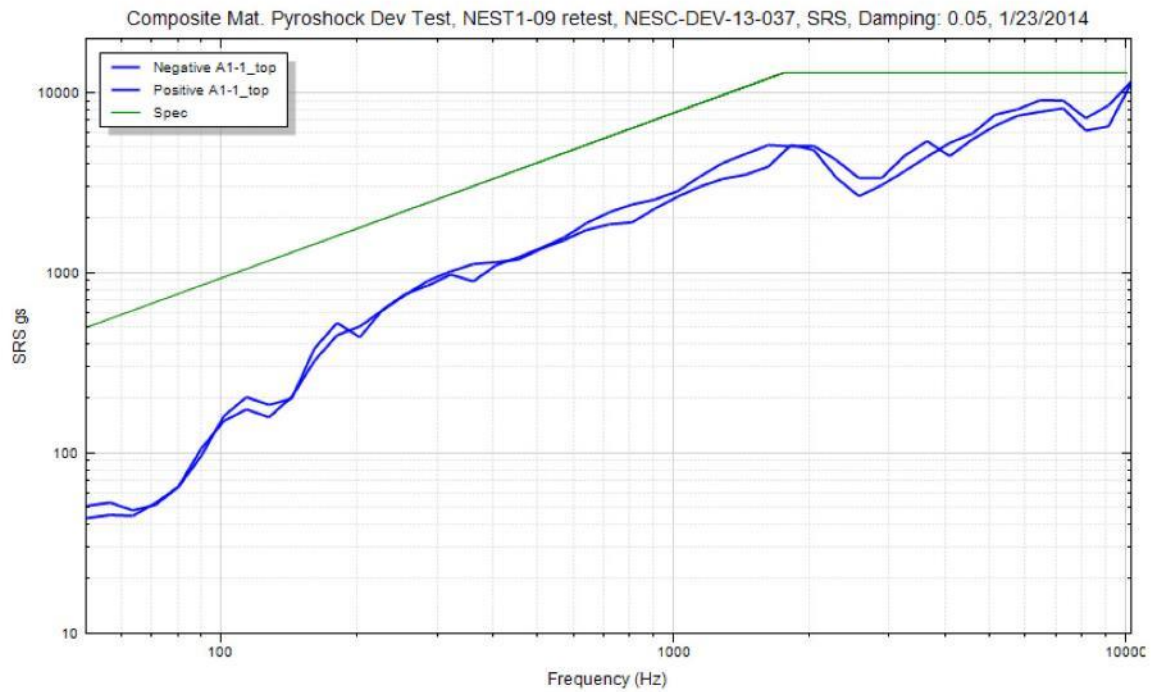
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
633 of 832





# NASA Engineering and Safety Center Technical Assessment Report

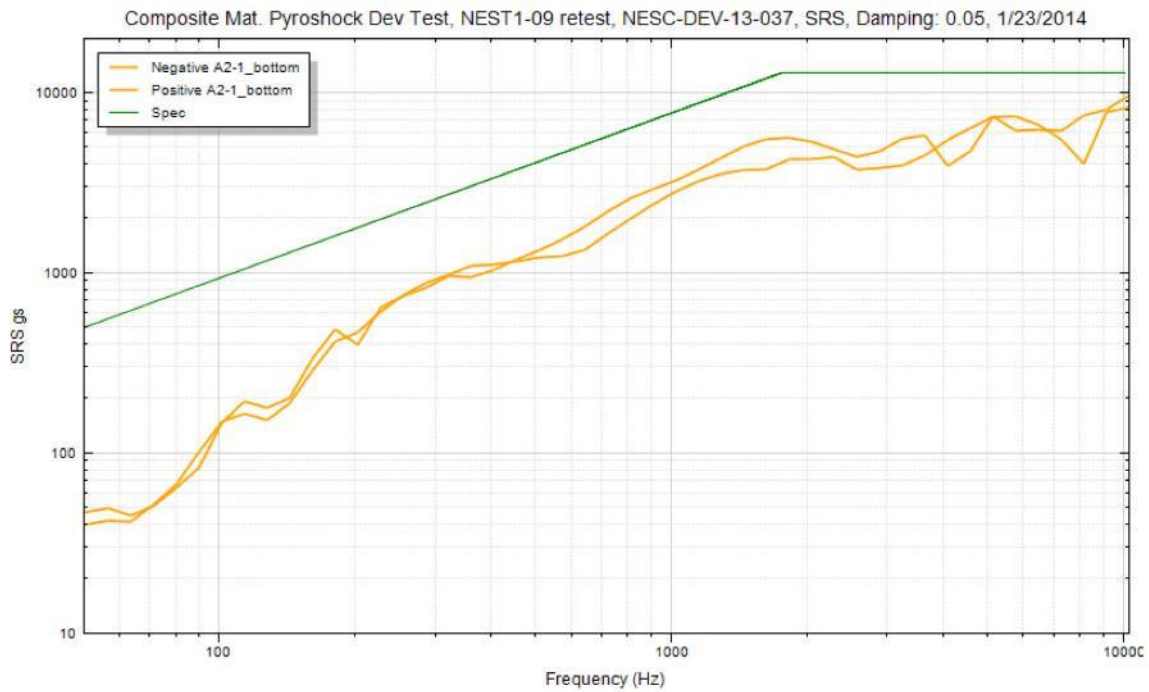
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
634 of 832





# NASA Engineering and Safety Center Technical Assessment Report

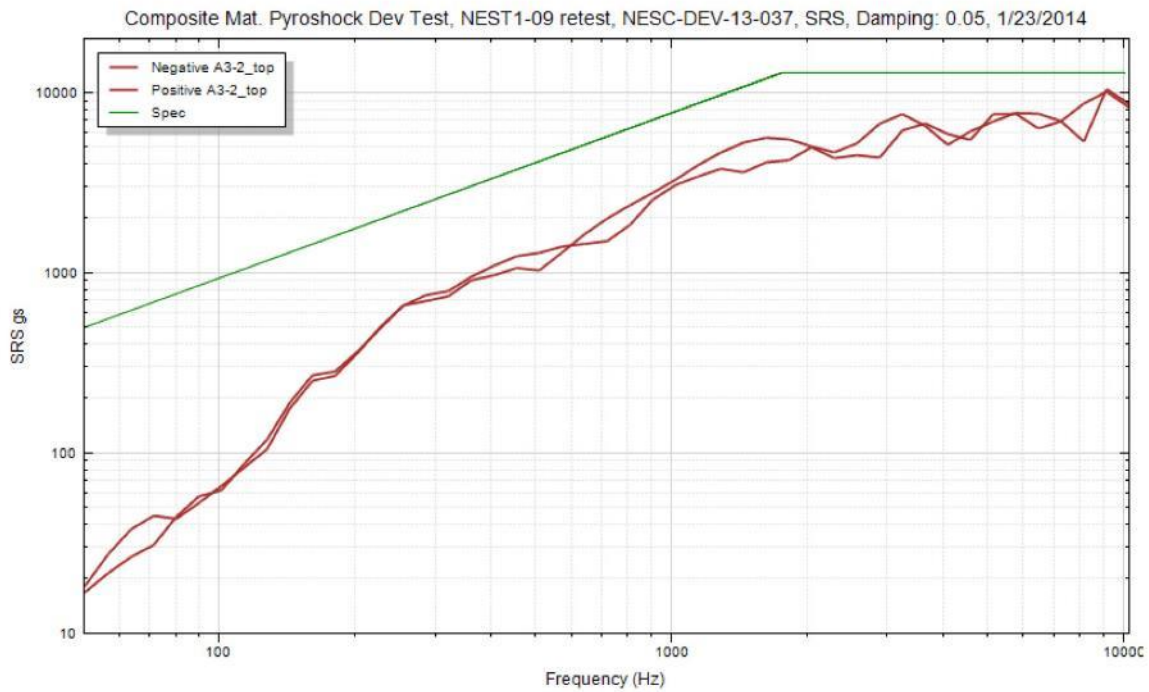
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
635 of 832





# NASA Engineering and Safety Center Technical Assessment Report

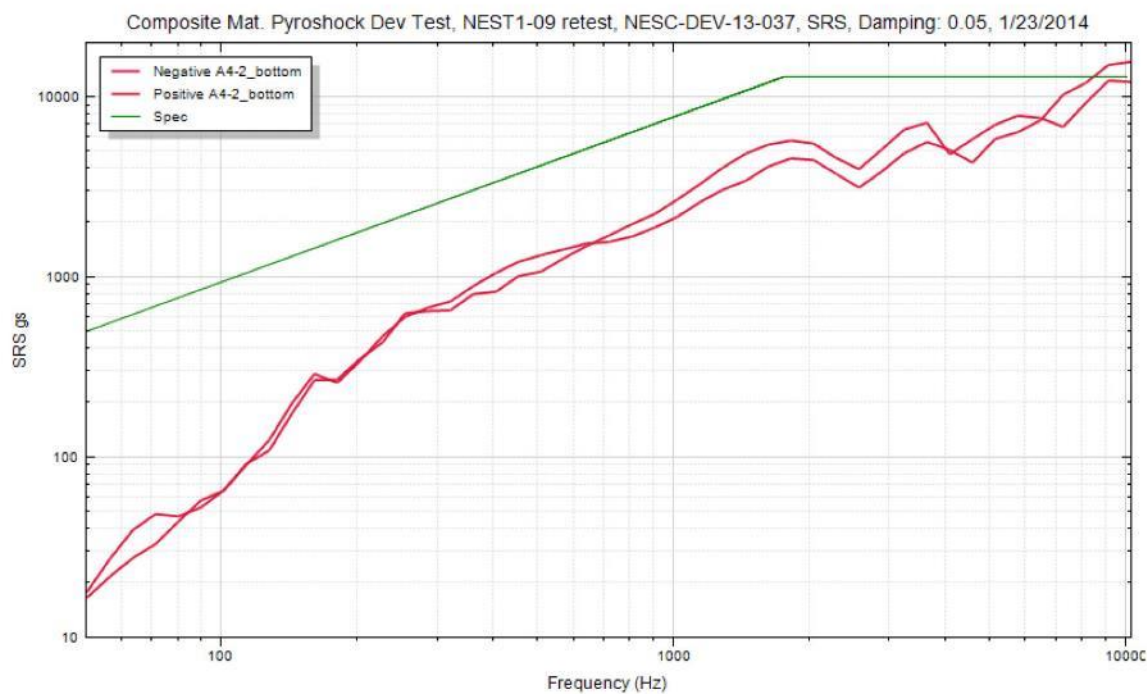
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
636 of 832







# NASA Engineering and Safety Center Technical Assessment Report

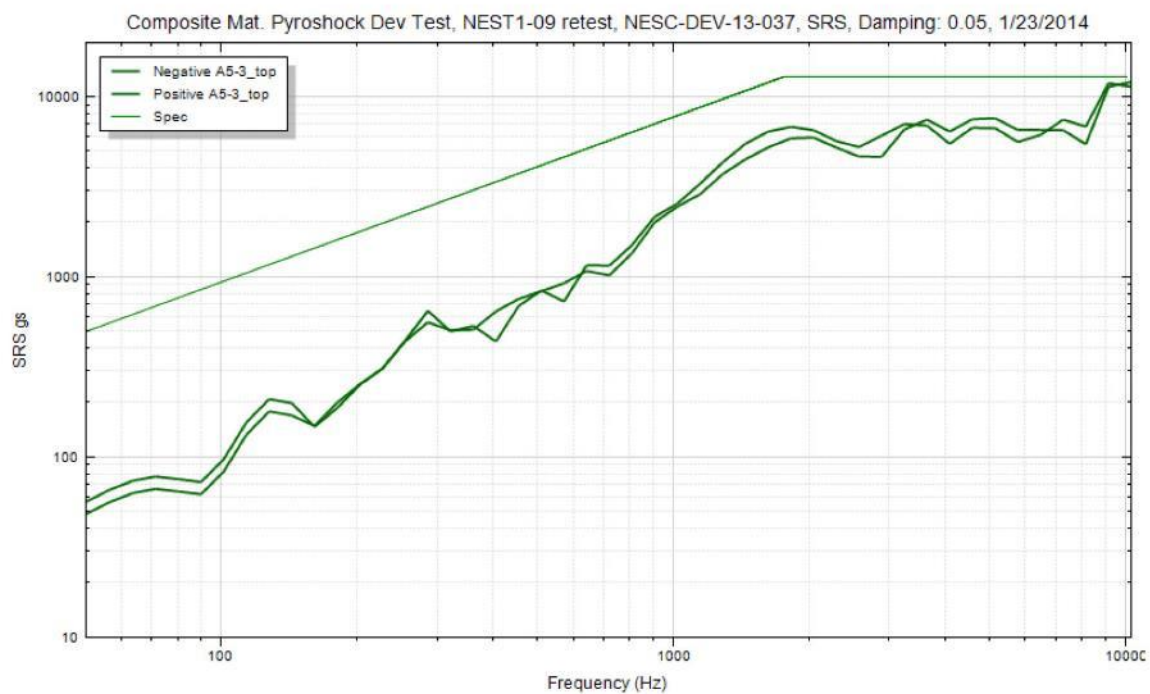
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
637 of 832





# NASA Engineering and Safety Center Technical Assessment Report

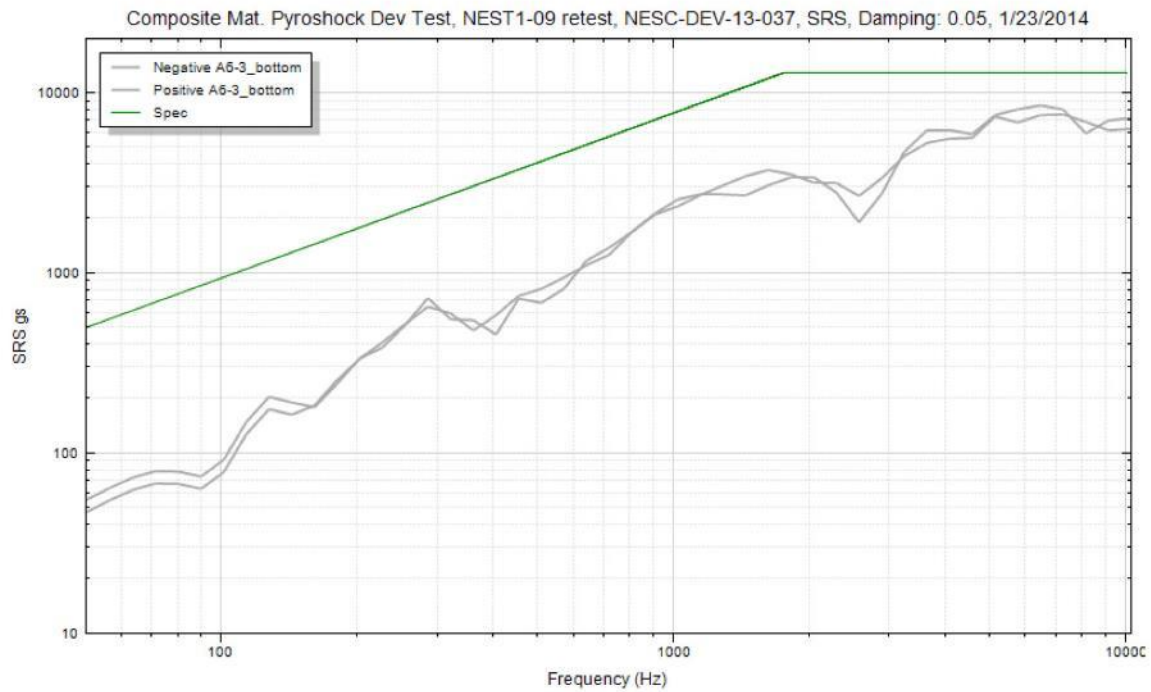
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
638 of 832





# NASA Engineering and Safety Center Technical Assessment Report

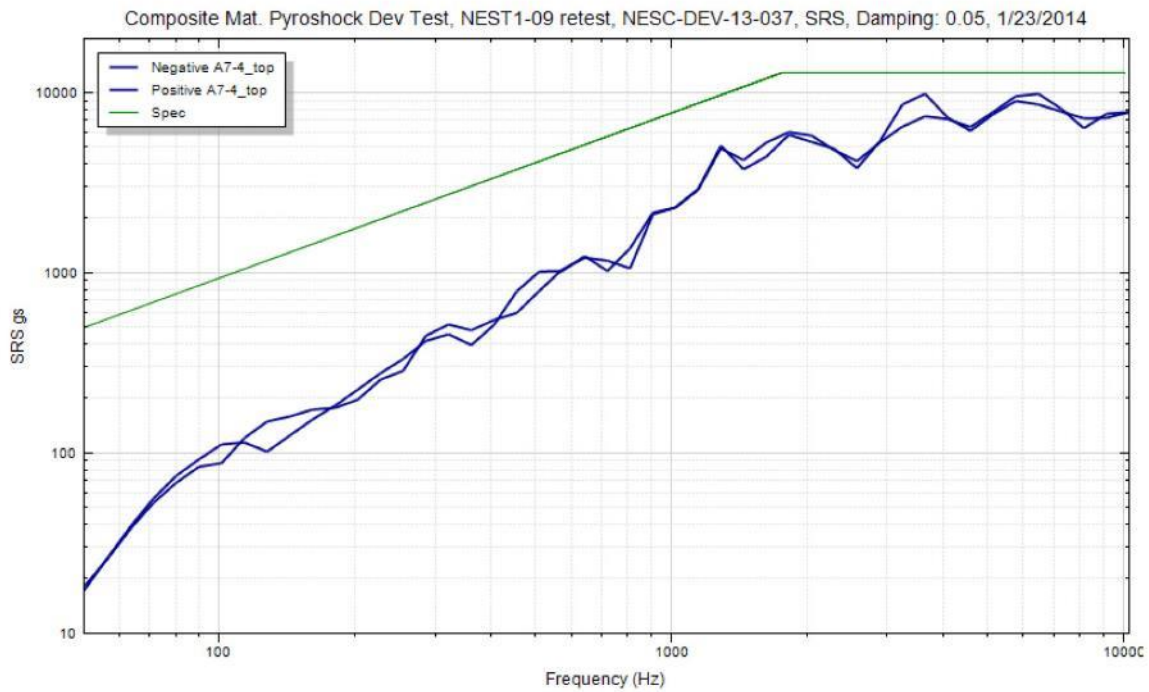
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
639 of 832



325 of 518



# NASA Engineering and Safety Center Technical Assessment Report

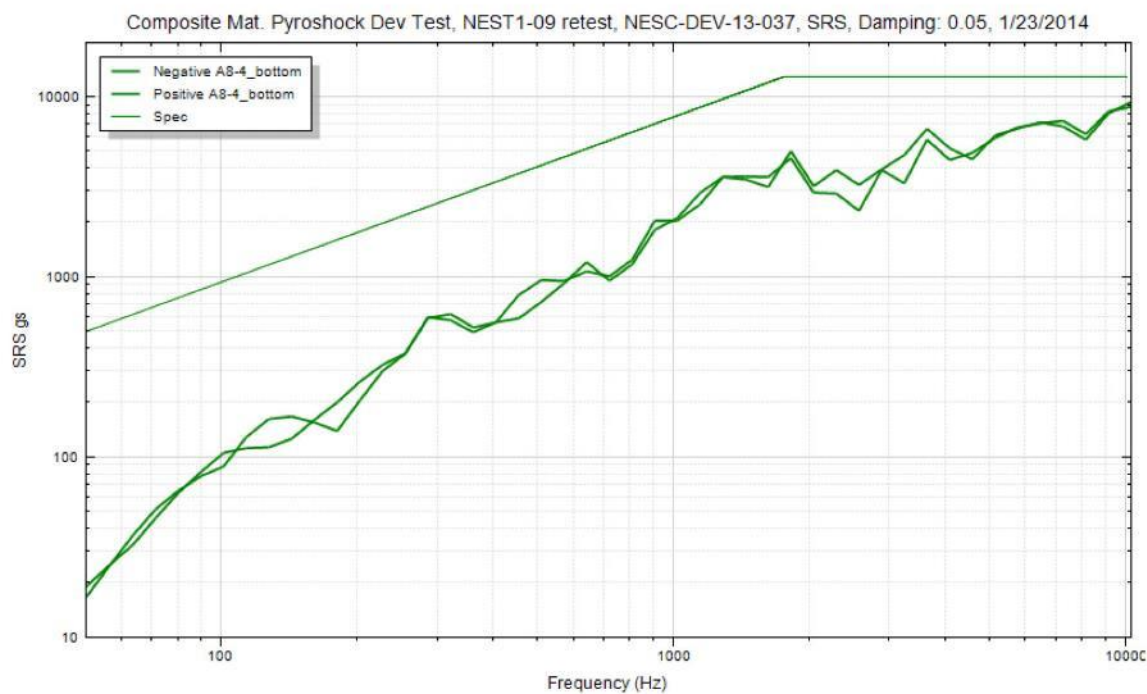
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
640 of 832





# NASA Engineering and Safety Center Technical Assessment Report

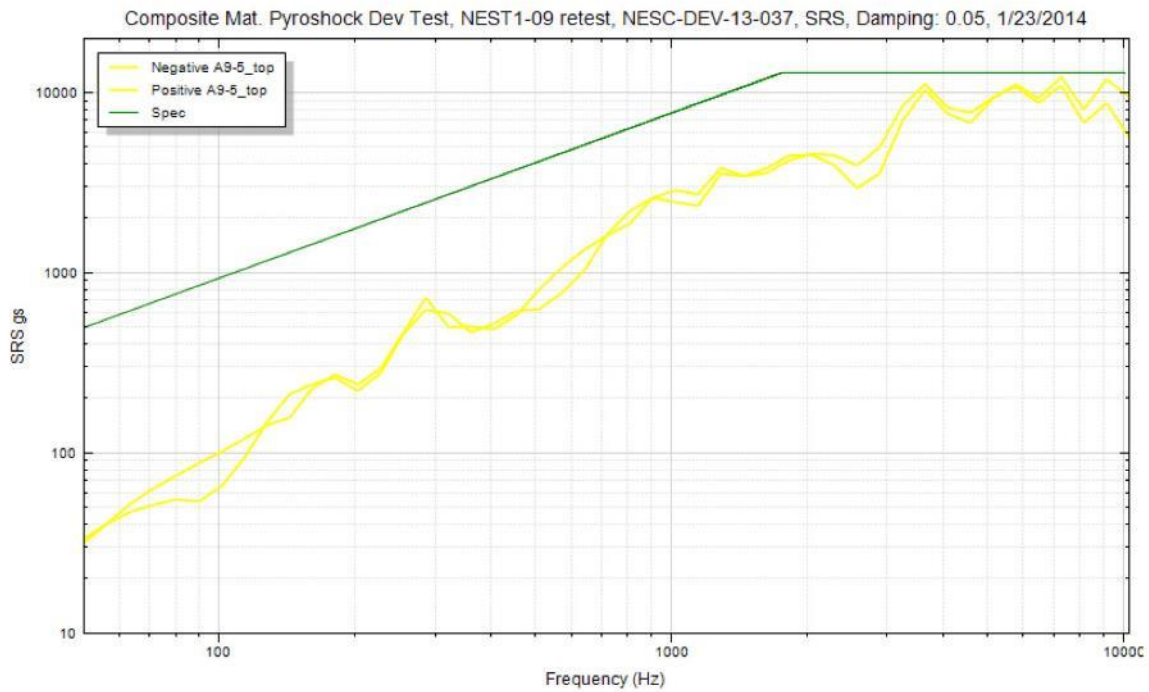
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
641 of 832





# NASA Engineering and Safety Center Technical Assessment Report

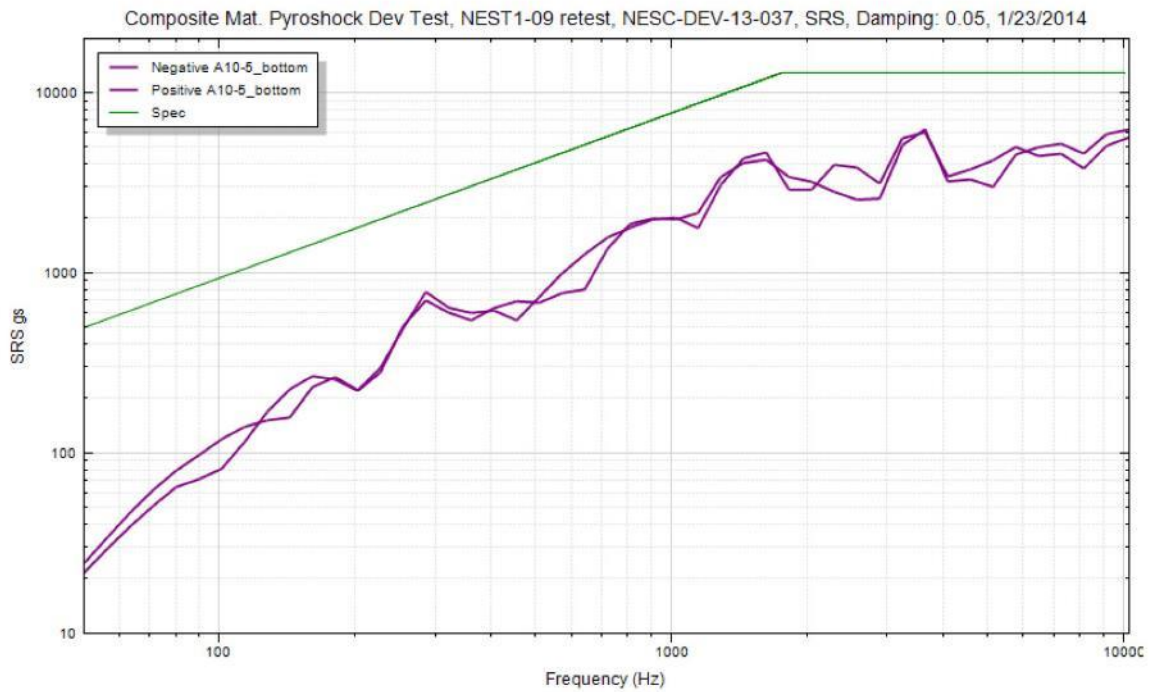
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
642 of 832





# NASA Engineering and Safety Center Technical Assessment Report

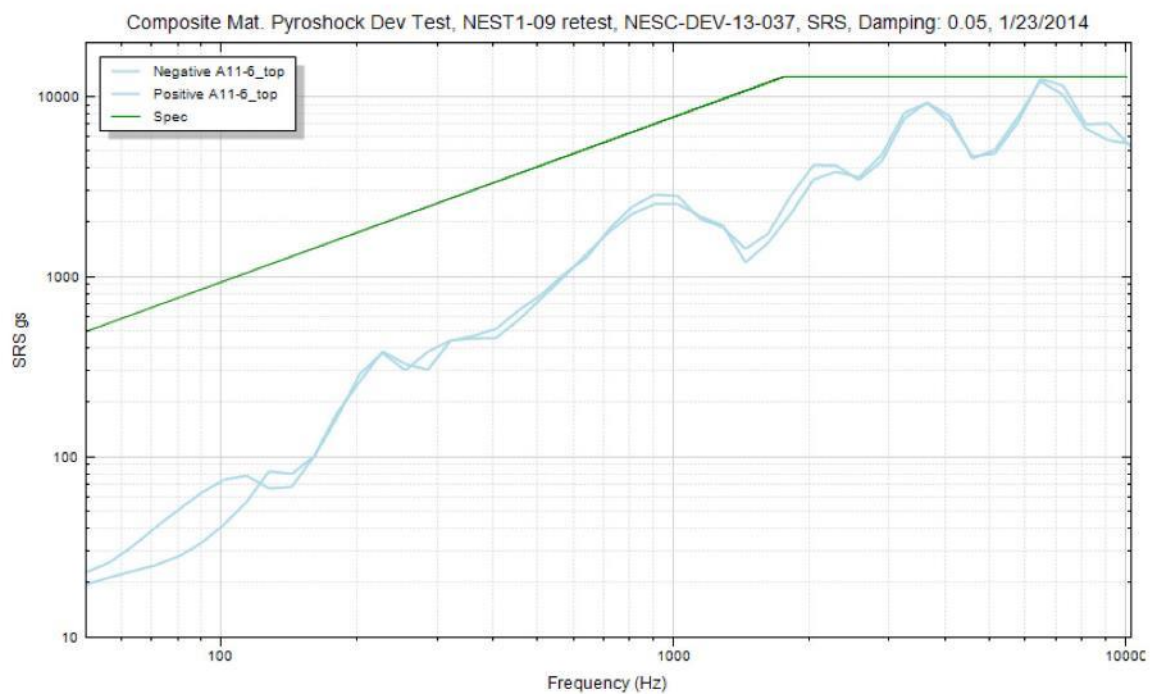
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
643 of 832





# NASA Engineering and Safety Center Technical Assessment Report

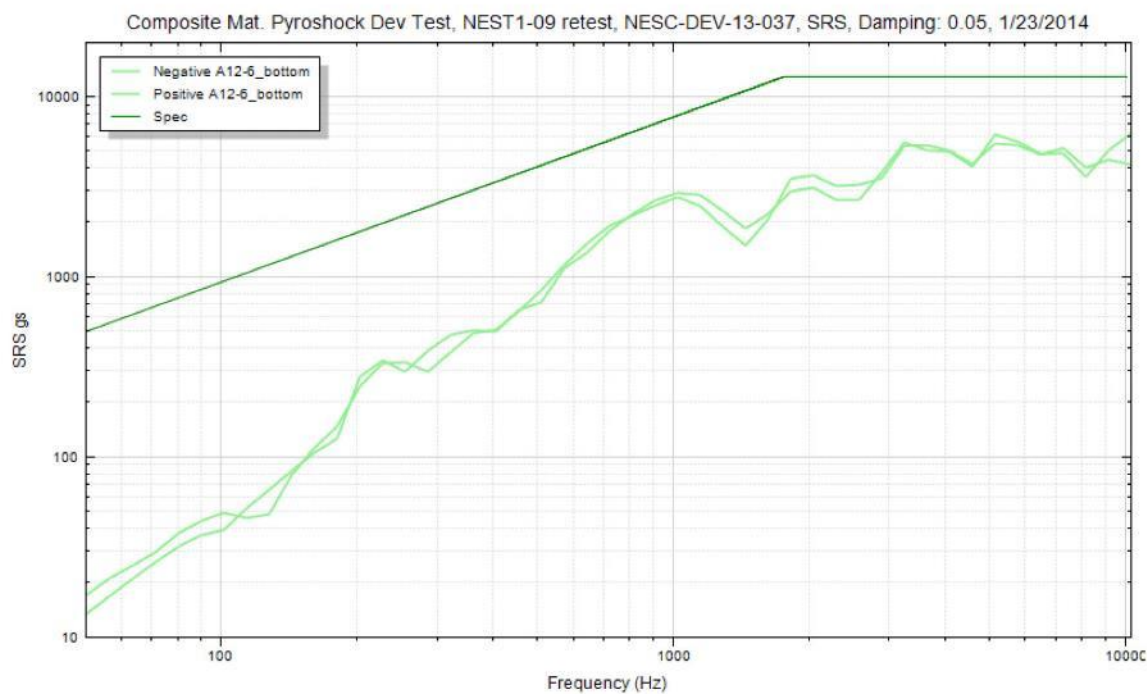
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
644 of 832







# NASA Engineering and Safety Center Technical Assessment Report

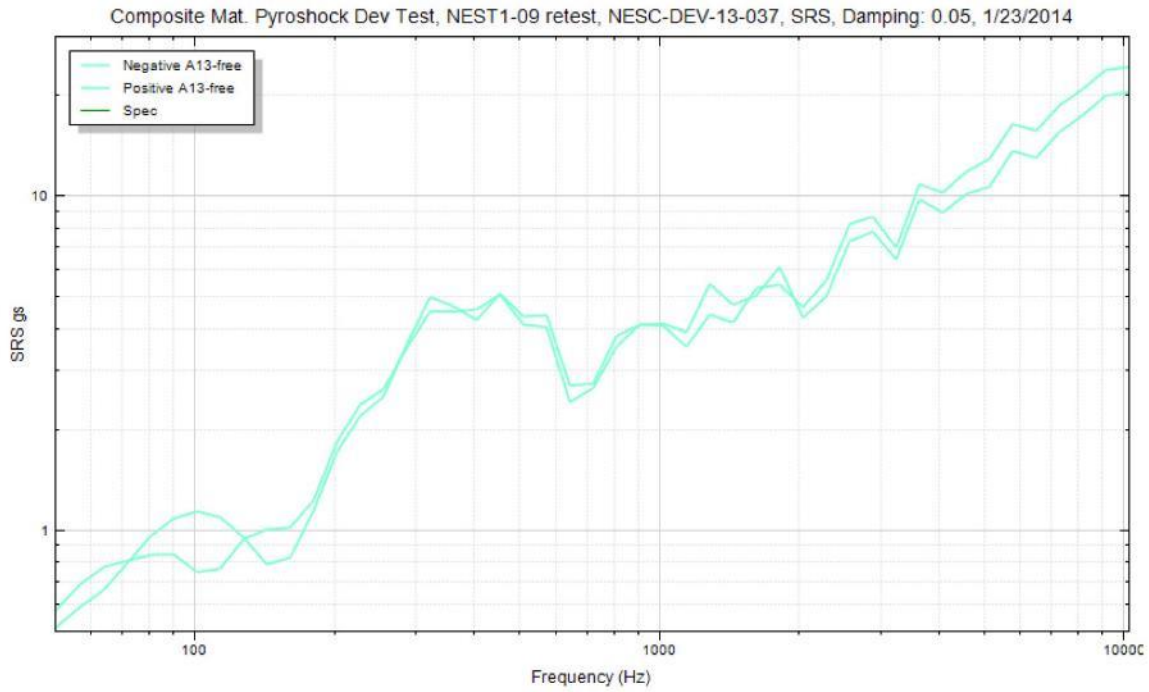
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
645 of 832





# NASA Engineering and Safety Center Technical Assessment Report

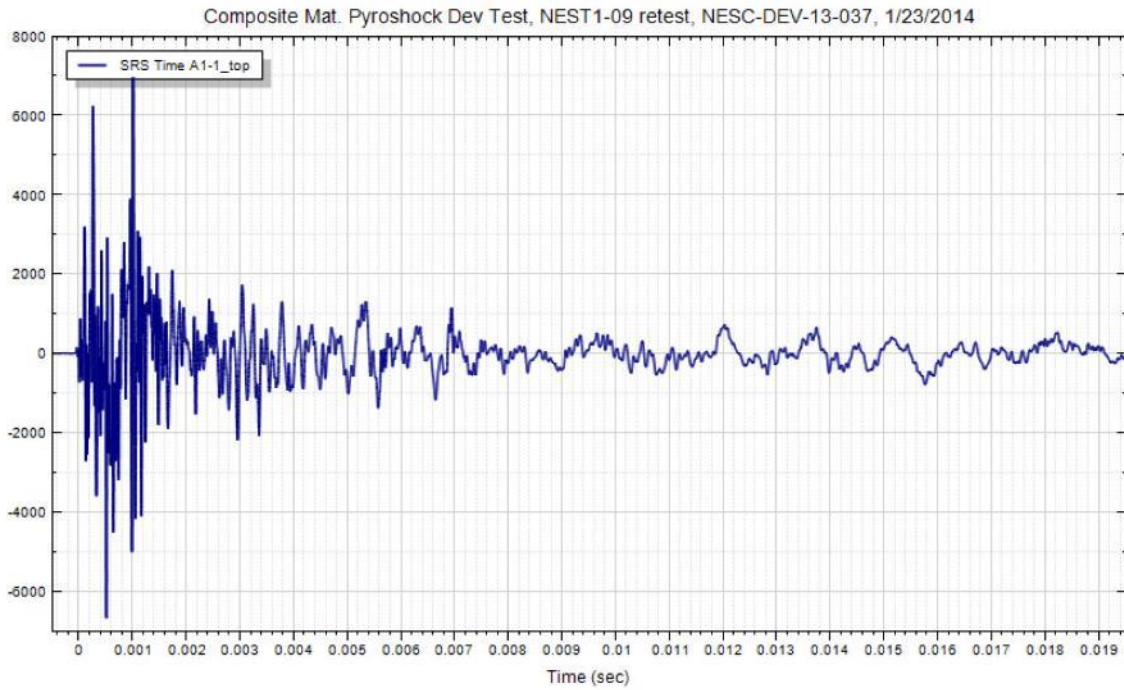
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
646 of 832





# NASA Engineering and Safety Center Technical Assessment Report

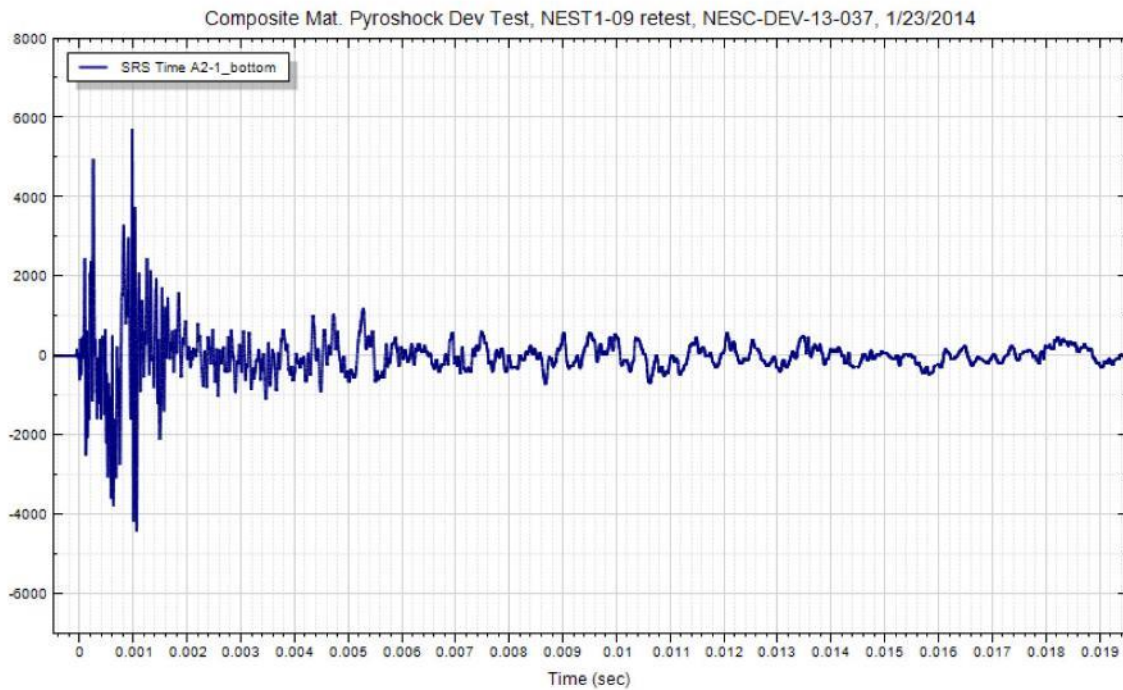
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
647 of 832





# NASA Engineering and Safety Center Technical Assessment Report

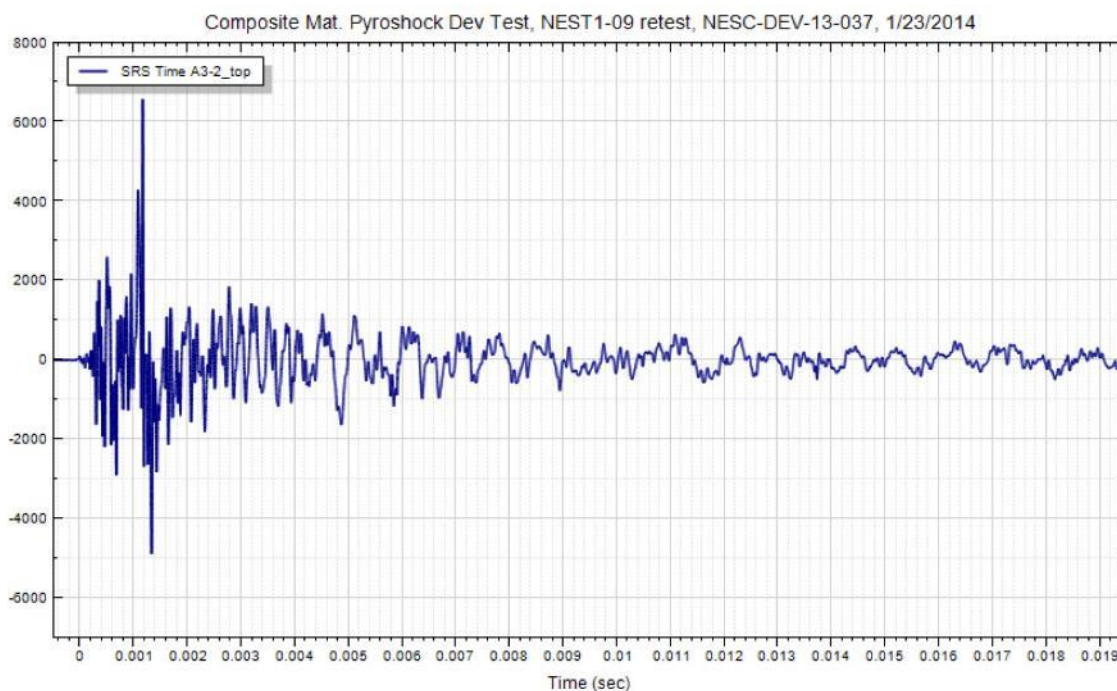
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
648 of 832





# NASA Engineering and Safety Center Technical Assessment Report

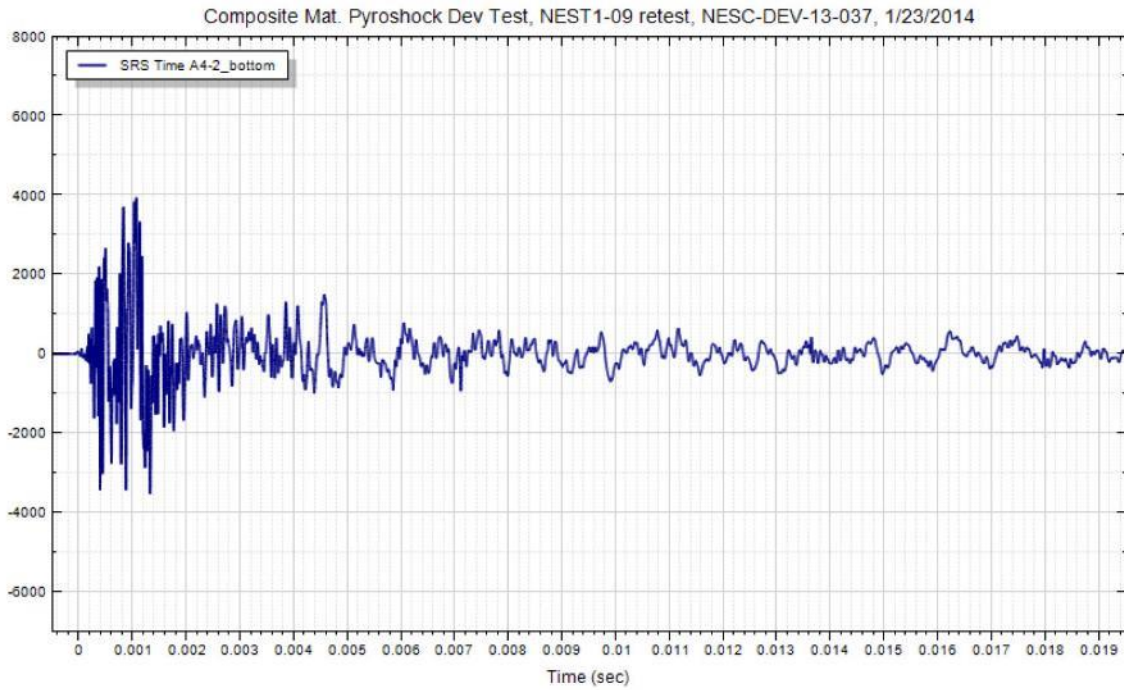
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
649 of 832





# NASA Engineering and Safety Center Technical Assessment Report

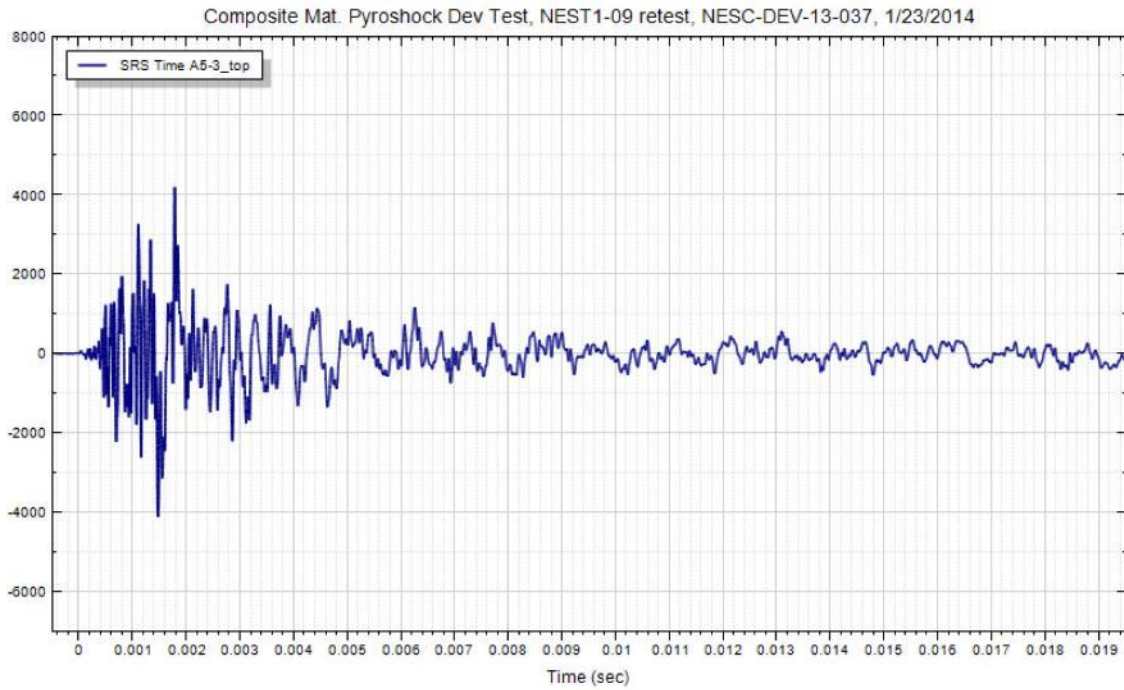
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
650 of 832





# NASA Engineering and Safety Center Technical Assessment Report

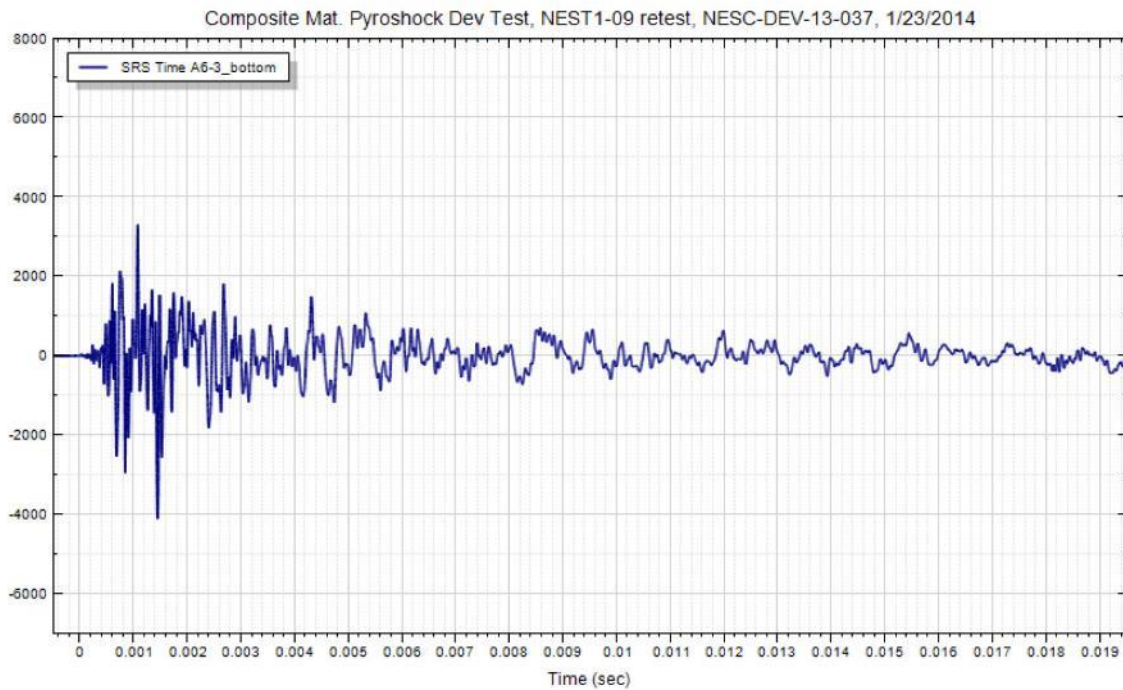
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
651 of 832



337 of 518



# NASA Engineering and Safety Center Technical Assessment Report

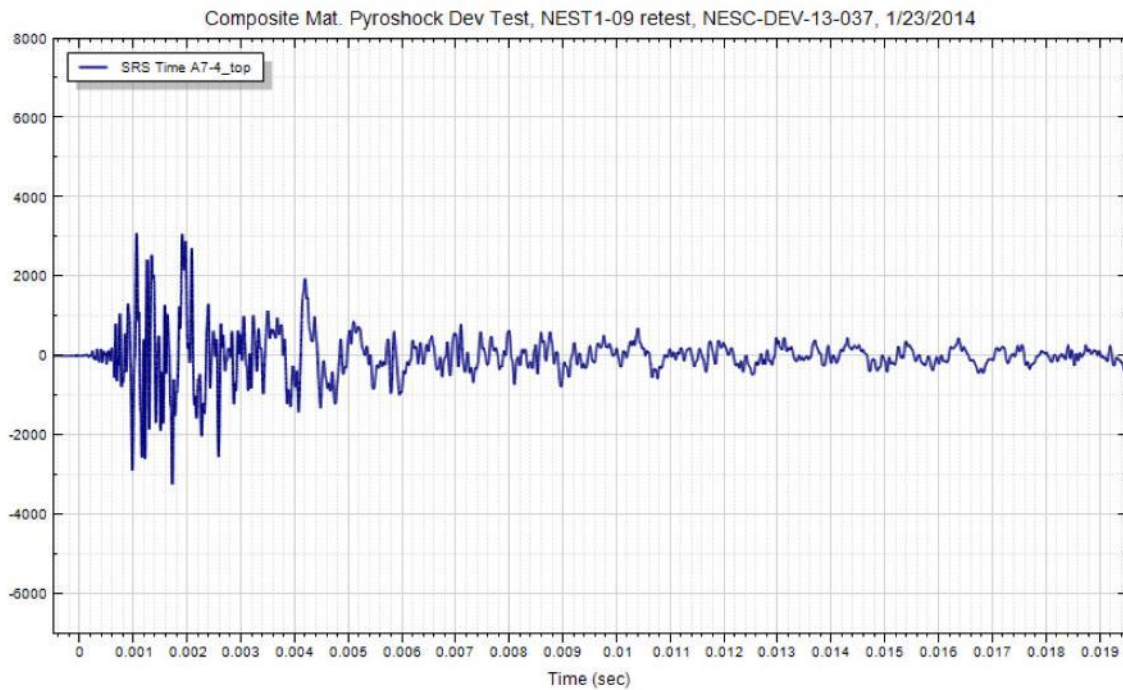
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
652 of 832







# NASA Engineering and Safety Center Technical Assessment Report

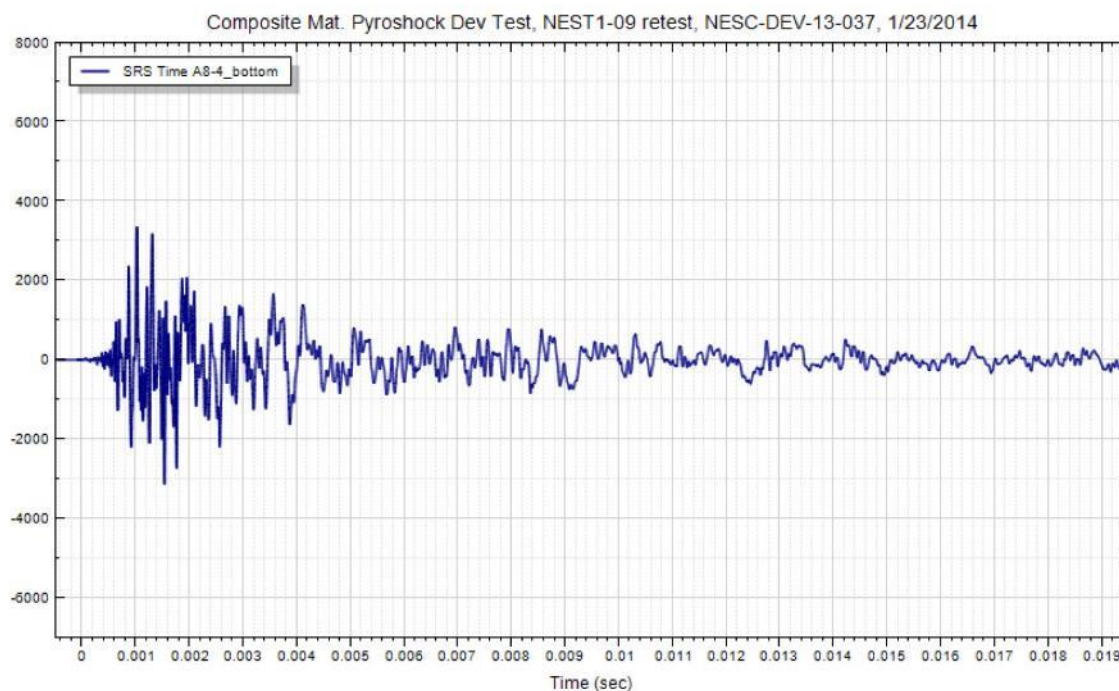
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
653 of 832





# NASA Engineering and Safety Center Technical Assessment Report

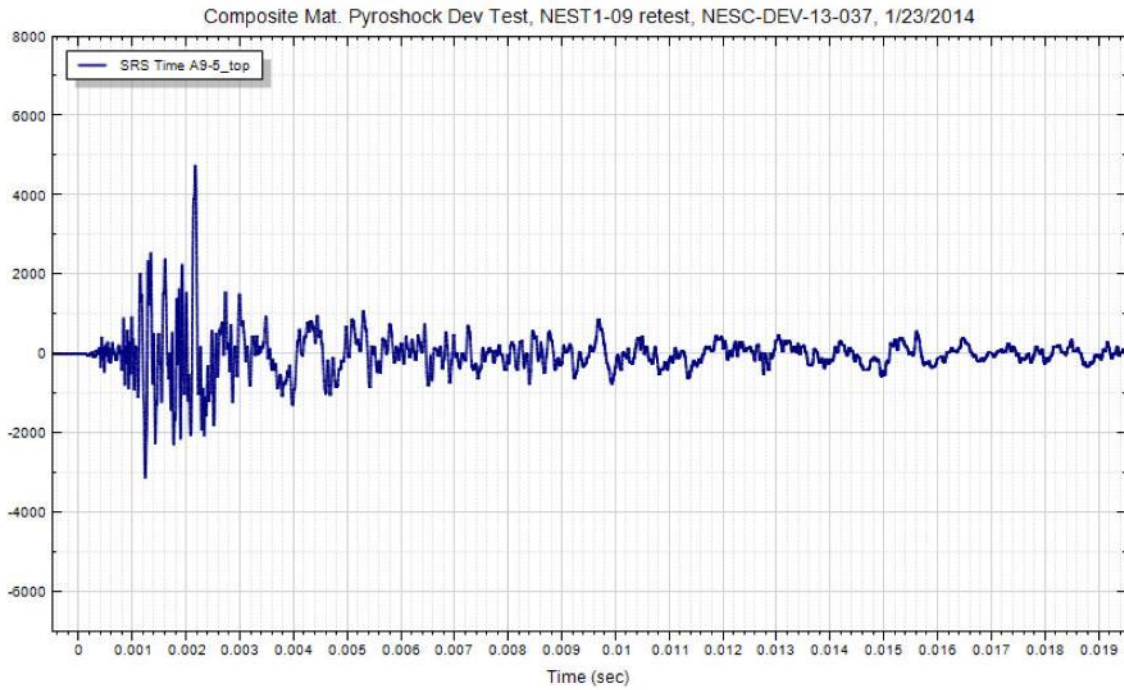
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
654 of 832





# NASA Engineering and Safety Center Technical Assessment Report

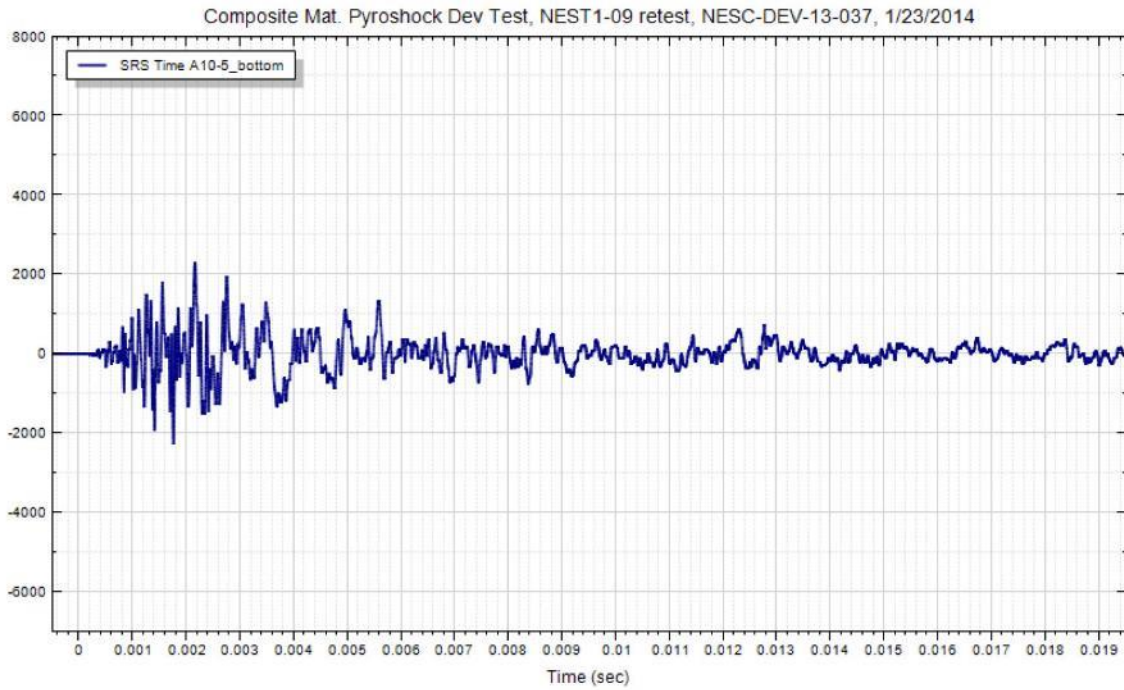
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
655 of 832





# NASA Engineering and Safety Center Technical Assessment Report

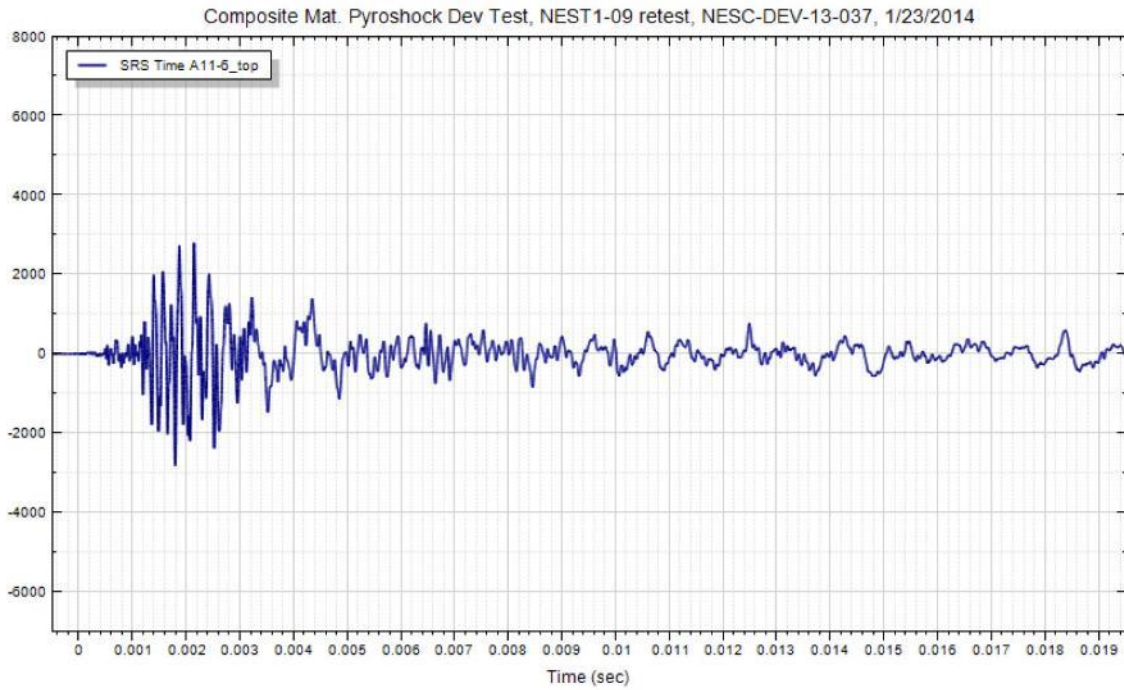
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
656 of 832





# NASA Engineering and Safety Center Technical Assessment Report

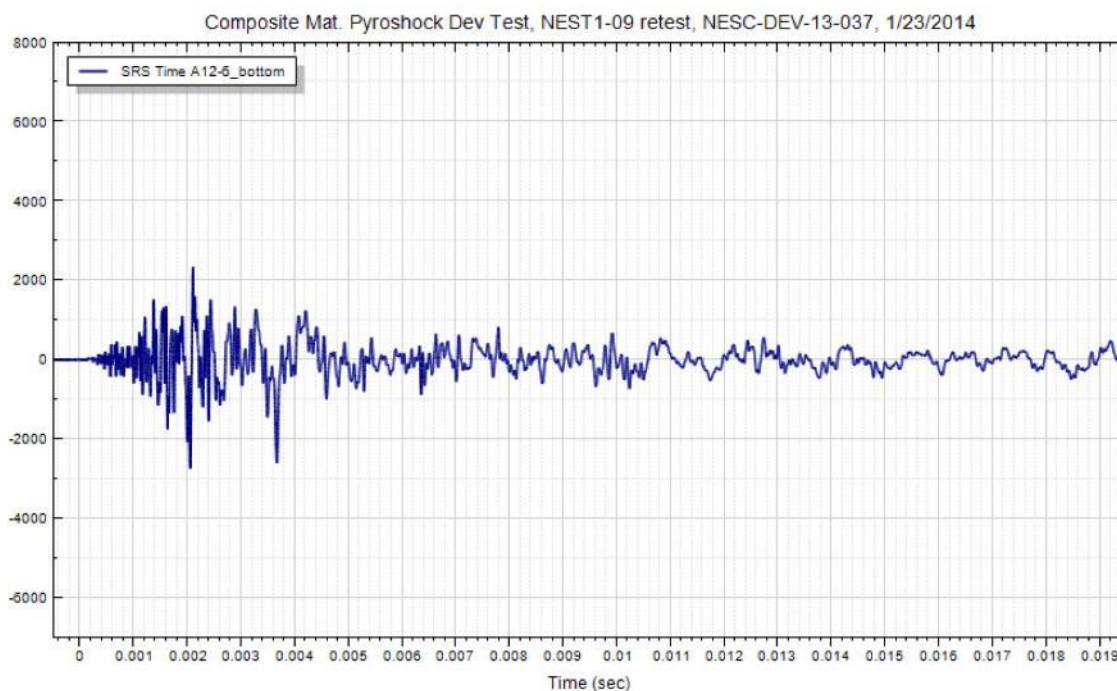
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
657 of 832





# NASA Engineering and Safety Center Technical Assessment Report

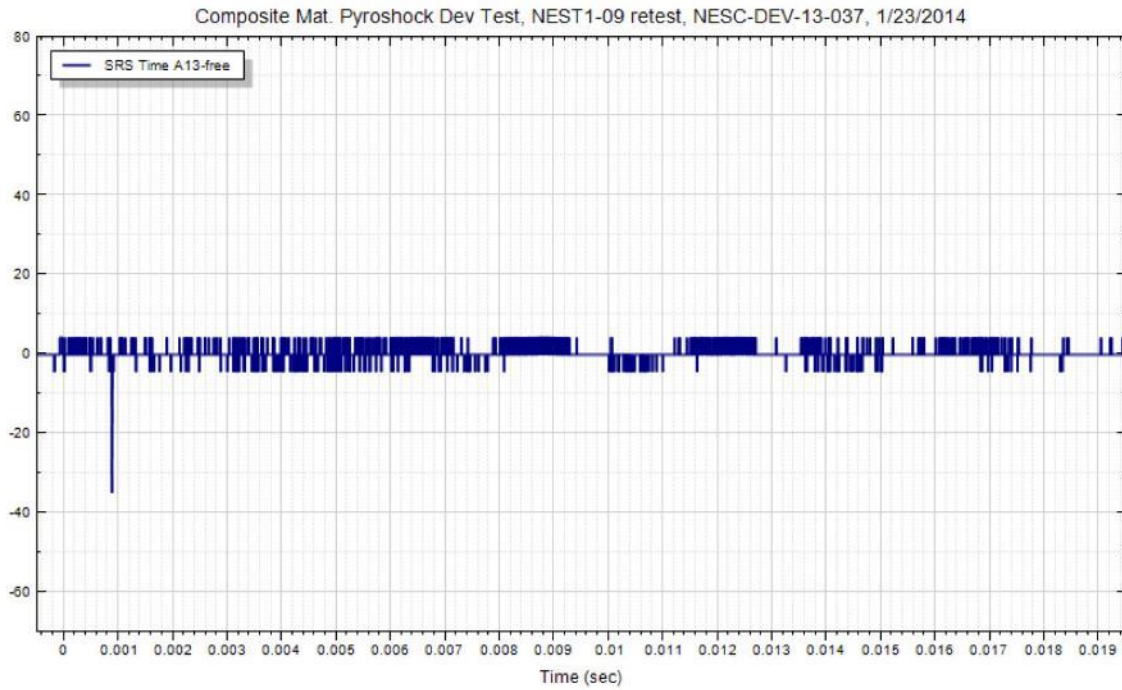
Document #:  
**NESC-RP-  
12-00783**


Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
658 of 832



	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 659 of 832</p>	

**NESC-DEV-13-037**  
**Composite Materials**  
**Shock Test**  
  
**Test #10 Accelerometer Data**  
**Panel 0346A028**



# NASA Engineering and Safety Center Technical Assessment Report

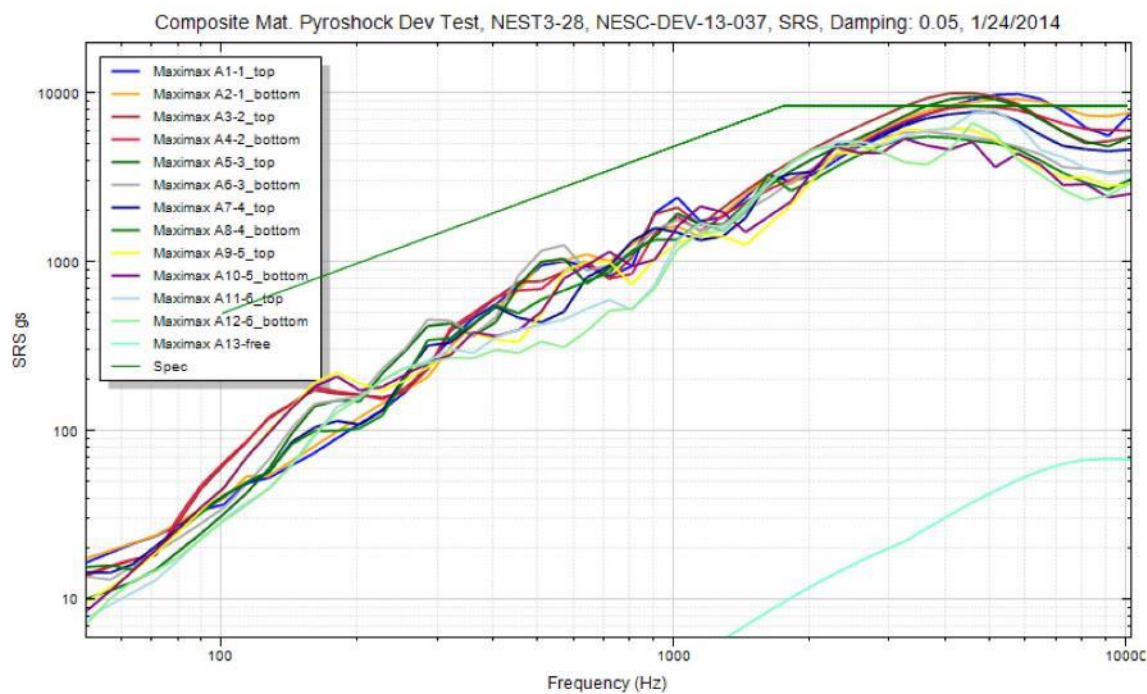
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
660 of 832







# NASA Engineering and Safety Center Technical Assessment Report

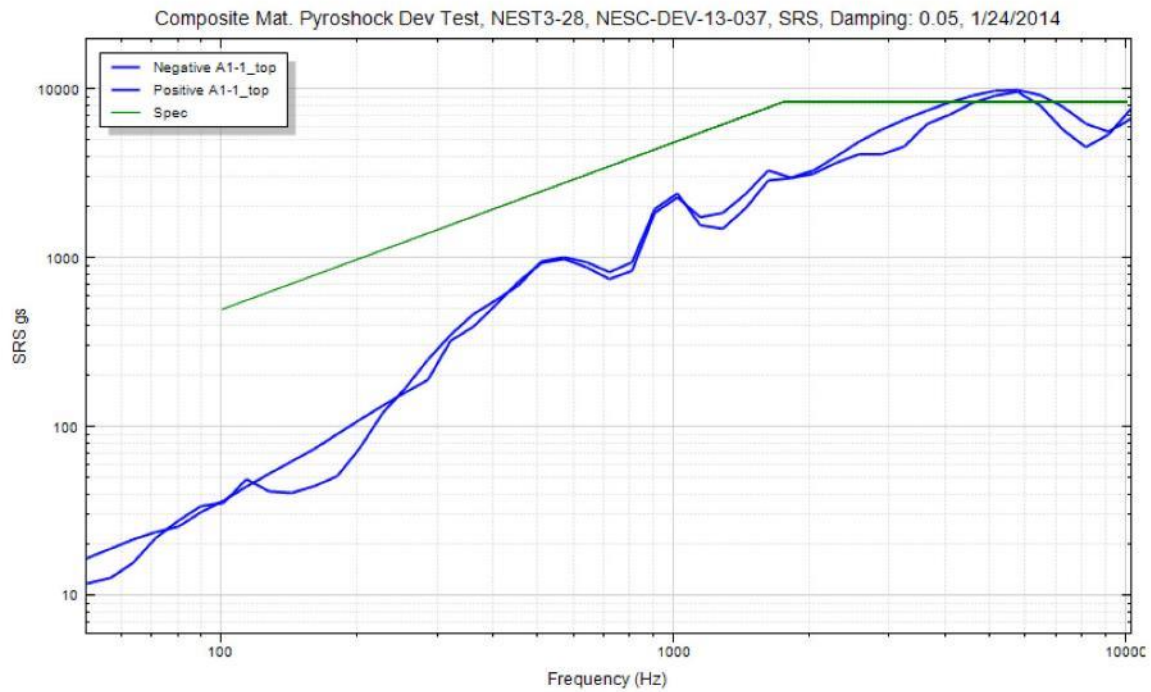
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
661 of 832





# NASA Engineering and Safety Center Technical Assessment Report

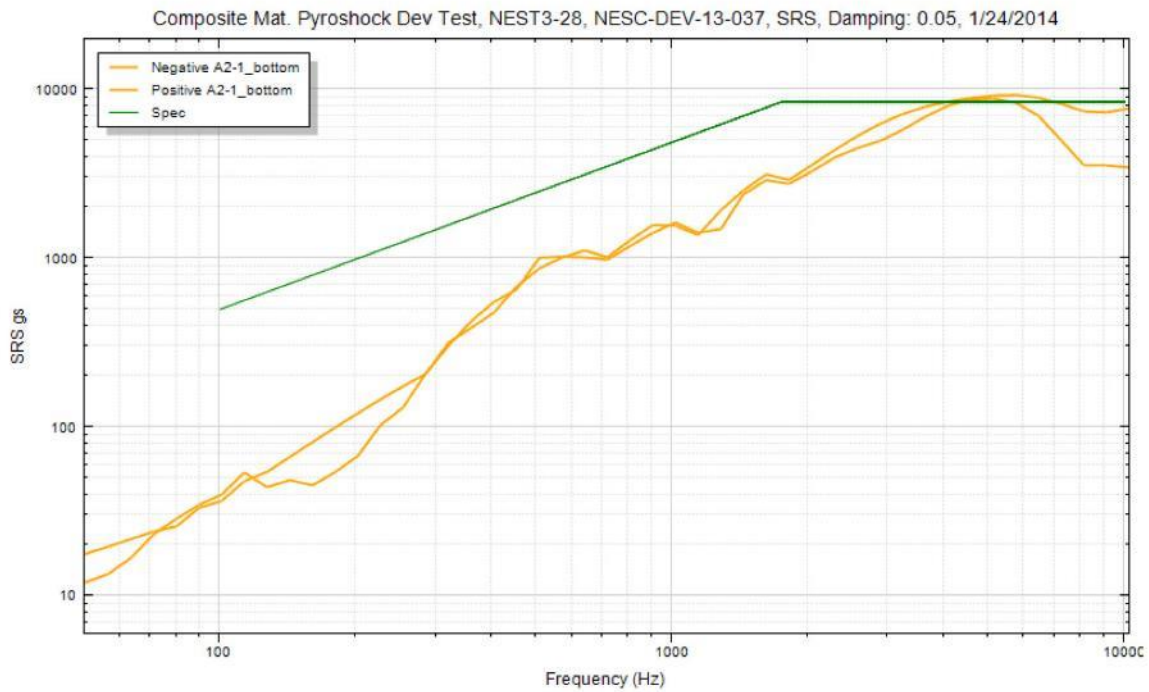
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
662 of 832





# NASA Engineering and Safety Center Technical Assessment Report

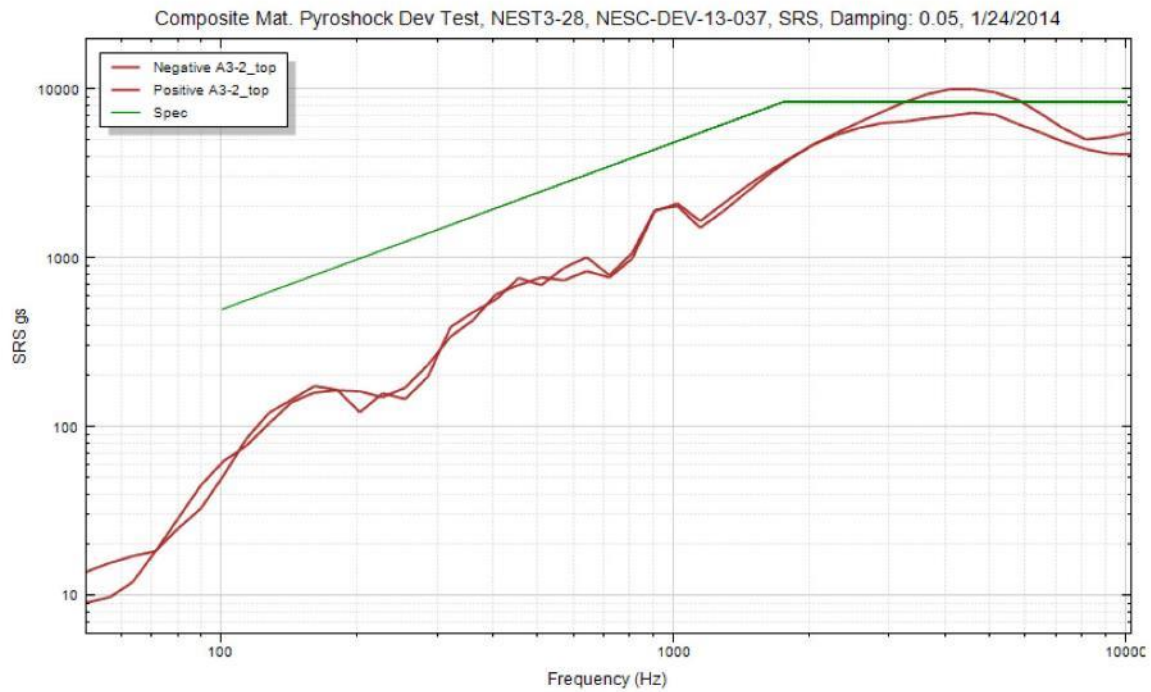
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
663 of 832





# NASA Engineering and Safety Center Technical Assessment Report

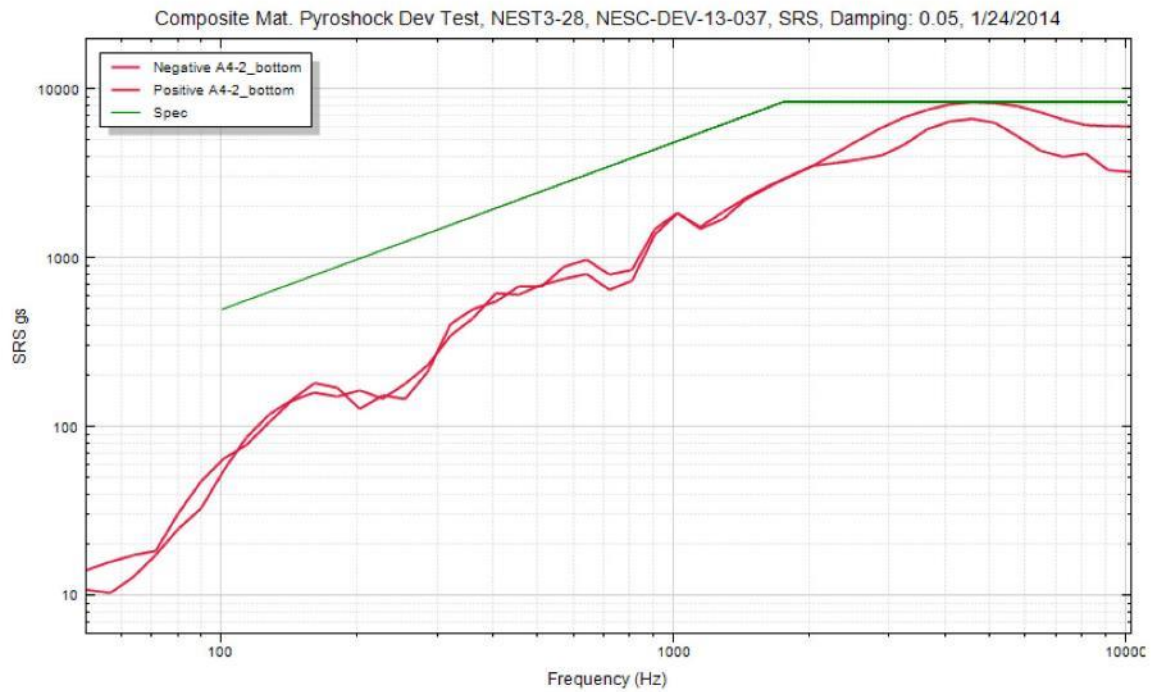
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
664 of 832





# NASA Engineering and Safety Center Technical Assessment Report

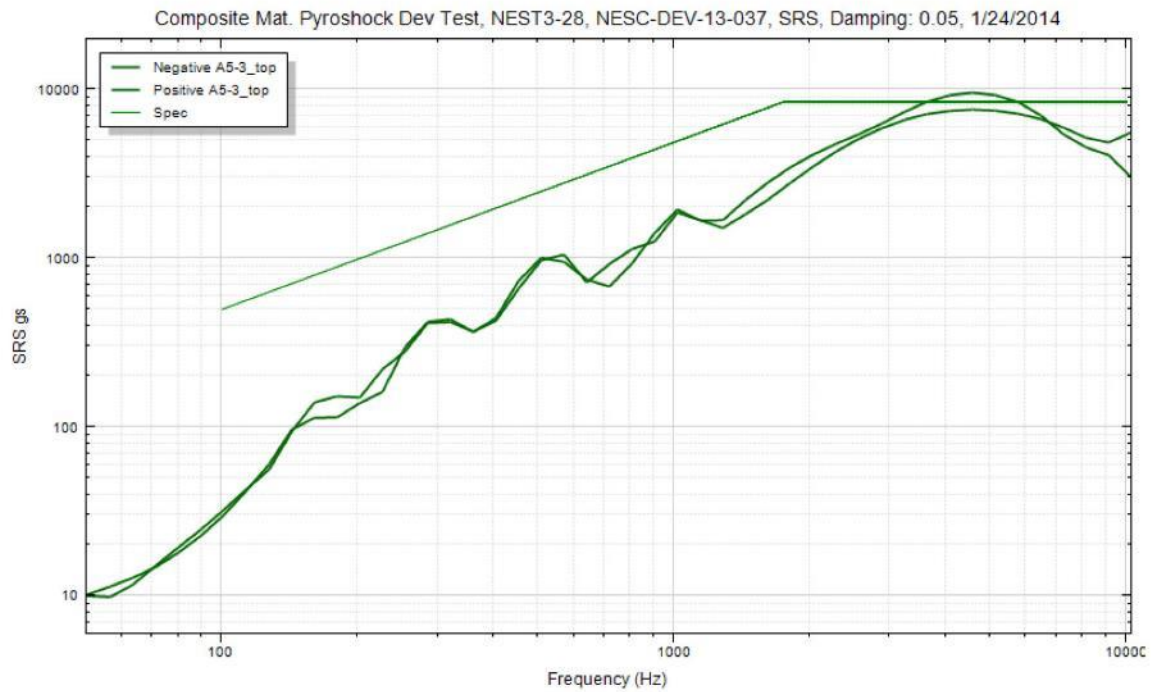
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
665 of 832





# NASA Engineering and Safety Center Technical Assessment Report

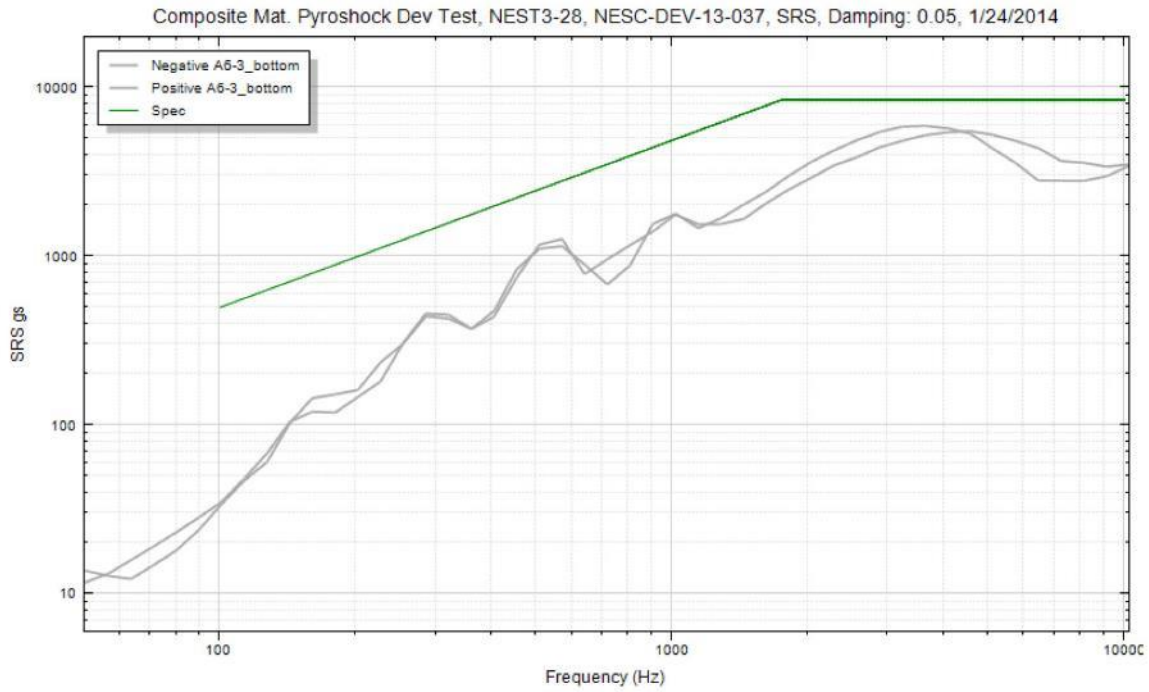
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
666 of 832





# NASA Engineering and Safety Center Technical Assessment Report

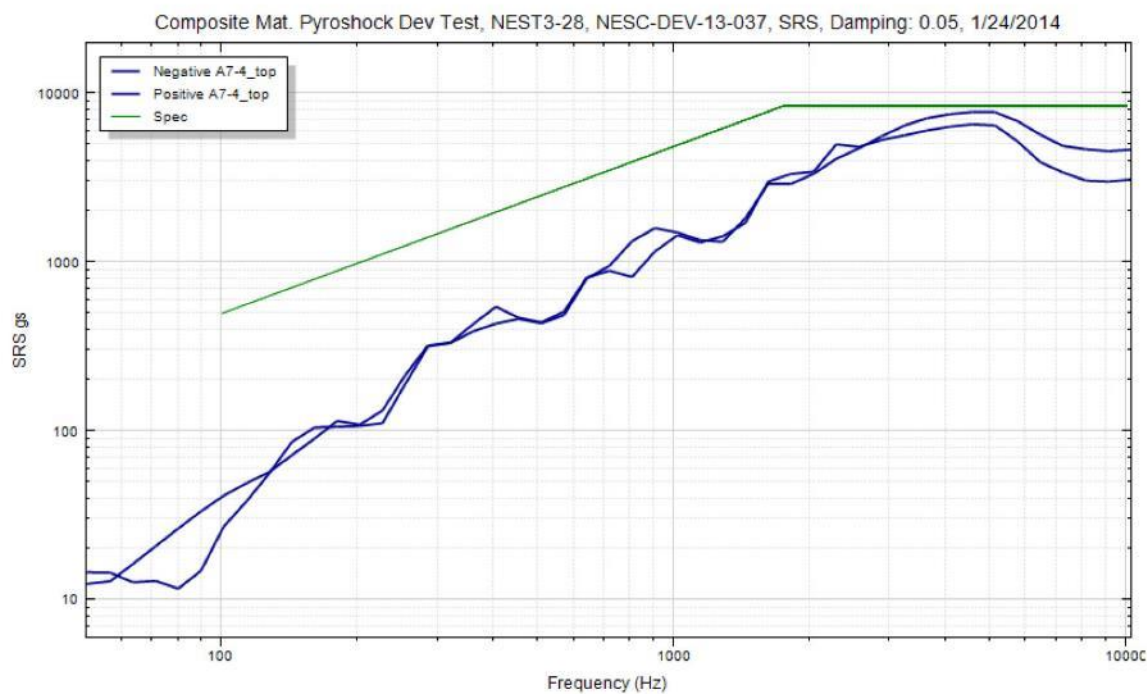
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
667 of 832





# NASA Engineering and Safety Center Technical Assessment Report

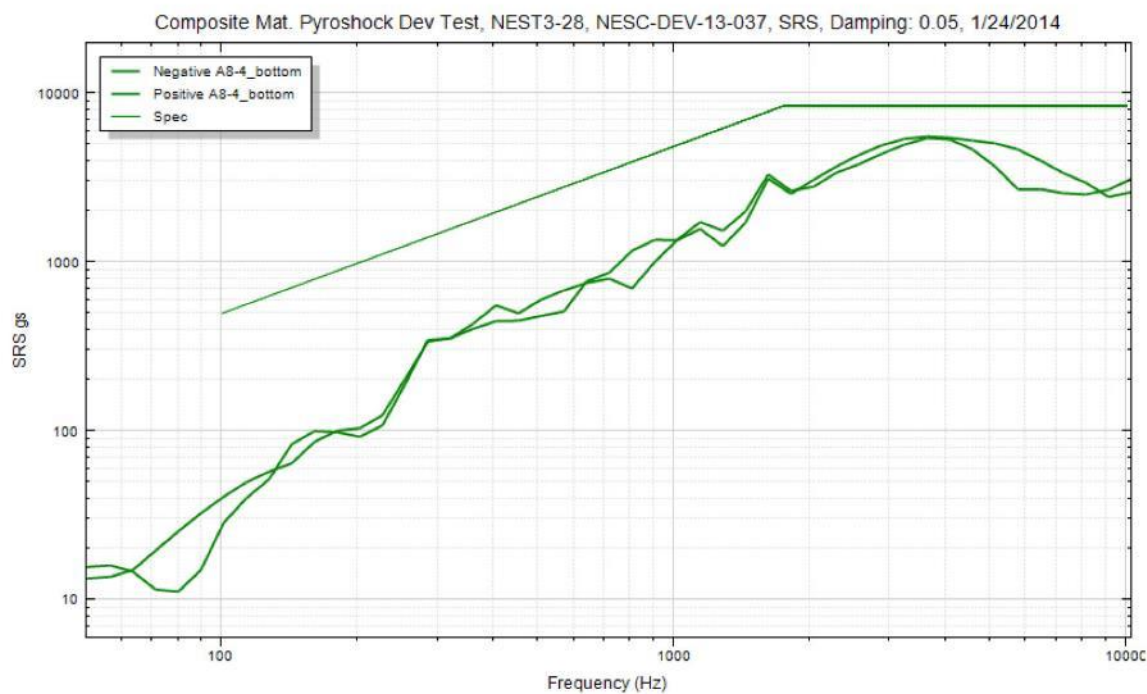
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
668 of 832







# NASA Engineering and Safety Center Technical Assessment Report

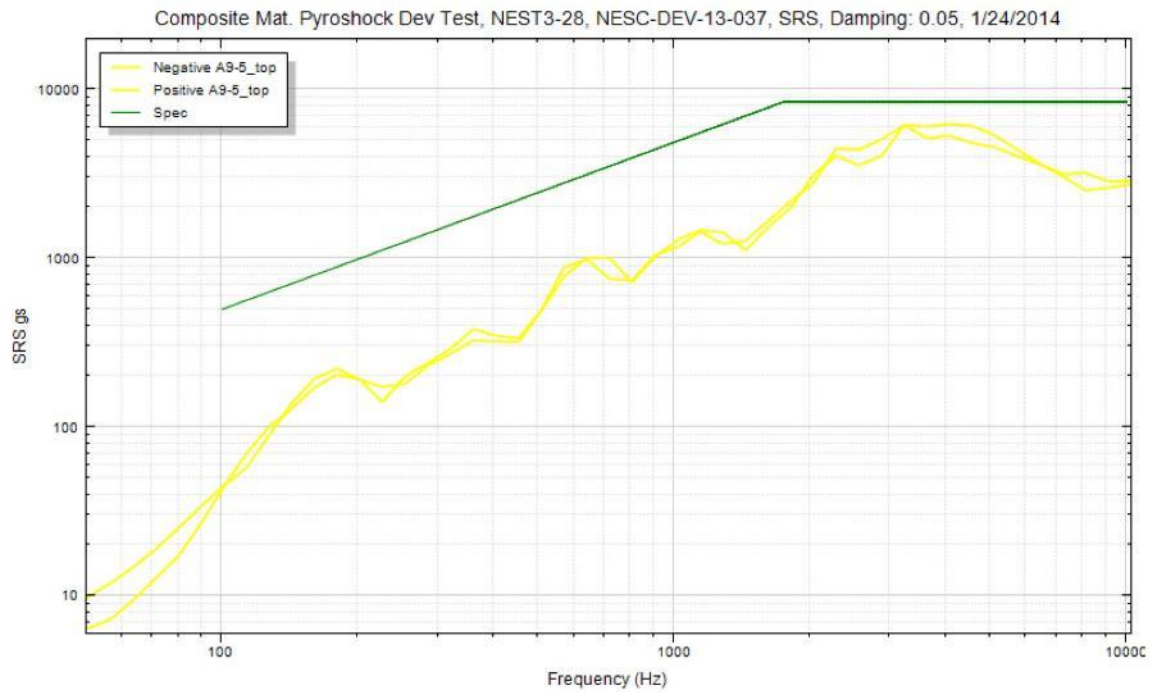
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
669 of 832





# NASA Engineering and Safety Center Technical Assessment Report

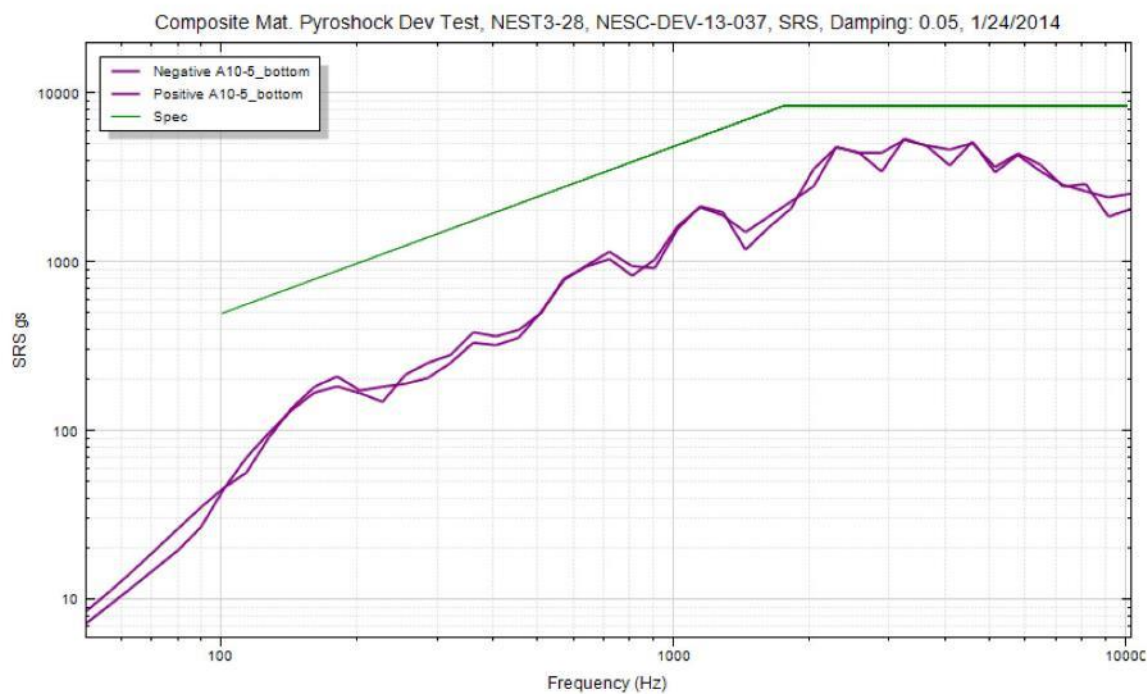
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
670 of 832





# NASA Engineering and Safety Center Technical Assessment Report

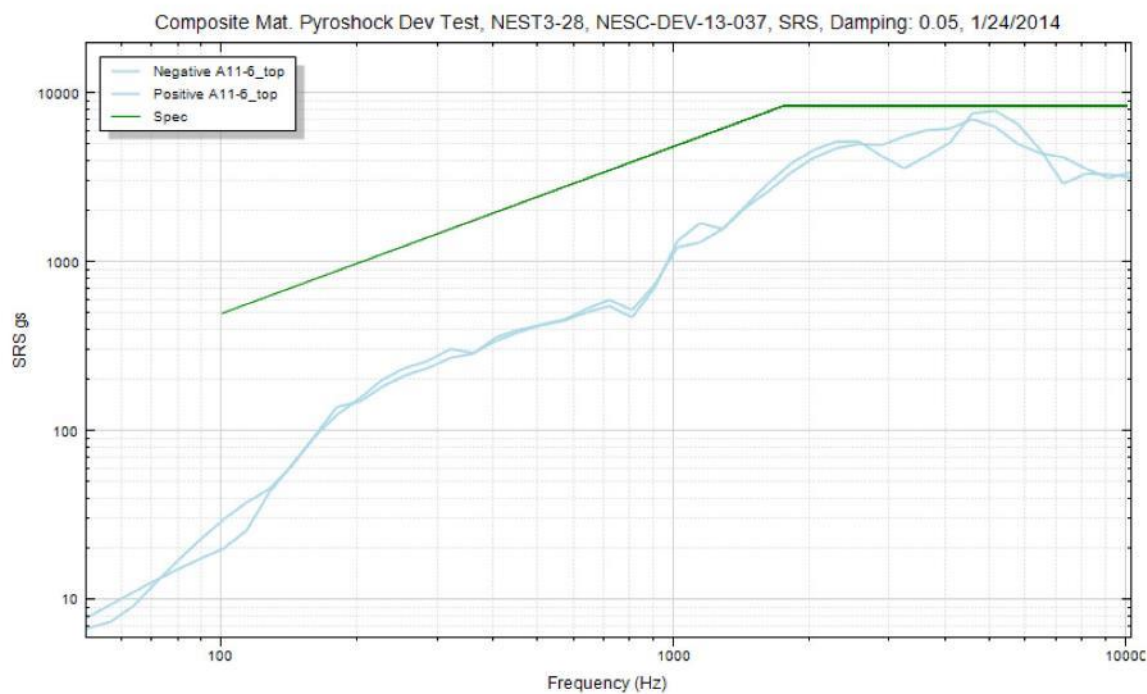
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
671 of 832





# NASA Engineering and Safety Center Technical Assessment Report

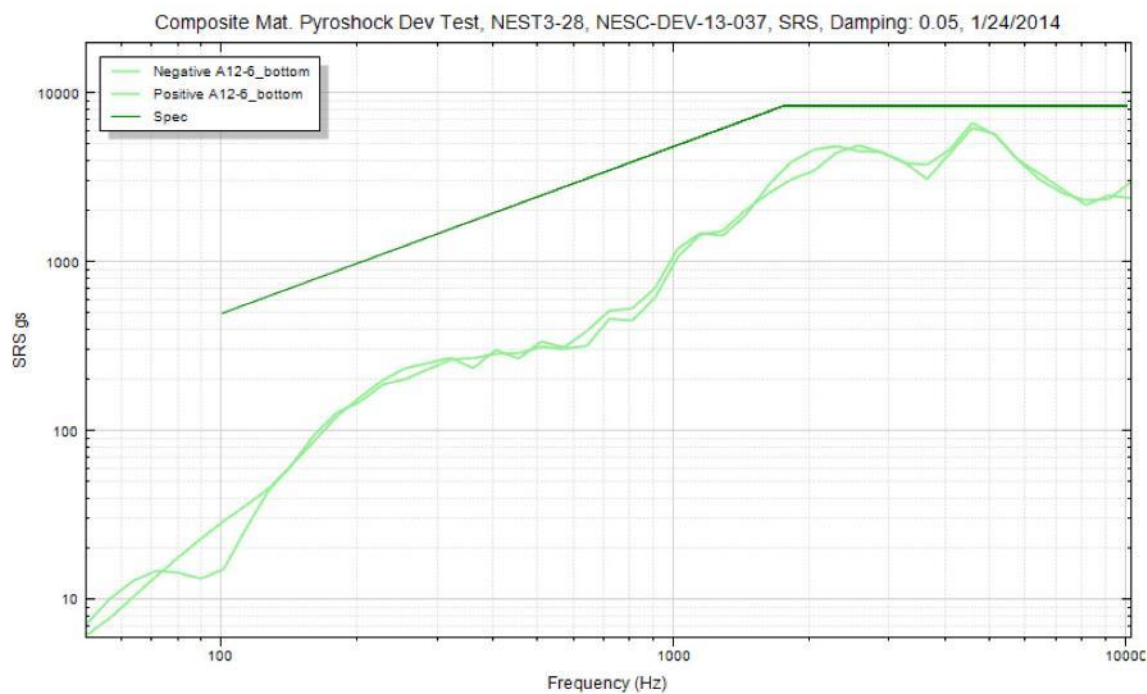
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
672 of 832





# NASA Engineering and Safety Center Technical Assessment Report

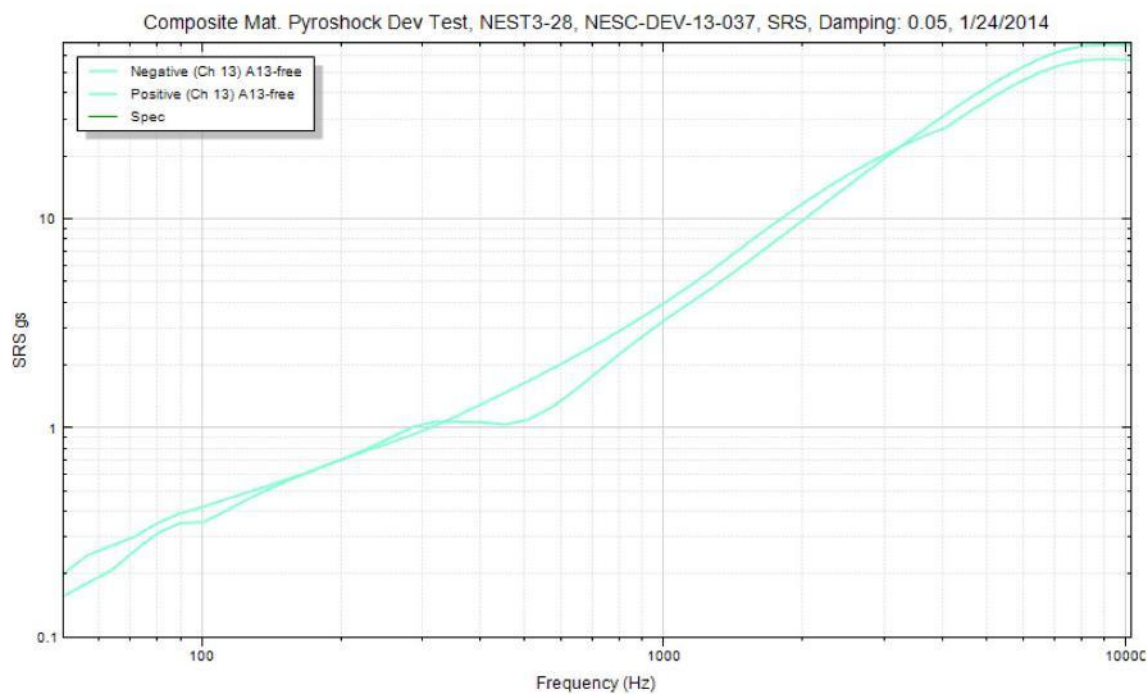
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
673 of 832





# NASA Engineering and Safety Center Technical Assessment Report

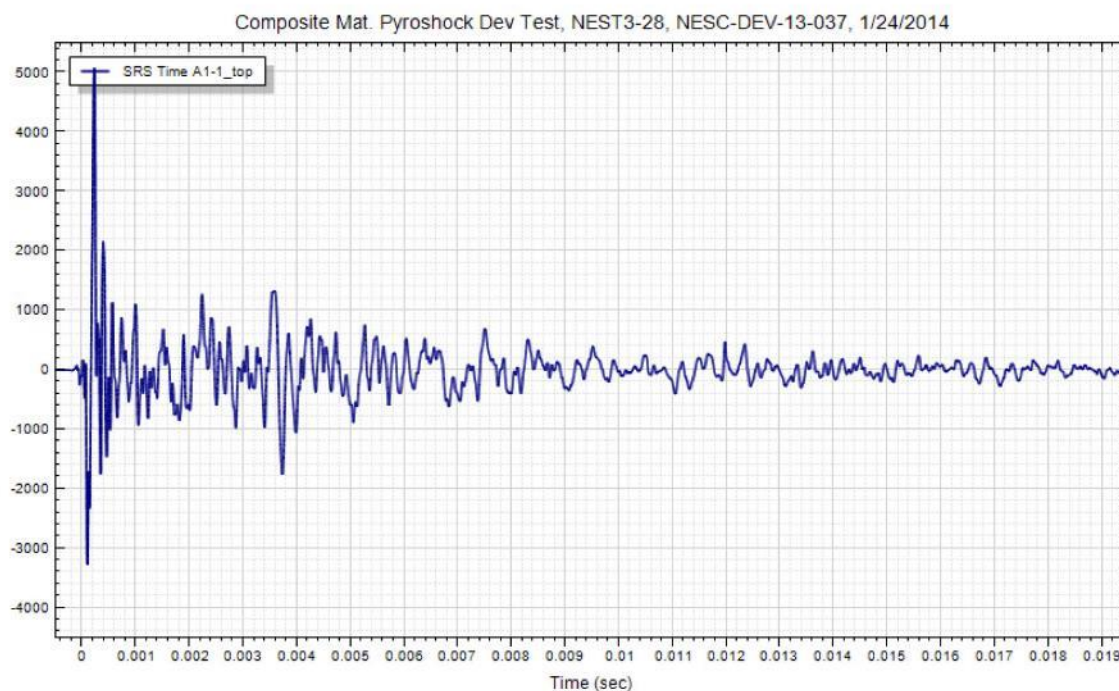
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
674 of 832





# NASA Engineering and Safety Center Technical Assessment Report

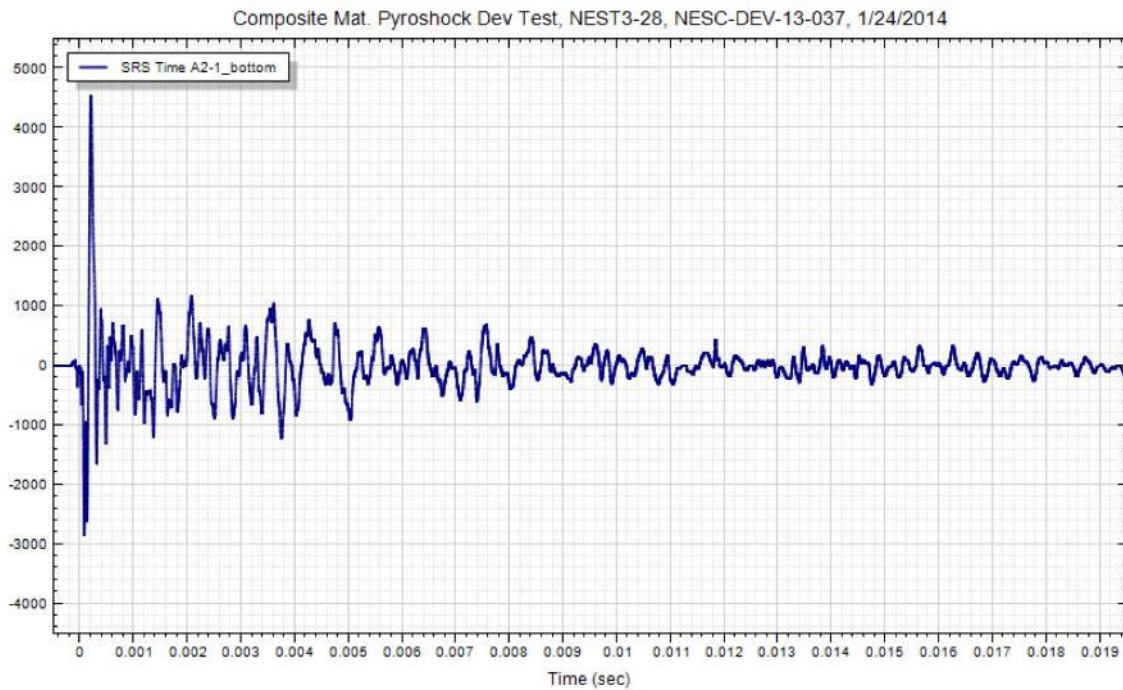
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
675 of 832





# NASA Engineering and Safety Center Technical Assessment Report

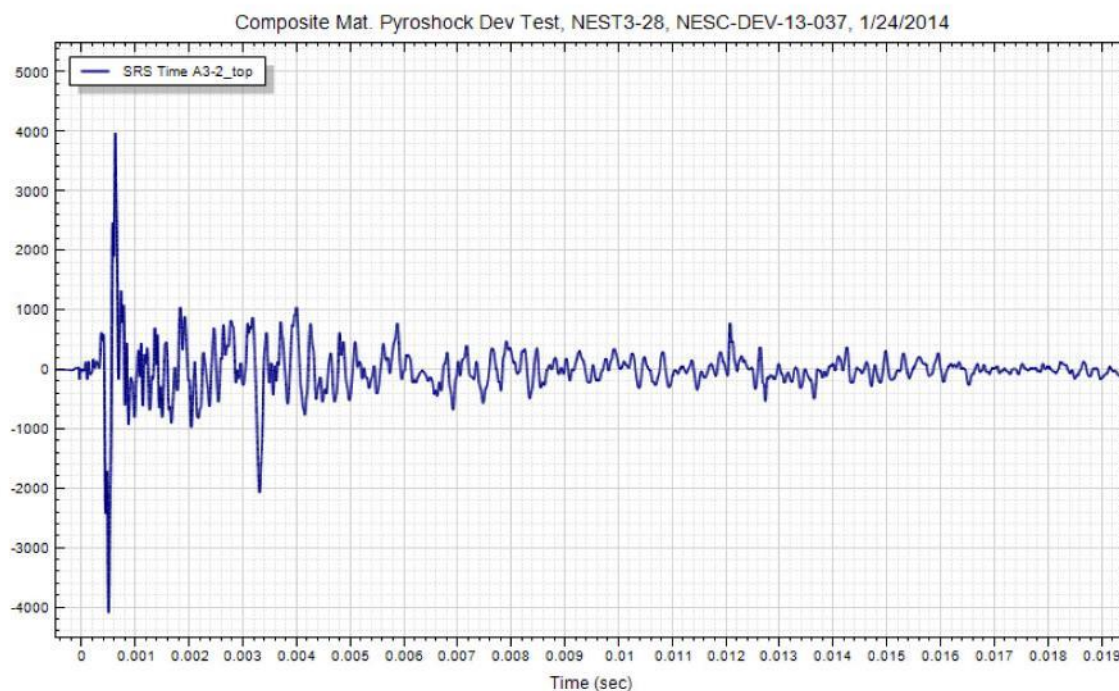
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
676 of 832







# NASA Engineering and Safety Center Technical Assessment Report

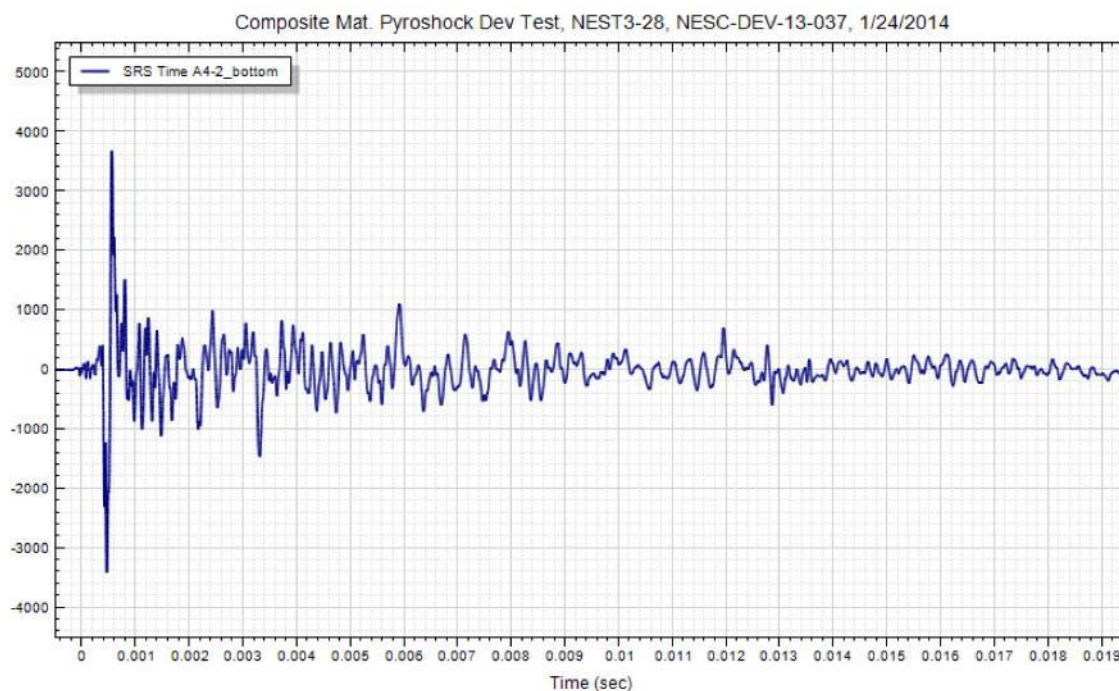
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
677 of 832



363 of 518



# NASA Engineering and Safety Center Technical Assessment Report

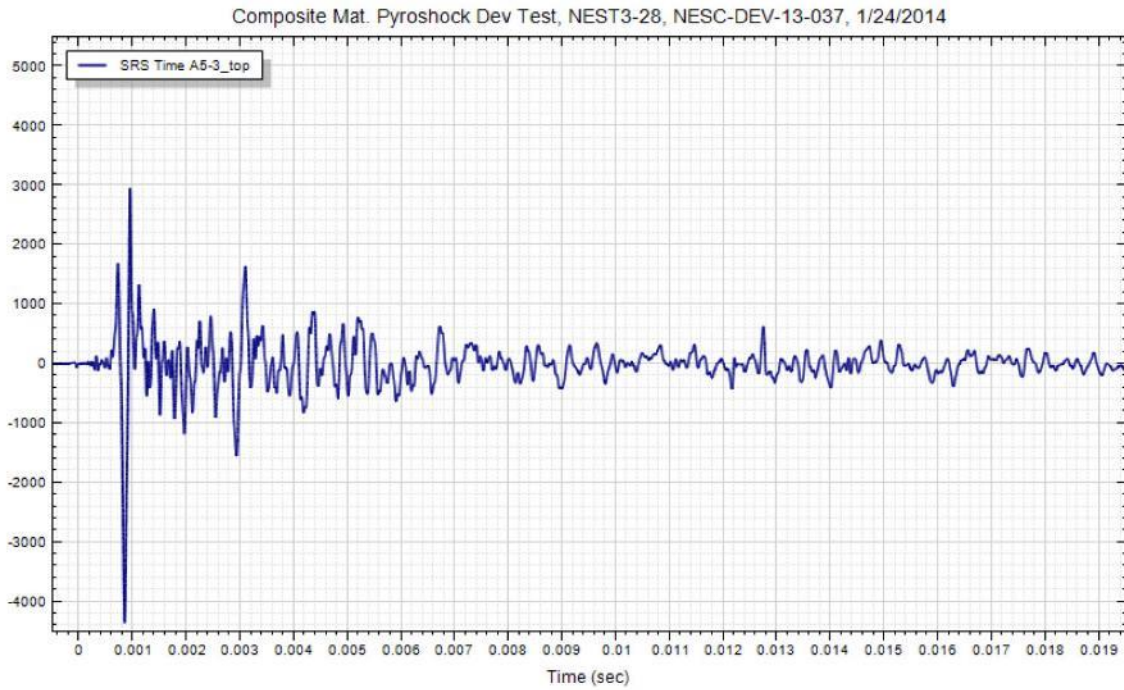
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
678 of 832





# NASA Engineering and Safety Center Technical Assessment Report

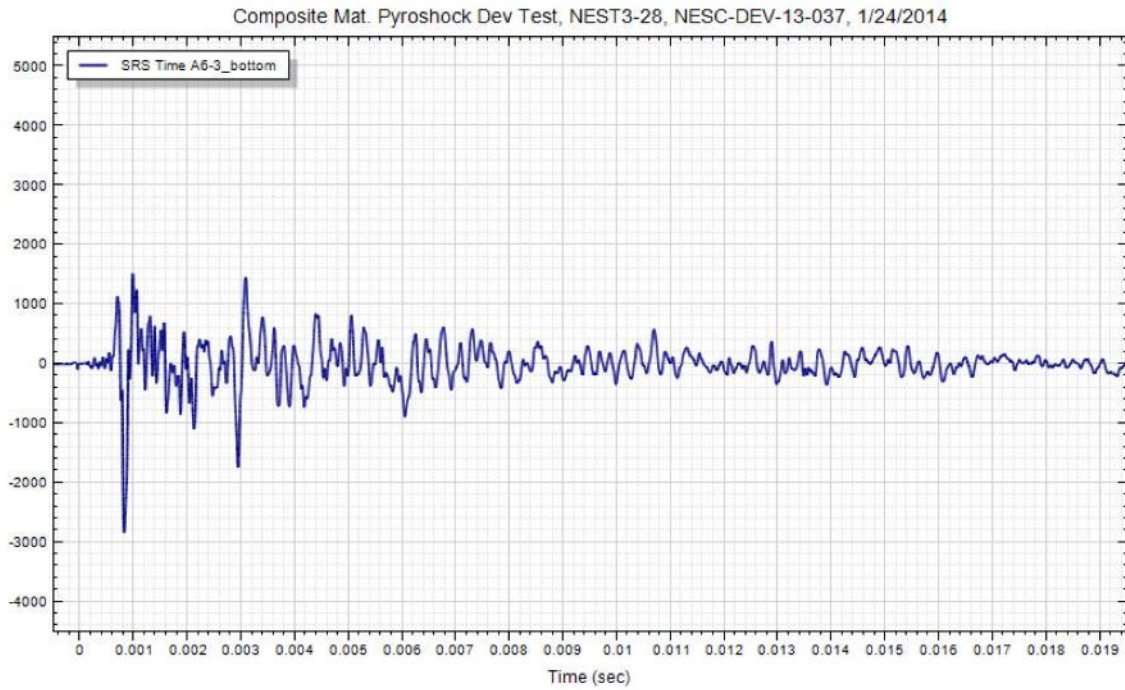
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
679 of 832





# NASA Engineering and Safety Center Technical Assessment Report

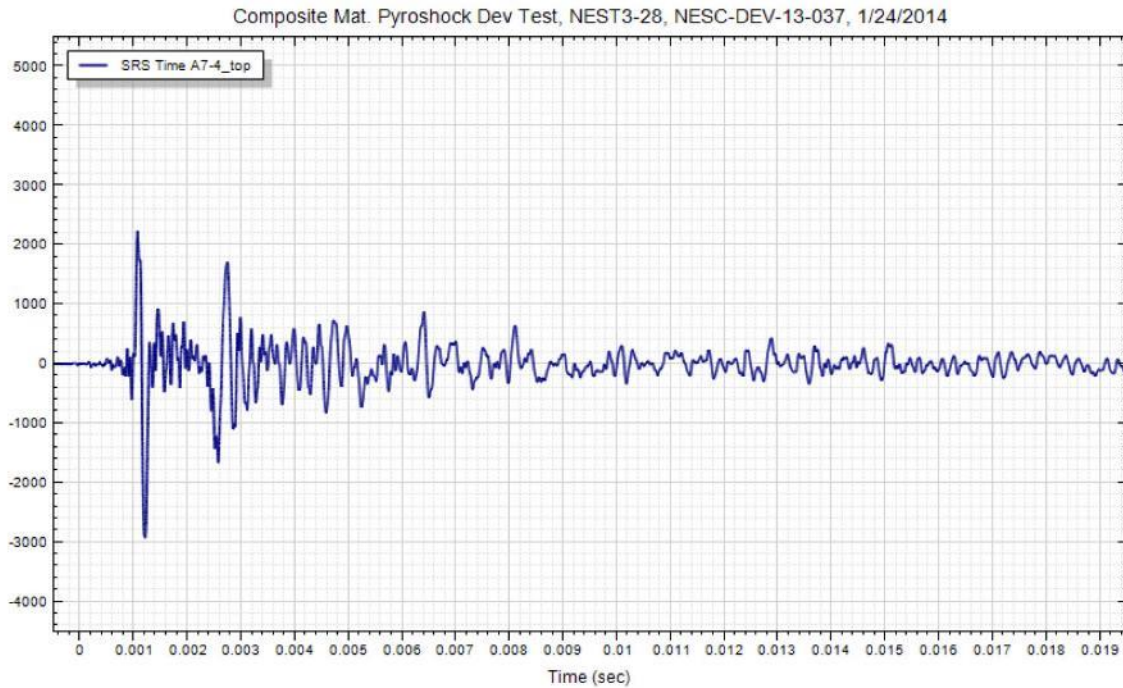
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
680 of 832



366 of 518



# NASA Engineering and Safety Center Technical Assessment Report

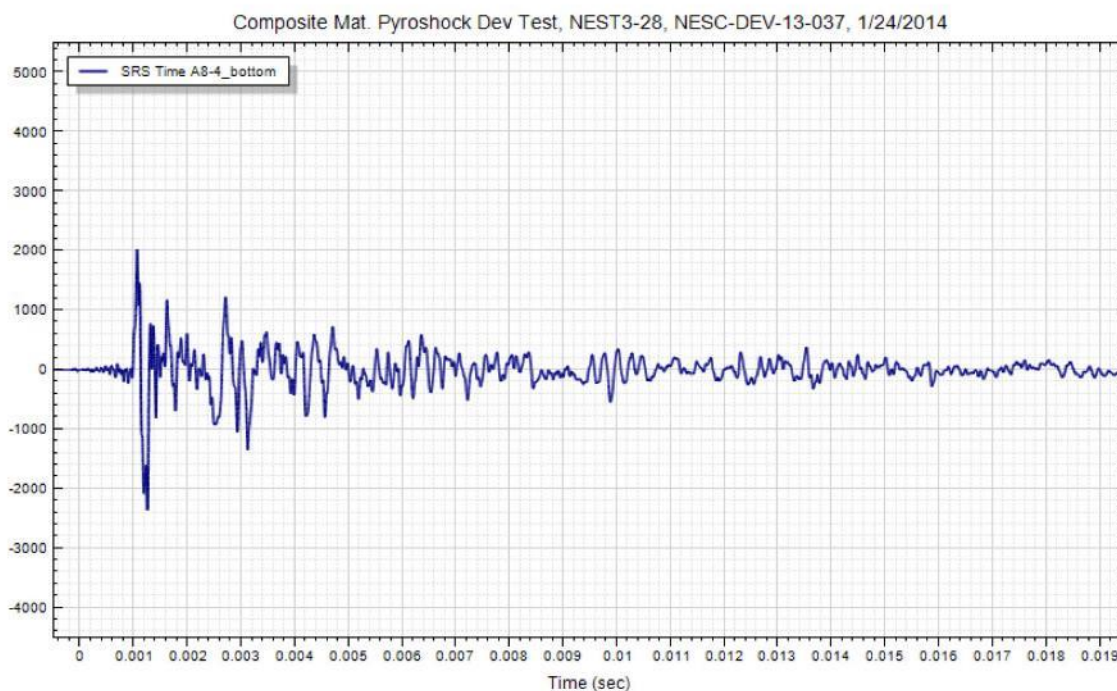
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
681 of 832





# NASA Engineering and Safety Center Technical Assessment Report

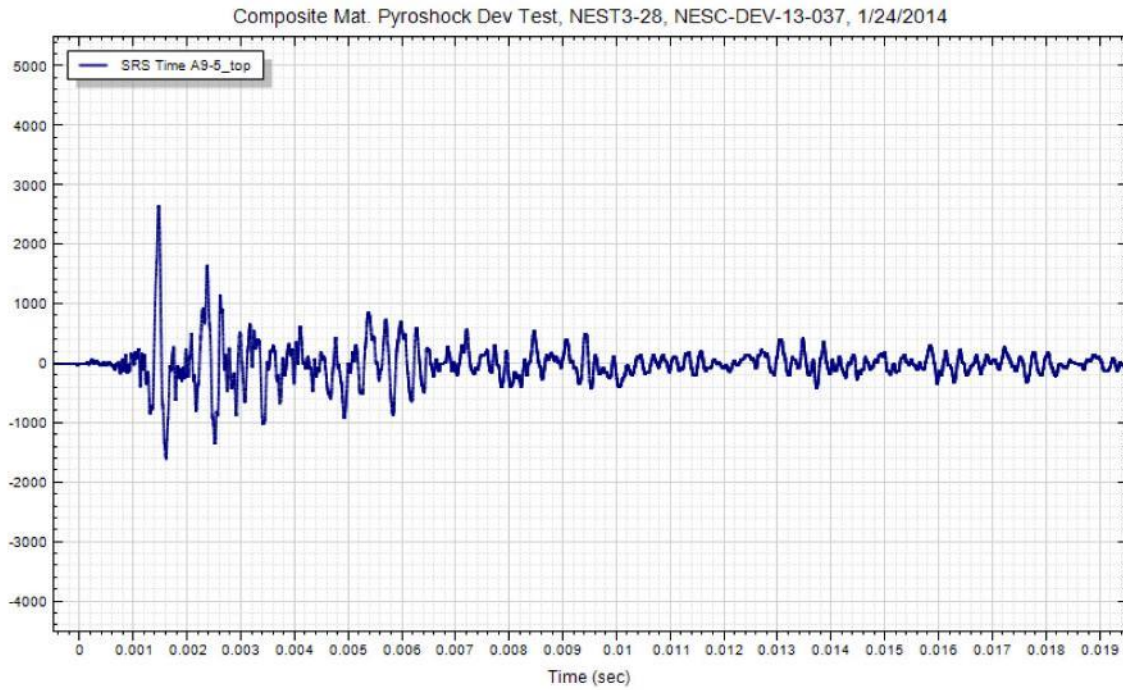
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
682 of 832





# NASA Engineering and Safety Center Technical Assessment Report

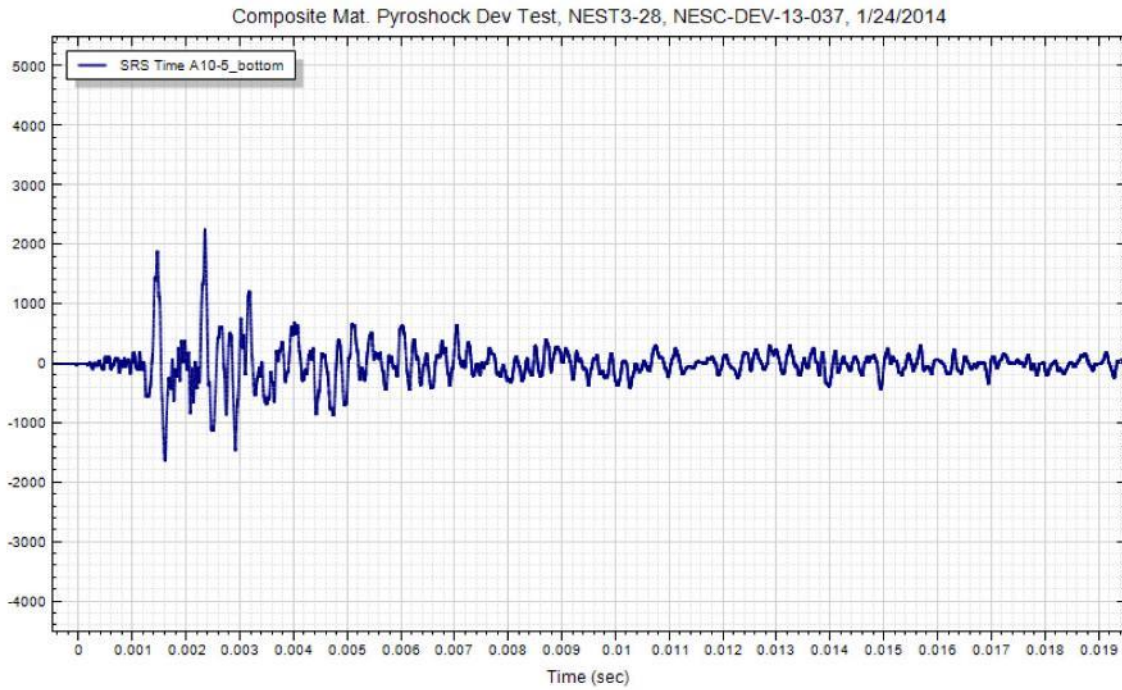
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
683 of 832





# NASA Engineering and Safety Center Technical Assessment Report

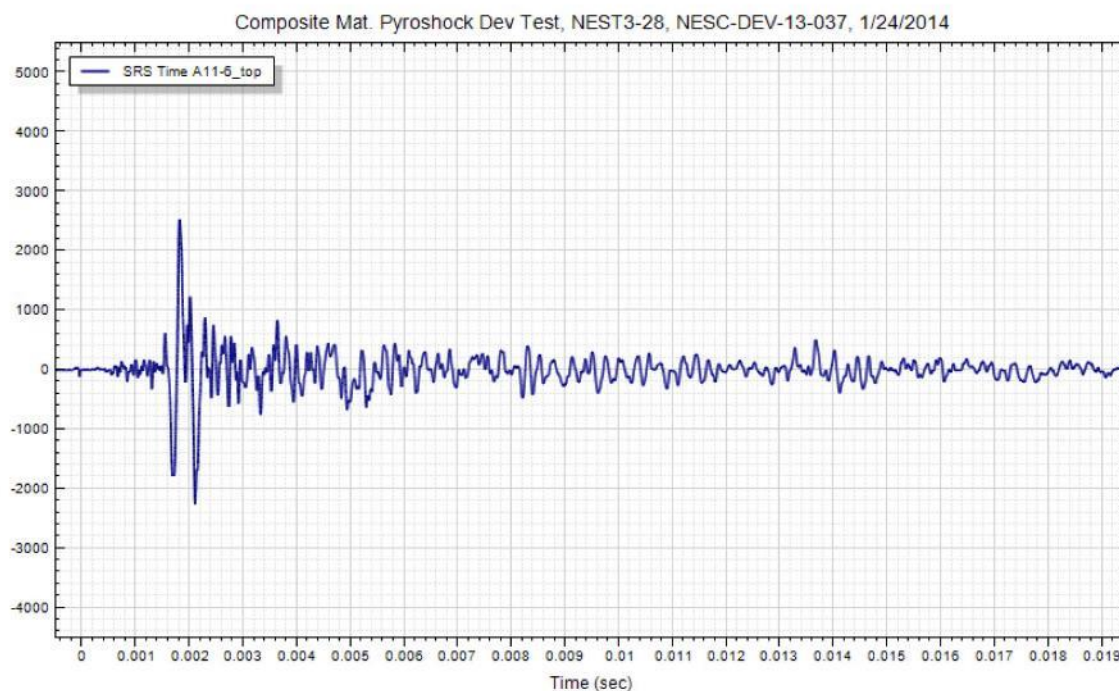
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
684 of 832



370 of 518





# NASA Engineering and Safety Center Technical Assessment Report

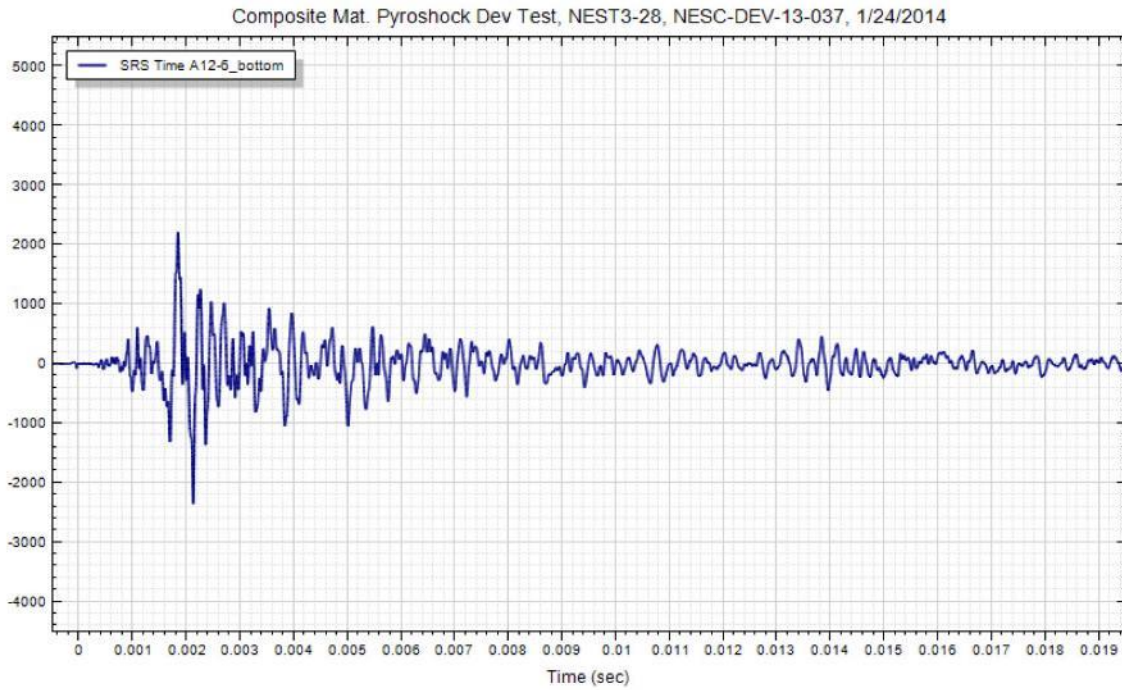
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
685 of 832





# NASA Engineering and Safety Center Technical Assessment Report

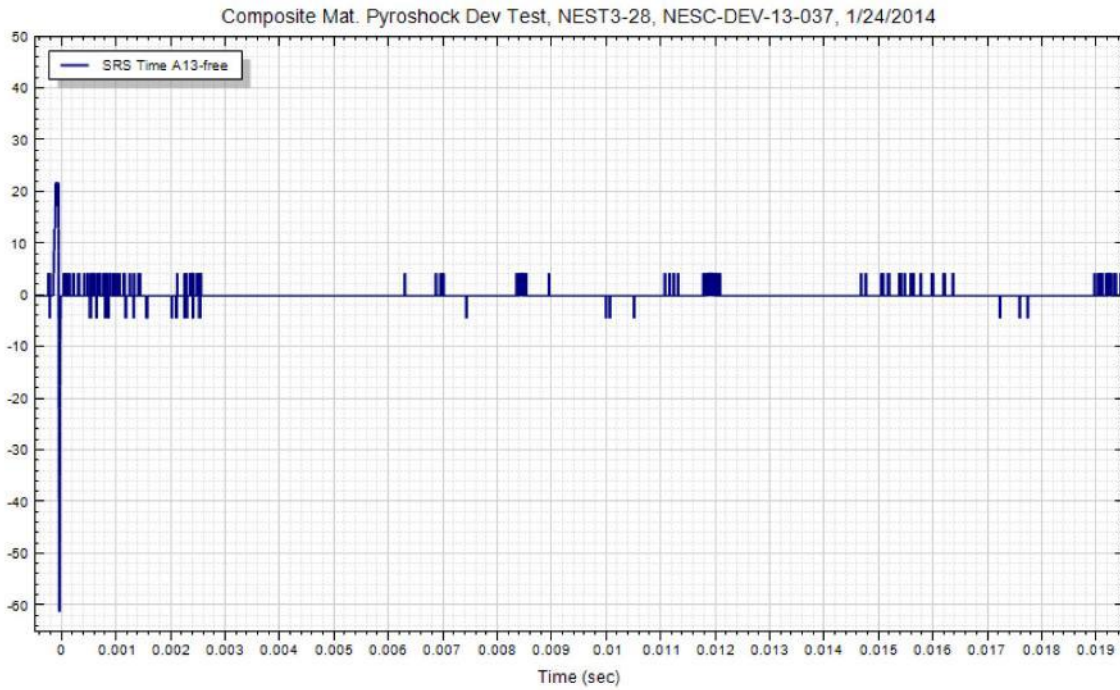
Document #:  
**NESC-RP-  
12-00783**


Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
686 of 832



	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 687 of 832	

**NESC-DEV-13-037**  
**Composite Materials**  
**Shock Test**  
  
**Test #11 Accelerometer Data**  
**Panel 0346A023**



# NASA Engineering and Safety Center Technical Assessment Report

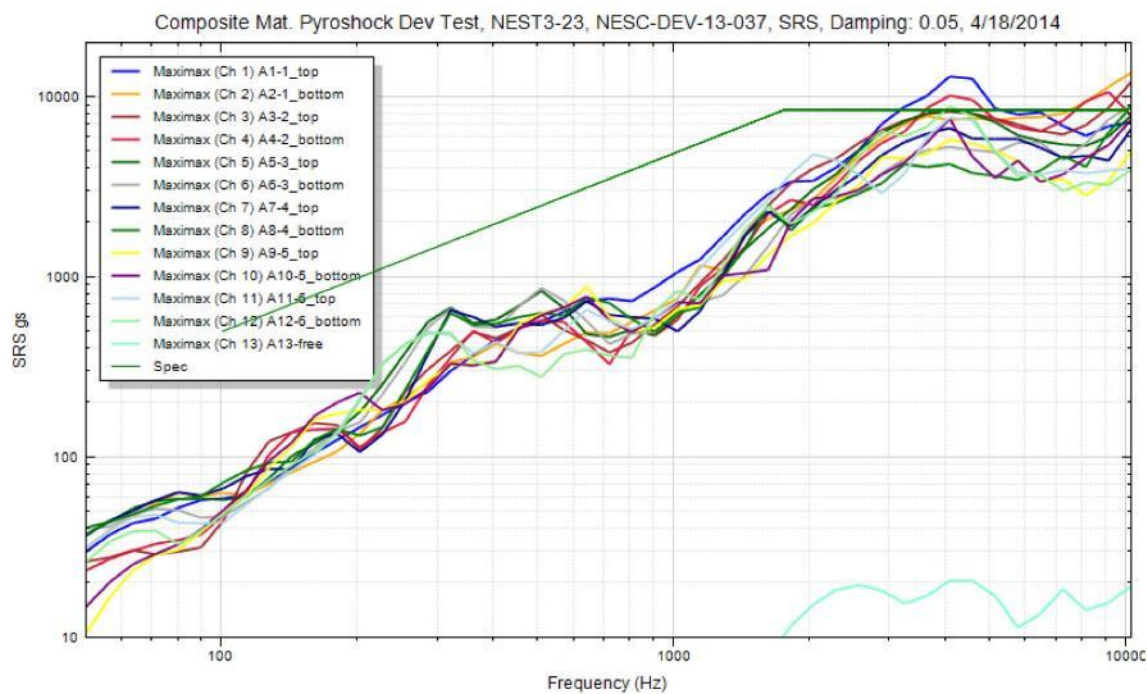
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
688 of 832





# NASA Engineering and Safety Center Technical Assessment Report

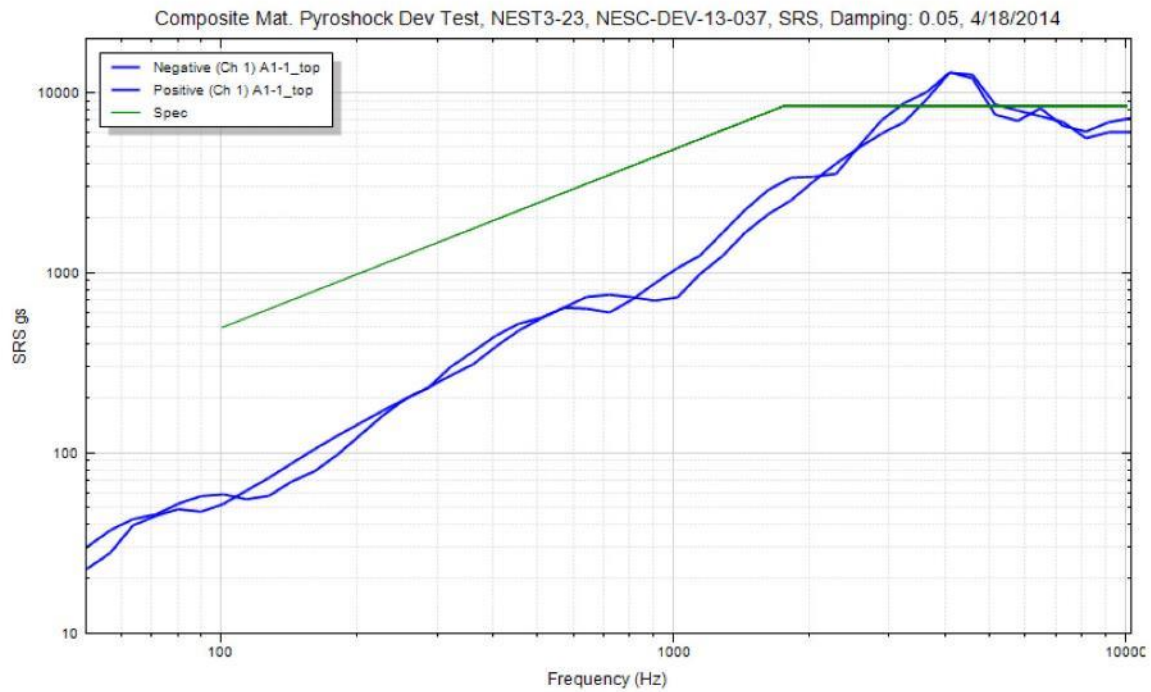
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
689 of 832



375 of 518



# NASA Engineering and Safety Center Technical Assessment Report

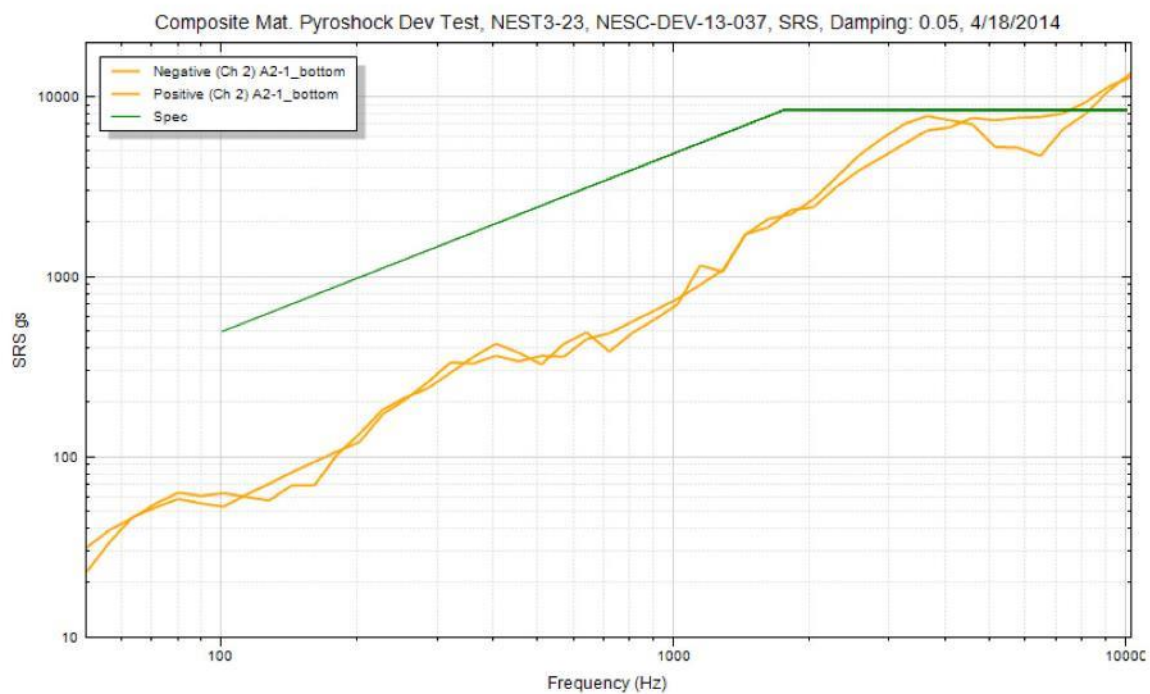
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
690 of 832





# NASA Engineering and Safety Center Technical Assessment Report

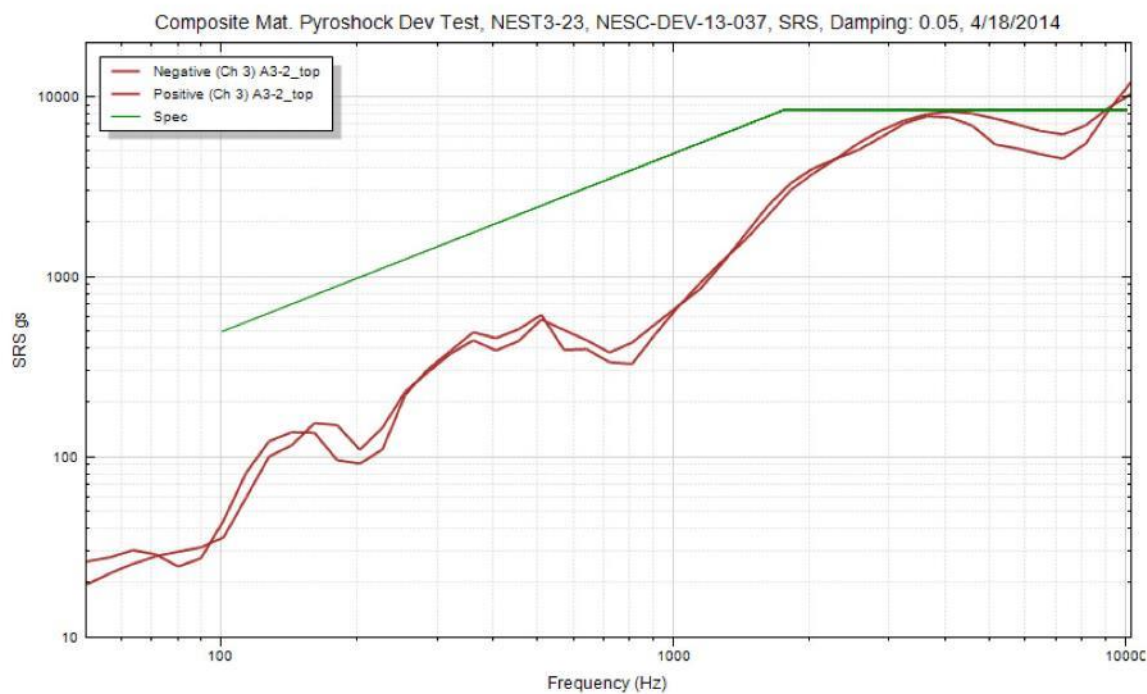
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
691 of 832





# NASA Engineering and Safety Center Technical Assessment Report

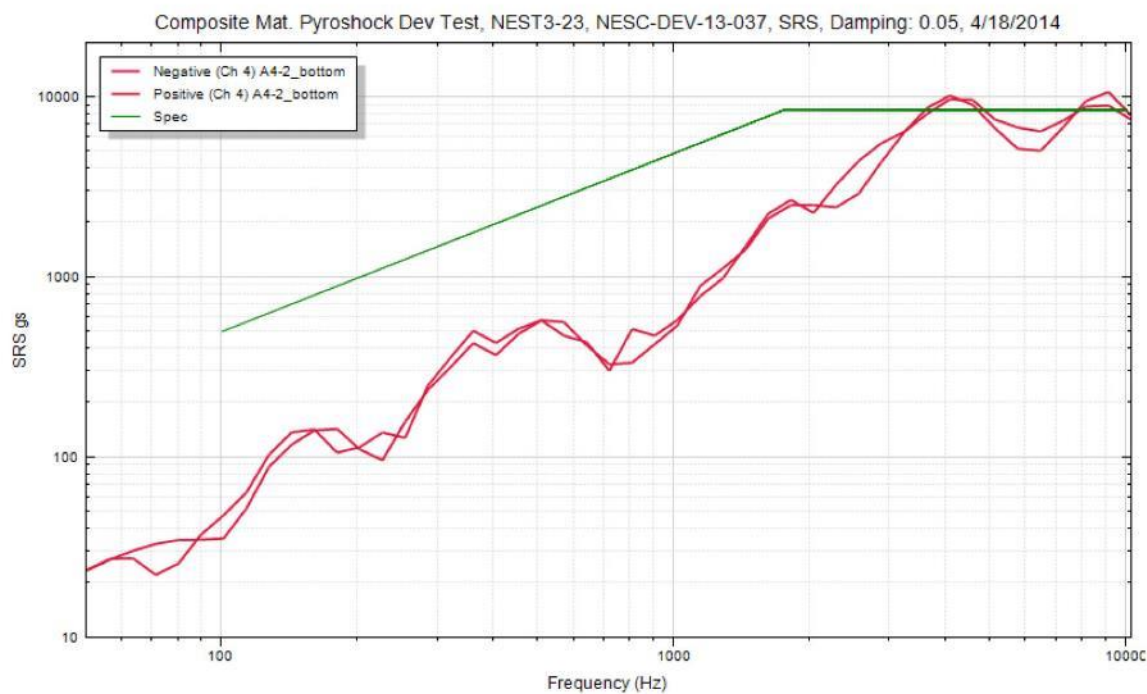
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
692 of 832







# NASA Engineering and Safety Center Technical Assessment Report

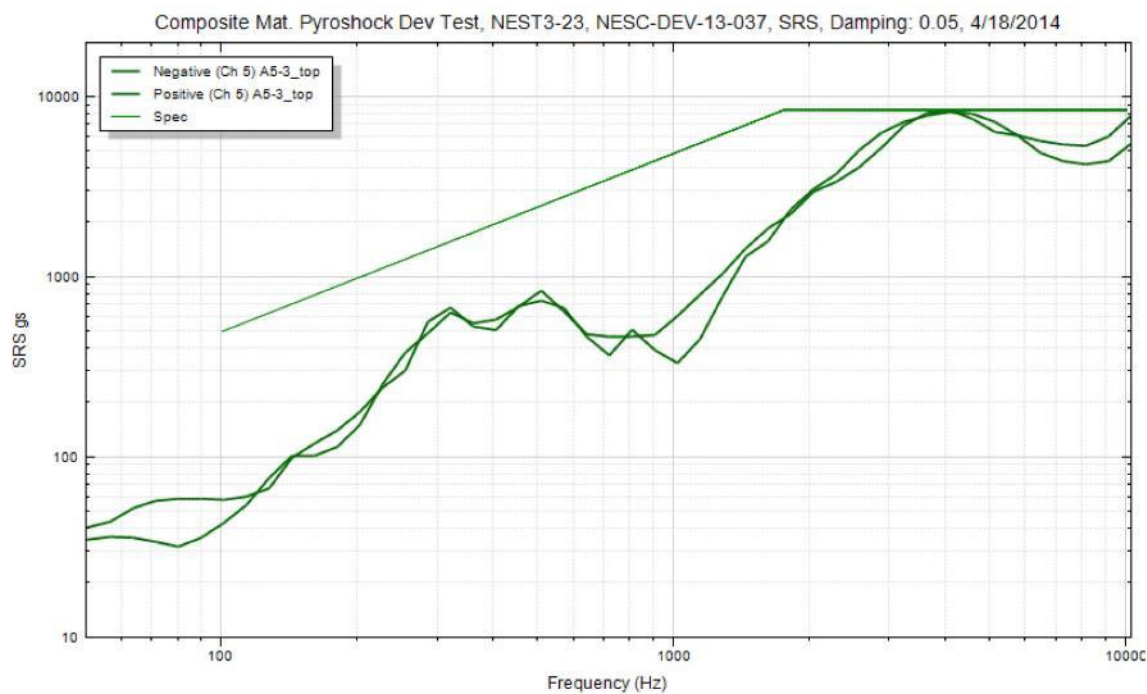
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
693 of 832



379 of 518



# NASA Engineering and Safety Center Technical Assessment Report

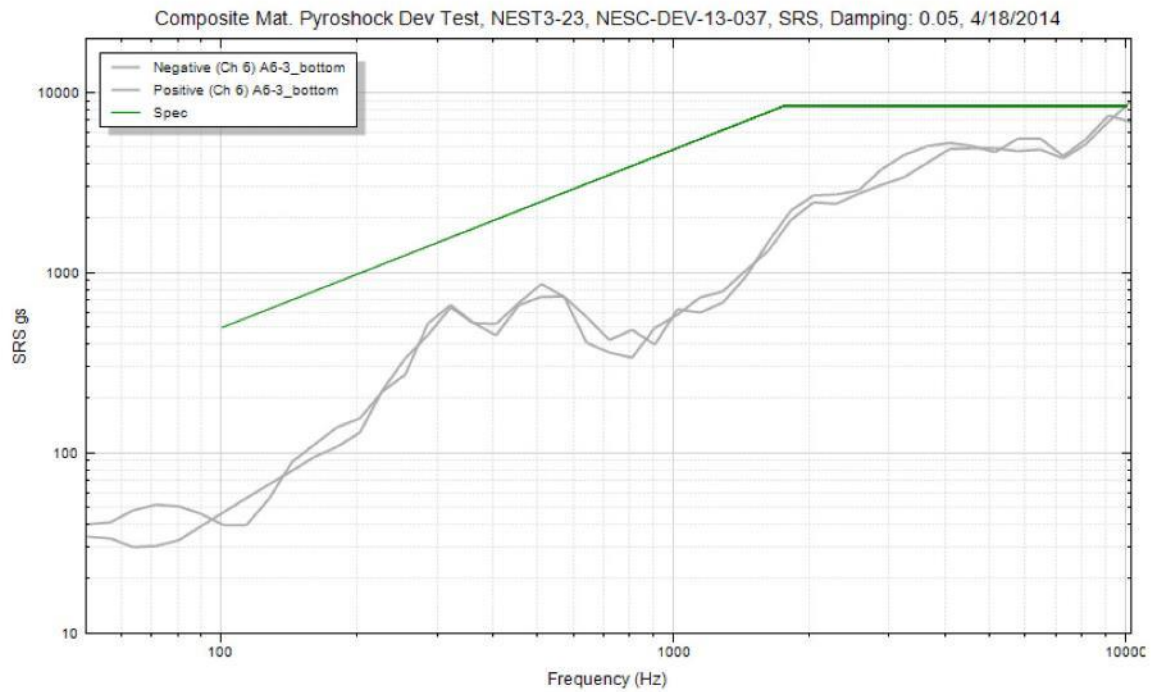
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
694 of 832





# NASA Engineering and Safety Center Technical Assessment Report

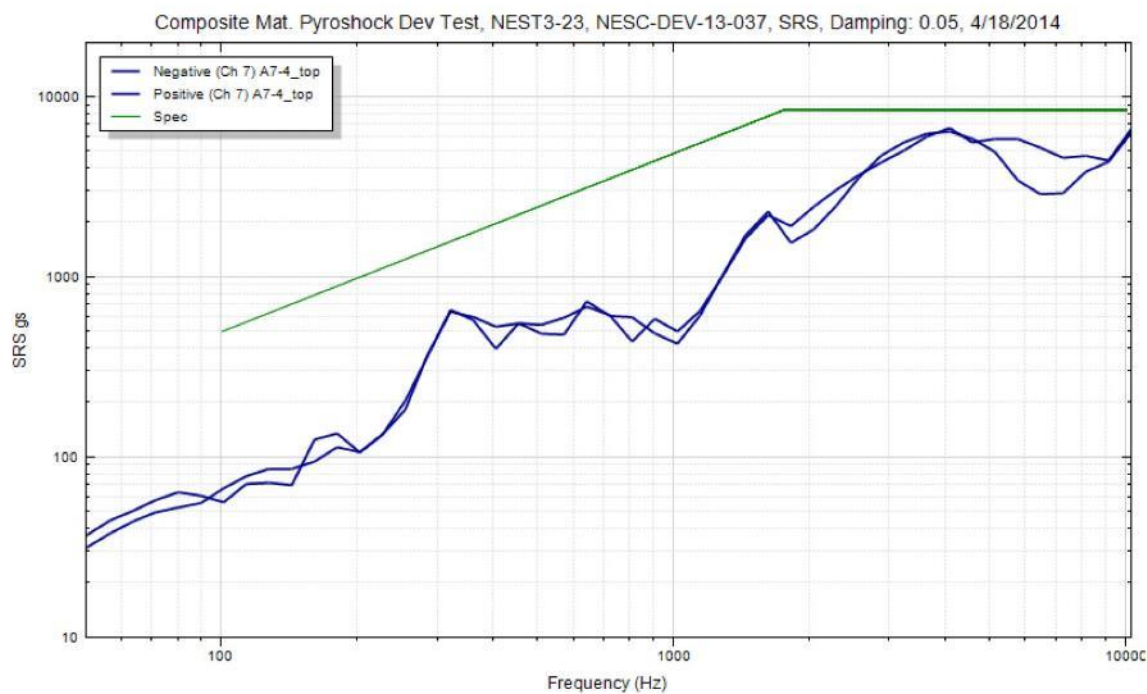
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
695 of 832





# NASA Engineering and Safety Center Technical Assessment Report

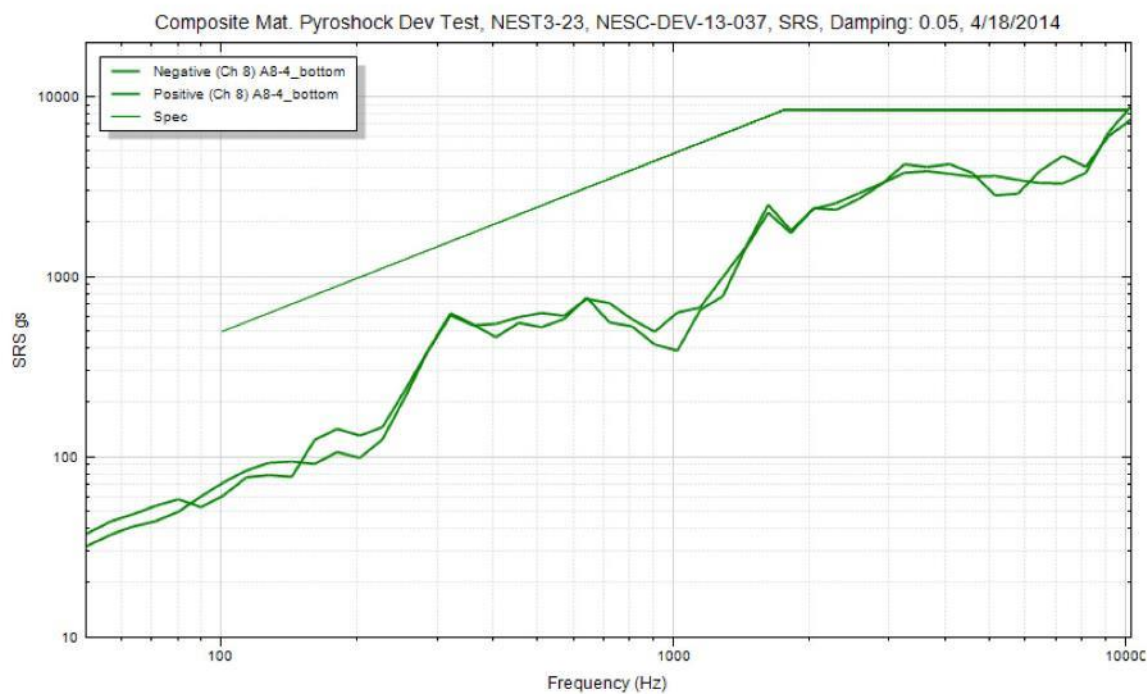
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
696 of 832





# NASA Engineering and Safety Center Technical Assessment Report

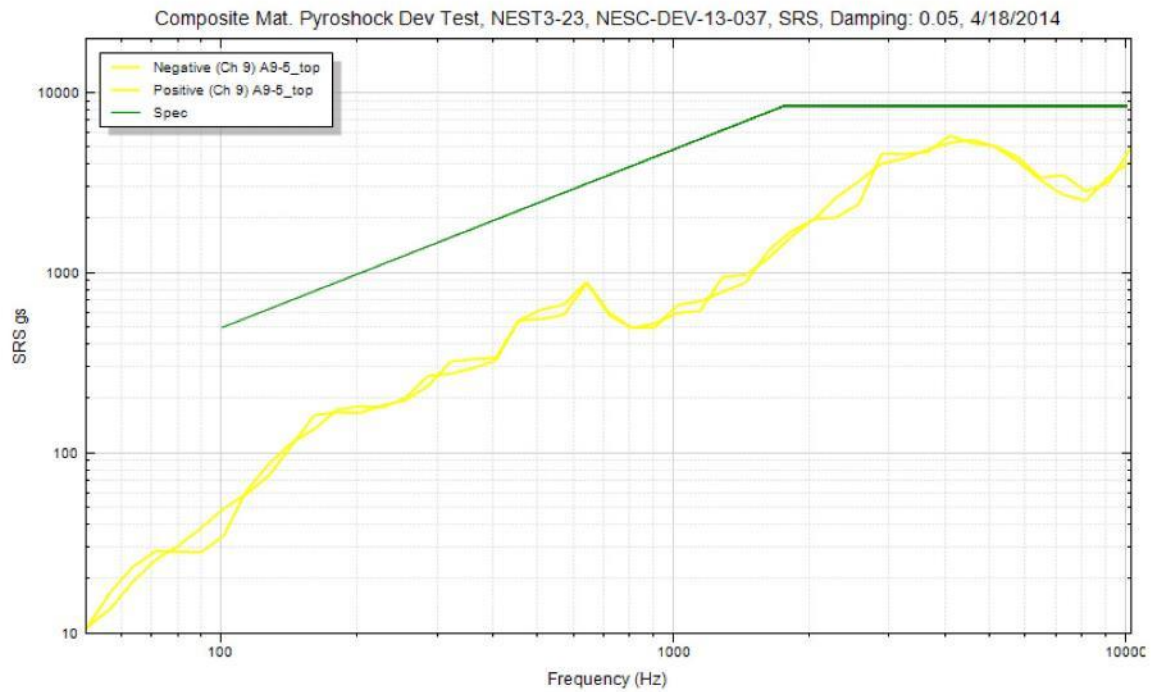
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
697 of 832





# NASA Engineering and Safety Center Technical Assessment Report

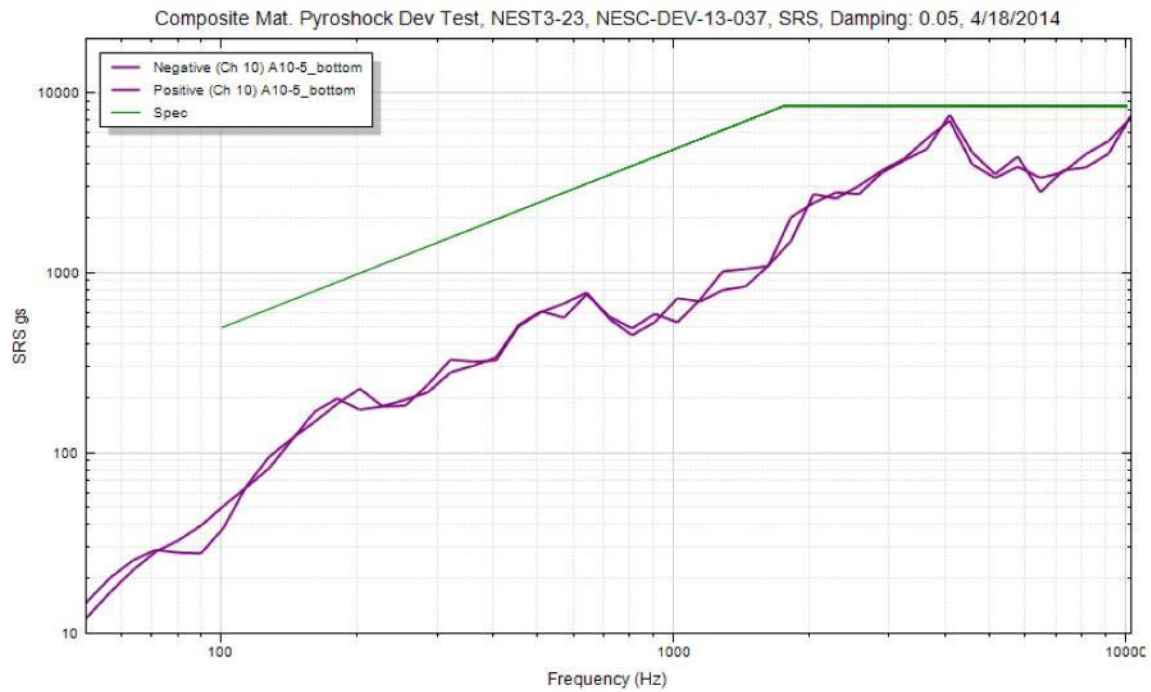
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
698 of 832





# NASA Engineering and Safety Center Technical Assessment Report

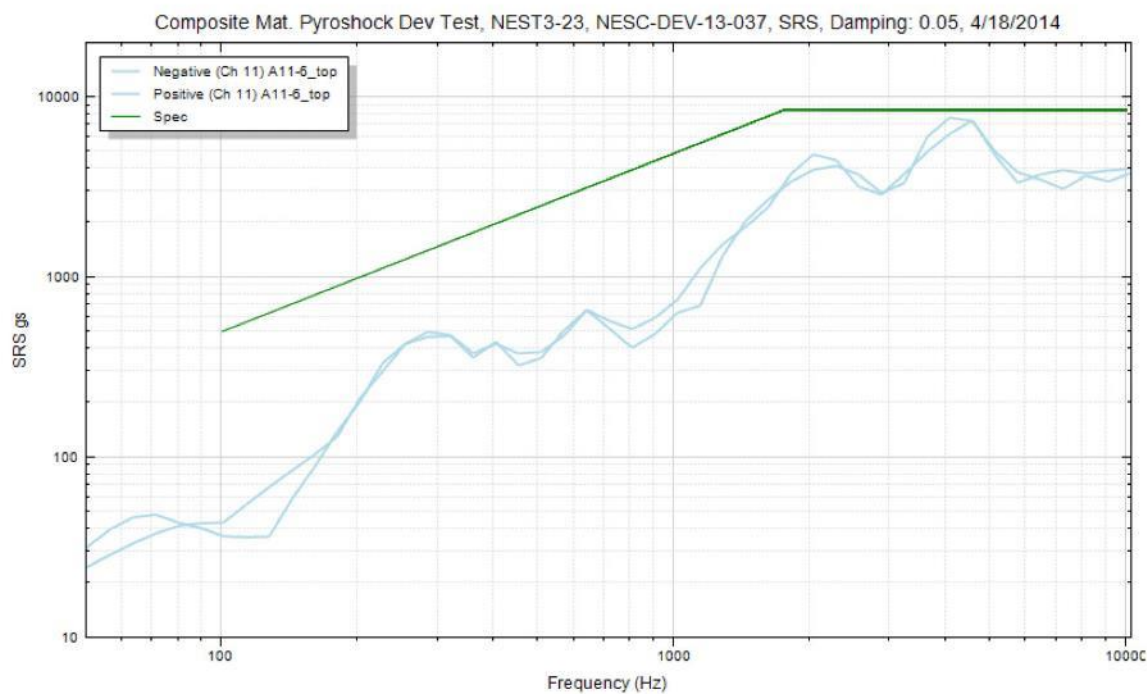
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
699 of 832





# NASA Engineering and Safety Center Technical Assessment Report

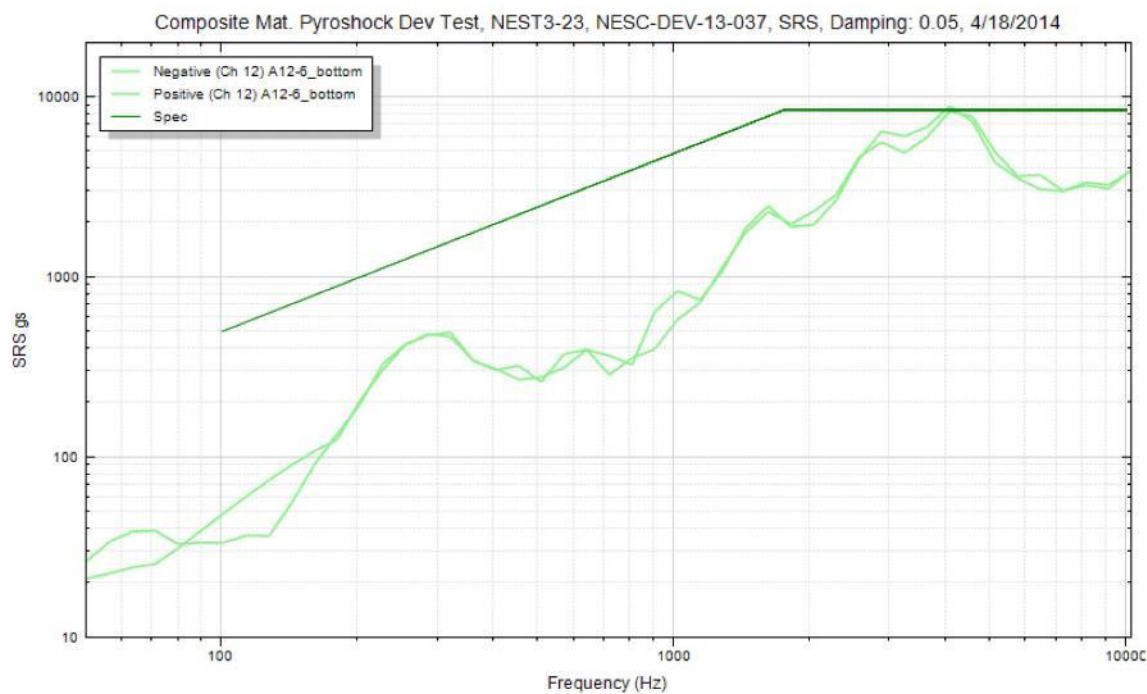
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
700 of 832







# NASA Engineering and Safety Center Technical Assessment Report

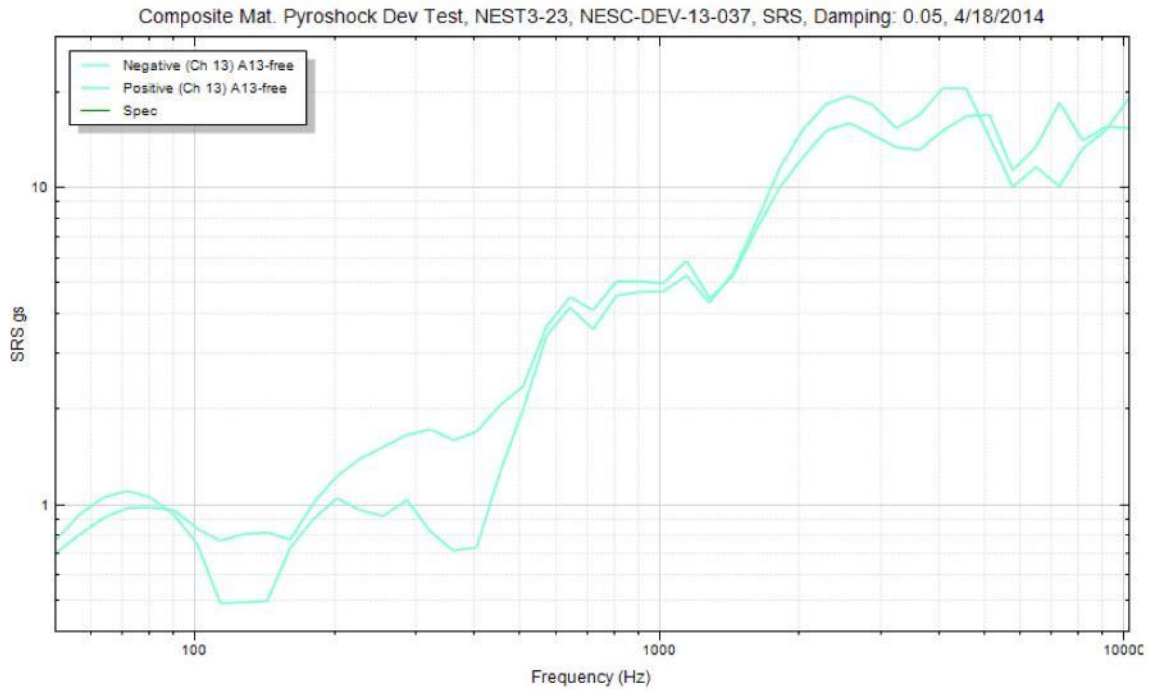
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
701 of 832





# NASA Engineering and Safety Center Technical Assessment Report

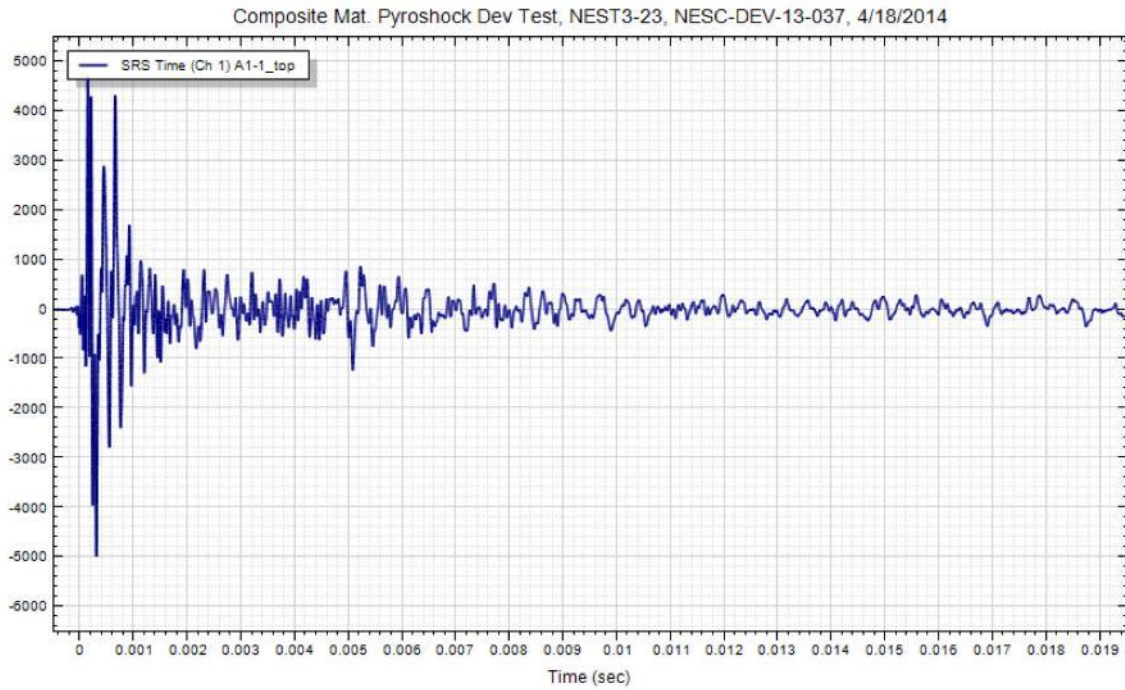
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
702 of 832





# NASA Engineering and Safety Center Technical Assessment Report

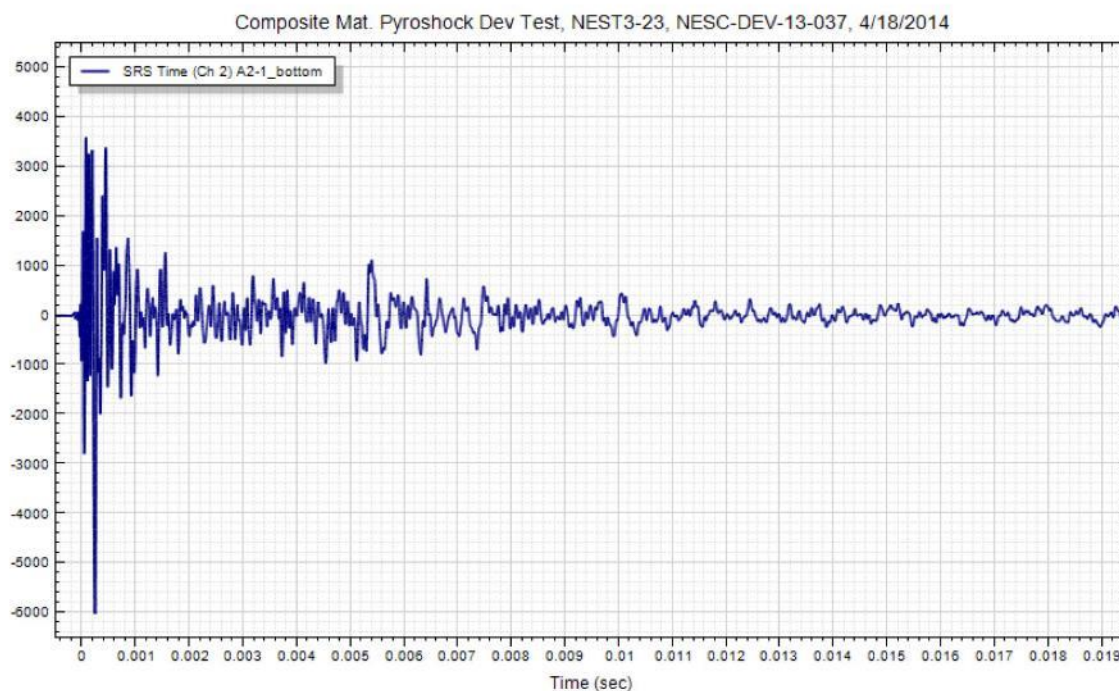
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
703 of 832





# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**

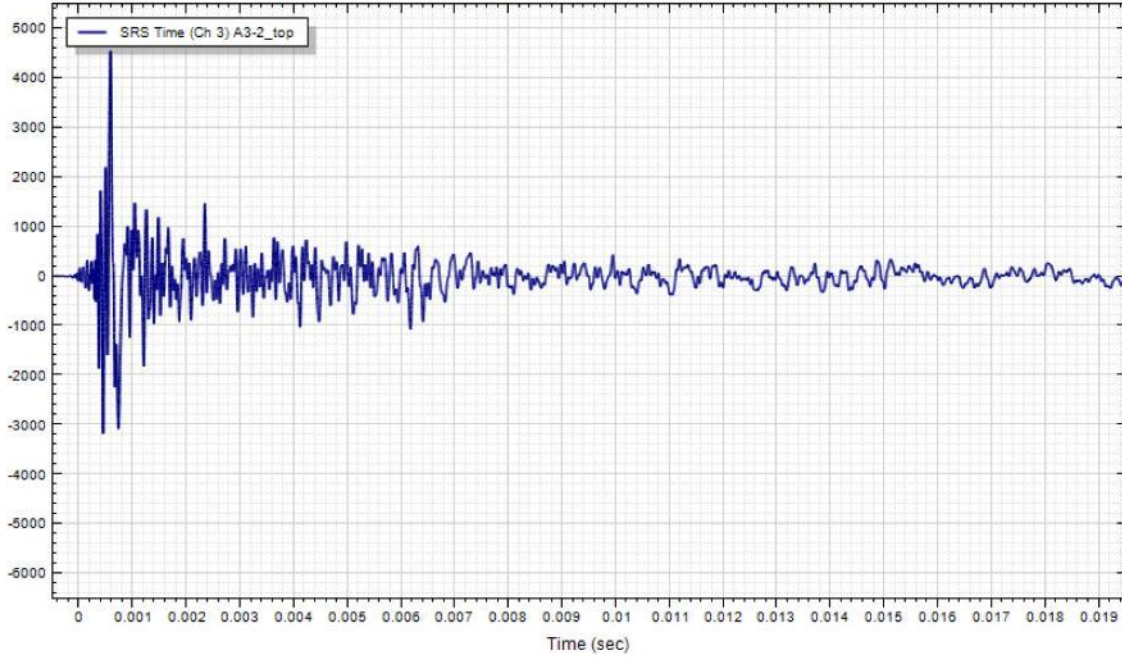
Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
704 of 832

Composite Mat. Pyroshock Dev Test, NEST3-23, NESC-DEV-13-037, 4/18/2014





# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**

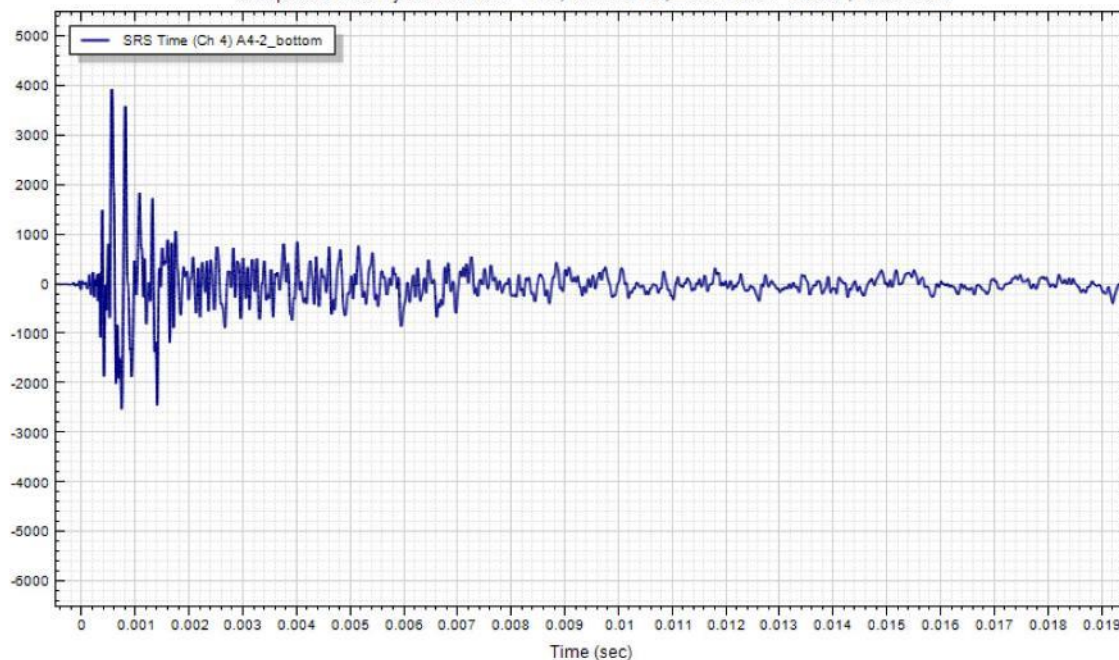
Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
705 of 832

Composite Mat. Pyroshock Dev Test, NEST3-23, NESC-DEV-13-037, 4/18/2014





# NASA Engineering and Safety Center Technical Assessment Report

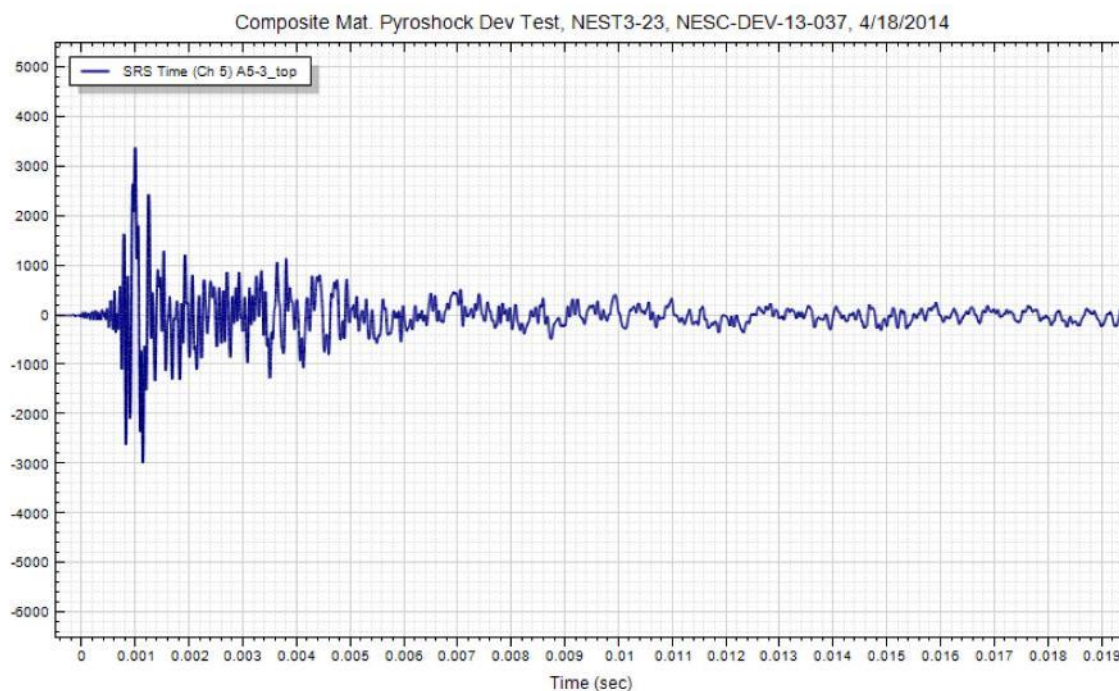
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
706 of 832





# NASA Engineering and Safety Center Technical Assessment Report

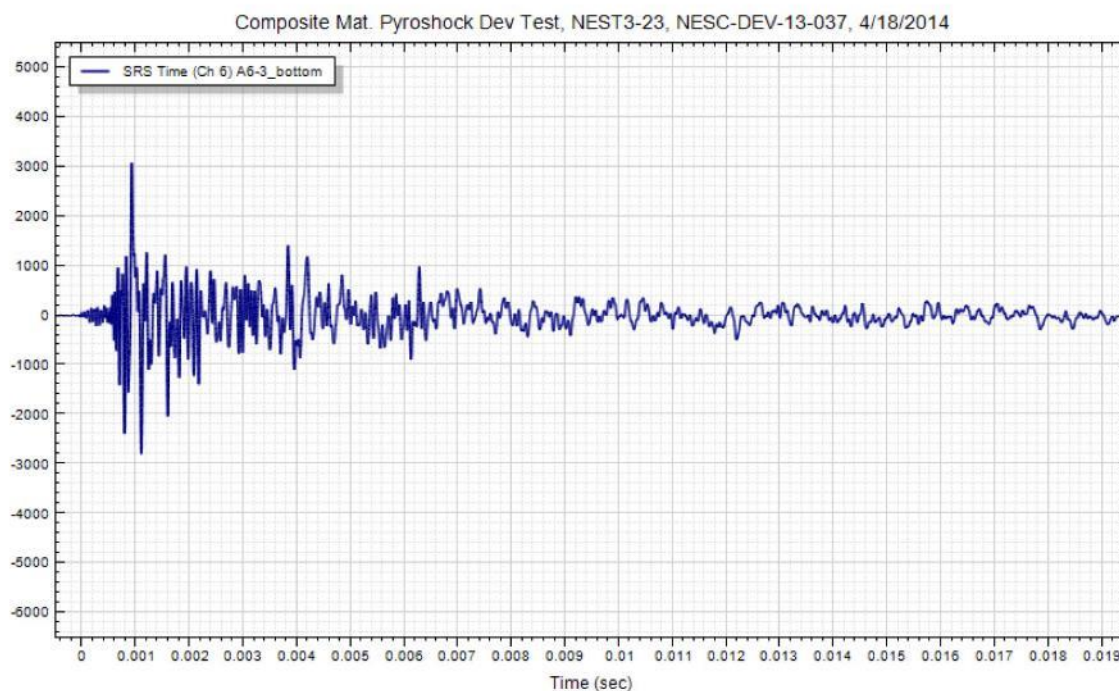
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
707 of 832





# NASA Engineering and Safety Center Technical Assessment Report

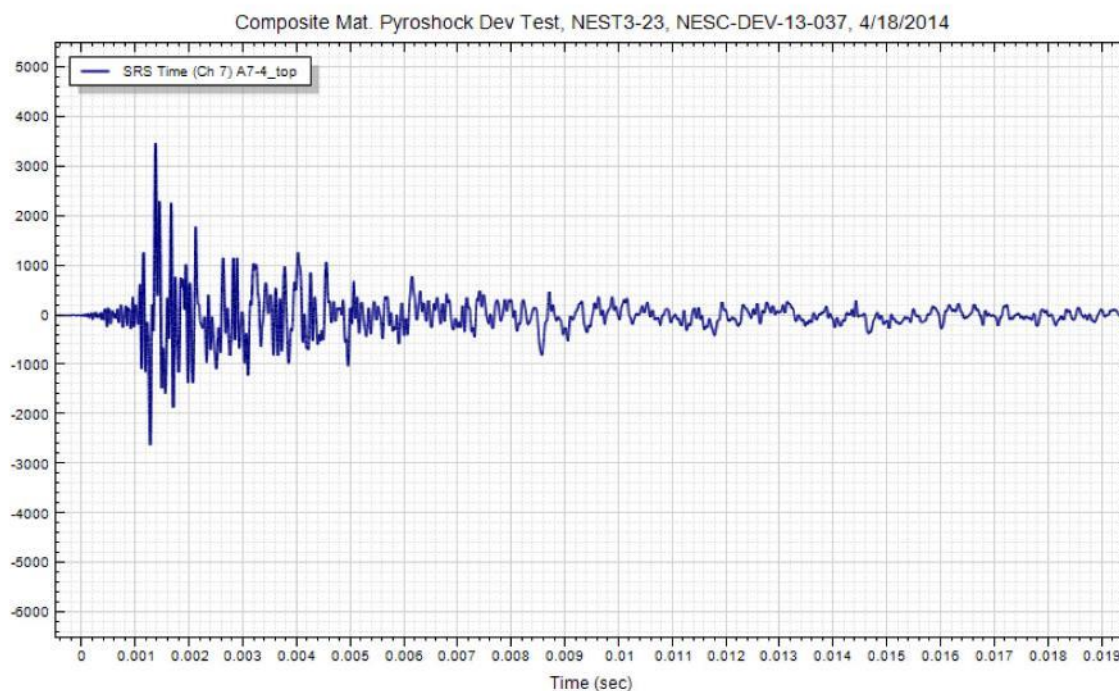
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
708 of 832







# NASA Engineering and Safety Center Technical Assessment Report

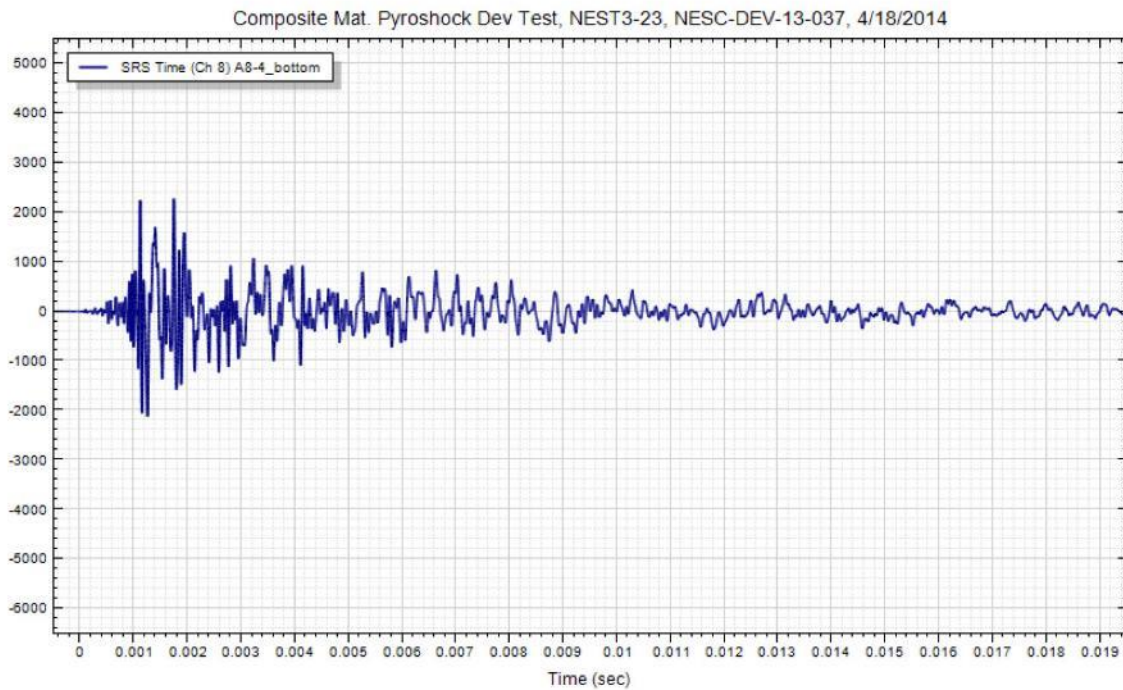
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
709 of 832





# NASA Engineering and Safety Center Technical Assessment Report

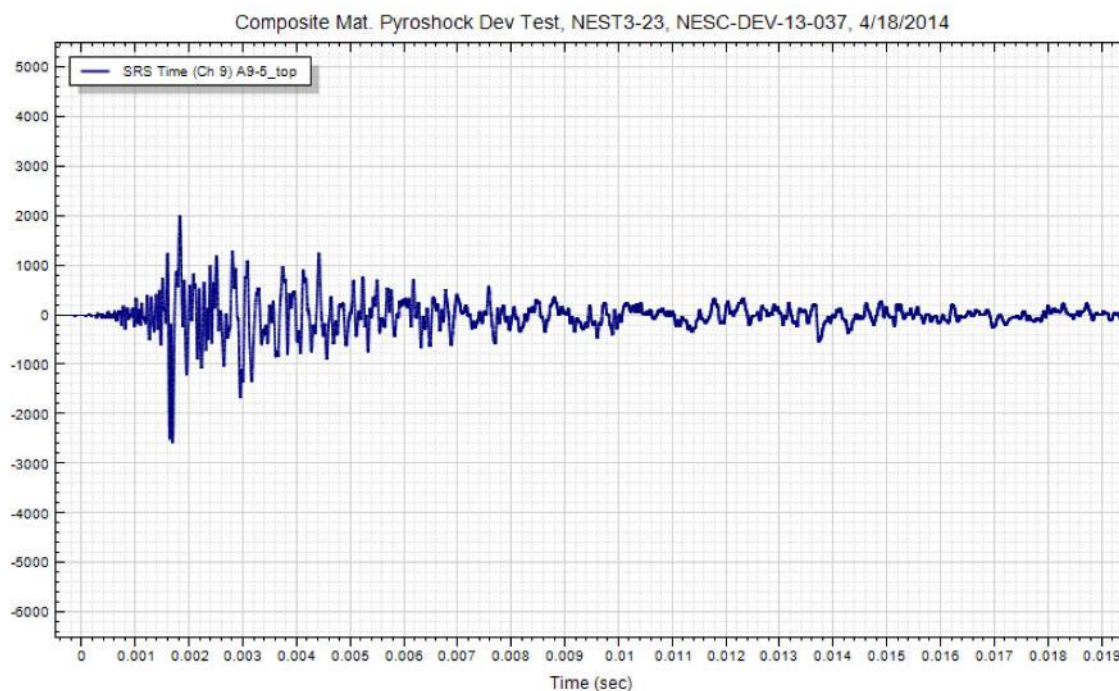
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
710 of 832





# NASA Engineering and Safety Center Technical Assessment Report

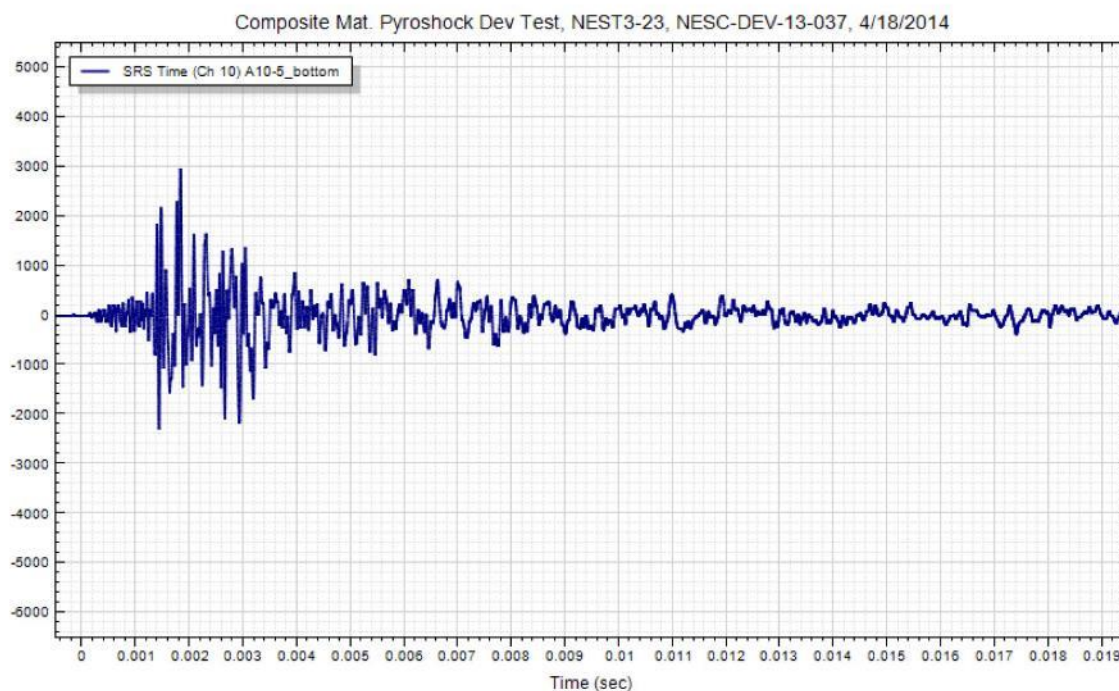
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
711 of 832





# NASA Engineering and Safety Center Technical Assessment Report

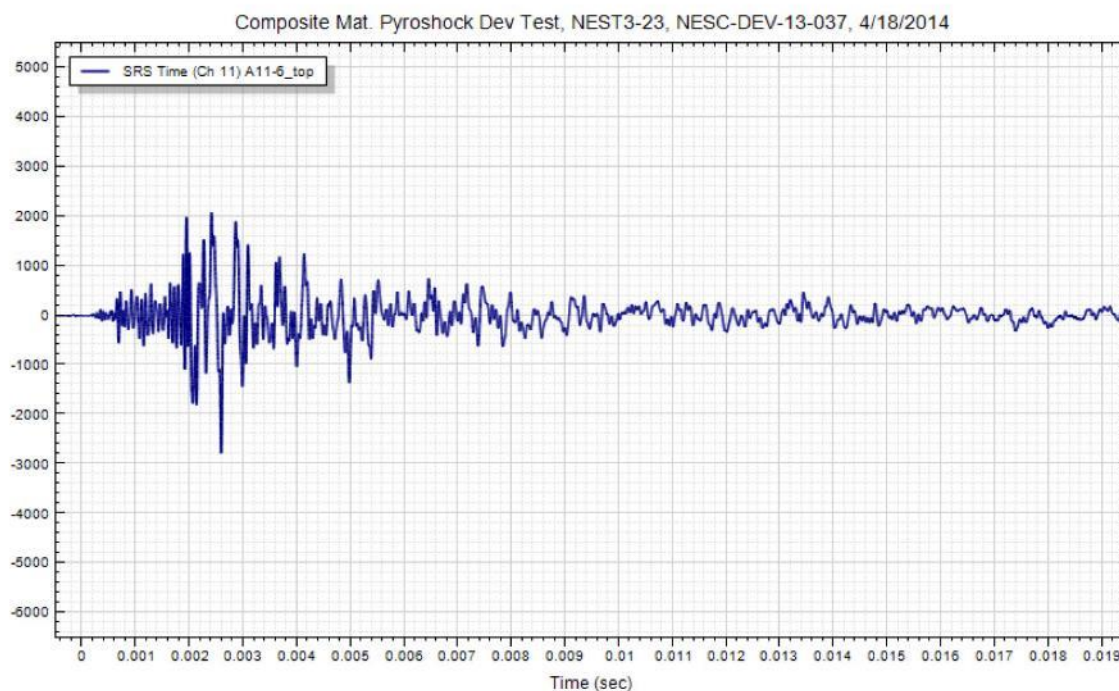
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
712 of 832





# NASA Engineering and Safety Center Technical Assessment Report

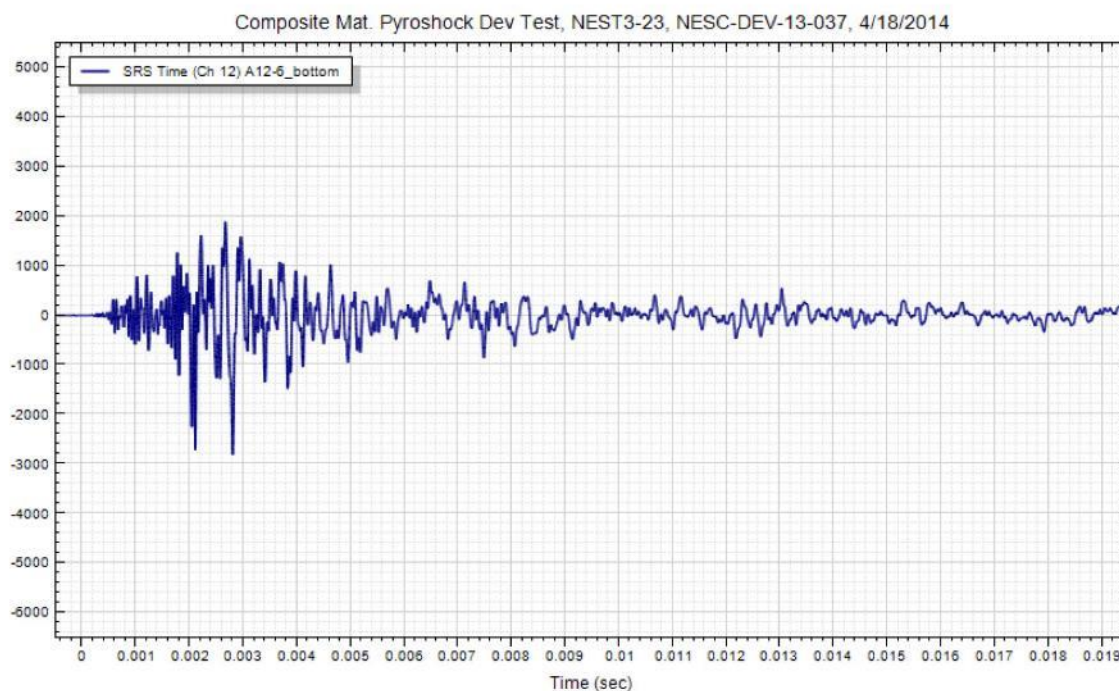
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
713 of 832





# NASA Engineering and Safety Center Technical Assessment Report

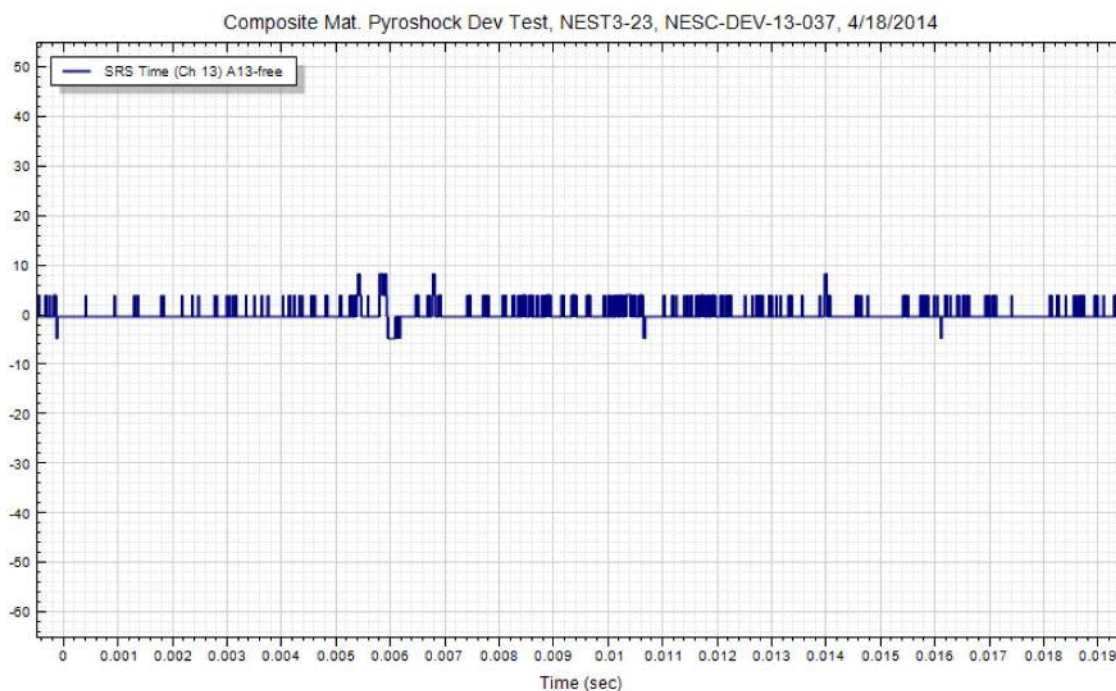
Document #:  
**NESC-RP-  
12-00783**


Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
714 of 832



	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 715 of 832	

**NESC-DEV-13-037**  
**Composite Materials**  
**Shock Test**  
  
**Test #12 Accelerometer Data**  
**Panel 0346A024**



# NASA Engineering and Safety Center Technical Assessment Report

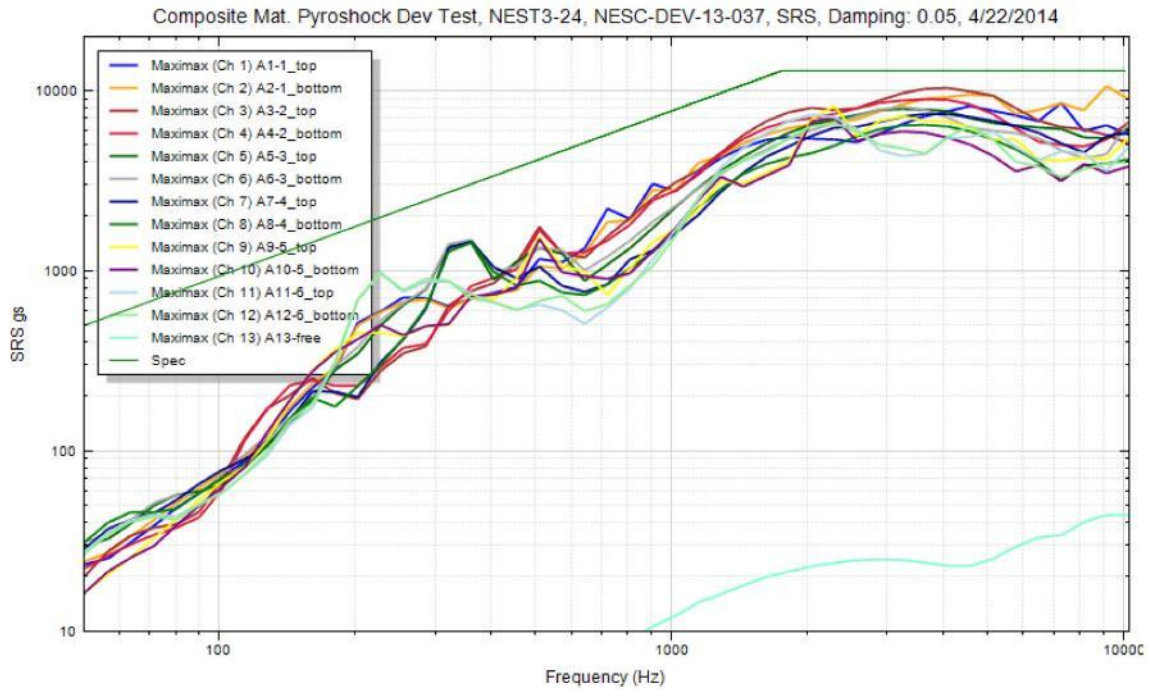
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
716 of 832







# NASA Engineering and Safety Center Technical Assessment Report

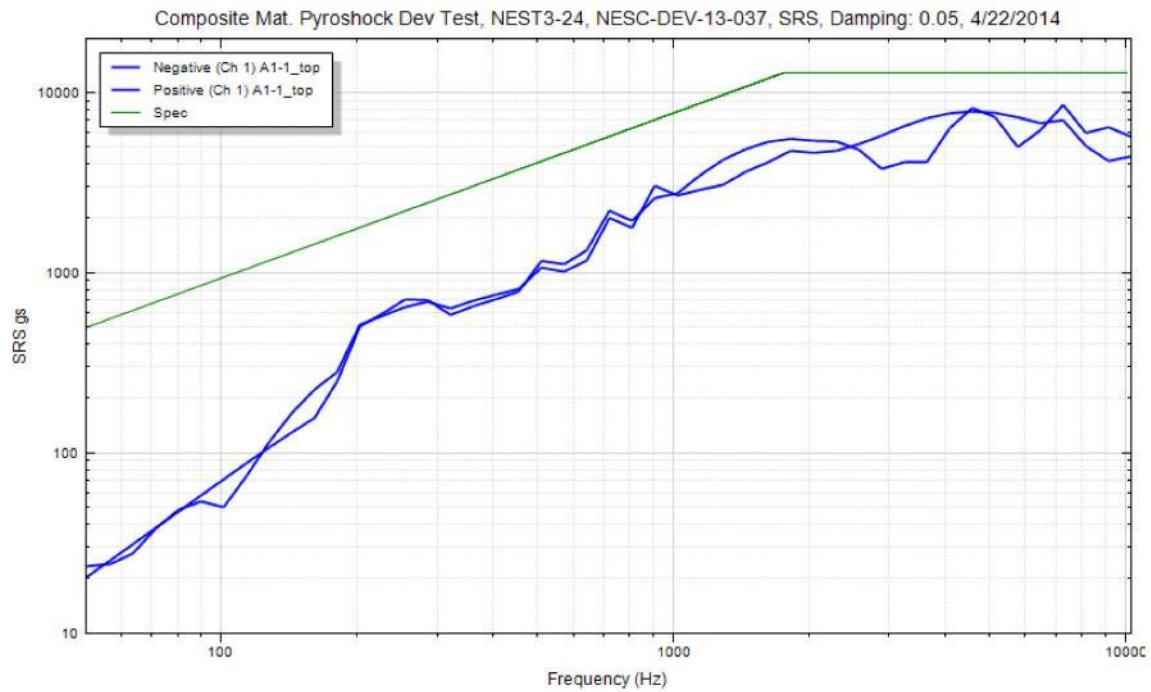
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
717 of 832





# NASA Engineering and Safety Center Technical Assessment Report

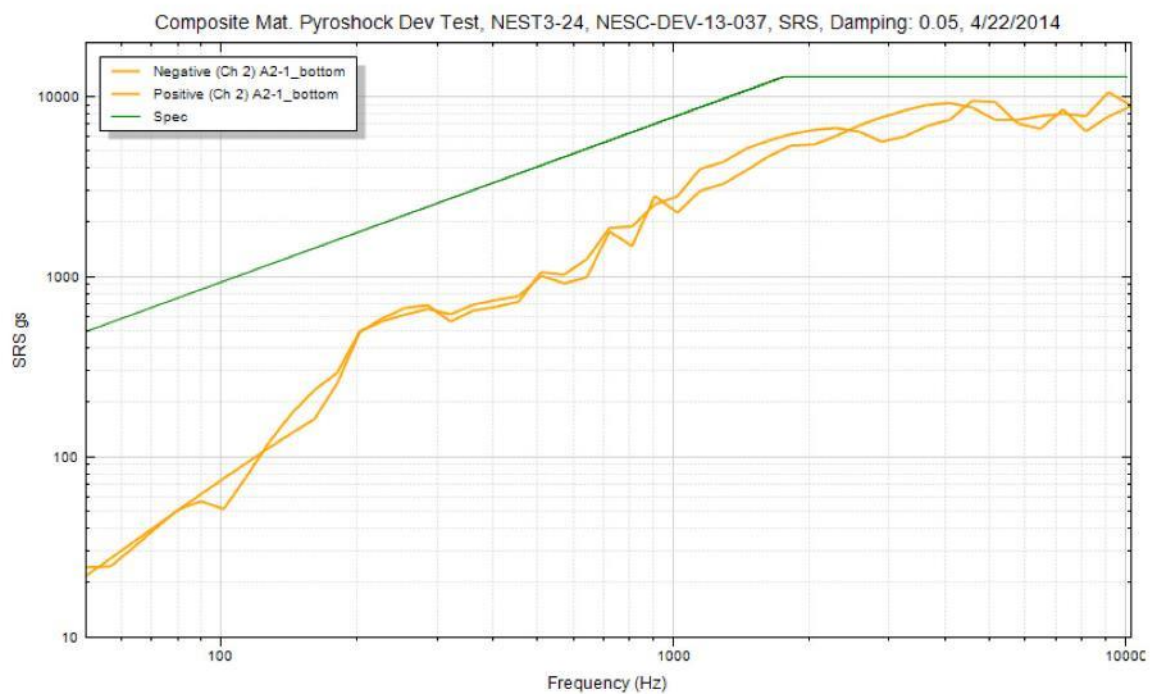
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
718 of 832





# NASA Engineering and Safety Center Technical Assessment Report

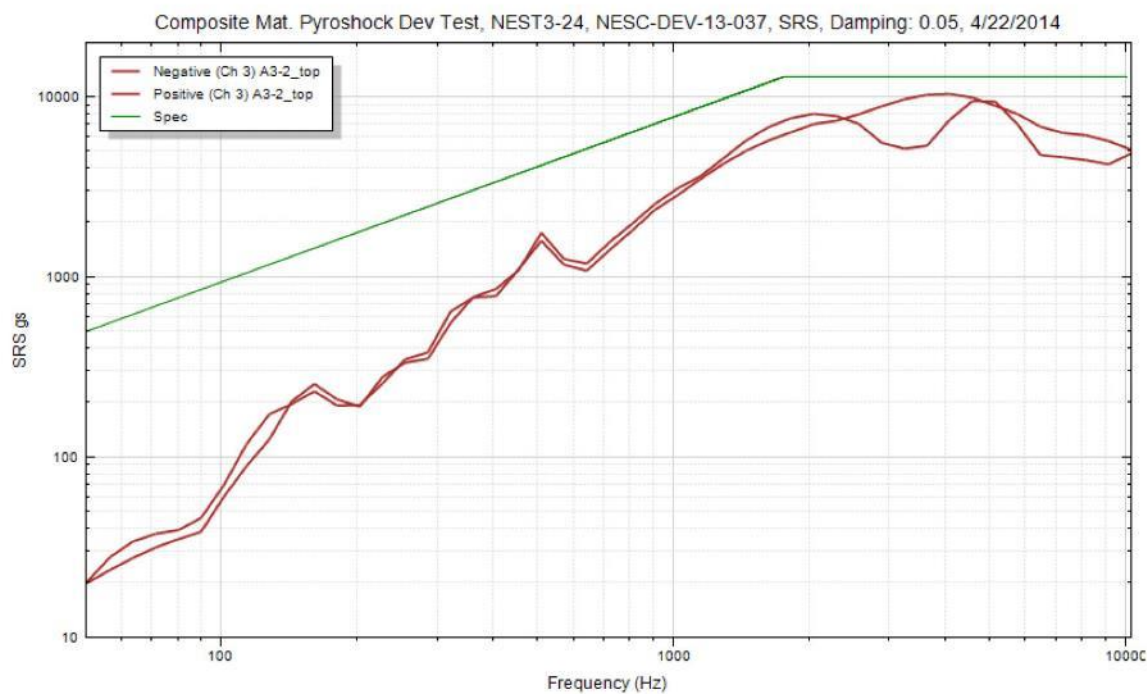
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
719 of 832





# NASA Engineering and Safety Center Technical Assessment Report

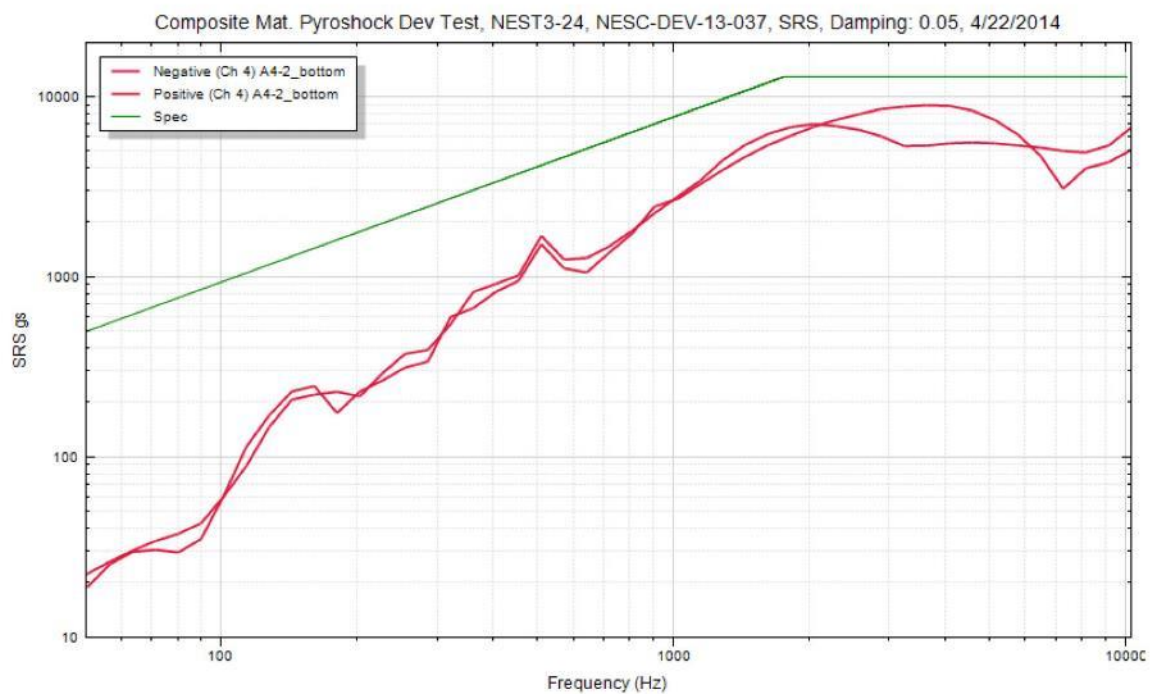
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
720 of 832





# NASA Engineering and Safety Center Technical Assessment Report

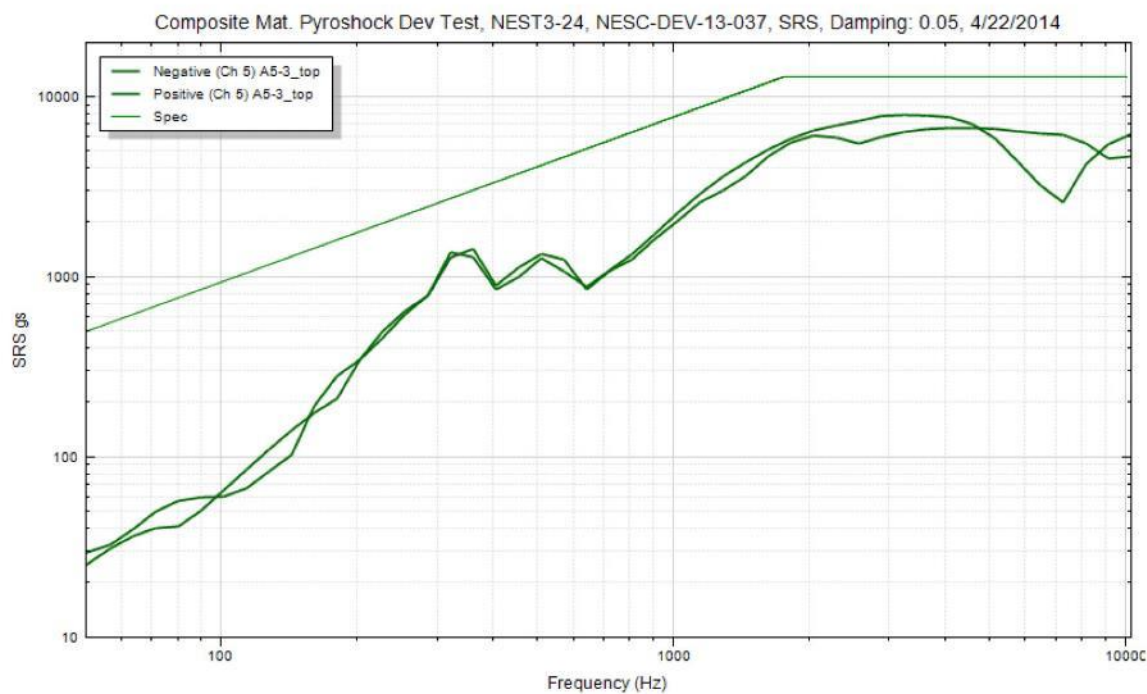
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
721 of 832





# NASA Engineering and Safety Center Technical Assessment Report

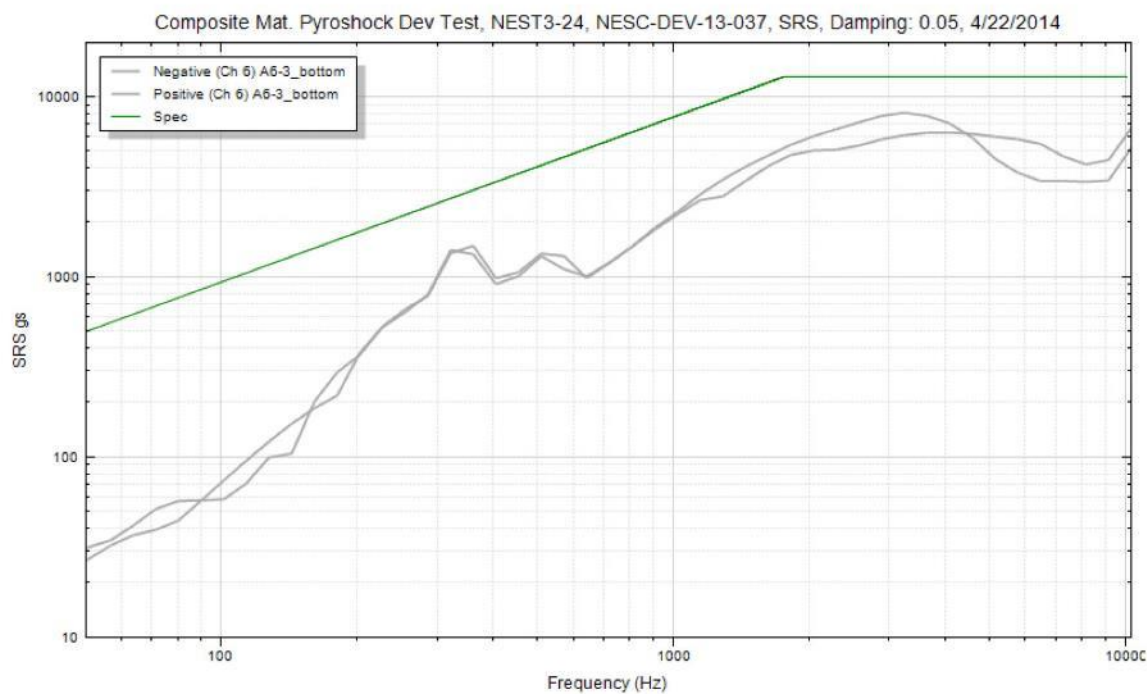
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
722 of 832





# NASA Engineering and Safety Center Technical Assessment Report

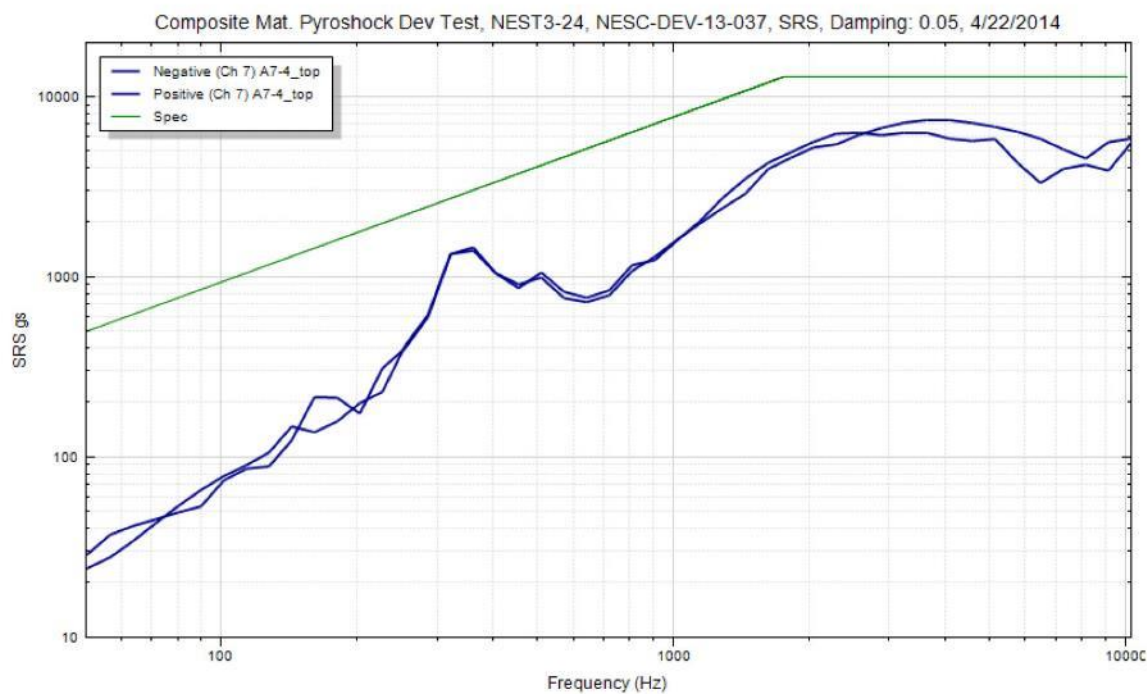
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
723 of 832





# NASA Engineering and Safety Center Technical Assessment Report

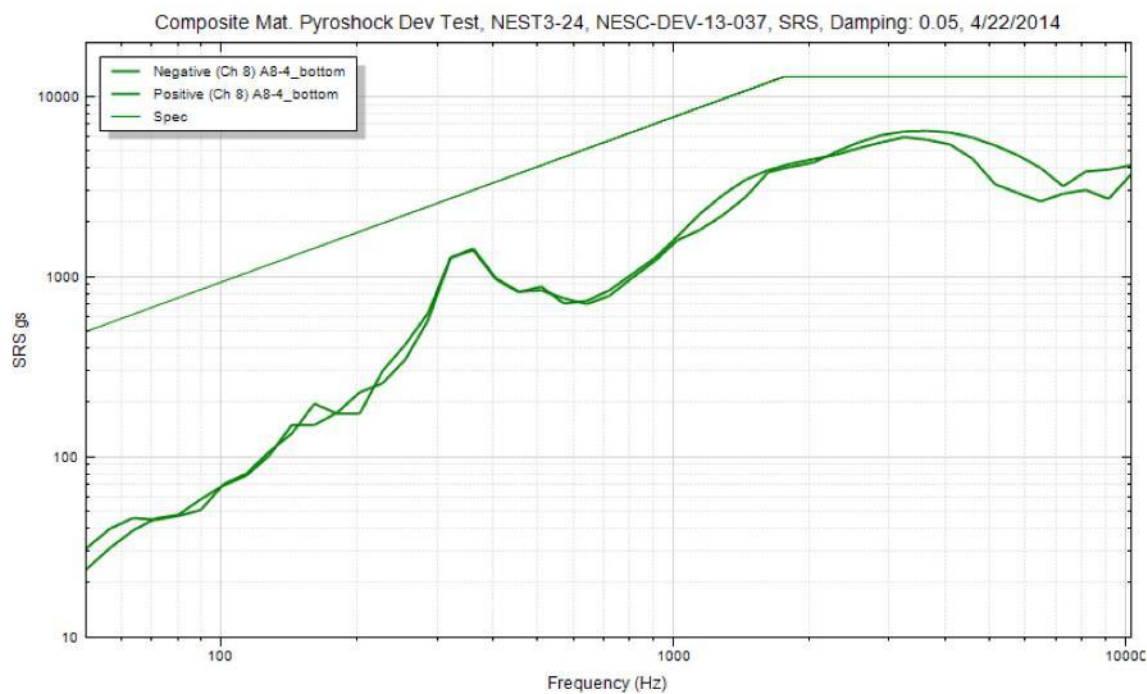
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
724 of 832







# NASA Engineering and Safety Center Technical Assessment Report

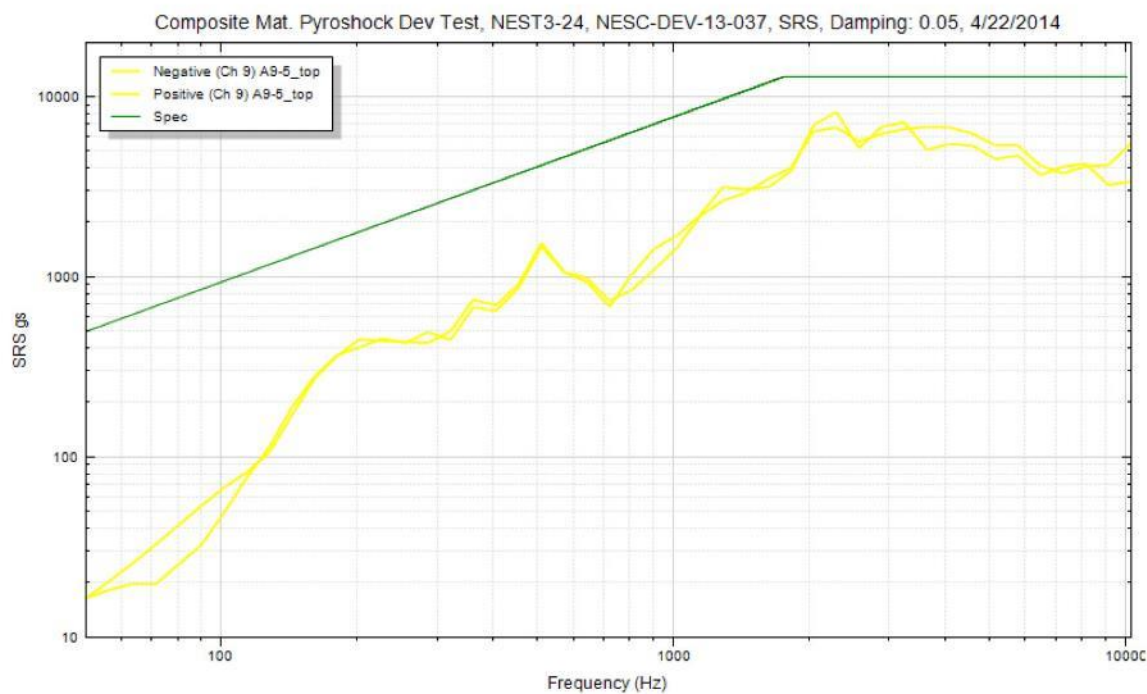
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
725 of 832





# NASA Engineering and Safety Center Technical Assessment Report

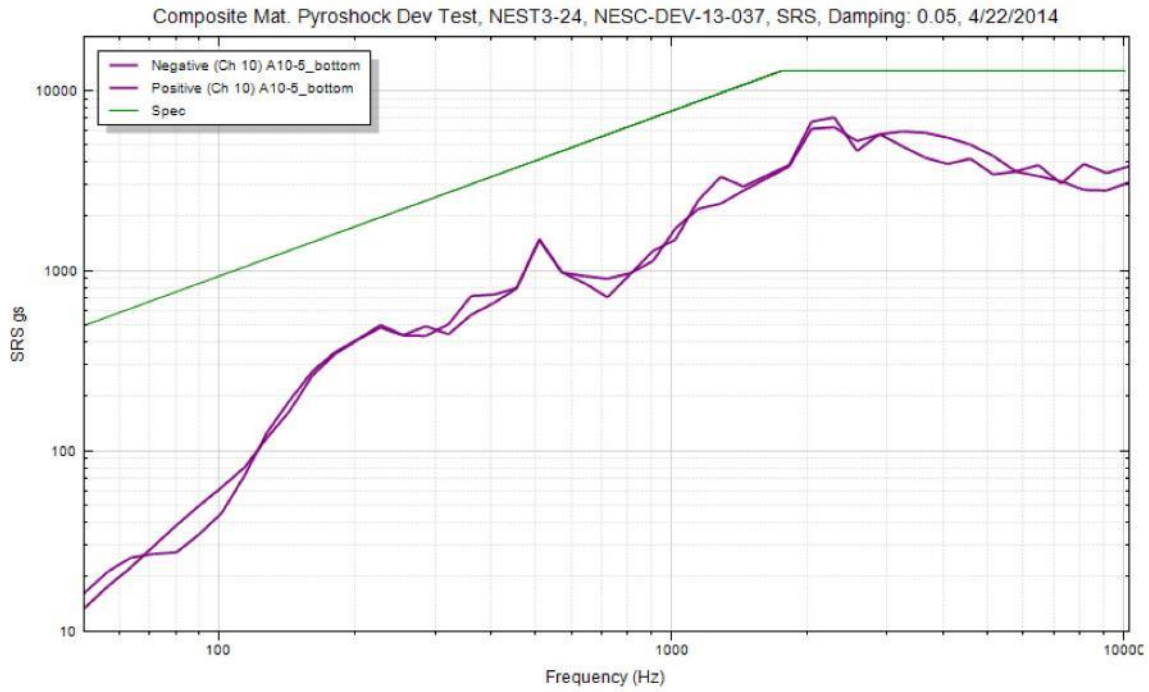
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
726 of 832





# NASA Engineering and Safety Center Technical Assessment Report

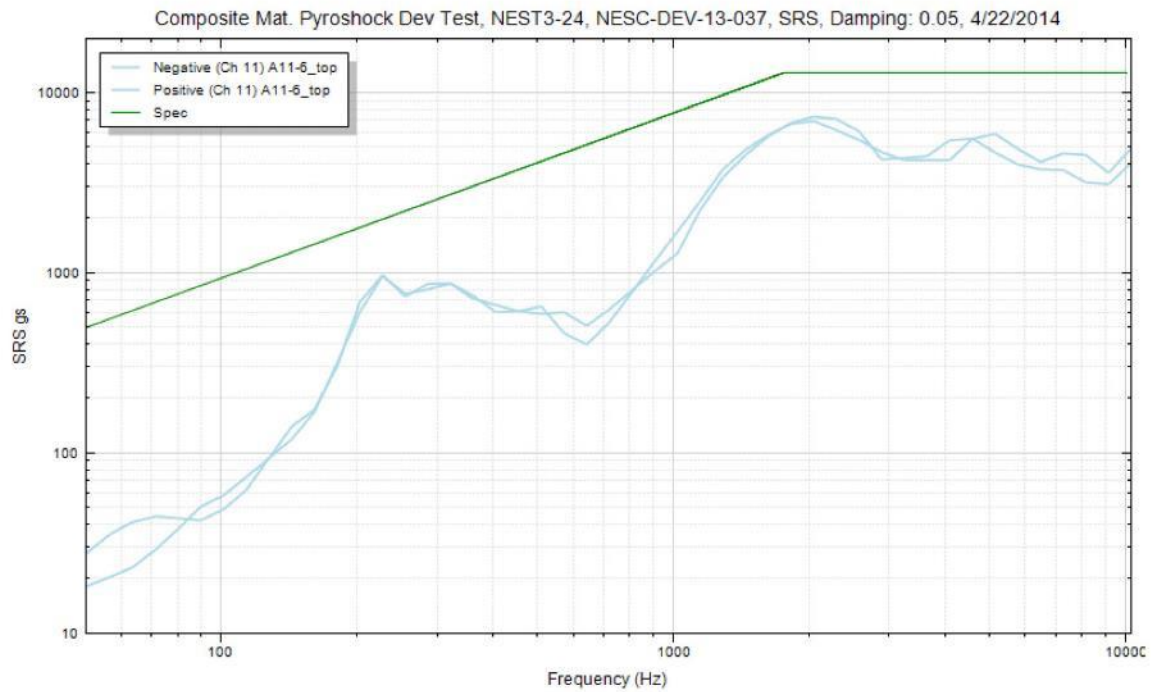
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
727 of 832





# NASA Engineering and Safety Center Technical Assessment Report

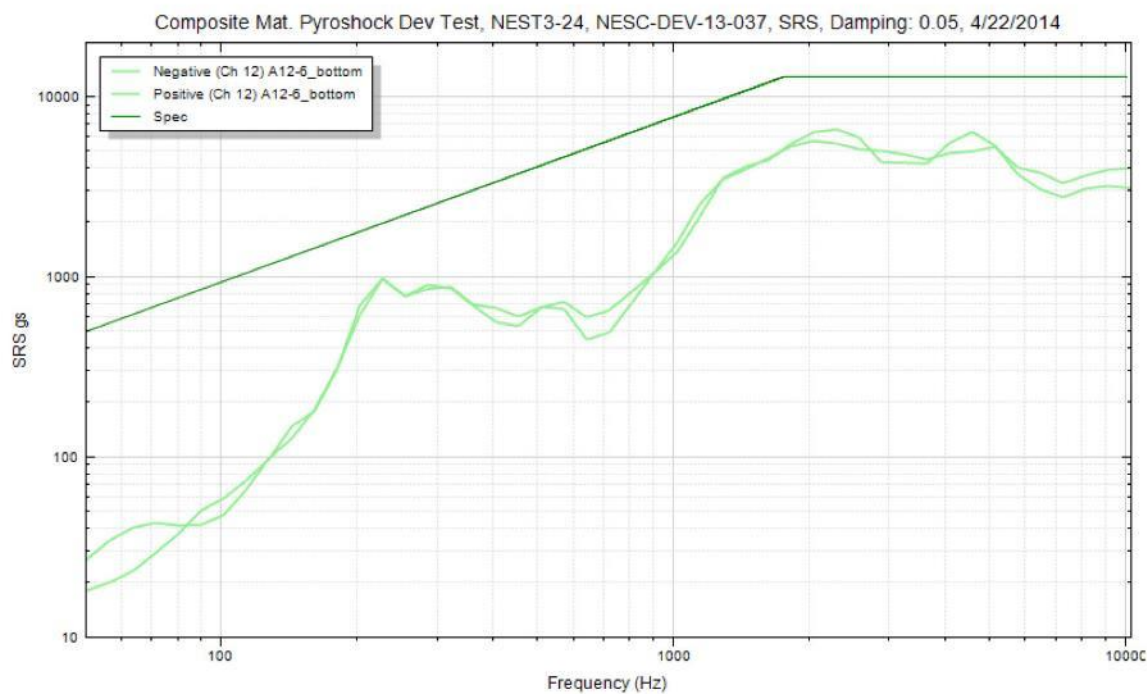
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
728 of 832





# NASA Engineering and Safety Center Technical Assessment Report

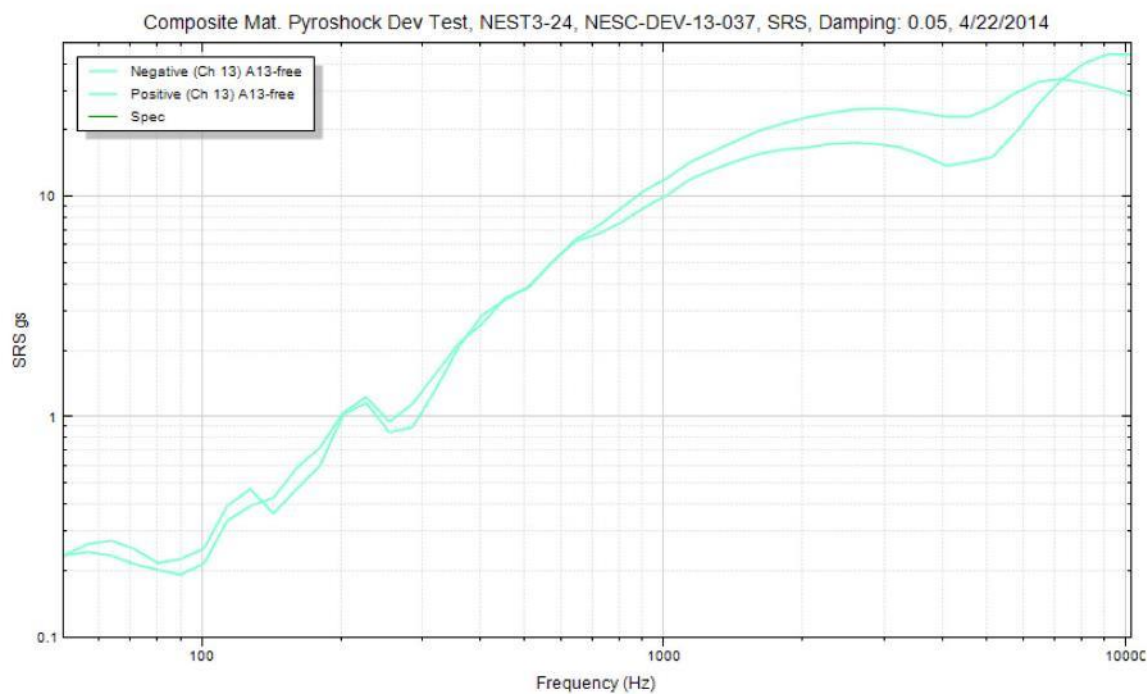
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
729 of 832





# NASA Engineering and Safety Center Technical Assessment Report

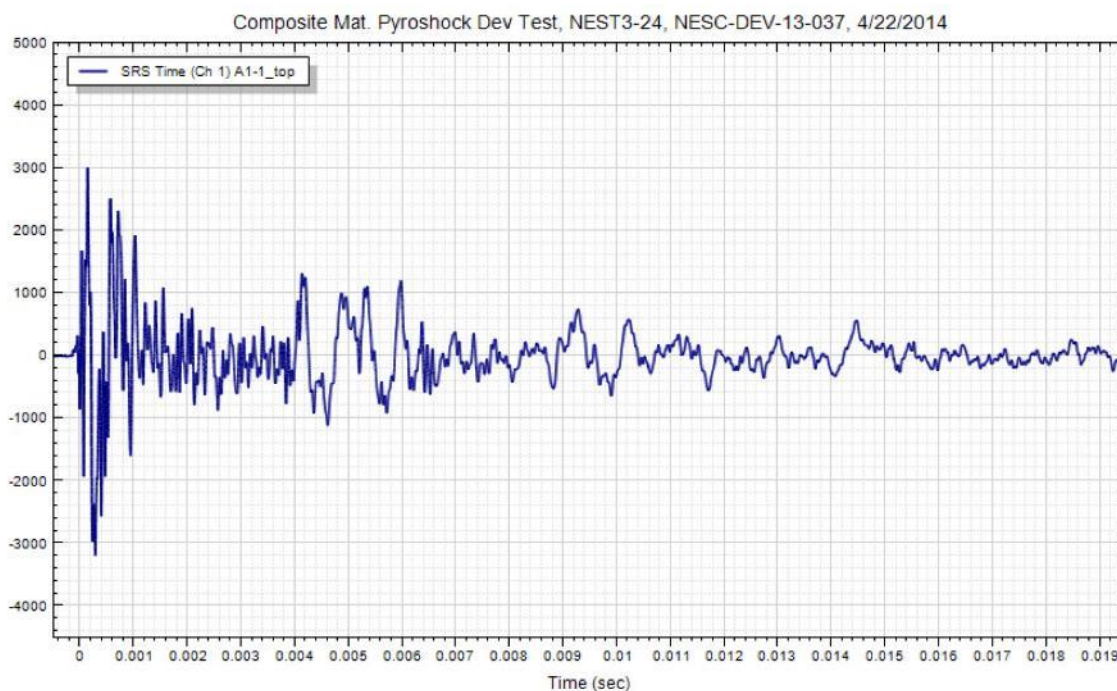
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
730 of 832





# NASA Engineering and Safety Center Technical Assessment Report

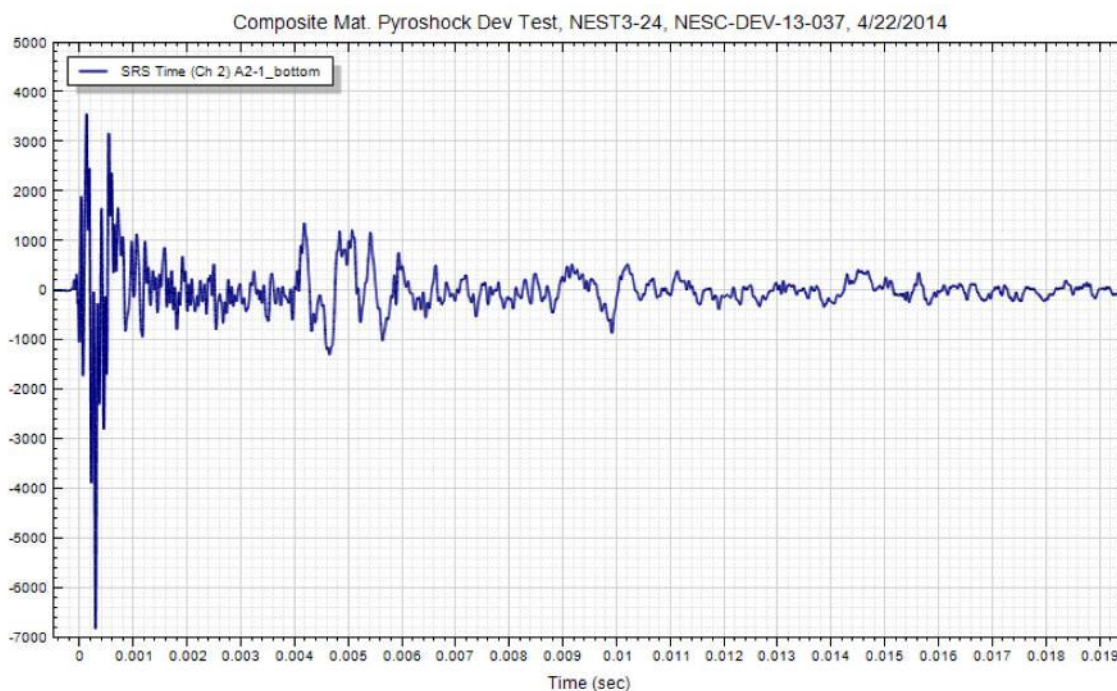
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
731 of 832





# NASA Engineering and Safety Center Technical Assessment Report

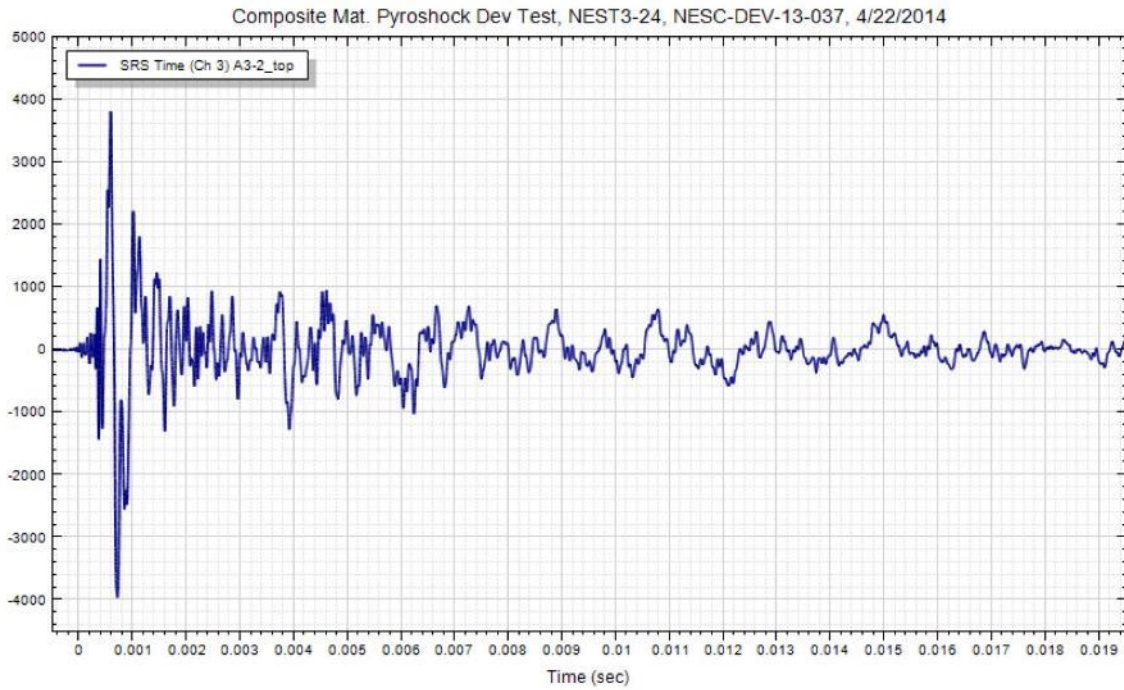
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
732 of 832







# NASA Engineering and Safety Center Technical Assessment Report

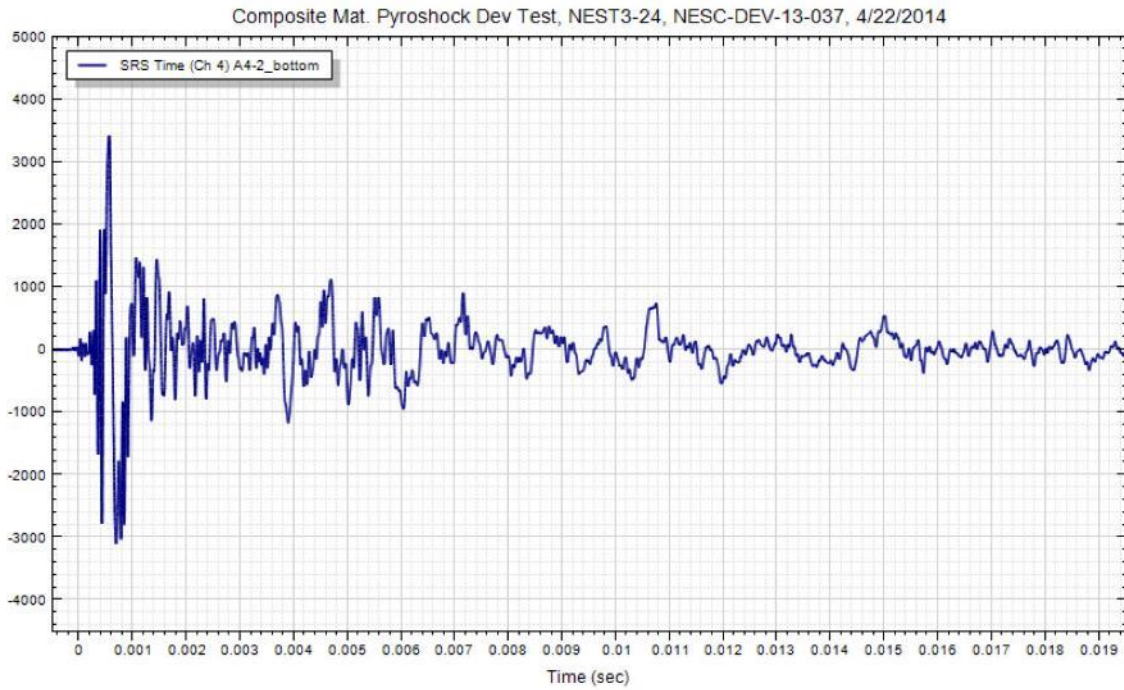
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
733 of 832





# NASA Engineering and Safety Center Technical Assessment Report

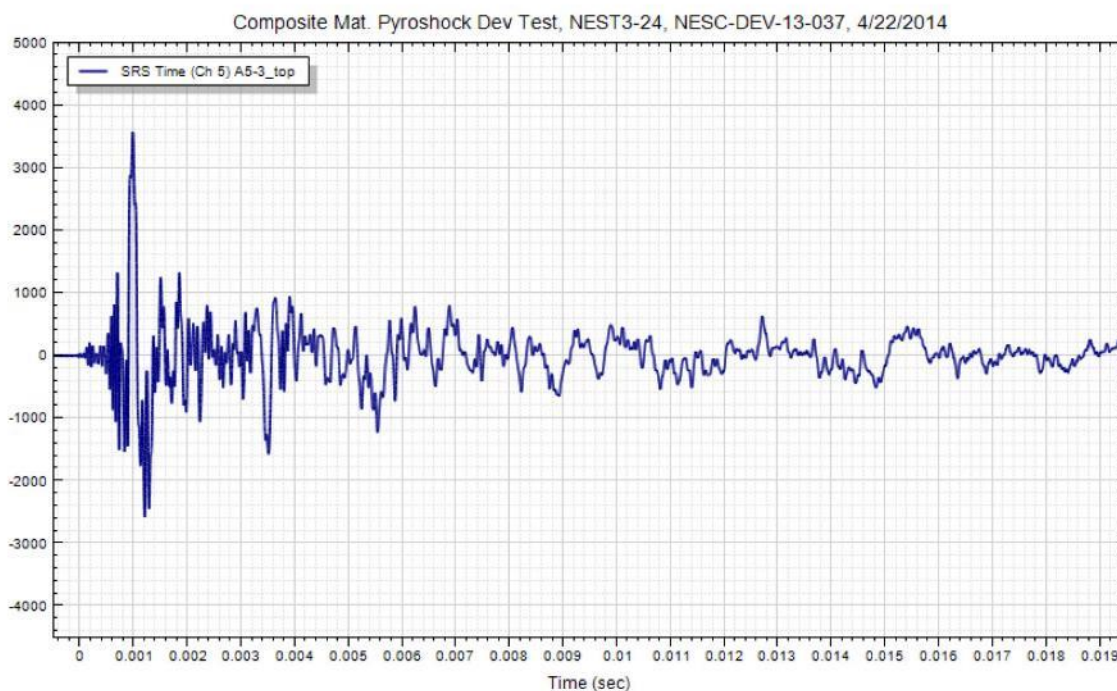
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
734 of 832





# NASA Engineering and Safety Center Technical Assessment Report

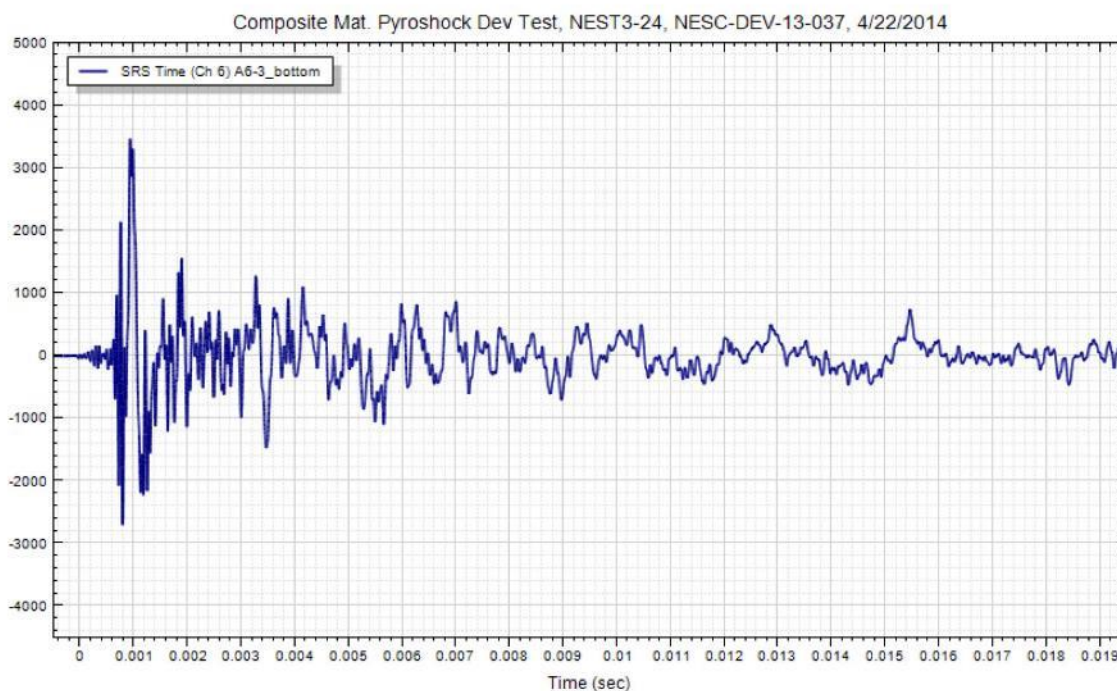
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
735 of 832





# NASA Engineering and Safety Center Technical Assessment Report

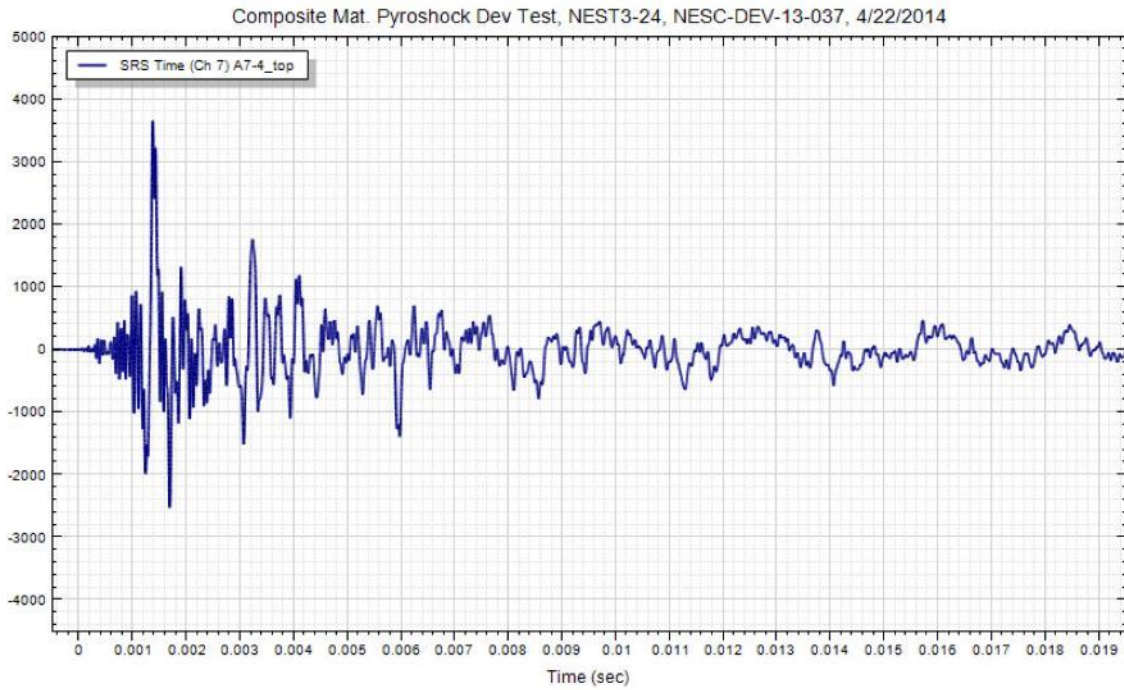
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
736 of 832





# NASA Engineering and Safety Center Technical Assessment Report

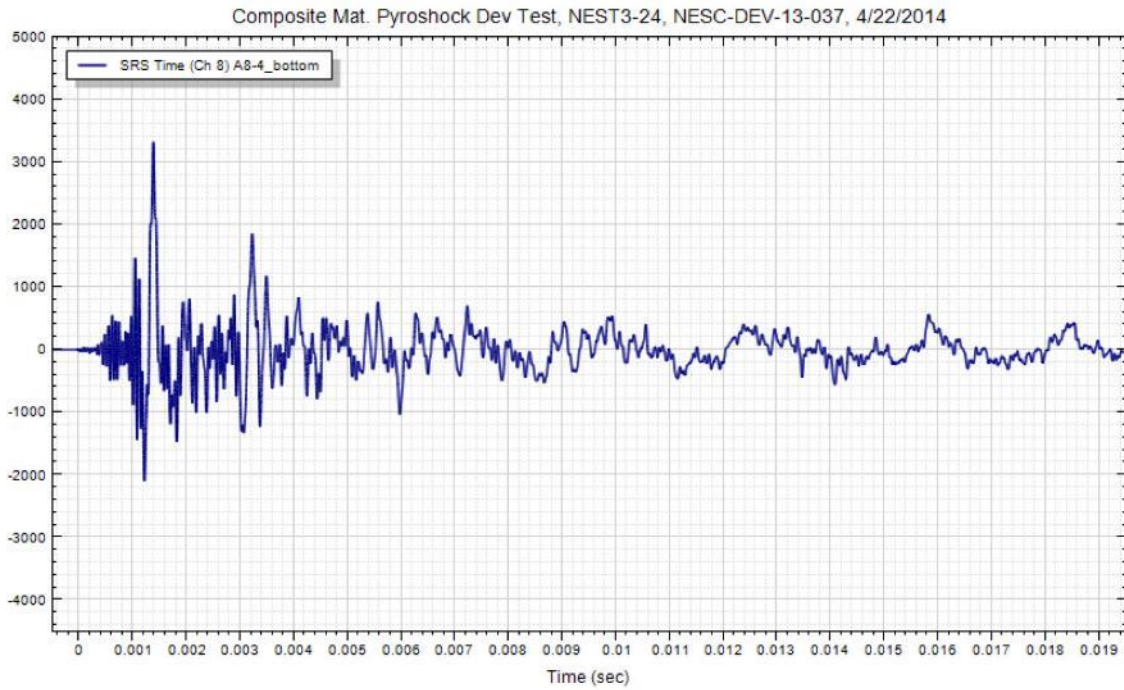
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
737 of 832





# NASA Engineering and Safety Center Technical Assessment Report

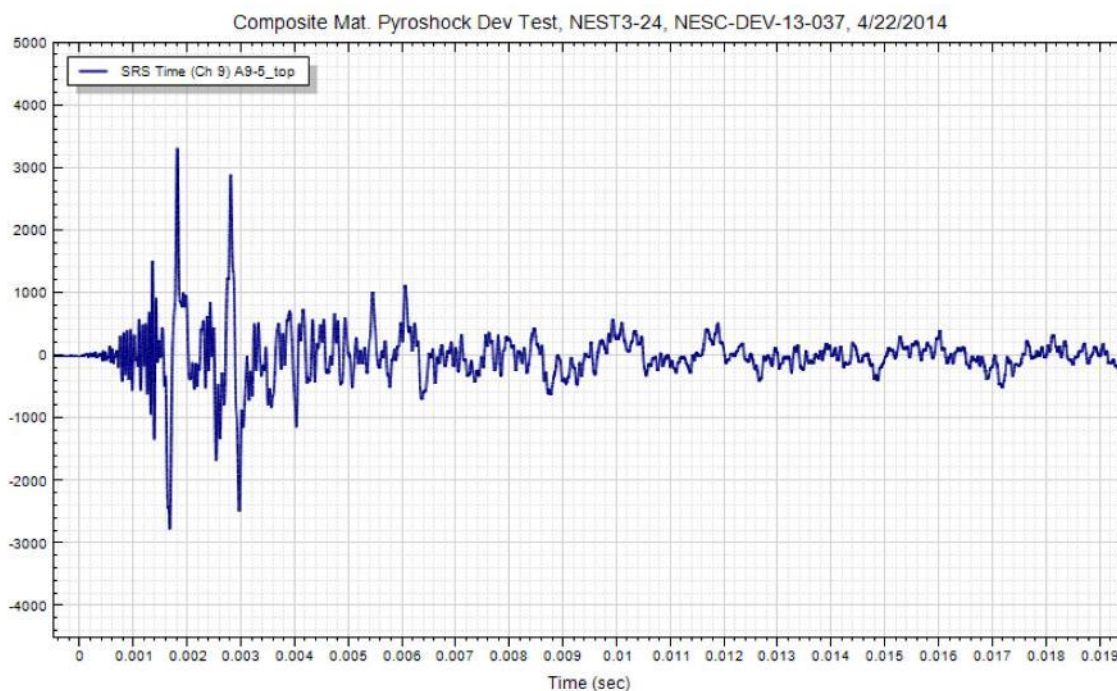
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
738 of 832





# NASA Engineering and Safety Center Technical Assessment Report

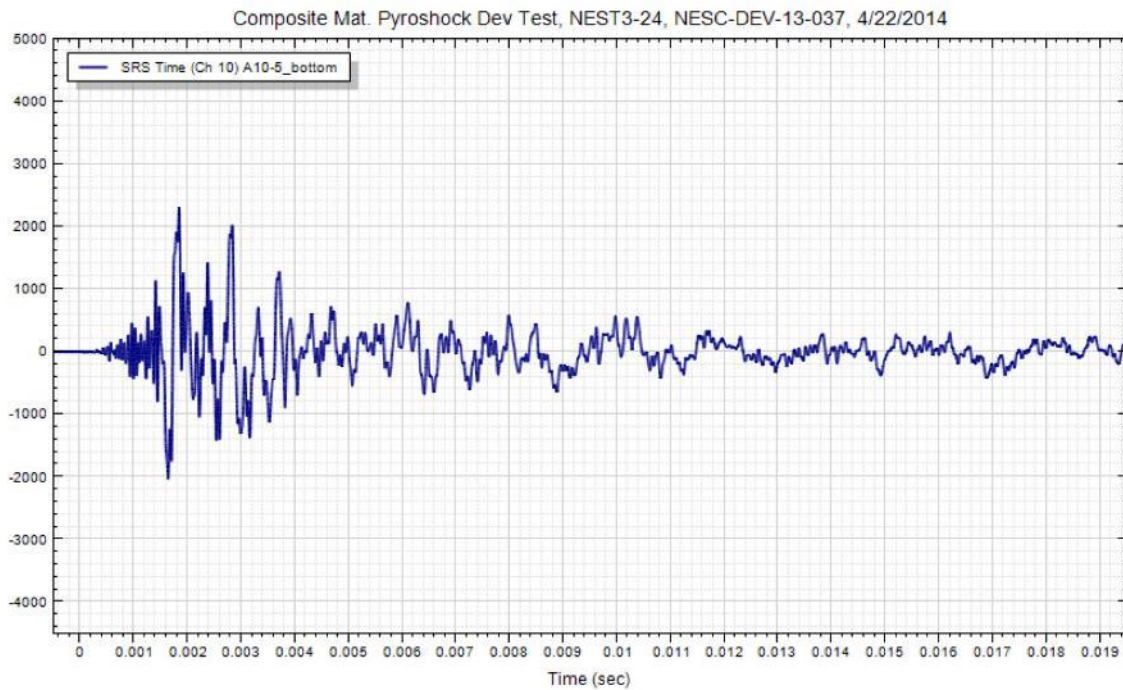
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
739 of 832



425 of 518



# NASA Engineering and Safety Center Technical Assessment Report

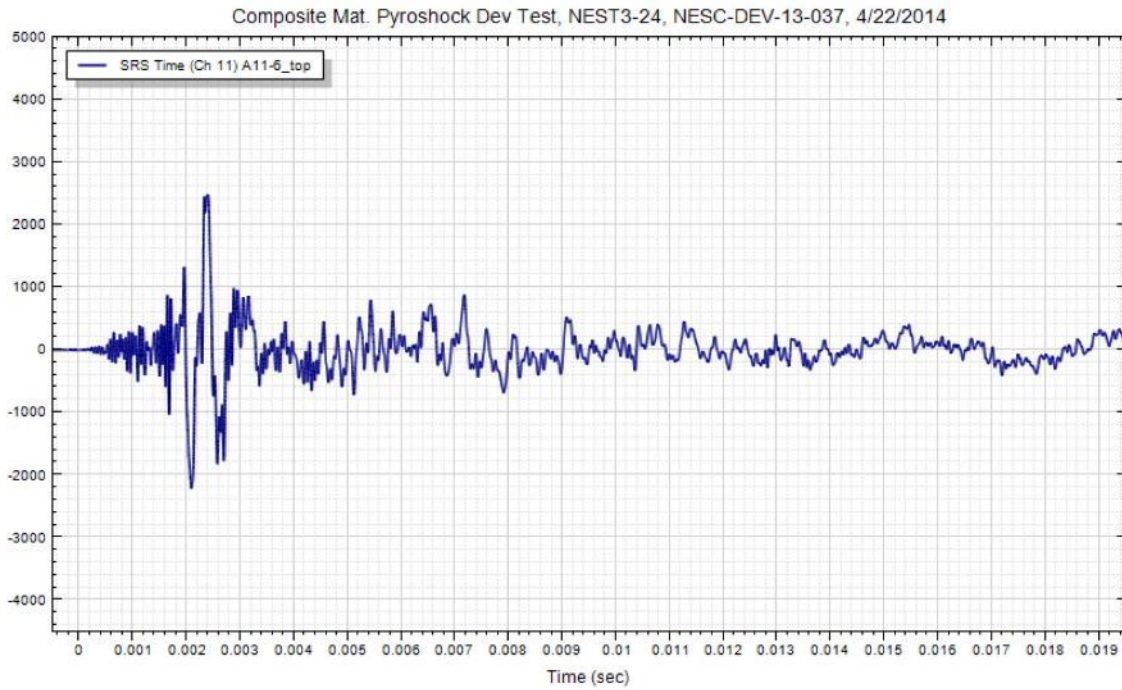
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
740 of 832







# NASA Engineering and Safety Center Technical Assessment Report

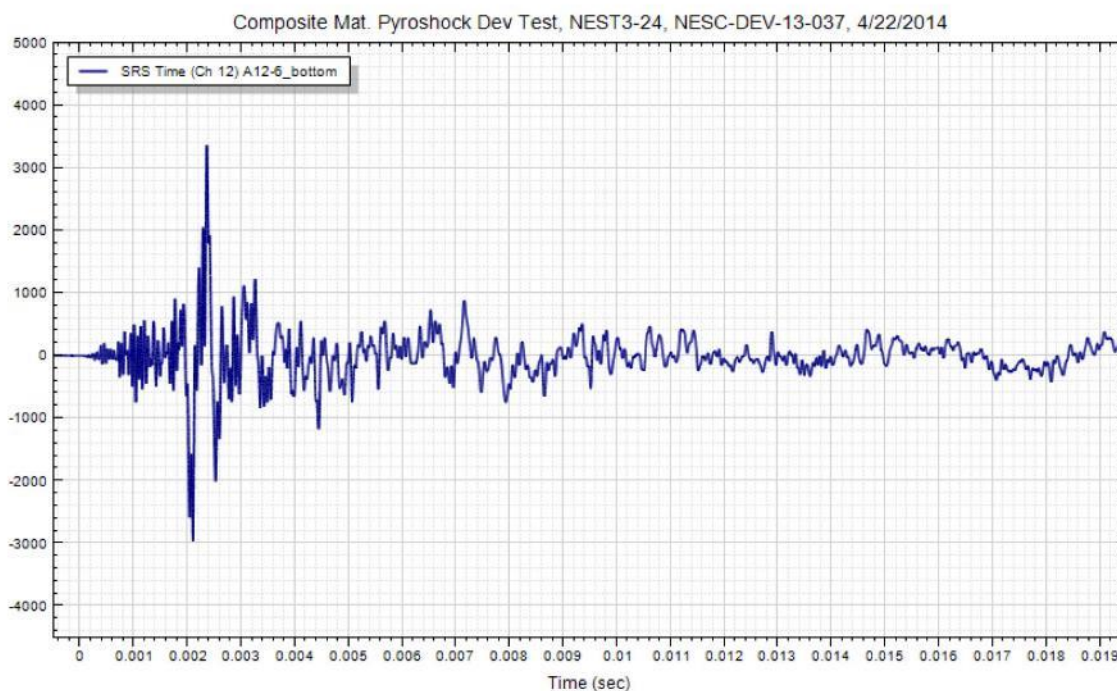
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
741 of 832





# NASA Engineering and Safety Center Technical Assessment Report

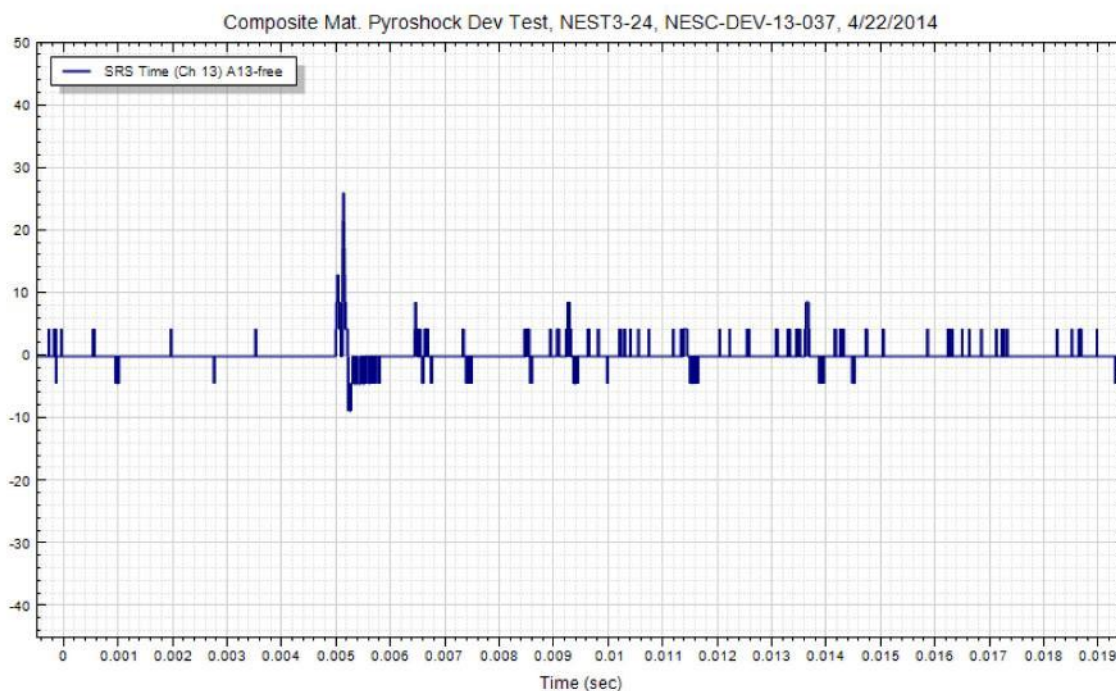
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**


Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
742 of 832



428 of 518

	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 743 of 832	

**NESC-DEV-13-037**  
**Composite Materials**  
**Shock Test**  
  
**Test #13 Accelerometer Data**  
**Panel 0346A025**



# NASA Engineering and Safety Center Technical Assessment Report

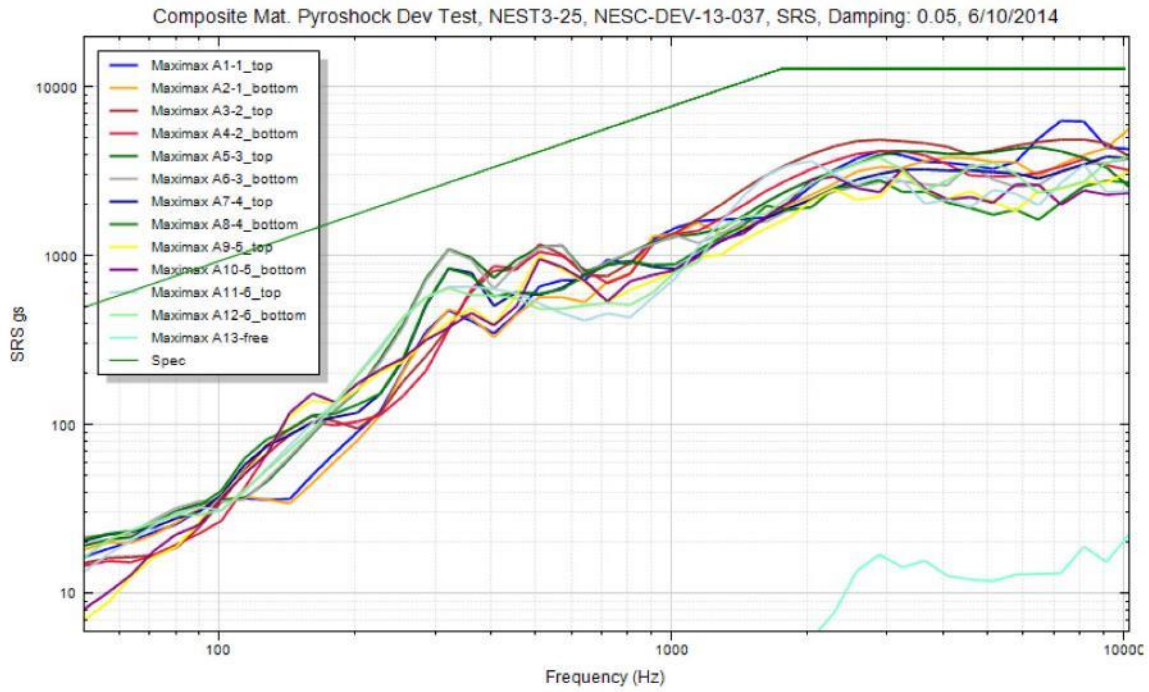
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
744 of 832





# NASA Engineering and Safety Center Technical Assessment Report

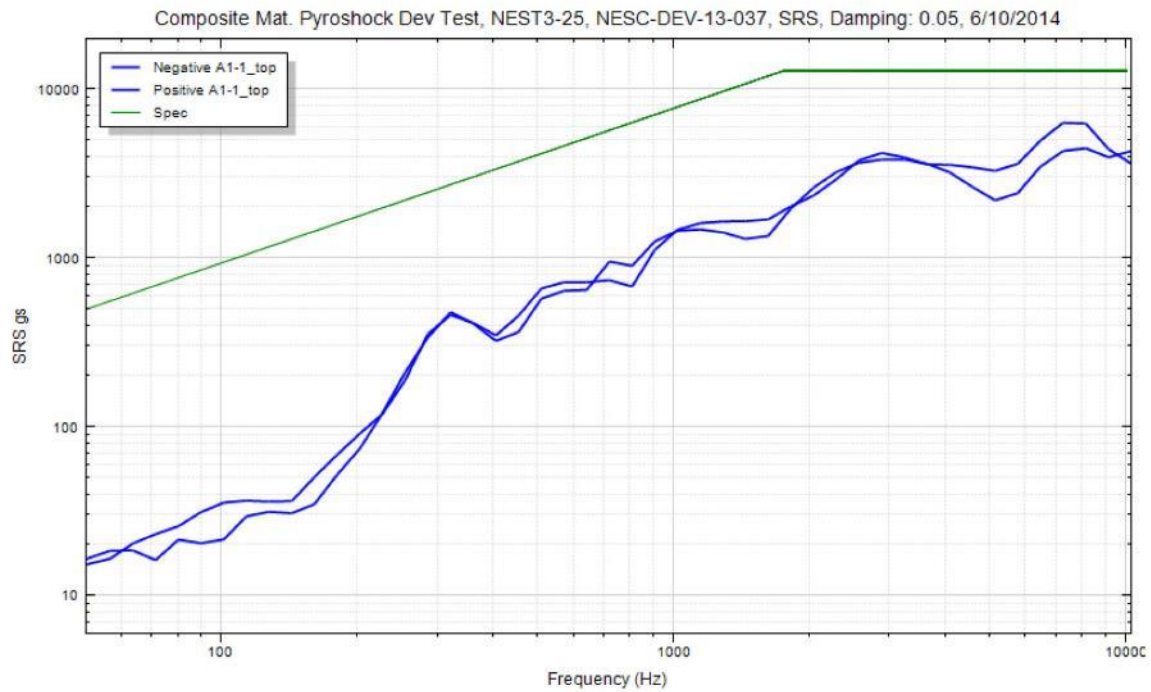
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
745 of 832





# NASA Engineering and Safety Center Technical Assessment Report

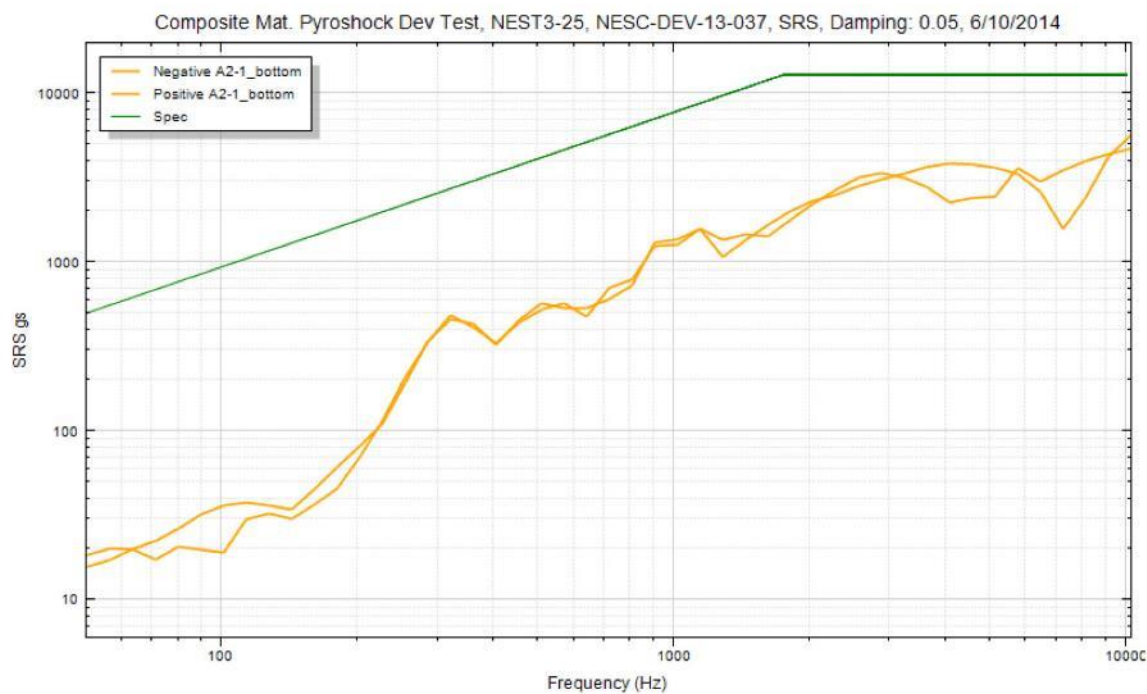
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
746 of 832





# NASA Engineering and Safety Center Technical Assessment Report

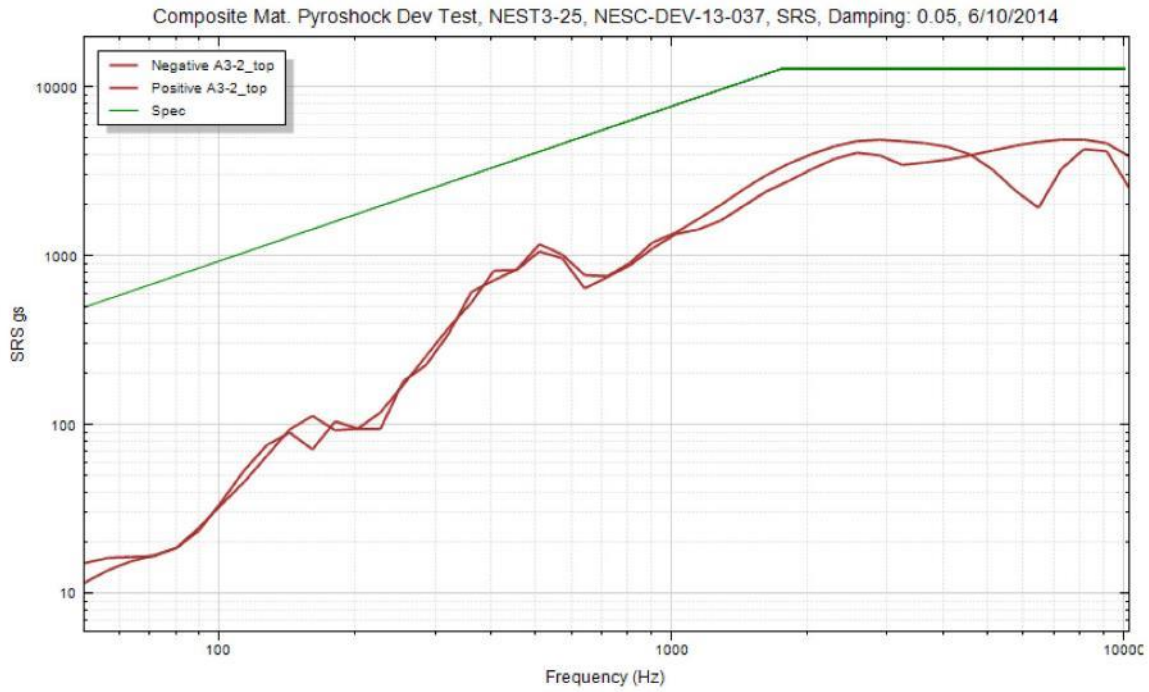
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
747 of 832





# NASA Engineering and Safety Center Technical Assessment Report

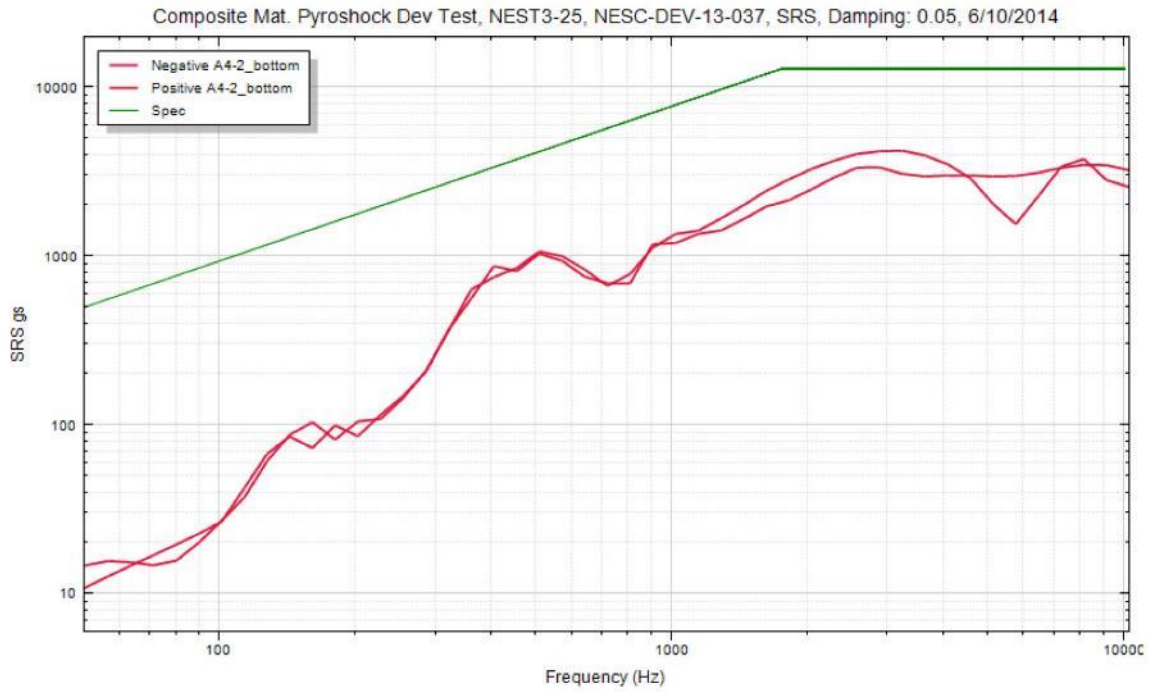
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
748 of 832







# NASA Engineering and Safety Center Technical Assessment Report

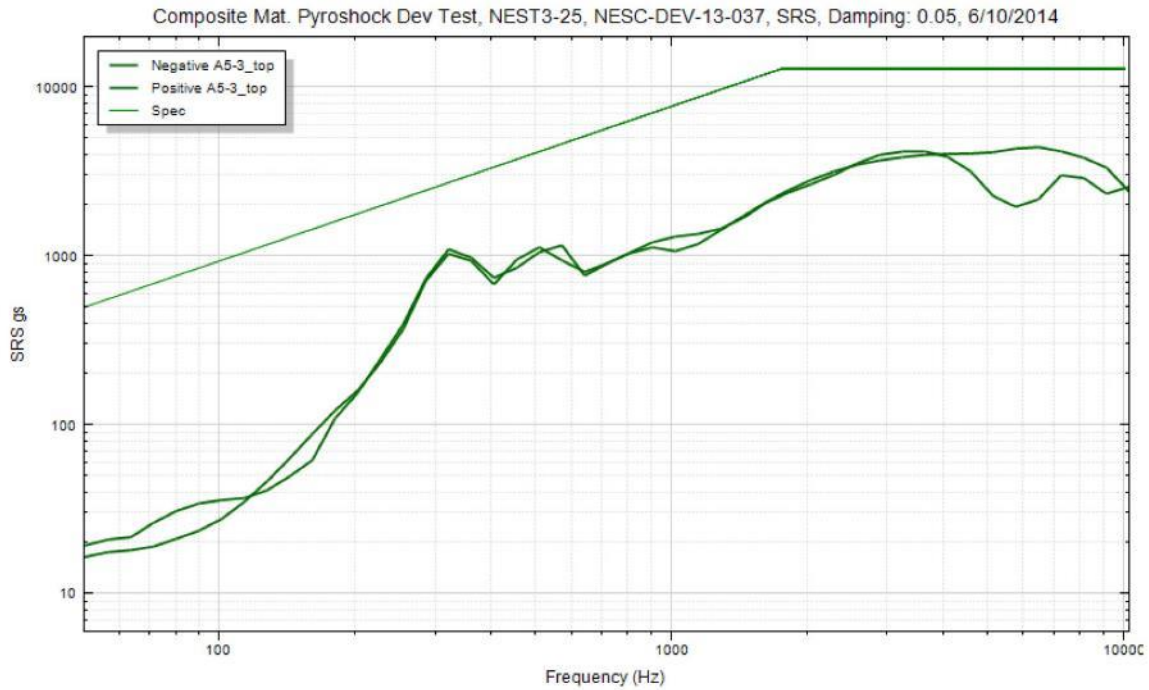
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
749 of 832





# NASA Engineering and Safety Center Technical Assessment Report

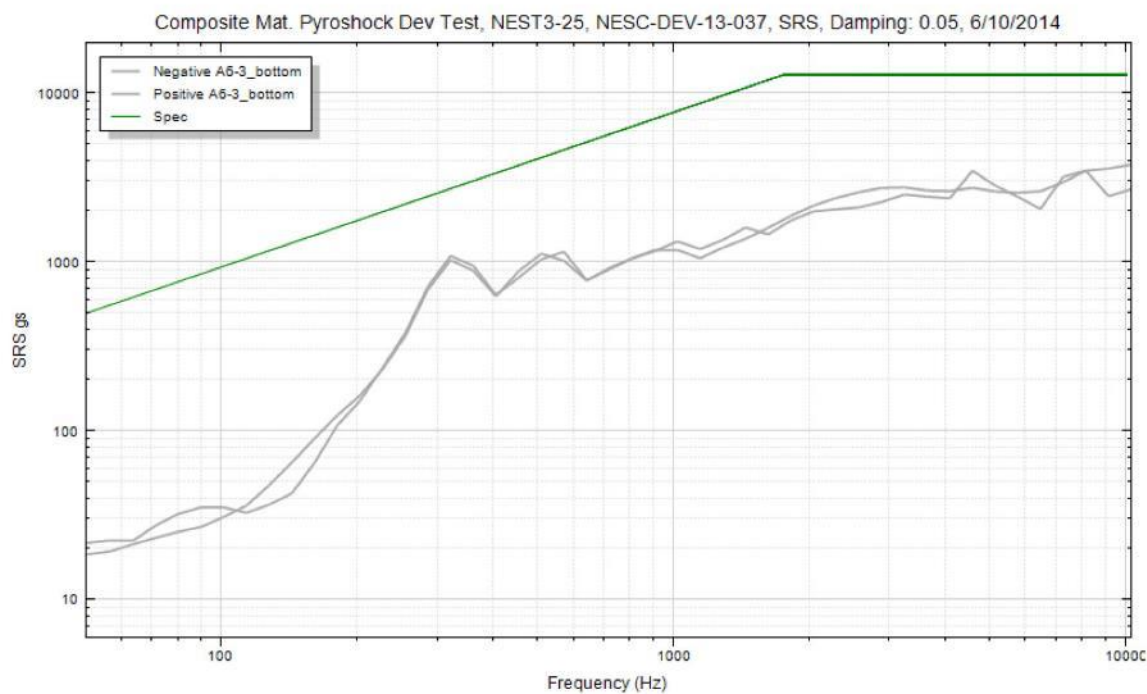
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
750 of 832





# NASA Engineering and Safety Center Technical Assessment Report

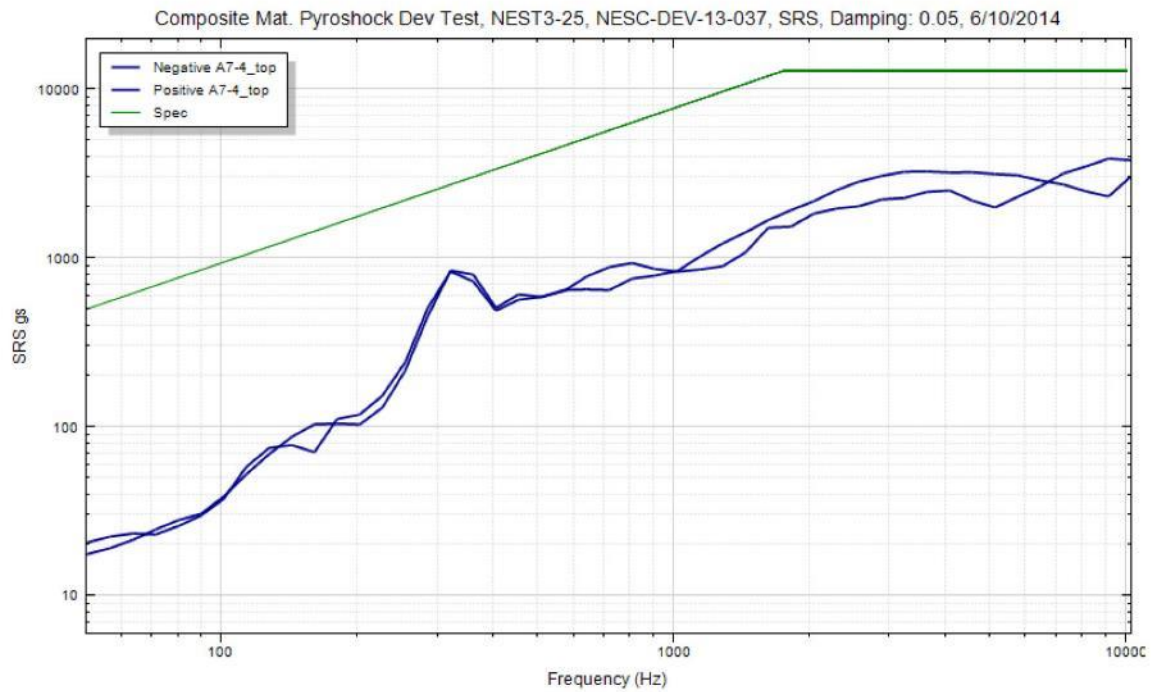
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
751 of 832





# NASA Engineering and Safety Center Technical Assessment Report

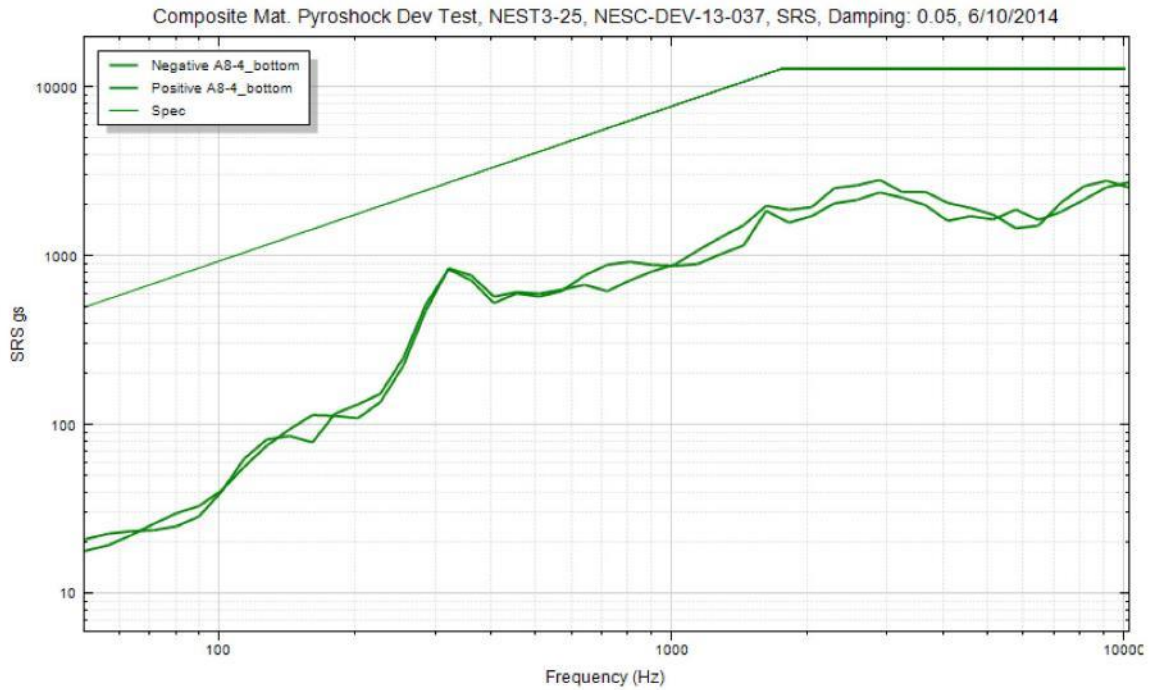
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
752 of 832





# NASA Engineering and Safety Center Technical Assessment Report

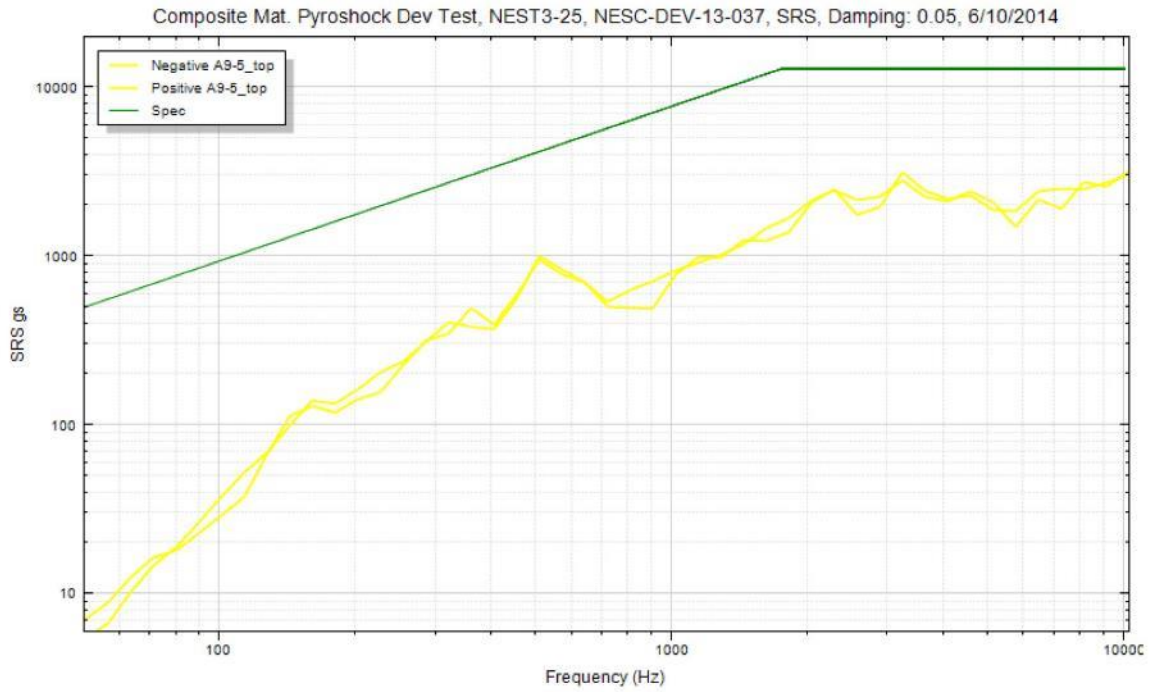
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
753 of 832





# NASA Engineering and Safety Center Technical Assessment Report

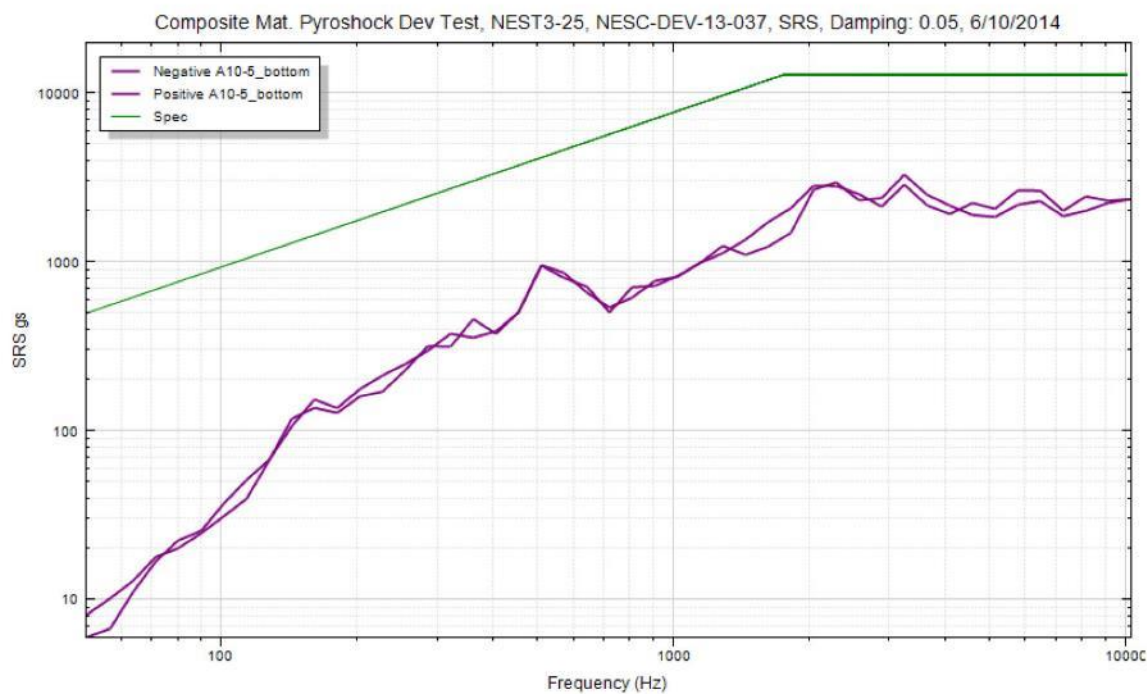
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
754 of 832





# NASA Engineering and Safety Center Technical Assessment Report

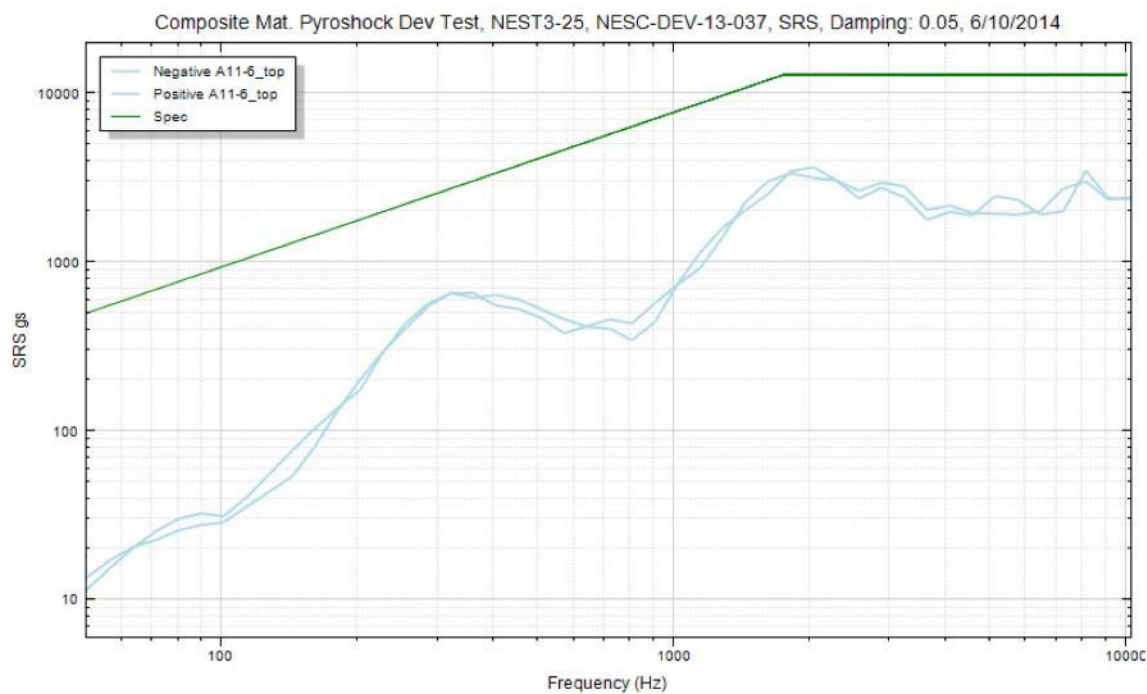
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
755 of 832





# NASA Engineering and Safety Center Technical Assessment Report

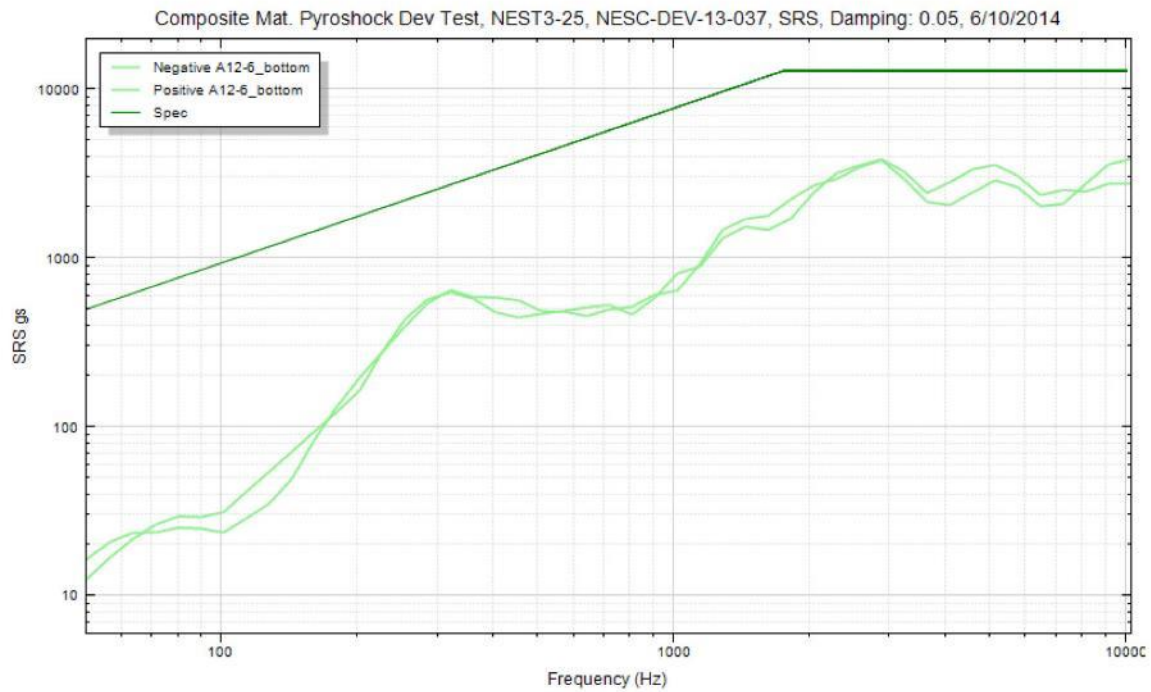
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
756 of 832







# NASA Engineering and Safety Center Technical Assessment Report

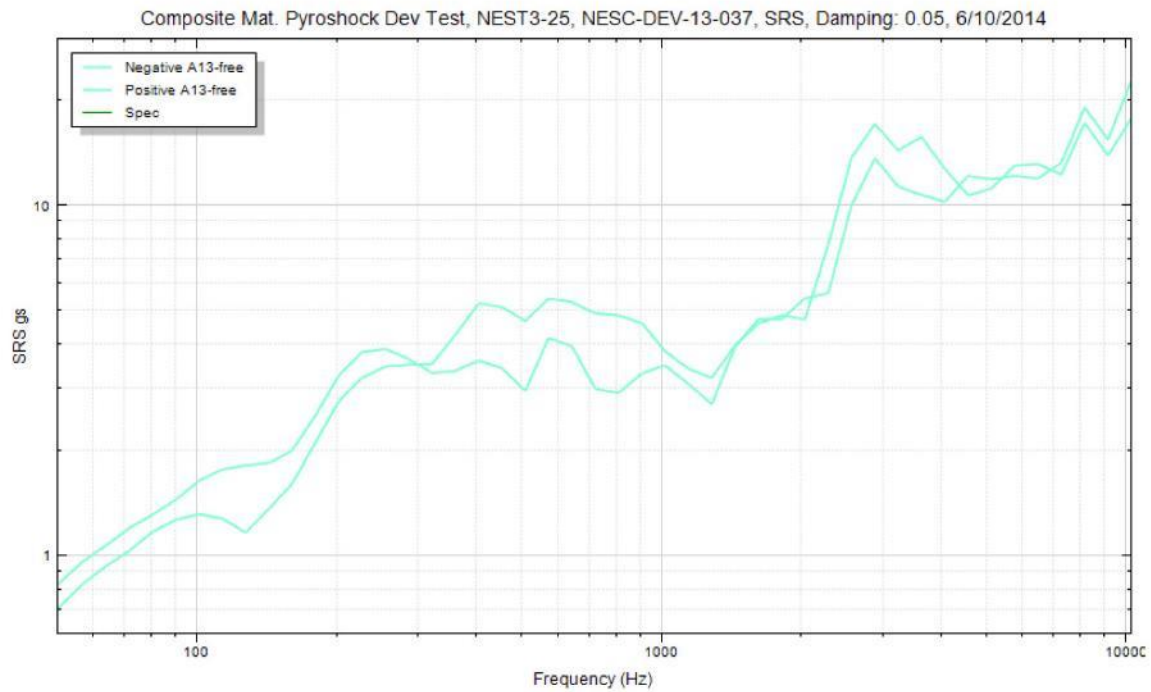
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
757 of 832





# NASA Engineering and Safety Center Technical Assessment Report

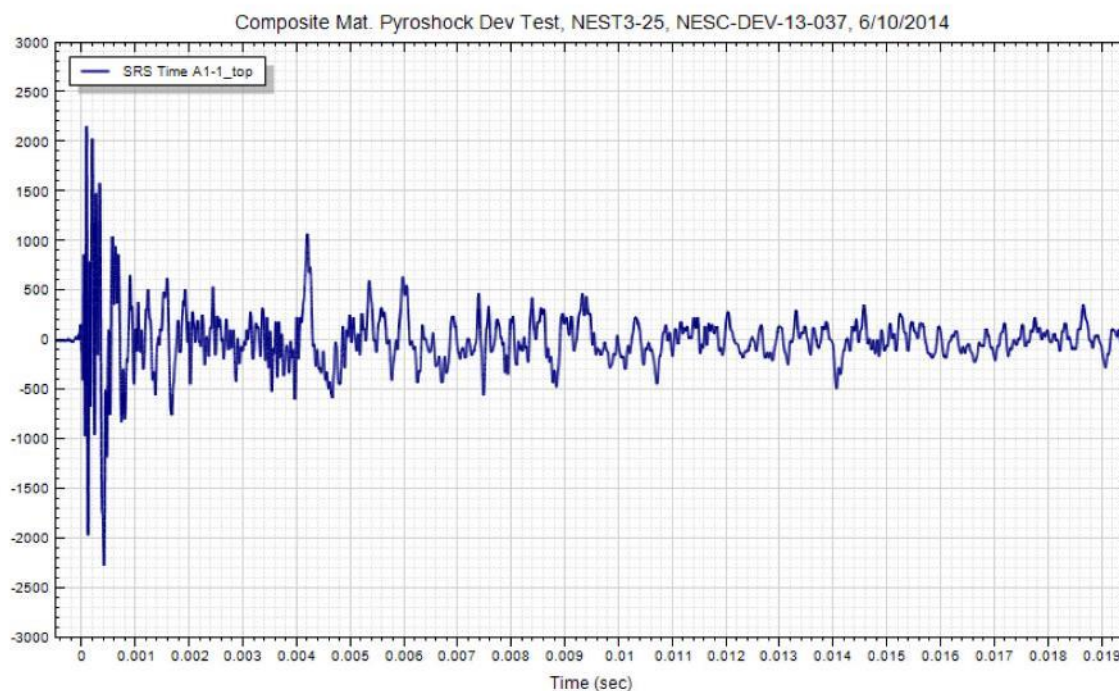
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
758 of 832





# NASA Engineering and Safety Center Technical Assessment Report

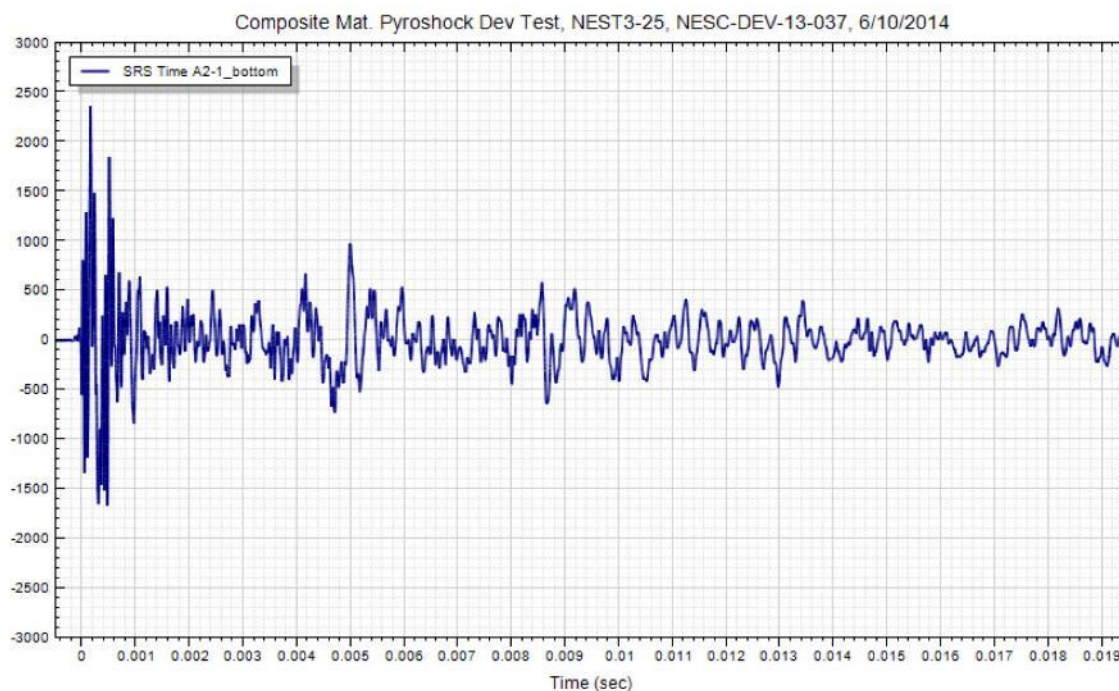
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
759 of 832





# NASA Engineering and Safety Center Technical Assessment Report

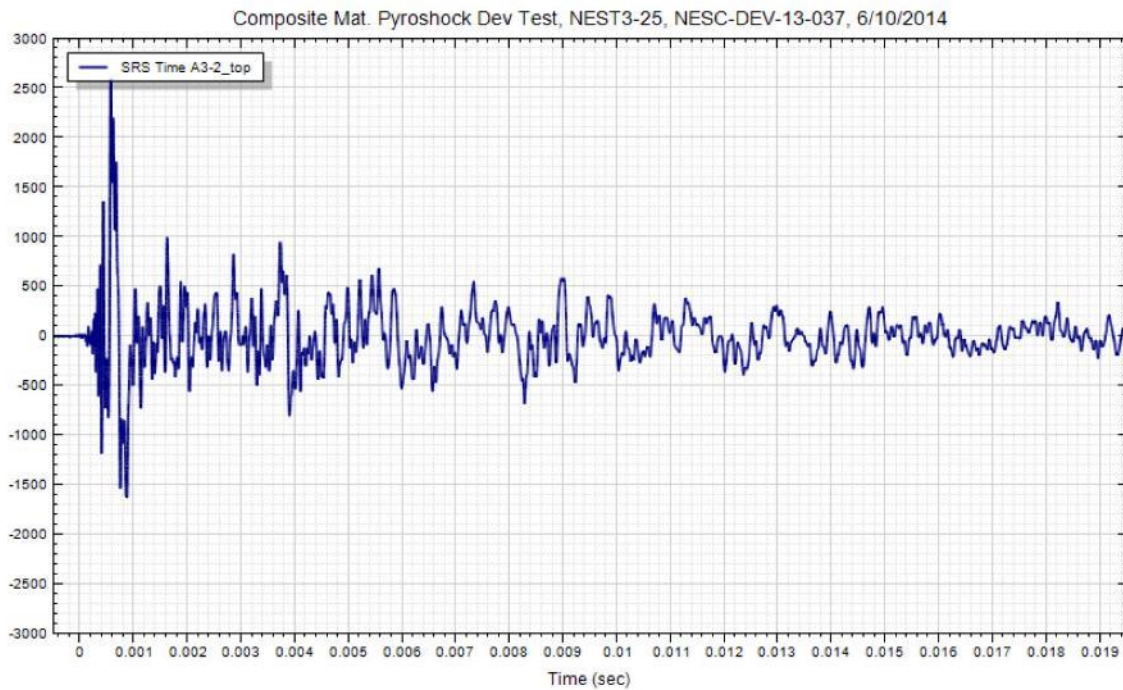
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
760 of 832





# NASA Engineering and Safety Center Technical Assessment Report

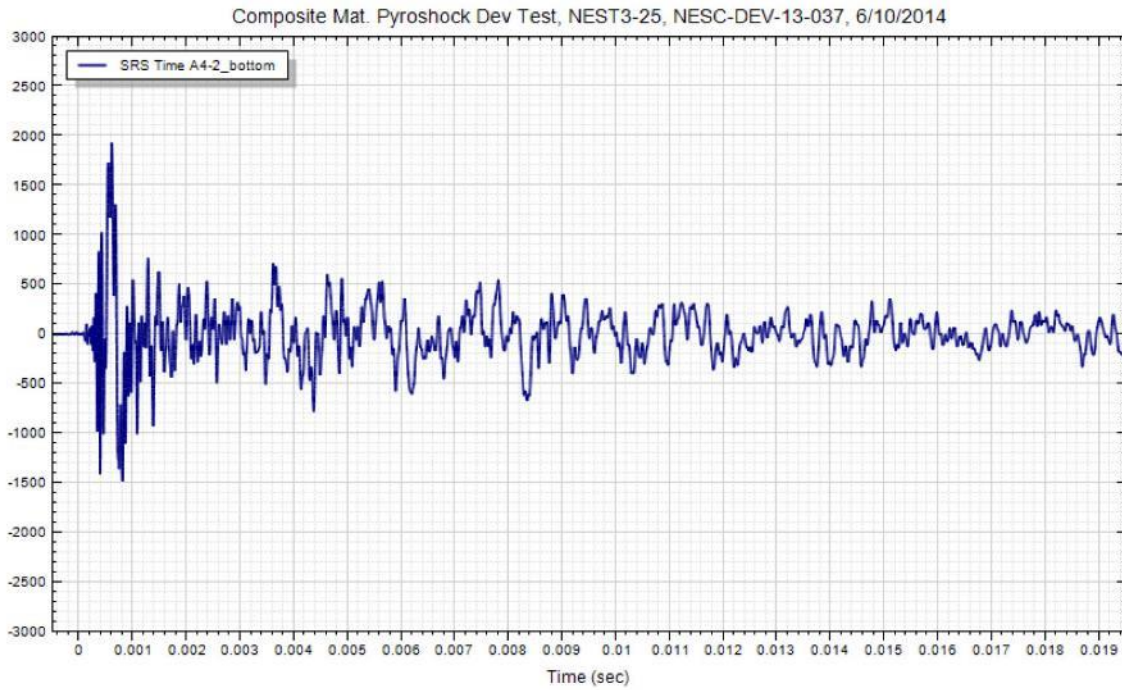
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
761 of 832





# NASA Engineering and Safety Center Technical Assessment Report

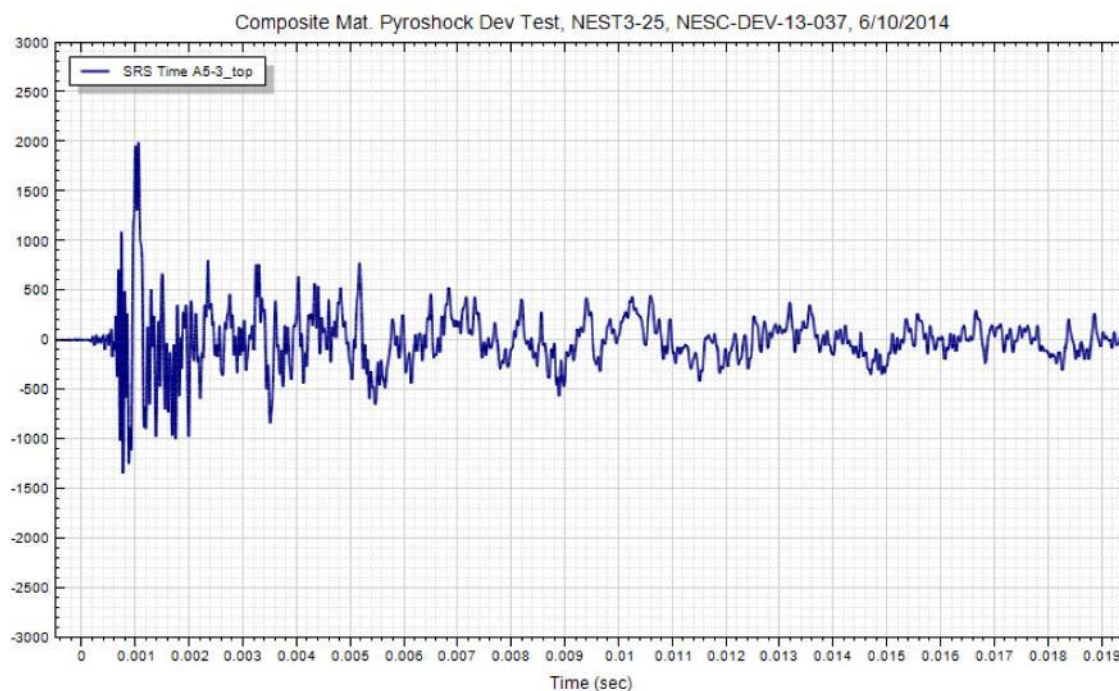
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
762 of 832





# NASA Engineering and Safety Center Technical Assessment Report

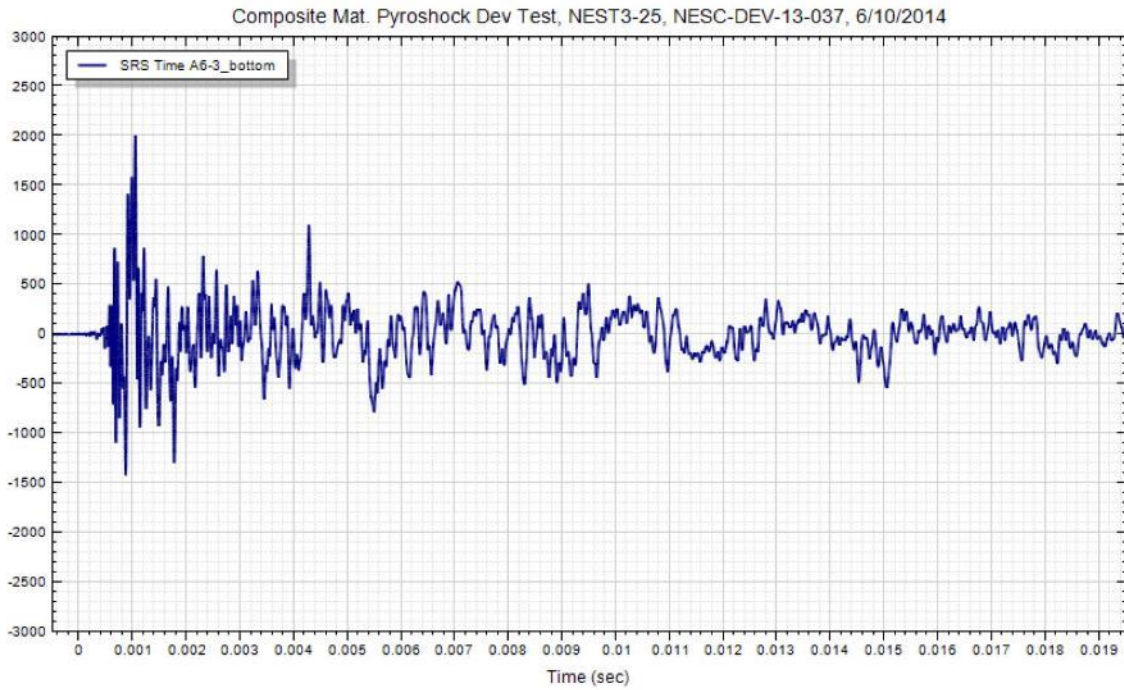
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
763 of 832





# NASA Engineering and Safety Center Technical Assessment Report

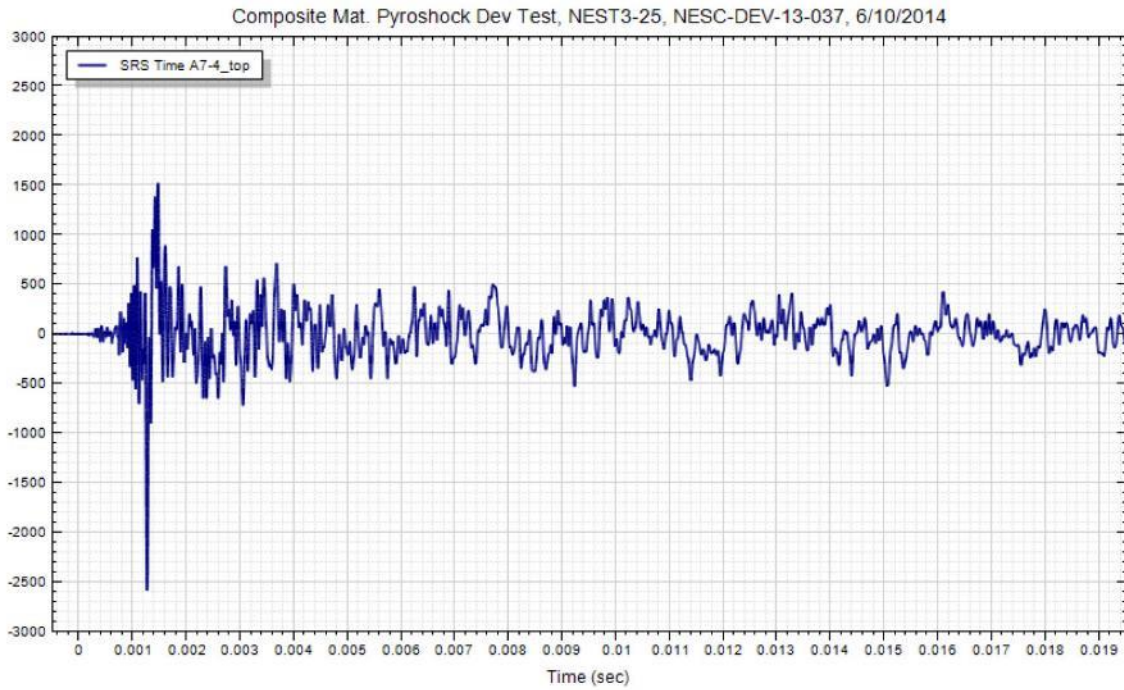
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
764 of 832







# NASA Engineering and Safety Center Technical Assessment Report

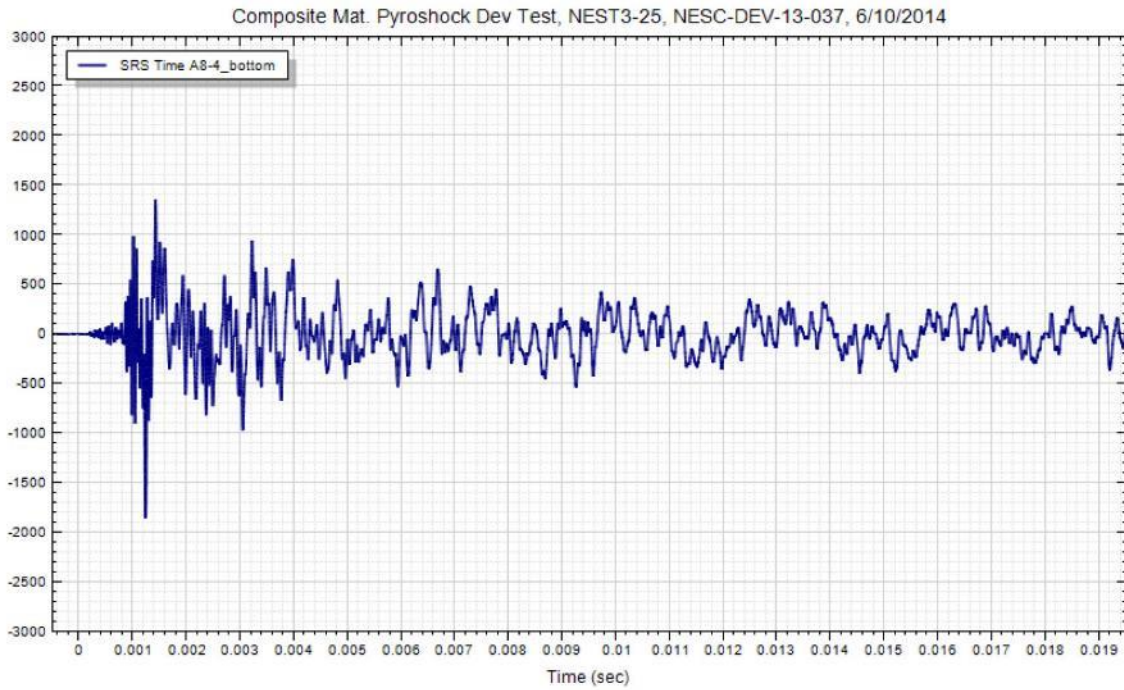
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
765 of 832





# NASA Engineering and Safety Center Technical Assessment Report

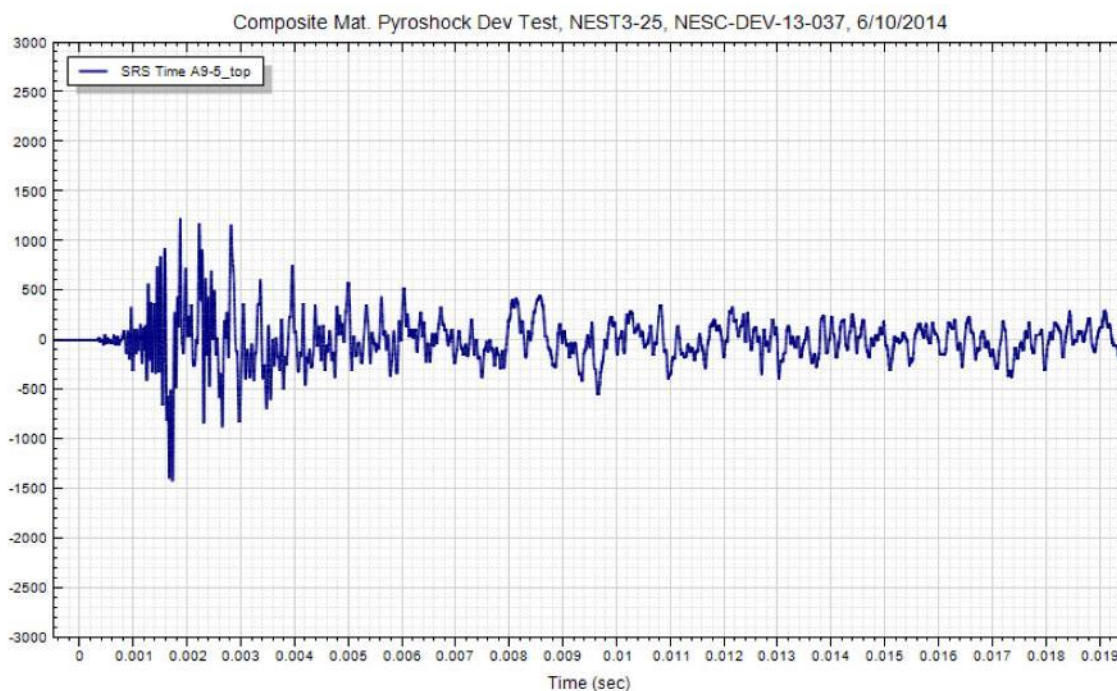
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
766 of 832





# NASA Engineering and Safety Center Technical Assessment Report

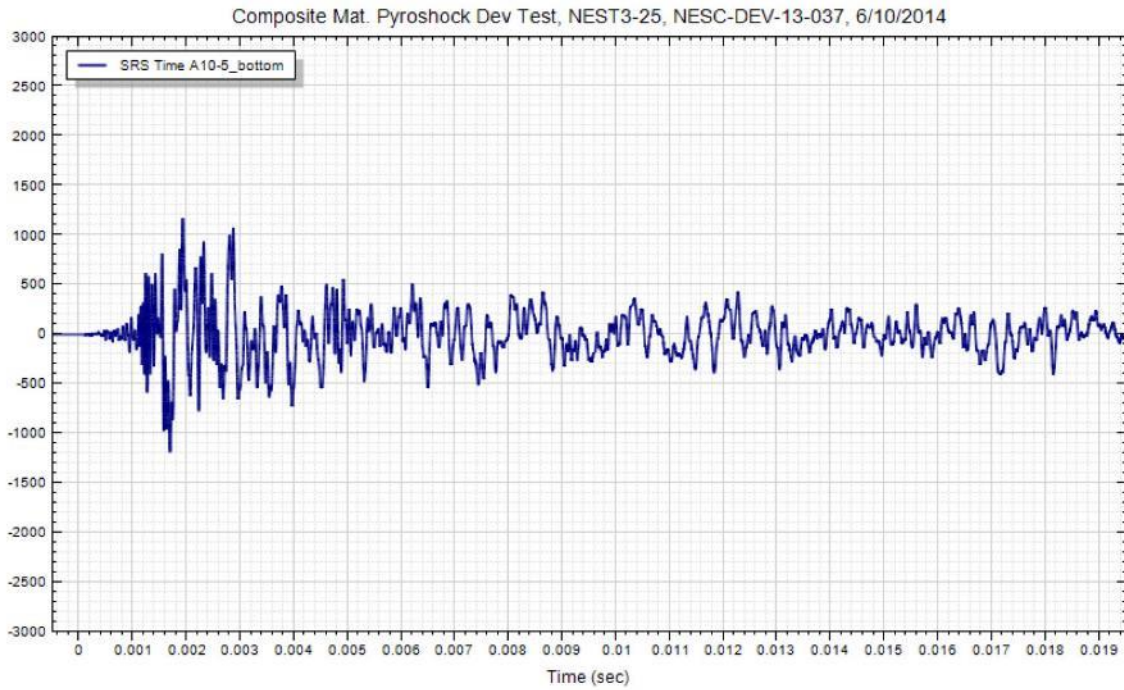
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
767 of 832





# NASA Engineering and Safety Center Technical Assessment Report

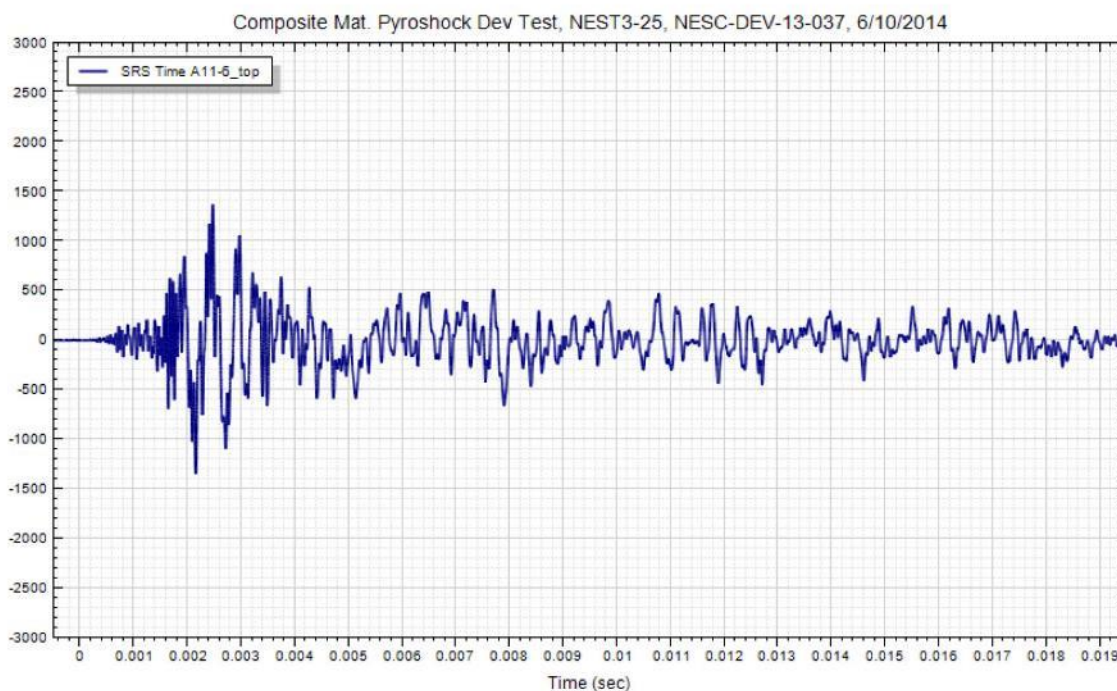
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
768 of 832





# NASA Engineering and Safety Center Technical Assessment Report

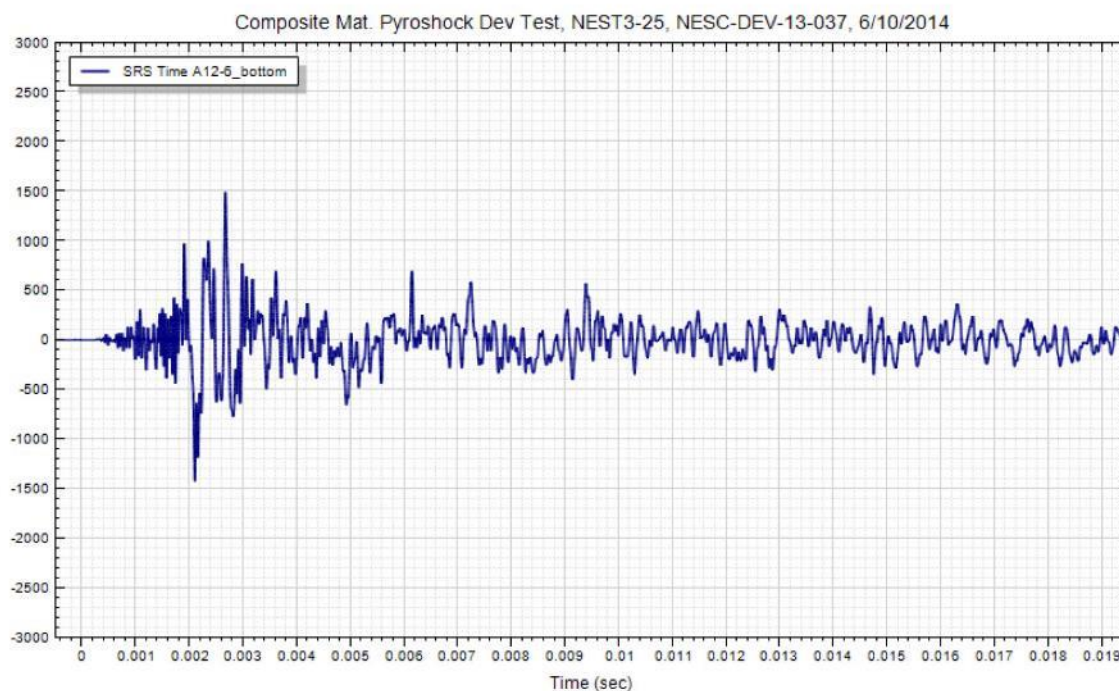
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
769 of 832





# NASA Engineering and Safety Center Technical Assessment Report

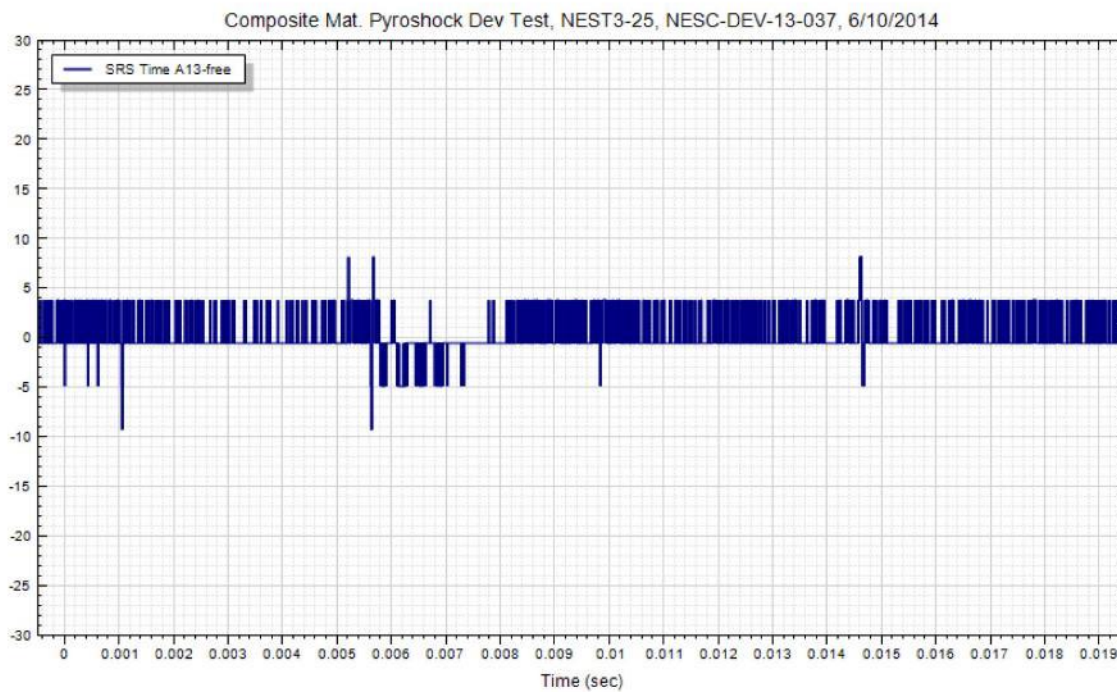
Document #:  
**NESC-RP-  
12-00783**


Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
770 of 832



	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 771 of 832</p>	

**NESC-DEV-13-037**  
**Composite Materials**  
**Shock Test**  
  
**Test #14 Accelerometer Data**  
**Panel 0346A027**



# NASA Engineering and Safety Center Technical Assessment Report

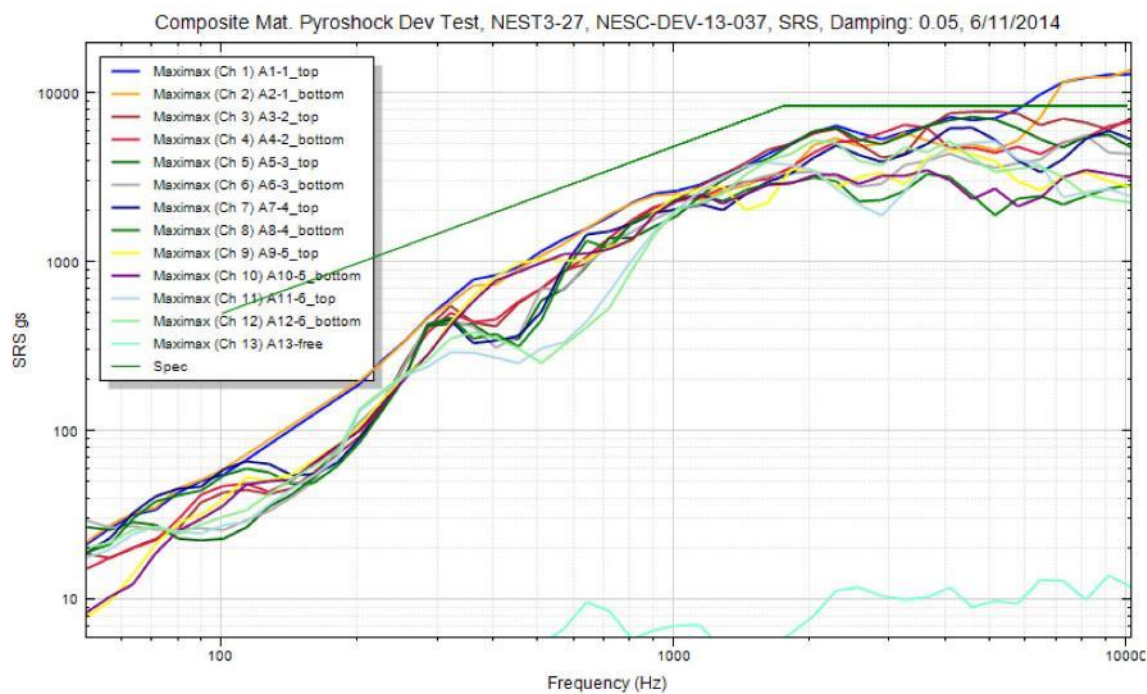
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
772 of 832







# NASA Engineering and Safety Center Technical Assessment Report

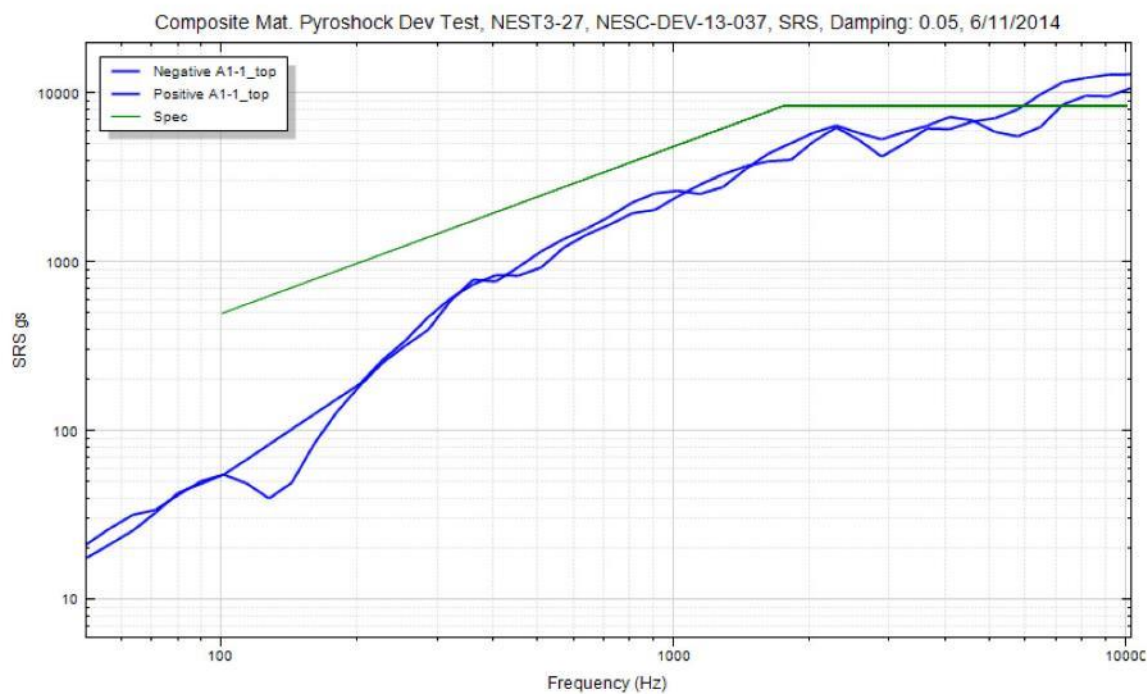
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
773 of 832





# NASA Engineering and Safety Center Technical Assessment Report

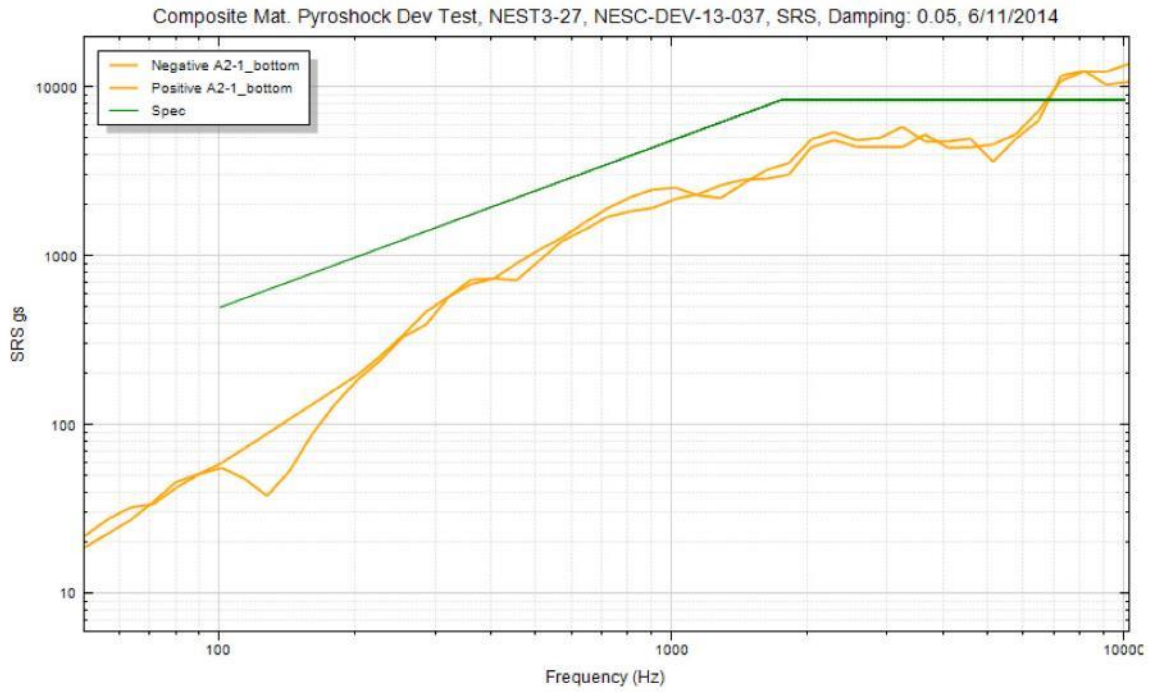
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
774 of 832





# NASA Engineering and Safety Center Technical Assessment Report

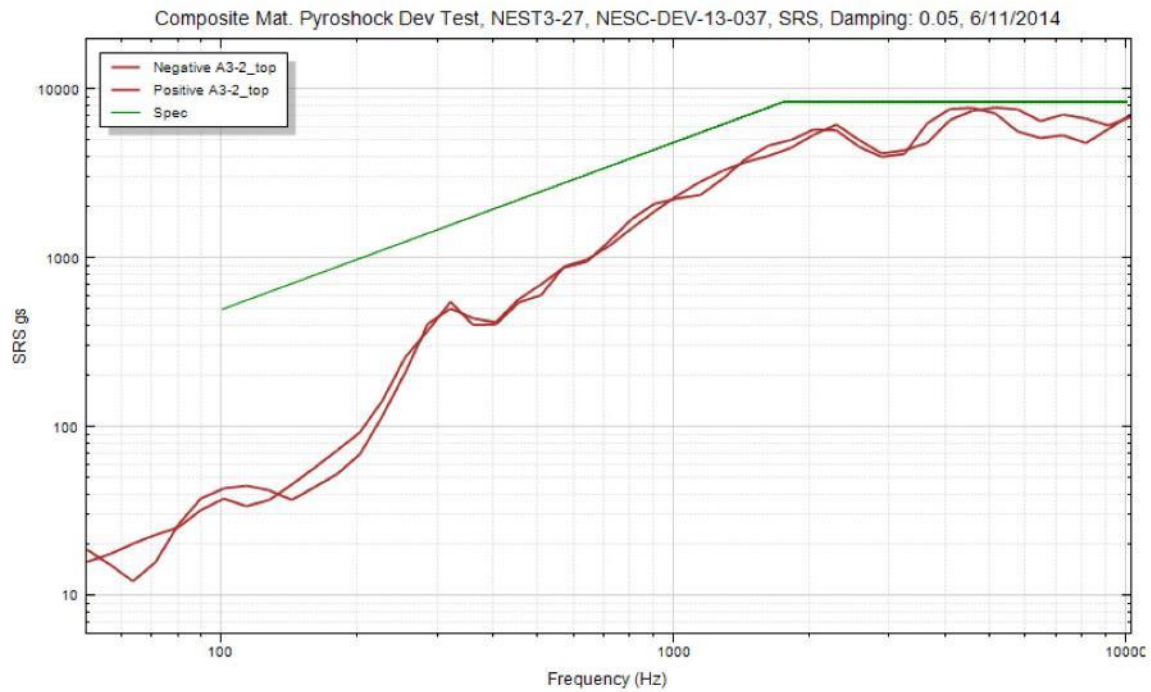
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
775 of 832





# NASA Engineering and Safety Center Technical Assessment Report

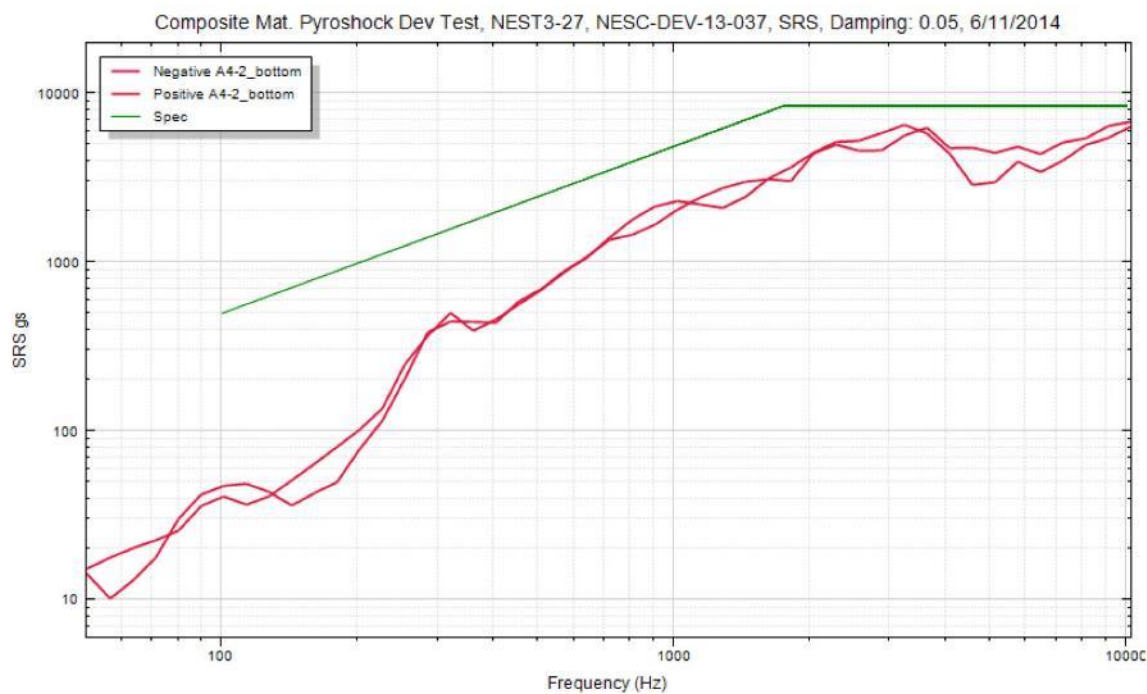
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
776 of 832





# NASA Engineering and Safety Center Technical Assessment Report

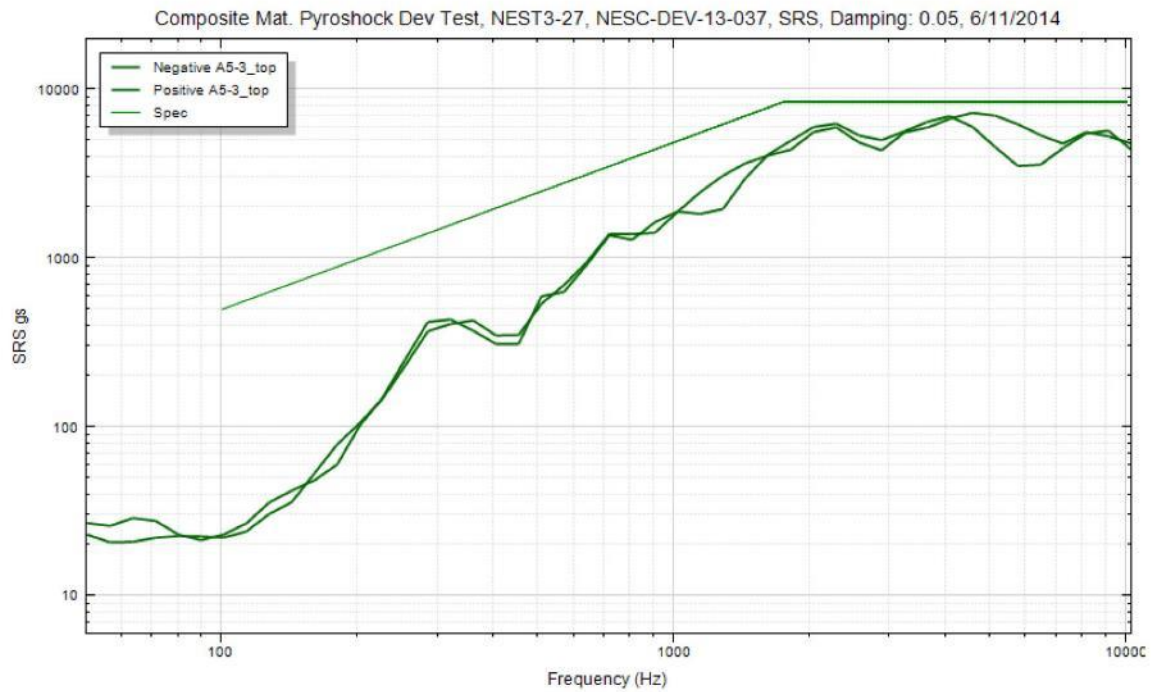
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
777 of 832





# NASA Engineering and Safety Center Technical Assessment Report

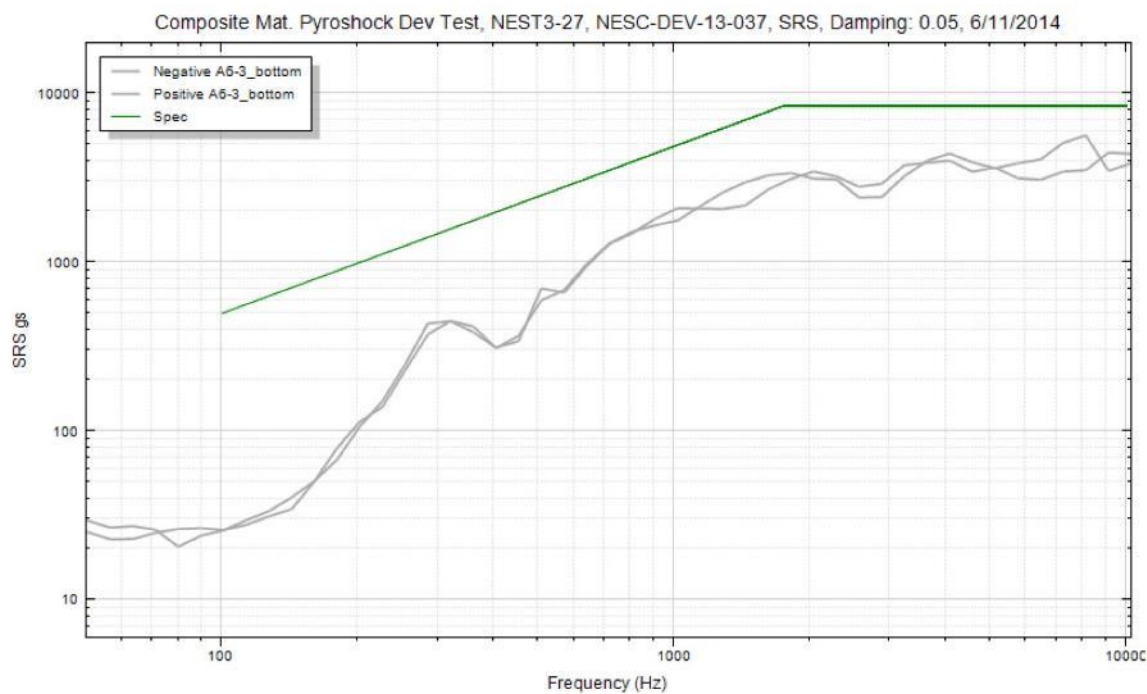
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
778 of 832





# NASA Engineering and Safety Center Technical Assessment Report

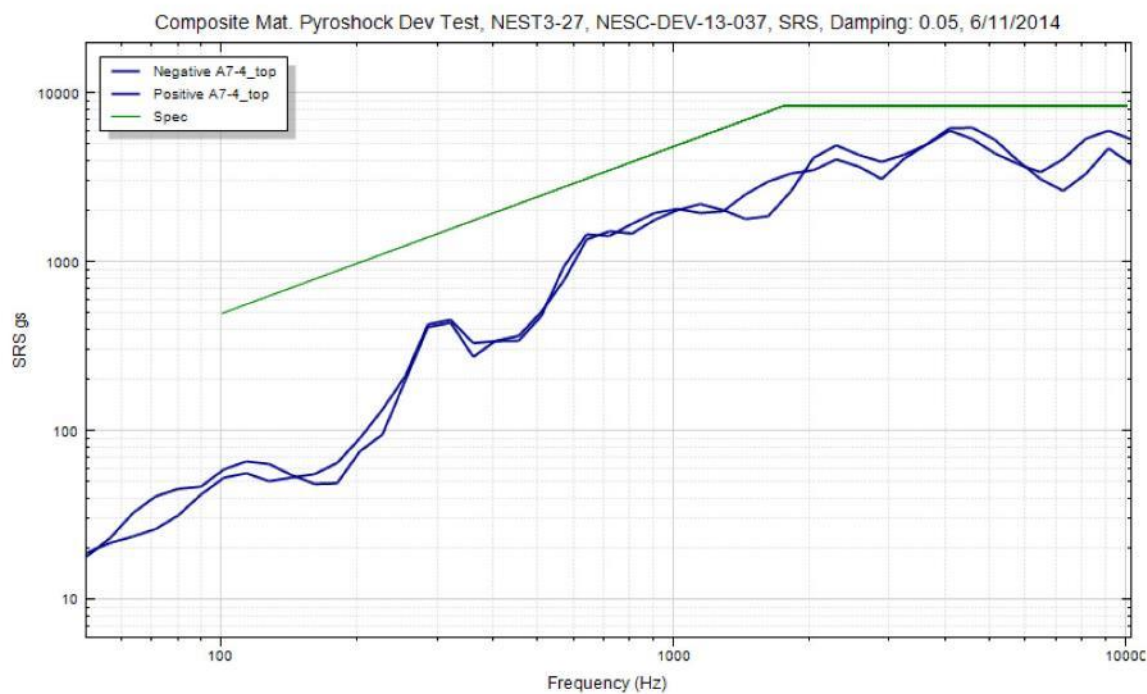
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
779 of 832





# NASA Engineering and Safety Center Technical Assessment Report

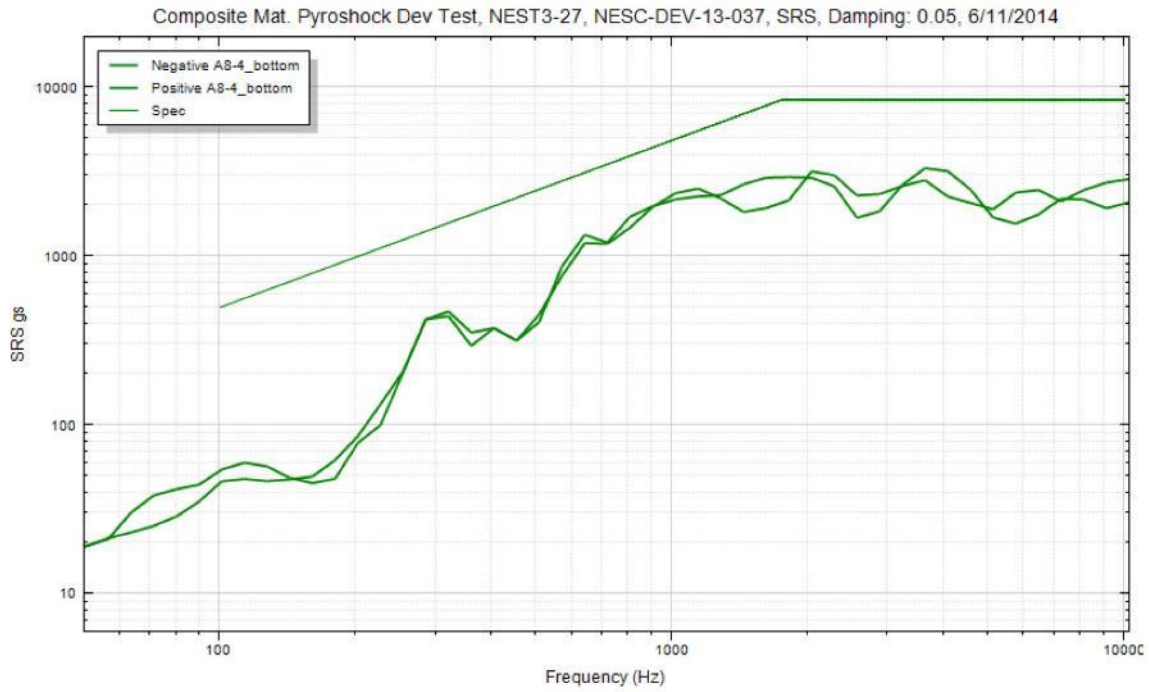
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
780 of 832







# NASA Engineering and Safety Center Technical Assessment Report

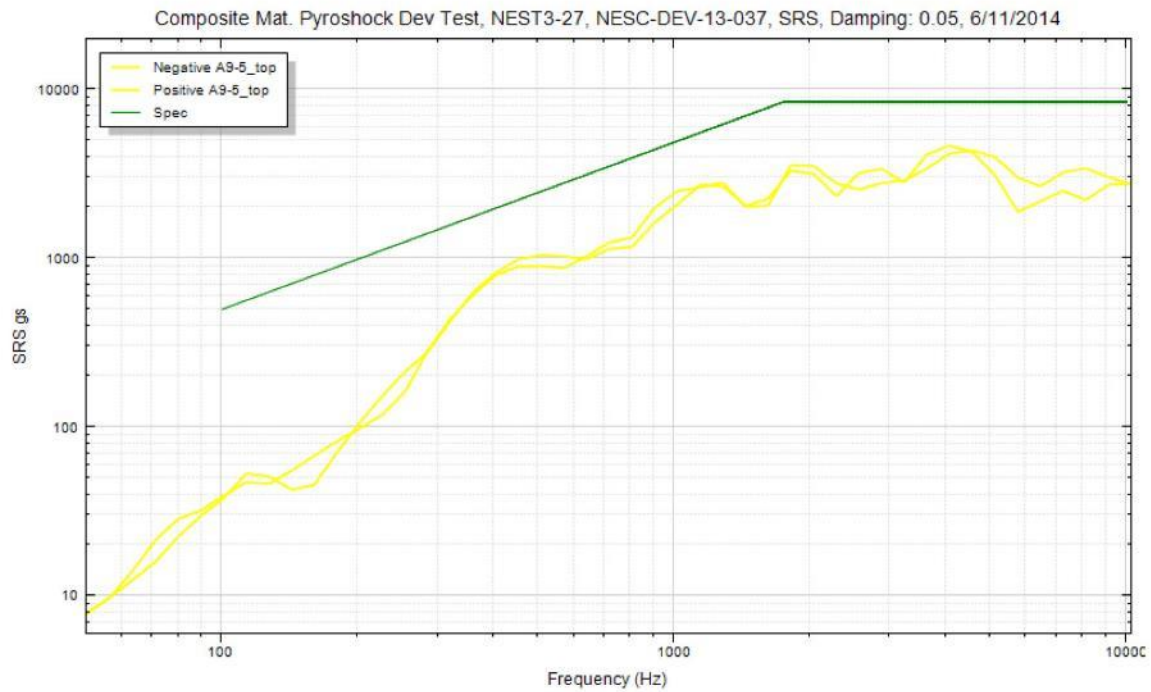
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
781 of 832





# NASA Engineering and Safety Center Technical Assessment Report

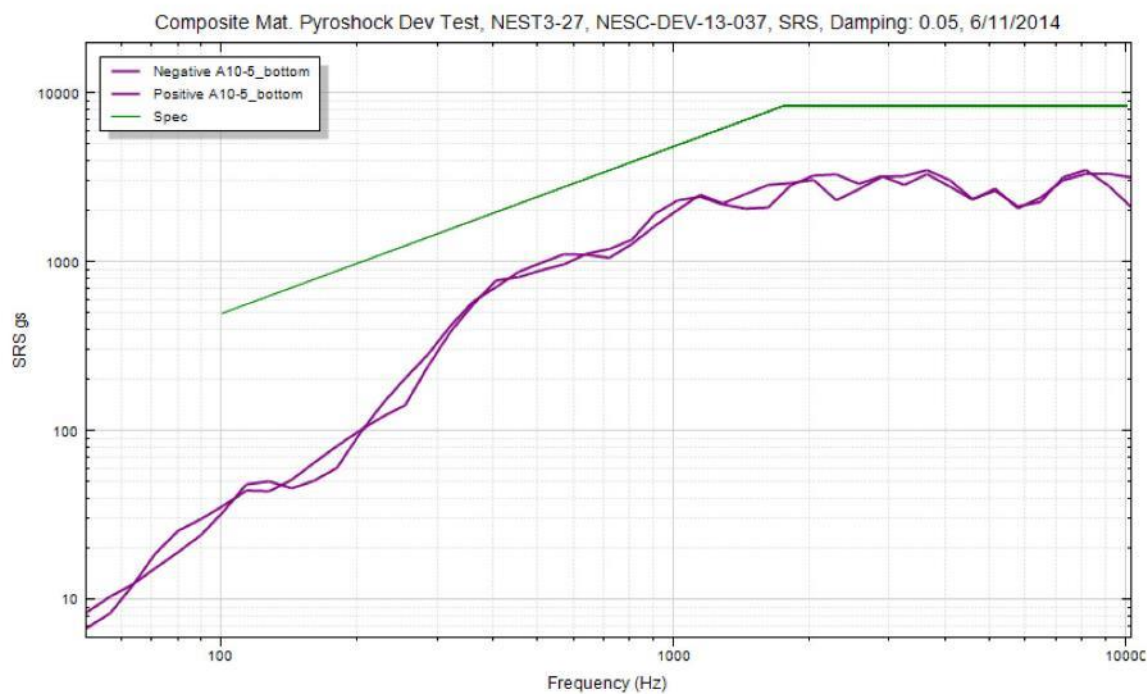
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
782 of 832





# NASA Engineering and Safety Center Technical Assessment Report

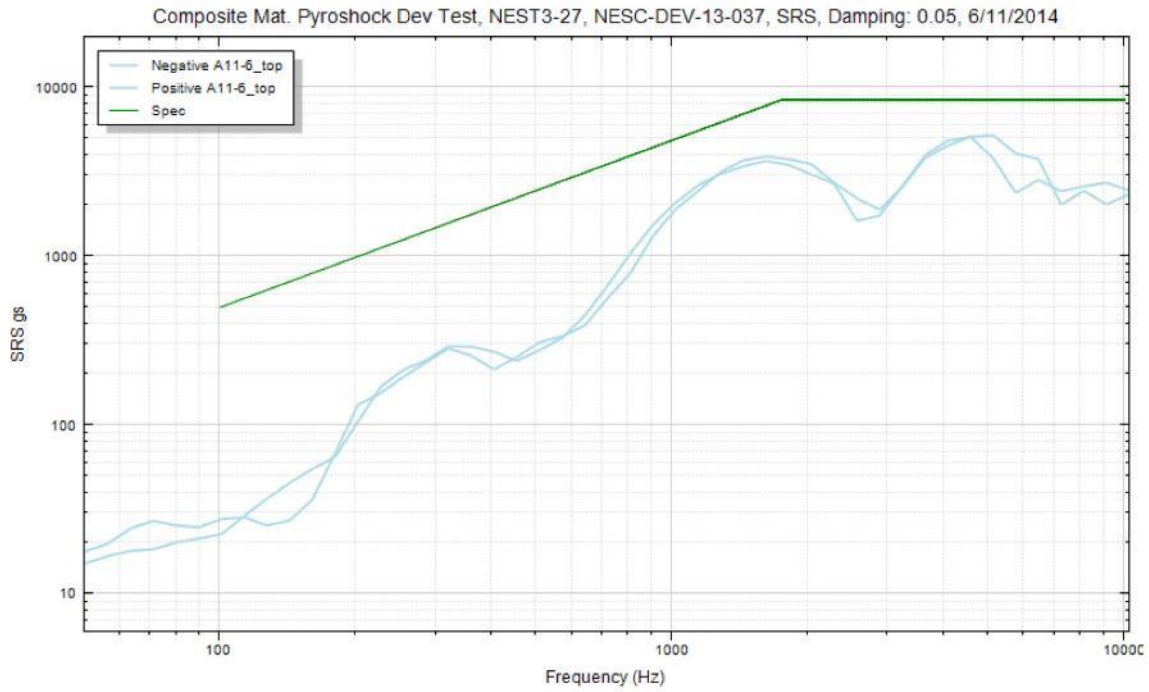
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
783 of 832





# NASA Engineering and Safety Center Technical Assessment Report

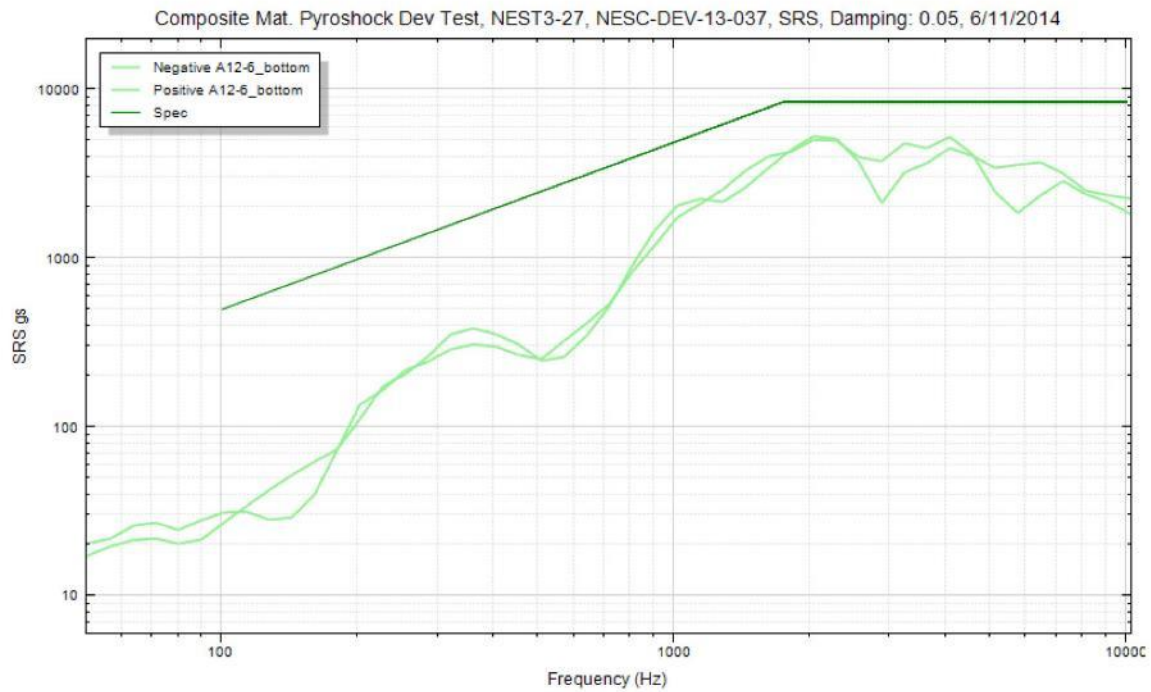
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
784 of 832





# NASA Engineering and Safety Center Technical Assessment Report

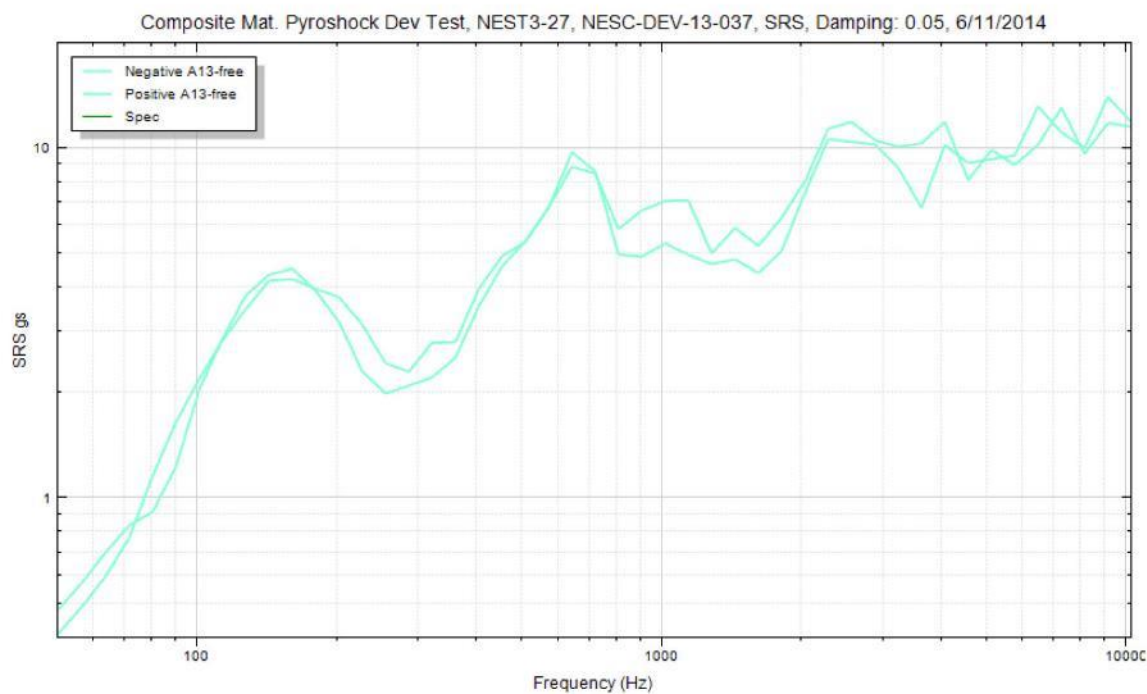
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
785 of 832



471 of 518



# NASA Engineering and Safety Center Technical Assessment Report

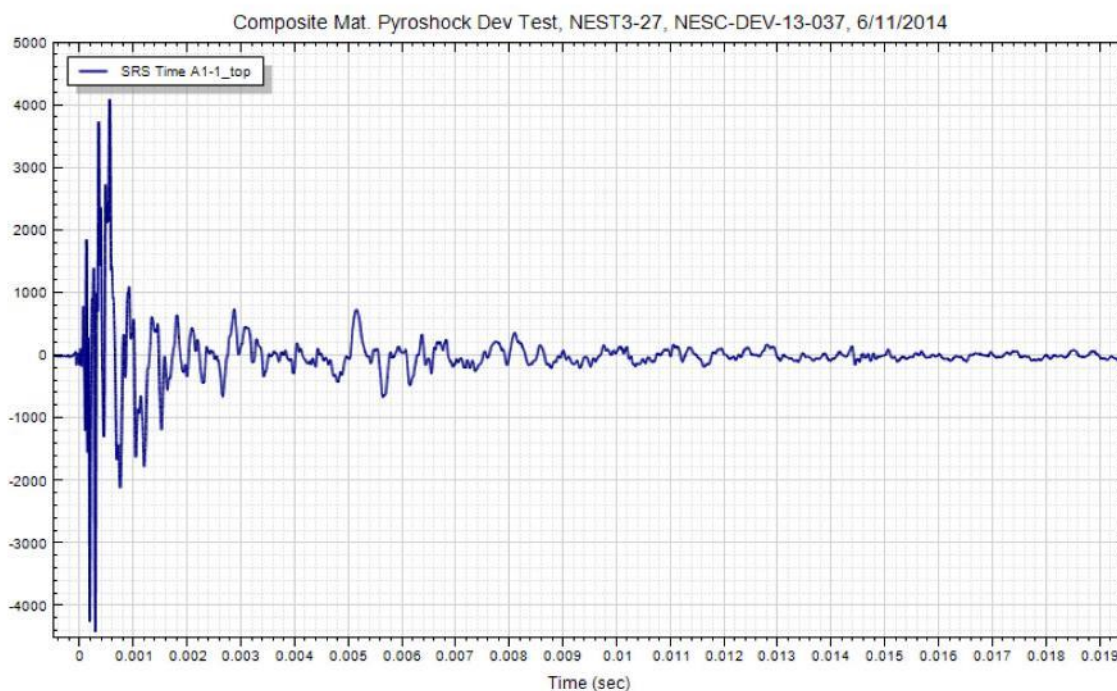
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
786 of 832





# NASA Engineering and Safety Center Technical Assessment Report

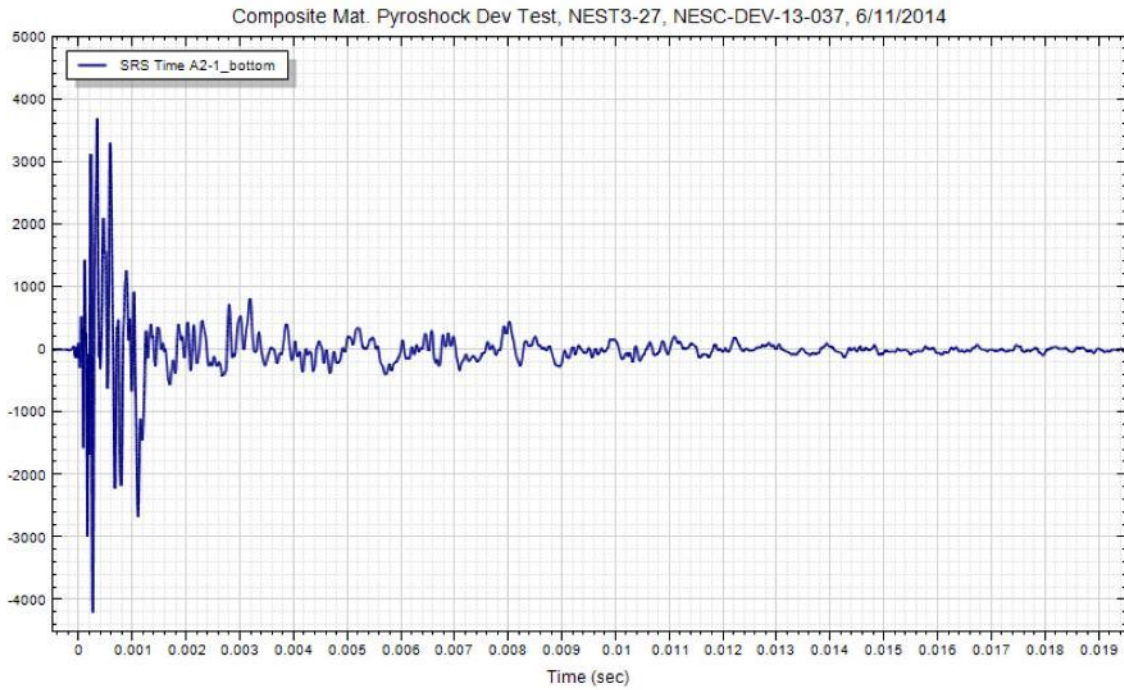
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
787 of 832





# NASA Engineering and Safety Center Technical Assessment Report

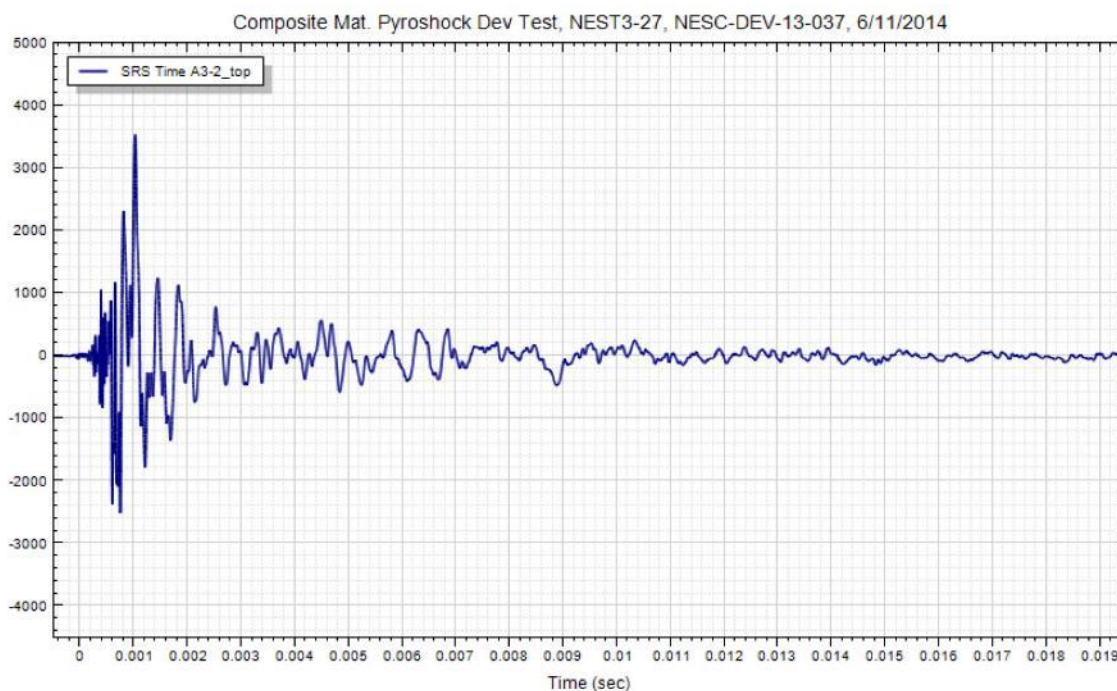
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
788 of 832







# NASA Engineering and Safety Center Technical Assessment Report

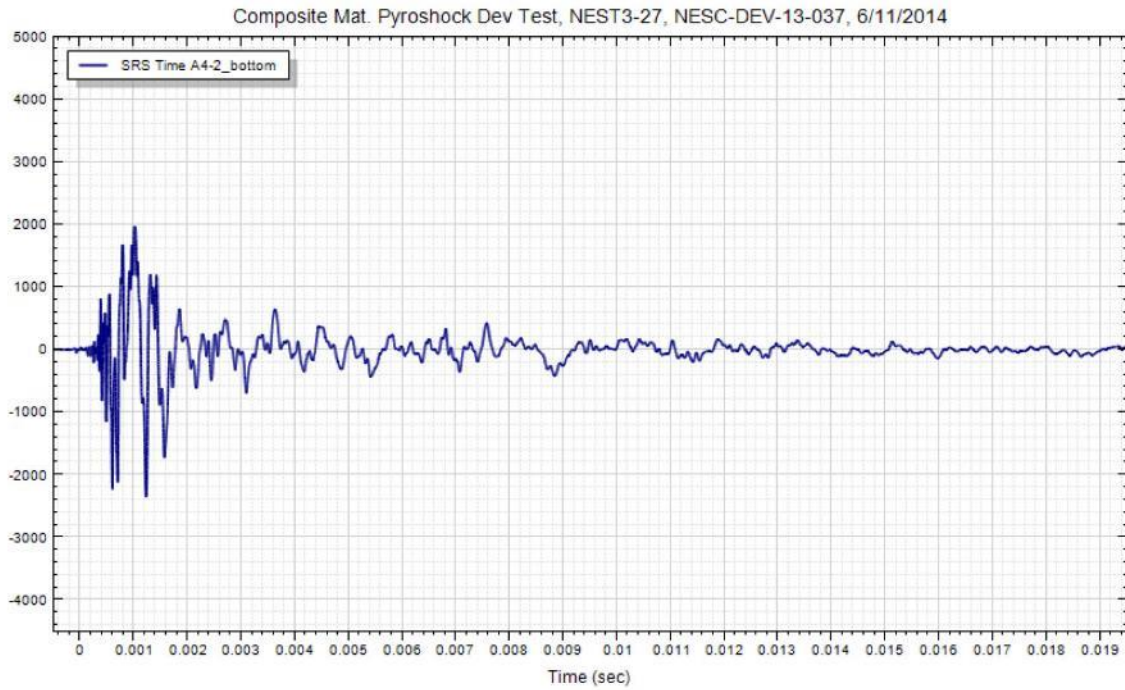
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
789 of 832





# NASA Engineering and Safety Center Technical Assessment Report

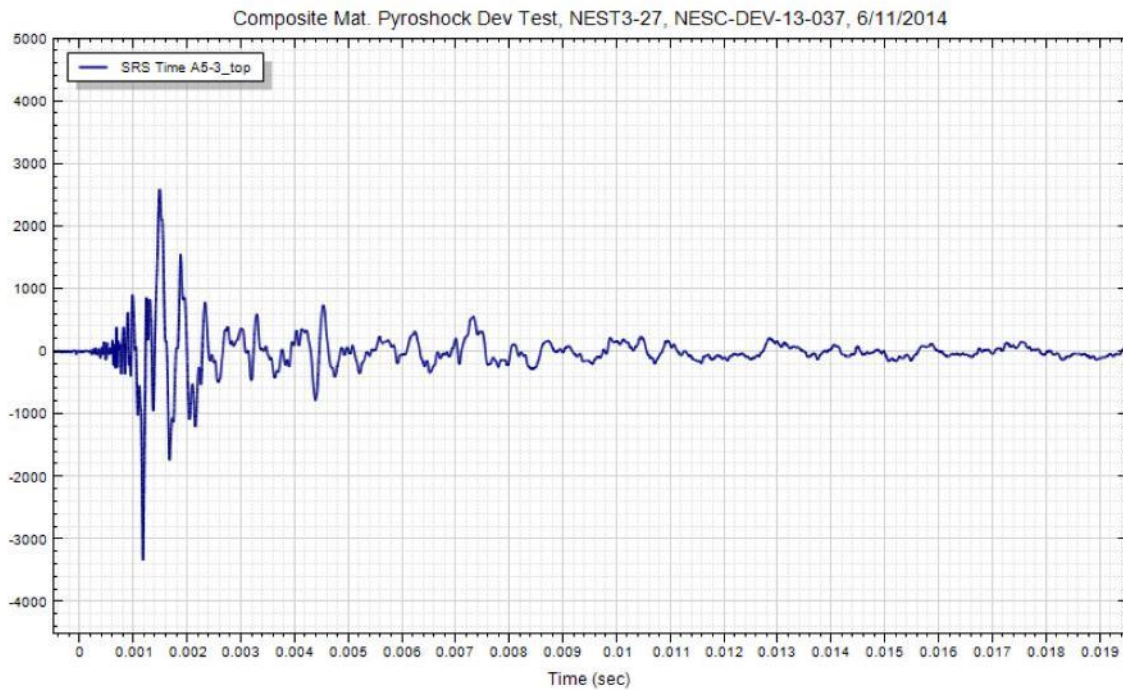
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
790 of 832





# NASA Engineering and Safety Center Technical Assessment Report

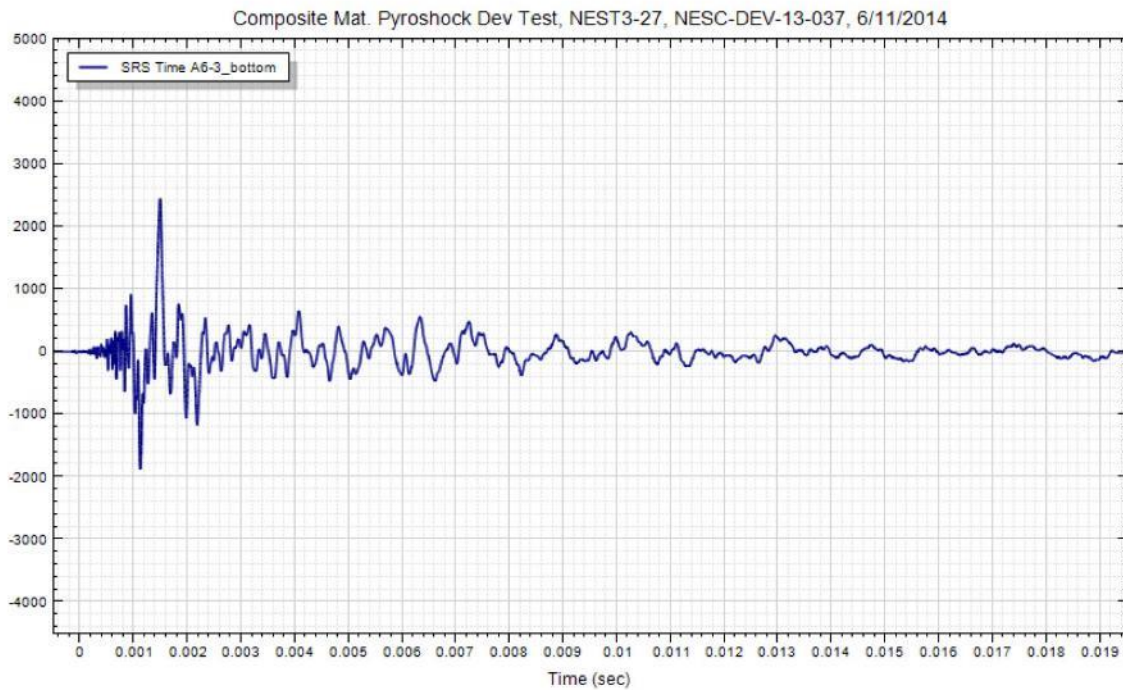
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
791 of 832





# NASA Engineering and Safety Center Technical Assessment Report

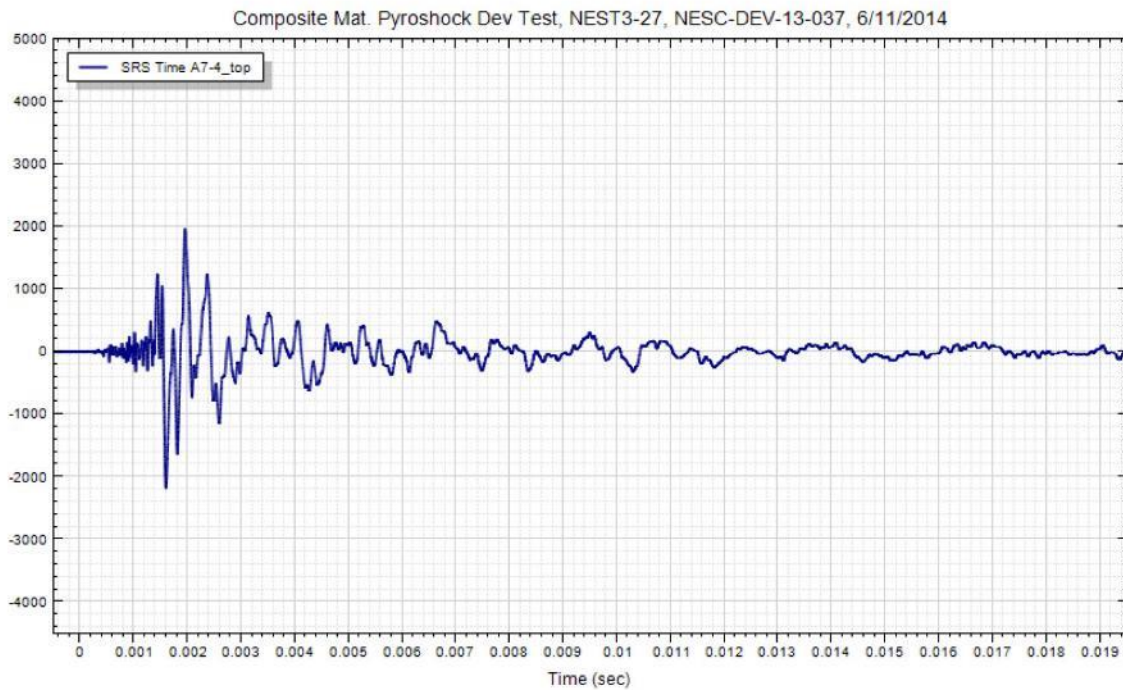
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
792 of 832





# NASA Engineering and Safety Center Technical Assessment Report

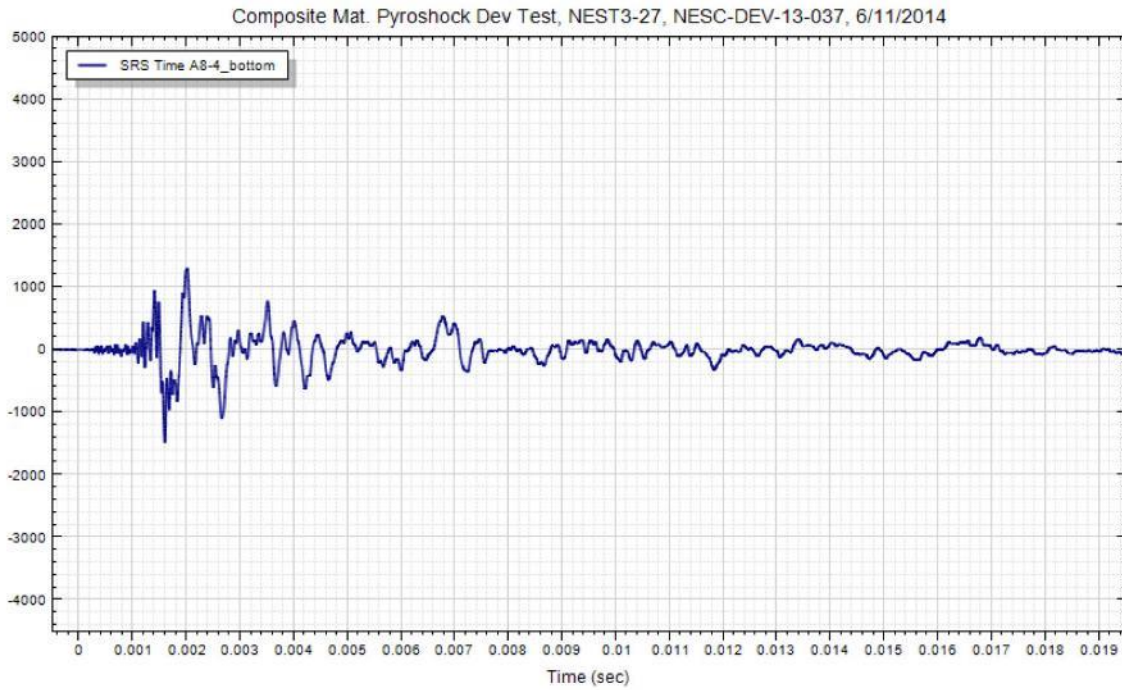
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
793 of 832





# NASA Engineering and Safety Center Technical Assessment Report

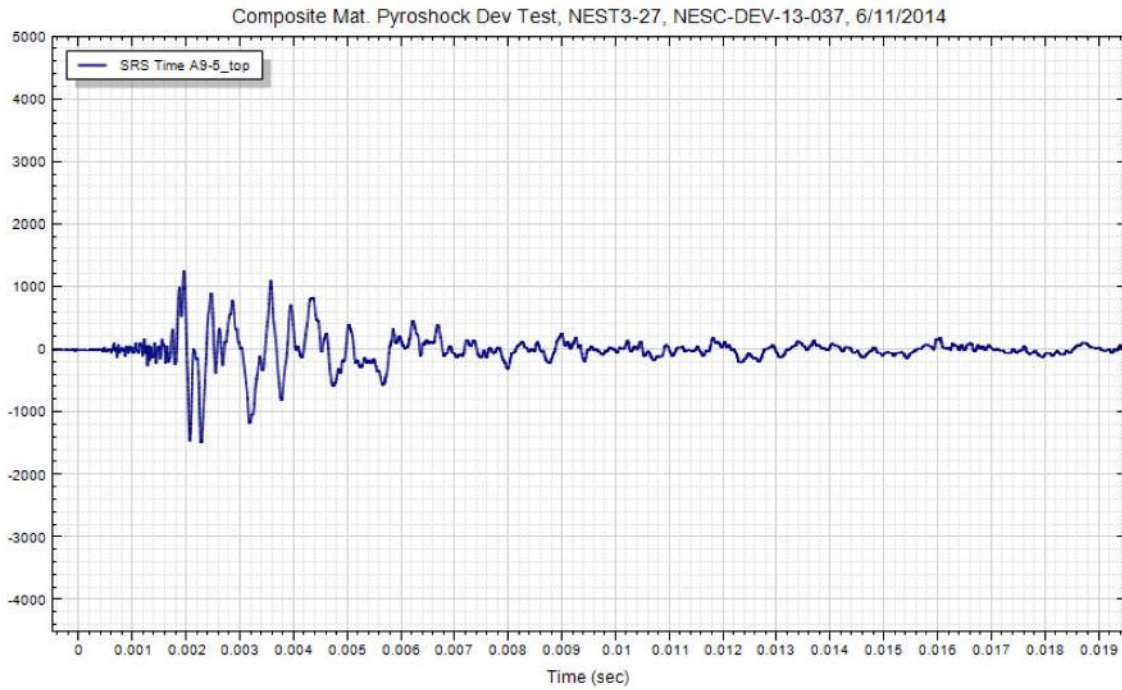
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
794 of 832





# NASA Engineering and Safety Center Technical Assessment Report

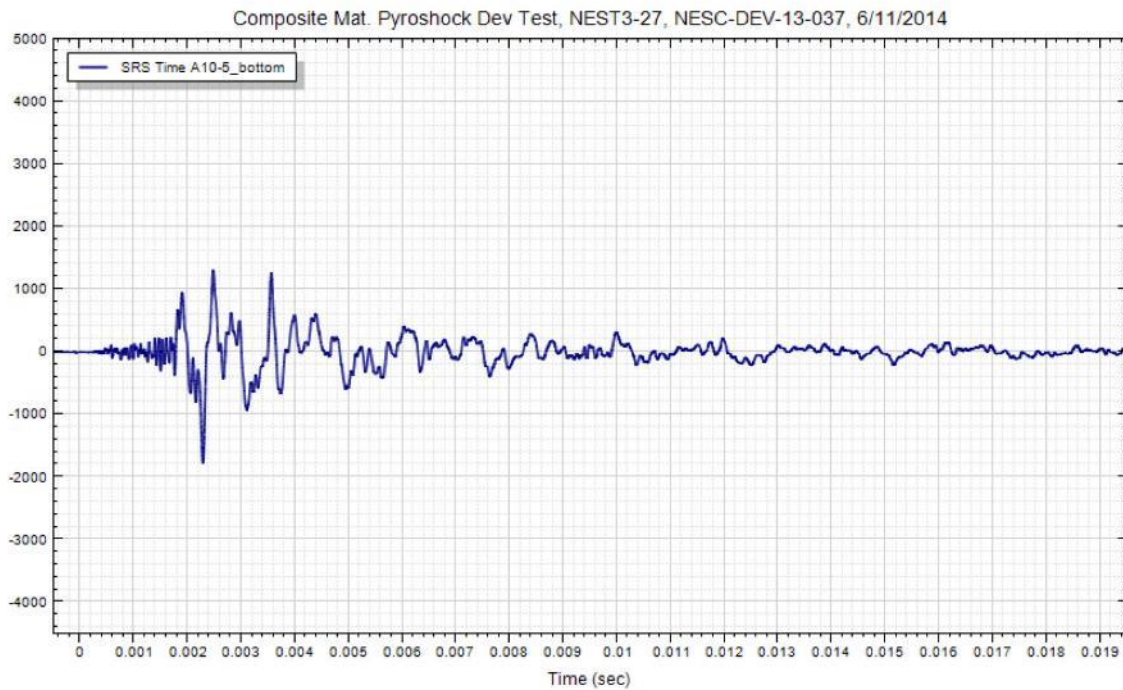
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
795 of 832



481 of 518



# NASA Engineering and Safety Center Technical Assessment Report

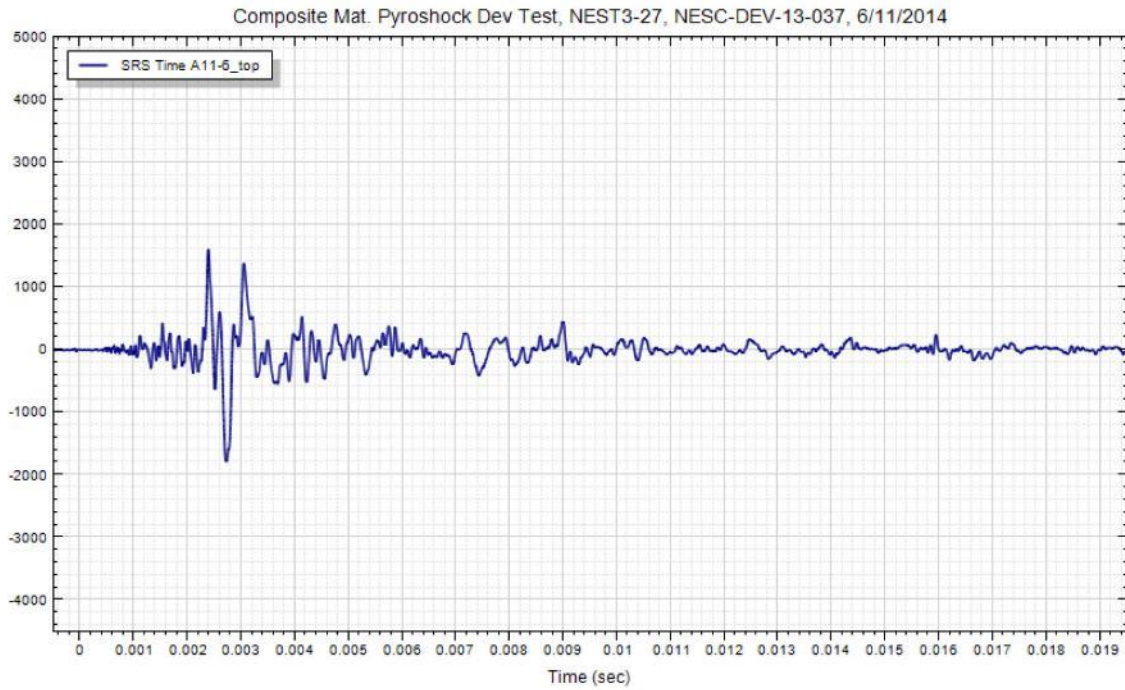
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
796 of 832







# NASA Engineering and Safety Center Technical Assessment Report

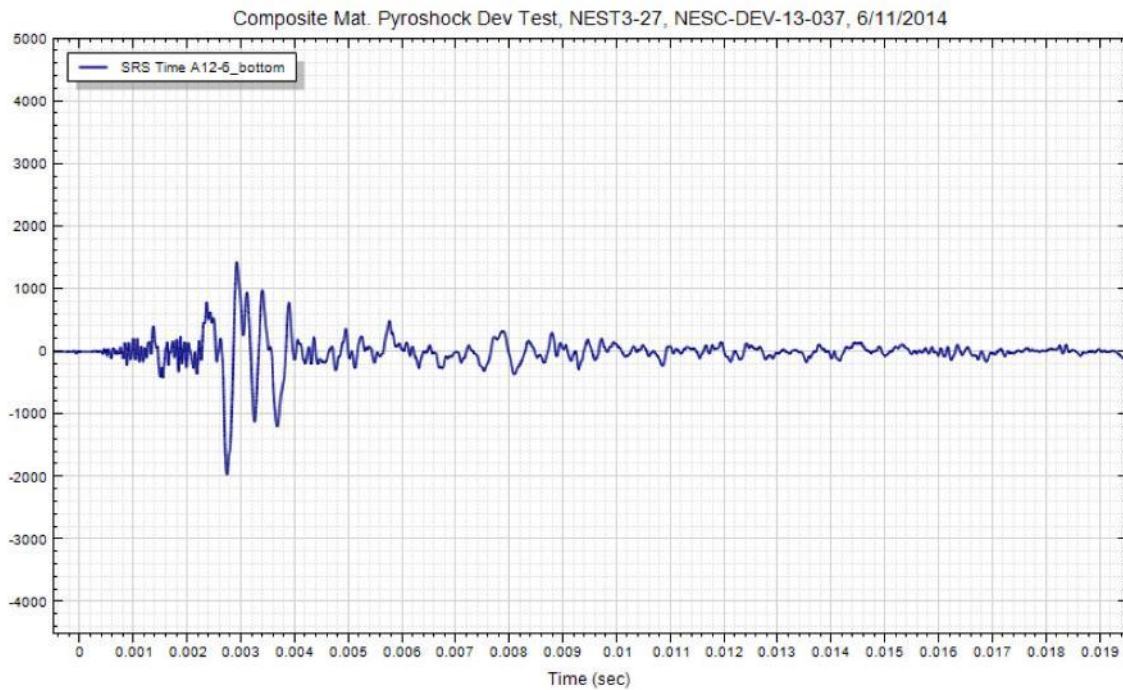
Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
797 of 832



483 of 518



# NASA Engineering and Safety Center Technical Assessment Report

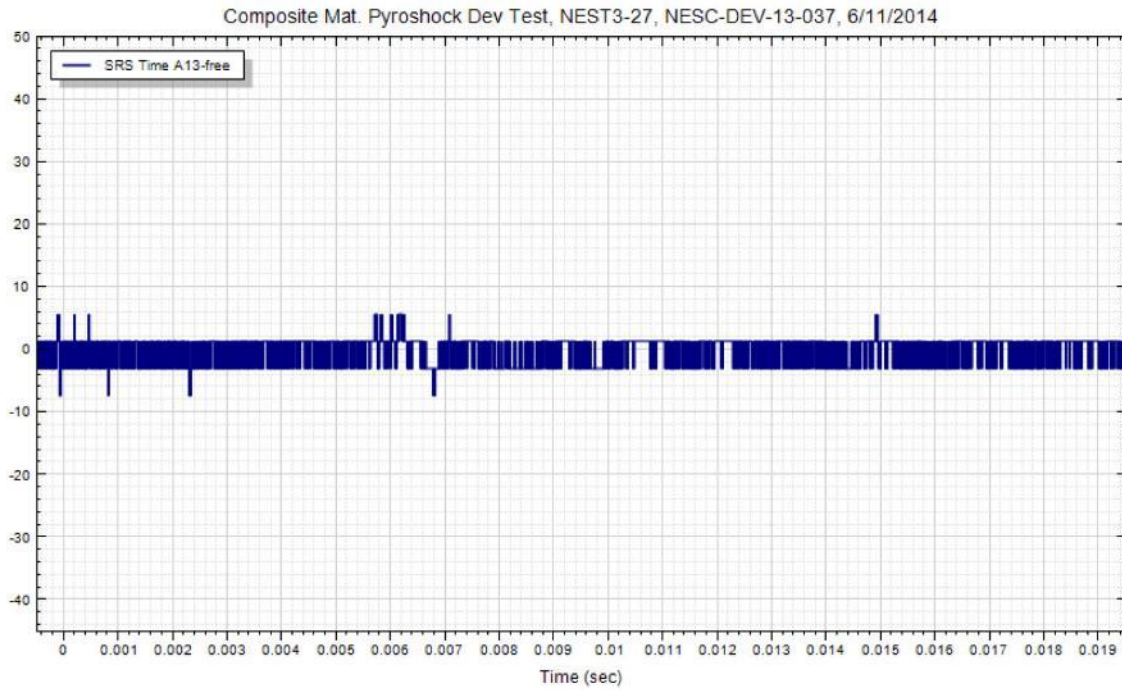
Document #:  
**NESC-RP-  
12-00783**


Version:  
**1.0**

Title:


## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
798 of 832



	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 799 of 832	

**NESC-DEV-13-037**  
**Composite Materials**  
**Shock Test**  
  
**Test and Checkout Procedure**

	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 800 of 832</p>	

*As Run  
Record COPY*

George C. Marshall Space Flight Center  
Marshall Space Flight Center, Alabama 35812

NESC-DEV-13-037  
10/21/2013

---

**TEST AND CHECK-OUT PROCEDURE**

**ET40 / VIBRATION, ACOUSTICS, AND  
SHOCK TEAM**

**COMPOSITE MATERIALS  
PYROSHOCK  
DEVELOPMENT TEST**

Group III – Tests 19 to 28

Group I – Retests 1 to 4

---

**This Procedure Describes  
Safety Critical Operations**

---



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
801 of 832

ET40 / Vibration, Acoustics, and Shock Team		
Composite Materials Pyroshock Development Test	NESC-DEV-13-037	Revision: Baseline
Group III - Tests 19 to 28, Group I - Retests 1 to 4	Date: 10/21/2013	Page 1 of 24

PREPARED BY: John Craig Garrison 10/29/2013  
John Craig Garrison / ET40 Date  
Test Engineer

APPROVED BY: Kathy O. Gwofford 10/29/13  
Kathy O. Gwofford / EV40 Date  
Deputy Branch Chief  
Structural Dynamics Test Branch

APPROVED BY: \_\_\_\_\_  
David Ordway / EV32 Date  
Aerospace Engineer, Pyrotechnics  
Structural & Mechanical Design Branch  
Test Requester

APPROVED BY: David Parsons 2013-10-23  
David Parsons / ES22 Date  
Structural Dynamics  
Mechanical, Thermal and Life Support Branch



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
802 of 832

ET40 / Vibration, Acoustics, and Shock Team		
Composite Materials Pyroshock Development Test	NESC-DEY-13-037	Revision: Baseline
Group III - Tests 19 to 28, Group I - Retests 1 to 4	Date: 10/21/2013	Page 1 of 24

PREPARED BY:

John Craig Garrison / ET40  
Test Engineer

Date

APPROVED BY:

Kathy O. Swofford / ET40  
Deputy Branch Chief  
Structural Dynamics Test Branch

Date

APPROVED BY:

DAVID ORDWAY  
David Ordway / EV32  
Acrospace Engineer, Pyrotechnics  
Structural & Mechanical Design Branch  
Test Requester

Digitally signed by DAVID ORDWAY  
DN: c=U.S., o=U.S. Government, ou=NASA,  
ou=People, cn=DAVID ORDWAY,  
&F.2542.1500090.100.11=daordway  
Date: 2013.10.22.15:42:26 -0500

10/22/2013

Date

APPROVED BY:

David Parsons / ES22  
Structural Dynamics  
Mechanical, Thermal and Life Support Branch

Date



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
803 of 832

ET40 / Vibration, Acoustics, and Shock Team		
Composite Materials Pyroshock Development Test	NESC-DEV-13-037	Revision: Baseline
Group III – Tests 19 to 28, Group I – Retests 1 to 4	Date: 10/21/2013	Page 2 of 24

### 1.0 INTRODUCTION

#### 1.1 PURPOSE

The purpose of this procedure is to define the steps necessary to perform a pyrotechnic shock test in the Pyrotechnic Shock Facility in Building 4619 using pyrotechnic devices.

Test Matrix Test Articles: Ten 3'x6' Sandwich composite panels with LSC plate and LSC backing plate. There are also 4 retest panels from Group I, tests 10, 4, 2 and 9 that are 3'x6' solid composite panels with LSC plate and LSC backing plate. The 2 test matrix are described in test plan, Table IV, Group III, tests 19 to 28 and Table VI, Group I retests.

Program: NESC Type of Test: Pyrotechnic Shock Development Test

Test Purpose: To capture the acceleration time histories for group III – Test 19 to 28 and 4 retests from the group I test series.

The Pyrotechnic Shock Facility is located in Rooms 170, 170A and 170B of Building 4619. Room 170A is designated as the Control Room. The area between Room 169 and 170 is used for storage of secondary pyrotechnic devices. Room 170B is used for storage of initiators. All detonation of pyrotechnic devices will be in Room 170.

#### 1.2 SCOPE

This document contains the steps and/or references the procedure to conduct the test.

### 2.0 SAFETY

Follow all emergency and safety requirements specified in ET01-DYN-SHK-FOP-001.

#### 2.1 Responsibilities

The Test Engineer will be responsible for all activities occurring in the hazardous test area and for the safety of personnel involved in the test activities. It is the responsibility of each individual in a test program to fully comply with the requirements of this document and to report any individual not complying. Failure to do so could lead to serious personnel injuries or death.

### 3.0 TEST REQUIREMENTS AND INFORMATION

#### 3.1 DOCUMENTS

##### 3.1.1 APPLICABLE DOCUMENTS

Test Requirements: Pyroshock Response Characterization of Composite Materials Test Plan Revision C, NESC Task # TI-12-0783 (SLS ADO-21), 8/15/2013



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-12-00783**

Version:  
**1.0**

Title:

## **Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading**

Page #:  
804 of 832

ET40 / Vibration, Acoustics, and Shock Team		
Composite Materials Pyroshock Development Test	NESC-DEV-13-037	Revision: Baseline
Group III – Tests 19 to 28, Group I – Retests 1 to 4	Date: 10/21/2013	Page 3 of 24

Test Procedure: ET01-DYN-SHK-FOP-001 Pyrotechnic Shock Tests

97M00200-02x PANEL TESTS 19-28 COMPOSITE SANDWICH PANEL  
GROUP III TESTS 19-28 (where dash number -02x is -020 to -029)  
97M00200-GRP I-TEST 2,4 COMPOSITE TEST PANEL, GROUP I, TEST #2 & #4  
97M00200-GRP I-TEST 9-10 COMPOSITE TEST PANEL, GROUP I, TEST #9&#10  
97M00202 LSC BACKING PLATE, COMPOSITE TEST PANEL PATHFINDER  
97M00203-MOD LSC PLATE, COMPOSITE TEST PANEL PATHFINDER  
97M00203-MOD-COMPOSITE COMPOSITE LSC PLATE, COMPOSITE TEST  
PANEL TEST  
97M00204-MOD-2-10 LSC SHIM, COMPOSITE TEST PANEL 10 GPF LSC  
97M00204-MOD-2-22 LSC SHIM, COMPOSITE TEST PANEL 22 GPF LSC

### 3.1.2 REFERENCED DOCUMENTS

ET01-DYN-OWI-001 Documentation Control

ET01-DYN-OWI-002 Test Operation Procedure Preparation and Change Control

### 3.2 TEST INFORMATION

3.2.1 The instrumentation locations are given in the drawings listed in the applicable documents and appendix A for the test.

3.2.2 Pyrotechnic shock tests may be performed on the test article in the order and configuration directed by the test requester.

3.2.3 The shock test will be performed on a room temperature test article.

### 3.3 TEST REQUIREMENTS

3.3.1 The Test Engineer will be in charge of all test preparations and activities.

3.3.2 All activities will be coordinated with the Test Engineer.

3.3.3 All changes to the procedure will be coordinated with the Test Engineer.

3.3.4 The development test articles will be tested with pyrotechnic shock test runs as directed by the test requester. The test article information will be recorded in this TCP.

### 4.0 TEST DATA

- a. The test data includes a time history of the real time shock recorded over a 20 millisecond or longer interval and the units are g's peak versus time.
- b. The second plot is a Shock Response Spectrum (SRS) using 5% damping and a





# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
805 of 832

ET140 / Vibration, Acoustics, and Shock Team		
Composite Materials Pyroshock Development Test	NESC-DEV-13-037	Revision: Baseline
Group III - Tests 19 to 28, Group 1 - Retests 1 to 4	Date: 10/21/2013	Page 4 of 24

1/6 octave shock spectrum analyzer. The SRS is computed over the frequency band from 50 to 10,000 Hertz. The SRS units are g's versus frequency.

- c. The data will be acquired on a Nicolet BE256LE data acquisition system and the SRS analysis will be performed using a personal computer and the Shock Analysis Tool Analysis Software.
- d. Sample rate of 1 million samples per second will be used for response from the accelerometers.

### 5.0 TEST SETUP

#### 5.1 TEST ARTICLE AND SHOCK PLATE SETUP

- a. The test setup is shown in Appendix A.
- b. Suspend the shock plate from ceiling using straps or cables and shackles.
- c. Suspend 1 accelerometer near the plate. Connect to data system for recording.
- d. At the start of each test day, complete ET01-DYN-SHK-FOP-001, section 6.

### 6.0 TEST OPERATION

#### 6.1 COMPOSITE MATERIALS PYROSHOCK DEV. TEST

- a. Record and verify the test information below and in appendix C.

Group III - Test No.: 19 Panel #19 Date: 10-31-2013 Test Article Desc.: IM7/TC350 Composite Sandwich Panel, see test plan for ply layup, 3'x6', Al Honeycomb & Fabric Face Sheets, Fabric LSC plate PID# 0346A019  
Shock Source LSC Core Load: 10 GR/FT Explosive Material: RDX Sheath: Al  
Actual Length Used: 4'

- b. Verify that the shock plate is ready for testing per section 5.1.
- c. Instrument shock plate. Use a #12 washer between the accelerometer and the insert. Each accelerometer's torque will be to 25±5 in.-lb.  
Torque wrench: M634527 Torque value: 25 Due: 3-12-2014 Cal.: 9-12-2013
- d. LSC plate & LSC backer plate to Test Panel 1/2-13 bolt's torque to 240±10 in.-lb.  
Torque wrench: M644973 Torque value: 240 Due: 3-6-2014 Cal.: 9-6-2013
- e. LSC plate D-ring 1/2-13 bolt's torque to 240 in.-lb. Right side D-rings are 220 in.-lb.  
Torque wrench: M659926 Torque value: 240/200 Due: 3-6-2014 Cal.: 9-6-2013 <sup>200 SCA</sup>
- f. Photograph the locations and orientations of all accelerometers.
- g. Perform the test per sections 7, 8, and 9 of ET01-DYN-SHK-FOP-001.
- h. Photograph the test setup after the test. Photograph and document any post-test visually inspected observations under this test number in appendix C.
- i. Verify that the test run has been completed.

*VJCA*  
10-31-2013



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
806 of 832

ET40 / Vibration, Acoustics, and Shock Team		
Composite Materials Pyroshock Development Test	NESC-DEV-13-037	Revision: Baseline
Group III - Tests 19 to 28, Group 1 - Retests 1 to 4	Date: 10/21/2013	Page 5 of 24

### 6.2 COMPOSITE MATERIALS PYROSHOCK DEV. TEST

- a. Record and verify the test information below and in appendix C.  
Group III - Test No.: 20 Panel #20 Date: 11-19-2013 Test Article Desc.: IM7/TC350 Composite Sandwich Panel, see test plan for ply layup, 3'x6', Rohacell Foam and Fabric Face Sheets, Fabric LSC plate PID# 0346A020  
Shock Source LSC Core Load: 22 GR/FT Explosive Material: CH-6 Sheath: Al  
Actual Length Used: 4'
- b. Verify that the shock plate is ready for testing per section 5.1.
- c. Instrument shock plate. Use a #12 washer between the accelerometer and the insert. Each accelerometer's torque will be to 25±5 in.-lb.  
Torque wrench: M134517 Torque value: 25 Due: 3-12-2014 Cal: 9-12-2013
- d. LSC plate & LSC backer plate to Test Panel 1/2-13 bolt's torque to 240±10 in.-lb.  
Torque wrench: M644973 Torque value: 240 Due: 3-16-2014 Cal: 9-16-2013
- e. LSC plate D-ring 1/2-13 bolt's torque to 240 in.-lb. Right side D-rings are 220 in.-lb.  
Torque wrench: ~~M644973~~ M659926 Torque value: 240/200 Due: ~~3-16-2014~~ 3-30-2014 Cal: ~~9-16-2013~~ 9-30-2013
- f. Photograph the locations and orientations of all accelerometers.
- g. Perform the test per sections 7, 8, and 9 of ET01-DYN-SHK-FOP-001.
- h. Photograph the test setup after the test. Photograph and document any post-test visually inspected observations under this test number in appendix C.
- i. Verify that the test run has been completed. ✓ JCO  
11-19-2013

### 6.3 COMPOSITE MATERIALS PYROSHOCK DEV. TEST

- a. Record and verify the test information below and in appendix C.  
Group III - Test No.: 21 Panel #21 Date: 12-4-2013 Test Article Desc.: IM7/TC350 Composite Sandwich Panel, see test plan for ply layup, 3'x6', Al Honeycomb & Tape Face Sheets, Al LSC plate PID# 0346A021  
Shock Source LSC Core Load: 22 GR/FT Explosive Material: CH-6 Sheath: Al  
Actual Length Used: 4'
- b. Verify that the shock plate is ready for testing per section 5.1.
- c. Instrument shock plate. Use a #12 washer between the accelerometer and the insert. Each accelerometer's torque will be to 25±5 in.-lb.  
Torque wrench: M634527 Torque value: 25 Due: 3-12-2014 Cal: 9-12-2013
- d. LSC plate & LSC backer plate to Test Panel 1/2-13 bolt's torque to 240±10 in.-lb.  
Torque wrench: M644973 Torque value: 240 Due: 3-16-2014 Cal: 9-16-2013
- e. LSC plate D-ring 1/2-13 bolt's torque to 240 in.-lb. Right side D-rings are 220 in.-lb.  
Torque wrench: M659926 Torque value: 200 Due: 3-30-2014 Cal: 9-30-2013
- f. Photograph the locations and orientations of all accelerometers.
- g. Perform the test per sections 7, 8, and 9 of ET01-DYN-SHK-FOP-001.
- h. Photograph the test setup after the test. Photograph and document any post-test visually inspected observations under this test number in appendix C.
- i. Verify that the test run has been completed. ✓ JCO  
12-4-2013



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
807 of 832

ET40 / Vibration, Acoustics, and Shock Team		
Composite Materials Pyroshock Development Test	NESC-DEV-13-037	Revision: Baseline
Group III - Tests 19 to 28, Group I - Retests 1 to 4	Date: 10/21/2013	Page 6 of 24

### 6.4 COMPOSITE MATERIALS PYROSHOCK DEV. TEST

- a. Record and verify the test information below and in appendix C.  
Group III - Test No.: 22 Panel #22 Date: 11-25-2013 Test Article Desc.: IM7/TC350 Composite Sandwich Panel, see test plan for ply layup, 3'x6', Rohacell Foam and Fabric Face Sheets, Al LSC plate PID# 0346A022  
Shock Source LSC Core Load: 10 GR/FT Explosive Material: RDX Sheath: Al  
Actual Length Used: 4'
- b. Verify that the shock plate is ready for testing per section 5.1.
- c. Instrument shock plate. Use a #12 washer between the accelerometer and the insert. Each accelerometer's torque will be to 25±5 in.-lb.  
Torque wrench: M1634527 Torque value: 25 Due: 3-12-2014 Cal.: 9-12-2013
- d. LSC plate & LSC backer plate to Test Panel ½-13 bolt's torque to 240±10 in.-lb.  
Torque wrench: M1644973 Torque value: 240 Due: 3-16-2014 Cal.: 9-16-2013
- e. LSC plate D-ring ½-13 bolt's torque to 240 in.-lb. Right side D-rings are 220 in.-lb.  
Torque wrench: M1659926 Torque value: 200 Due: 3-30-14 Cal.: 9-30-2013
- f. Photograph the locations and orientations of all accelerometers.
- g. Perform the test per sections 7, 8, and 9 of ET01-DYN-SHK-FOP-001.
- h. Photograph the test setup after the test. Photograph and document any post-test visually inspected observations under this test number in appendix C.
- i. Verify that the test run has been completed.

✓ JCD  
11-25-2013

### 6.5 COMPOSITE MATERIALS PYROSHOCK DEV. TEST

- a. Record and verify the test information below and in appendix C.  
Group III - Test No.: 23 Panel #23 Date: 4-18-2014 Test Article Desc.: IM7/TC350 Composite Sandwich Panel, see test plan for ply layup, 3'x6', Al Honeycomb & Fabric Face Sheets, Al LSC plate PID# 0346A023  
Shock Source LSC Core Load: 10 GR/FT Explosive Material: RDX Sheath: Al  
Actual Length Used: 4'
- b. Verify that the shock plate is ready for testing per section 5.1.
- c. Instrument shock plate. Use a #12 washer between the accelerometer and the insert. Each accelerometer's torque will be to 25±5 in.-lb.  
Torque wrench: M1658783 Torque value: 25 Due: 5-29-2014 Cal.: 11-29-2013
- d. LSC plate & LSC backer plate to Test Panel ½-13 bolt's torque to 240±10 in.-lb.  
Torque wrench: M1627361 Torque value: 240 Due: 5-29-2014 Cal.: 11-29-2013
- e. LSC plate D-ring ½-13 bolt's torque to 240 in.-lb. Right side D-rings are 220 in.-lb.  
Torque wrench: M1627361 Torque value: 240/220 Due: 5-29-2014 Cal.: 11-29-2013
- f. Photograph the locations and orientations of all accelerometers.
- g. Perform the test per sections 7, 8, and 9 of ET01-DYN-SHK-FOP-001.
- h. Photograph the test setup after the test. Photograph and document any post-test visually inspected observations under this test number in appendix C.
- i. Verify that the test run has been completed.

✓ JCD  
4-18-2014



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
808 of 832

ET40 / Vibration, Acoustics, and Shock Team		
Composite Materials Pyroshock Development Test	NESC-DEV-13-037	Revision: Baseline
Group III - Tests 19 to 28, Group I - Retests 1 to 4	Date: 10/21/2013	Page 7 of 24

### 6.6 COMPOSITE MATERIALS PYROSHOCK DEV. TEST

- a. Record and verify the test information below and in appendix C.  
Group III - Test No.: 24 Panel #24 Date: 4-22-2014 Test Article Desc.: IM7/TC350 Composite Sandwich Panel, see test plan for ply layup, 3'x6', Al Honeycomb & Fabric Face Sheets, Al LSC plate PID# 0346A024  
Shock Source LSC Core Load: 22 GR/FT Explosive Material: CH-6 Sheath: Al  
Actual Length Used: 4'
- b. Verify that the shock plate is ready for testing per section 5.1.
- c. Instrument shock plate. Use a #12 washer between the accelerometer and the insert. Each accelerometer's torque will be to 25±5 in.-lb.  
Torque wrench: M658783 Torque value: 25 Due: 5-29-2014 Cal.: 11-29-2013
- d. LSC plate & LSC backer plate to Test Panel ½-13 bolt's torque to 240±10 in.-lb.  
Torque wrench: M659395 Torque value: 240 Due: 5-21-2014 Cal.: 11-21-2013
- e. LSC plate D-ring ½-13 bolt's torque to 240 in.-lb. Right side D-rings are 220 in.-lb.  
Torque wrench: M659395 Torque value: 240/220 Due: 5-21-14 Cal.: 11-21-2013
- f. Photograph the locations and orientations of all accelerometers.
- g. Perform the test per sections 7, 8, and 9 of ET01-DYN-SHK-FOP-001.
- h. Photograph the test setup after the test. Photograph and document any post-test visually inspected observations under this test number in appendix C.
- i. Verify that the test run has been completed. ✓ JCD  
4-24-2014

### 6.7 COMPOSITE MATERIALS PYROSHOCK DEV. TEST

- a. Record and verify the test information below and in appendix C.  
Group III - Test No.: 25 Panel #25 Date: 6-10-2014 Test Article Desc.: IM7/TC350 Composite Sandwich Panel, see test plan for ply layup, 3'x6', Al Honeycomb & Fabric Face Sheets, Fabric LSC plate PID# 0346A025  
Shock Source LSC Core Load: 22 GR/FT Explosive Material: CH-6 Sheath: Al  
Actual Length Used: 4'
- b. Verify that the shock plate is ready for testing per section 5.1.
- c. Instrument shock plate. Use a #12 washer between the accelerometer and the insert. Each accelerometer's torque will be to 25±5 in.-lb.  
Torque wrench: M634527 Torque value: 25 Due: 5-9-2014 Cal.: 11-9-2014
- d. LSC plate & LSC backer plate to Test Panel ½-13 bolt's torque to 240±10 in.-lb.  
Torque wrench: M650749 Torque value: 240 Due: 10-3-2014 Cal.: 4-3-2014
- e. LSC plate D-ring ½-13 bolt's torque to 240 in.-lb. Right side D-rings are 220 in.-lb.  
Torque wrench: M650749 Torque value: 240/220 Due: 10-3-14 Cal.: 4-3-2014
- f. Photograph the locations and orientations of all accelerometers.
- g. Perform the test per sections 7, 8, and 9 of ET01-DYN-SHK-FOP-001.
- h. Photograph the test setup after the test. Photograph and document any post-test visually inspected observations under this test number in appendix C.
- i. Verify that the test run has been completed. ✓ JCD  
6-10-2014



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
809 of 832

ET40 / Vibration, Acoustics, and Shock Test		
Composite Materials Pyroshock Development Test	NESC-DEV-13-037	Revision: Baseline
Group III - Tests 19 to 28, Group I - Retests 1 to 4	Date: 10/21/2013	Page 8 of 24

### 6.8 COMPOSITE MATERIALS PYROSHOCK DEV. TEST

- a. Record and verify the test information below and in appendix C.  
Group III - Test No.: 26 Panel #26 Date: 12-18-2013 Test Article Desc.: IM7/TC350 Composite Sandwich Panel, see test plan for ply layup, 3'x6', Rohacell Foam and Tape Face Sheets, Tape LSC plate PID# 0346A026  
Shock Source LSC Core Load:22 GR/FT Explosive Material: CH-6 Sheath: Al  
Actual Length Used: 4'
- b. Verify that the shock plate is ready for testing per section 5.1.
- c. Instrument shock plate. Use a #12 washer between the accelerometer and the insert. Each accelerometer's torque will be to 25±5 in.-lb.  
Torque wrench: M658783 Torque value: 25 Due: 5/29/2014 Cal.: 11/29/2013
- d. LSC plate & LSC backer plate to Test Panel ½-13 bolt's torque to 240±10 in.-lb.  
Torque wrench: M644973 Torque value: 240 Due: 3/16/2014 Cal.: 9/16/2013
- e. LSC plate D-ring ½-13 bolt's torque to 240 in.-lb. Right side D-rings are 220 in.-lb.  
Torque wrench: M659926 Torque value: 200 Due: 3/30/2014 Cal.: 9/30/2013
- f. Photograph the locations and orientations of all accelerometers.
- g. Perform the test per sections 7, 8, and 9 of ET01-DYN-SHK-FOP-001.
- h. Photograph the test setup after the test. Photograph and document any post-test visually inspected observations under this test number in appendix C.
- i. Verify that the test run has been completed.

VJCA  
12-18-2013

### 6.9 COMPOSITE MATERIALS PYROSHOCK DEV. TEST

- a. Record and verify the test information below and in appendix C.  
Group III - Test No.: 27 Panel #27 Date: 6-11-2014 Test Article Desc.: IM7/TC350 Composite Sandwich Panel, see test plan for ply layup, 3'x6', Rohacell Foam and Fabric Face Sheets, Fabric LSC plate PID# 0346A027  
Shock Source LSC Core Load:10 GR/FT Explosive Material: RDX Sheath: Al  
Actual Length Used: 4'
- b. Verify that the shock plate is ready for testing per section 5.1.
- c. Instrument shock plate. Use a #12 washer between the accelerometer and the insert. Each accelerometer's torque will be to 25±5 in.-lb.  
Torque wrench: M634527 Torque value: 25 Due: 11-9-2014 Cal.: 5-9-2014
- d. LSC plate & LSC backer plate to Test Panel ½-13 bolt's torque to 240±10 in.-lb.  
Torque wrench: M650749 Torque value: 240 Due: 10-3-2014 Cal.: 4-3-2014
- e. LSC plate D-ring ½-13 bolt's torque to 240 in.-lb. Right side D-rings are 220 in.-lb.  
Torque wrench: M650749 Torque value: 240/220 Due: 10-3-14 Cal.: 4-3-2014
- f. Photograph the locations and orientations of all accelerometers.
- g. Perform the test per sections 7, 8, and 9 of ET01-DYN-SHK-FOP-001.
- h. Photograph the test setup after the test. Photograph and document any post-test visually inspected observations under this test number in appendix C.
- i. Verify that the test run has been completed.

VJCA  
6-11-2014



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
810 of 832

ET40 / Vibration, Acoustics, and Shock Team		
Composite Materials Pyroshock Development Test	NESC-DEV-13-037	Revision: Baseline
Group III - Tests 19 to 28, Group I - Retests 1 to 4	Date: 10/21/2013	Page 9 of 24

### 6.10 COMPOSITE MATERIALS PYROSHOCK DEV. TEST

- Record and verify the test information below and in appendix C.  
Group III - Test No.: 28 Panel #28 Date: 1-24-2014 Test Article Desc.: IM7/TC350 Composite Sandwich Panel, see test plan for ply layup, 3'x6', A1 Honeycomb & Tape Face Sheets, Tape LSC plate PID# 0346 A 028  
Shock Source LSC Core Load: 10 GR/FT Explosive Material: RDX Sheath: A1  
Actual Length Used: 4'
- Verify that the shock plate is ready for testing per section 5.1.
- Instrument shock plate. Use a #12 washer between the accelerometer and the insert. Each accelerometer's torque will be to 25±5 in.-lb.  
Torque wrench: M658783 Torque value: 25 Due: 5-29-2014 Cal.: 11-29-2013
- LSC plate & LSC backer plate to Test Panel ½-13 bolt's torque to 240±10 in.-lb.  
Torque wrench: M644973 Torque value: 240 Due: 3-16-2014 Cal.: 9-16-2013
- LSC plate D-ring ½-13 bolt's torque to 240 in.-lb. Right side D-rings are 220 in.-lb.  
Torque wrench: M644973/M6577 Torque value: 240/200 Due: 3-16-2014 Cal.: 9-16-2013
- Photograph the locations and orientations of all accelerometers.
- Perform the test per sections 7, 8, and 9 of ET01-DYN-SHK-FOP-001.
- Photograph the test setup after the test. Photograph and document any post-test visually inspected observations under this test number in appendix C.
- Verify that the test run has been completed.

VPC  
1-24-2014

### 6.11 COMPOSITE MATERIALS PYROSHOCK DEV. TEST

- Record and verify the test information below and in appendix C.  
Group I (retest of #10) - Test No.: 01 Panel #10 Date: 1-16-2014 Test Article Desc.: IM7/TC350 Solid Tape Composite Panel, 3'x6'x0.2" PID# 0326 A 010  
Shock Source LSC Core Load: 10 GR/FT Explosive Material: RDX Sheath: A1  
Actual Length Used: 4'
- Verify that the shock plate is ready for testing per section 5.1.
- Instrument shock plate. Each accelerometer's torque will be to 30±5 in.-lb.  
Torque wrench: M658783 Torque value: 30 Due: 5/29/2014 Cal.: 11-29-2013
- LSC plate & LSC backer plate to Test Panel ½-13 bolt's torque to 55±5 ft.-lb.  
Torque wrench: M644973 Torque value: 55 Due: 3-16-2014 Cal.: 9-16-2013
- D-ring ½-13 bolt's torque to 28 ft.-lb.  
Torque wrench: M644973 Torque value: 28 Due: 3-16-2014 Cal.: 9-16-2013
- Photograph the locations and orientations of all accelerometers.
- Perform the test per sections 7, 8, and 9 of ET01-DYN-SHK-FOP-001.
- Photograph the test setup after the test. Photograph and document any post-test visually inspected observations under this test number in appendix C.
- Verify that the test run has been completed.

VCA  
1-16-2014



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
811 of 832

ET40 / Vibration, Acoustics, and Shock Team		
Composite Materials Pyroshock Development Test	NESC-DEV-13-037	Revision: Baseline
Group III - Tests 19 to 28, Group I - Retests 1 to 4	Date: 10/21/2013	Page 10 of 24

### 6.12 COMPOSITE MATERIALS PYROSHOCK DEV. TEST

- a. Record and verify the test information below and in appendix C.  
Group I (retest of #4) - Test No.: 02 Panel #4 Date: 12-12-2013 Test Article Desc.: IM7/TC350 Solid Fabric Composite Panel, 3'x6'x0.3" PID# 0320A004  
Shock Source LSC Core Load: 22 GR/FT Explosive Material: CH-6 Sheath: Al  
Actual Length Used: 4'
- b. Verify that the shock plate is ready for testing per section 5.1.
- c. Instrument shock plate. Each accelerometer's torque will be to 30±5 in.-lb.  
Torque wrench: M658783 Torque value: 30 Due: 5/29/14 Cal.: 11/29/13
- d. LSC plate & LSC backer plate to Test Panel ½-13 bolt's torque to 55±5 ft.-lb.  
Torque wrench: M644973 Torque value: 55 Due: 3/16/2014 Cal: 9/16/2013
- e. D-ring ½-13 bolt's torque to 28 ft.-lb.  
Torque wrench: M644973 Torque value: 28 Due: 3/16/2014 Cal: 9/16/2013
- f. Photograph the locations and orientations of all accelerometers.
- g. Perform the test per sections 7, 8, and 9 of ET01-DYN-SHK-FOP-001.
- h. Photograph the test setup after the test. Photograph and document any post-test visually inspected observations under this test number in appendix C.
- i. Verify that the test run has been completed.

VACB  
12-12-2013

### 6.13 COMPOSITE MATERIALS PYROSHOCK DEV. TEST

- a. Record and verify the test information below and in appendix C.  
Group I (retest of #2) - Test No.: 03 Panel #2 Date: 12-16-2013 Test Article Desc.: IM7/TC350 Solid Fabric Composite Panel, 3'x6'x0.2" PID# 0320A002  
Shock Source LSC Core Load: 22 GR/FT Explosive Material: CH-6 Sheath: Al  
Actual Length Used: 4'
- b. Verify that the shock plate is ready for testing per section 5.1.
- c. Instrument shock plate. Each accelerometer's torque will be to 30±5 in.-lb.  
Torque wrench: M658783 Torque value: 30 Due: 5/29/2014 Cal.: 11/29/2013
- d. LSC plate & LSC backer plate to Test Panel ½-13 bolt's torque to 55±5 ft.-lb.  
Torque wrench: M644973 Torque value: 55 Due: 3/16/2014 Cal: 9/16/2013
- e. D-ring ½-13 bolt's torque to 28 ft.-lb.  
Torque wrench: M644973 Torque value: 28 Due: 3/16/2014 Cal: 9/16/2013
- f. Photograph the locations and orientations of all accelerometers.
- g. Perform the test per sections 7, 8, and 9 of ET01-DYN-SHK-FOP-001.
- h. Photograph the test setup after the test. Photograph and document any post-test visually inspected observations under this test number in appendix C.
- i. Verify that the test run has been completed.

JCA  
12-16-2013



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
812 of 832

ET40 / Vibration, Acoustics, and Shock Team		
Composite Materials Pyroshock Development Test	NESC-DEV-13-037	Revision: Baseline
Group III - Tests 19 to 28, Group I - Retests 1 to 4	Date: 10/21/2013	Page 11 of 24

### 6.14 COMPOSITE MATERIALS PYROSHOCK DEV. TEST

- a. Record and verify the test information below and in appendix C.  
Group I (retest of #9) - Test No.: 04 Panel #9 Date: 1-23-2014 Test Article Desc.:  
IM7/TC350 Solid Tape Composite Panel, 3'x6'x0.3" PID# 0326A009  
Shock Source LSC Core Load: 22 GR/FT Explosive Material: CH-6 Sheath: Al  
Actual Length Used: 4'

- b. Verify that the shock plate is ready for testing per section 5.1.

- ① c. Instrument shock plate. Each accelerometer's torque will be to 30±5 in.-lb.  
Torque wrench: M658783 Torque value: 30 Due: 5-29-2014 Cal.: 11-29-2013

- d. LSC plate & LSC backer plate to Test Panel 1/2-13 bolt's torque to 55±5 ft.-lb.

- Torque wrench: M644973 Torque value: 55 Due: 3-16-2014 Cal.: 9-16-2013

- e. D-ring 1/2-13 bolt's torque to 28 ft.-lb.

- Torque wrench: M644973 Torque value: 28 Due: 3-16-2014 Cal.: 9-16-2013

- f. Photograph the locations and orientations of all accelerometers.

- g. Perform the test per sections 7, 8, and 9 of ET01-DYN-SHK-FOP-001.

- h. Photograph the test setup after the test. Photograph and document any post-test visually inspected observations under this test number in appendix C.

- i. Verify that the test run has been completed.

*JCD*  
*1-23-2014* ① Accelerometer A7 only torqued to 20 in.-lb. and insert started to move. *JCD*  
Accelerometer A9 only torqued to 25 in.-lb. and insert started to move. *1-23-2014*  
Test Requester Approval to proceed: *David Hudson 1/23/14*

### 7.0 RECORDS

The test report for this test will control and include the following records:

- This "AS RUN" TCP.
- The test data and the equipment list.

The test report is controlled by ET01-DYN-OWI-001, Documentation Control. However, due to the ITAR designation for the test results, the test report and data will be securely controlled. The test report will be available no later than 30 days after test completion. The Test Requirements will not be included in this TCP or in the report, but a copy may be filed with the report for future reference.


### 8.0 TOOLS, EQUIPMENT, AND MATERIALS

The equipment used during this test will be listed in a table as part of the test report. The list will include test equipment calibration due dates.

### 9.0 PERSONNEL TRAINING AND CERTIFICATION

Personnel certified as Propellant and Explosive Handler are required to conduct this test.

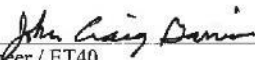


	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 813 of 832	


ET40 / Vibration, Acoustics, and Shock Team		
Composite Materials Pyroshock Development Test	NESC-DEV-13-037	Revision: Baseline
Group III – Tests 19 to 28, Group I – Retests 1 to 4	Date: 10/21/2013	Page 12 of 24

**POST-TEST VERIFICATION**

The Test and Check-out Procedure NESC-DEV-13-037 has been satisfactorily completed and documented.

  
 \_\_\_\_\_  
 Test Engineer / ET40

\_\_\_\_\_  
 6/11/2014  
 Date

	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 814 of 832	

ET40 / Vibration, Acoustics, and Shock Team		
Composite Materials Pyroshock Development Test	NESC-DEV-13-037	Revision: Baseline
Group III – Tests 19 to 28, Group I – Rctests 1 to 4	Date: 10/21/2013	Page 13 of 24

## APPENDIX A

### TEST SETUP



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-12-00783**

Version:  
**1.0**

Title:

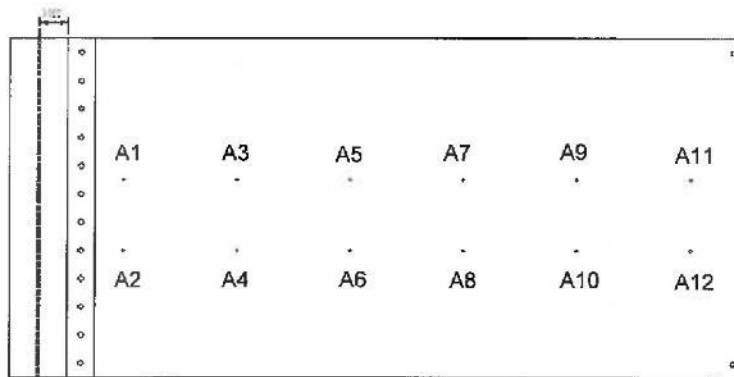
## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
815 of 832

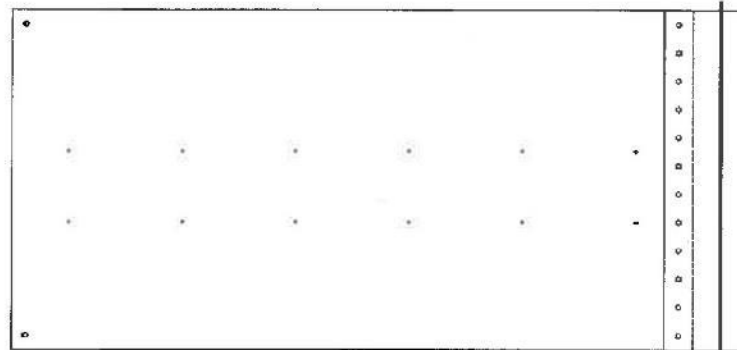
ET40 / Vibration, Acoustics, and Shock Team		
Composite Materials Pyroshock Development Test	NESC-DEV-13-037	Revision: Baseline
Group III – Tests 19 to 28, Group I – Retests 1 to 4	Date: 10/21/2013	Page 14 of 24

### Composite Materials Pyroshock Development Test


Test Article Panel: Sandwich or Solid Composite, Vertical Position  
Supports: Straps and Shackles



Front View



Back View

	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #:	Version:
		<b>NESC-RP-12-00783</b>	<b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 816 of 832	

ET40 / Vibration, Acoustics, and Shock Team		
Composite Materials Pyroshock Development Test	NESC-DEV-13-037	Revision: Baseline
Group III – Tests 19 to 28, Group I – Retests 1 to 4	Date: 10/21/2013	Page 15 of 24

## APPENDIX B

### GROUP III – TEST #19 - #28 PLY LAYUP (from the test plan)



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-12-00783**

Version:  
**1.0**

Title:


## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
817 of 832

<b>ET40 / Vibration, Acoustics, and Shock Team</b>		
Composite Materials Pyroshock Development Test	NESC-DEV-13-037	Revision: Baseline
Group III – Tests 19 to 28, Group I – Retests 1 to 4	Date: 10/21/2013	Page 16 of 24

### Group III Tests #19-#28 Fill and Ply Layup

Panel and Test Number	Material	Panel Thickness	Fill/Ply	Orientation	Type	LSC (gpf)	LSC Plate
19	Composite, IM7/TC350	8 Ply/ 1-inch thick fill	Al Honeycomb & Fabric Face Sheets	90°/+45°/-45°/0°/0°/ -45°/+45°/90°, 8 ply both faces	Sandwich	10	Composite, IM7/TC350
20	Composite, IM7/TC350	8 Ply/ 1-inch thick fill	Rohacell Foam & Fabric Face Sheets	90°/+45°/-45°/0°/0°/ -45°/+45°/90°, 8 ply both faces	Sandwich	22	Composite, IM7/TC350
21	Composite, IM7/TC350	8 Ply/ 1-inch thick fill	Al Honeycomb & Tape Face Sheets	90°/+45°/-45°/0°/0°/ -45°/+45°/90°, 8 ply both faces	Sandwich	22	Aluminum
22	Composite, IM7/TC350	8 Ply/ 1-inch thick fill	Rohacell Foam & Fabric Face Sheets	90°/+45°/-45°/0°/0°/ -45°/+45°/90°, 8 ply both faces	Sandwich	10	Aluminum
23	Composite, IM7/TC350	8 Ply/ 1-inch thick fill	Al Honeycomb & Fabric Face Sheets	90°/+45°/-45°/0°/0°/ -45°/+45°/90°, 8 ply both faces	Sandwich	10	Aluminum
24	Composite, IM7/TC350	8 Ply/ 1-inch thick fill	Al Honeycomb & Fabric Face Sheets	90°/+45°/-45°/0°/0°/ -45°/+45°/90°, 8 ply both faces	Sandwich	22	Aluminum
25	Composite, IM7/TC350	8 Ply/ 1-inch thick fill	Al Honeycomb & Fabric Face Sheets	90°/+45°/-45°/0°/0°/ -45°/+45°/90°, 8 ply both faces	Sandwich	22	Composite, IM7/TC350
26	Composite, IM7/TC350	8 Ply/ 1-inch thick fill	Rohacell Foam & Tape Face Sheets	90°/+45°/-45°/0°/0°/ -45°/+45°/90°, 8 ply both faces	Sandwich	22	Composite, IM7/TC350
27	Composite, IM7/TC350	8 Ply/ 1-inch thick fill	Rohacell Foam & Fabric Face Sheets	90°/+45°/-45°/0°/0°/ -45°/+45°/90°, 8 ply both faces	Sandwich	10	Composite, IM7/TC350
28	Composite, IM7/TC350	8 Ply/ 1-inch thick fill	Al Honeycomb & Tape Face Sheets	90°/+45°/-45°/0°/0°/ -45°/+45°/90°, 8 ply both faces	Sandwich	10	Composite, IM7/TC350

	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 818 of 832	

ET40 / Vibration, Acoustics, and Shock Team		
Composite Materials Pyroshock Development Test	NESC-DEV-13-037	Revision: Baseline
Group III – Tests 19 to 28, Group I – Retests 1 to 4	Date: 10/21/2013	Page 17 of 24

## APPENDIX C

### TEST DATA SHEET



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
819 of 832

ET40 / Vibration, Acoustics, and Shock Team		
Composite Materials Pyroshock Development Test	NESC-DEV-13-037	Revision: Baseline
Group III - Tests 19 to 28, Group I - Retests 1 to 4	Date: 10/21/2013	Page 18 of 24

### TEST DATA SHEET

Group: III - Test No.: 19 Panel #19 Date: 10-31-2013 Test Article Desc.: IM7/TC350  
 Composite Sandwich Panel, see test plan for ply layup, 3'x6', Al Honeycomb & Fabric Face  
 Sheets Test Article Configuration: hanging  
 Test Article Drawing #: 97M00200-020 PANEL TESTS 19-28 Material: IM7/TC350  
 PID# 0346A019  
 Test Article Drawing #: 97M00202 Material: Aluminum S/N: Pathfinder  
 Test Article Drawing #: 97M00203-MOD-COMPOSITE Material: Composite S/N: Fabric 0346-53  
 Test Article Drawing #: 97M00204-MOD-2-10 Material: Aluminum S/N: Pathfinder  
 Shock Source: LSC L/N: none LSC Core Load: 10 GR/FT Explosive Material: RDX  
 Sheath: Aluminum Actual Length Used: 4'  
 Accelerometer MFG: PCB Model: 350XXX

Loc.	Model	S/N	Loc.	Model	S/N	Loc.	Model	S/N	Loc.	Model	S/N
1	C02	31334	2	D02	43026	3	D02	43028	4	C02	31331
5	C02	31328	6	D02	43029	7	D02	43179	8	C02	31351
9	C02	31330	10	D02	43180	11	D02	43181	12	C02	40274
13	B02	11439									

Composite Aluminum LSC panel severance: (Yes/No) (No) 1-2 layers of composite severed.  
 Post-test visually inspected observations: Accels did not loose torque. Bolts did not lose torque except, from top-left, 1, 2, 3, 8, 9, 12 were less than 160 in-lbs.

Group: III - Test No.: 20 Panel #20 Date: 11-19-2013 Test Article Desc.: IM7/TC350  
 Composite Sandwich Panel, see test plan for ply layup, 3'x6', Rohacell Foam and Fabric Face  
 Sheets Test Article Configuration: hanging  
 Test Article Drawing #: 97M00200-021 PANEL TESTS 19-28 Material: IM7/TC350  
 PID# 0346A020  
 Test Article Drawing #: 97M00202 Material: Aluminum S/N: Pathfinder  
 Test Article Drawing #: 97M00203-MOD-COMPOSITE Material: Composite S/N: Fabric 0346-52  
 Test Article Drawing #: 97M00204-MOD-2-22 Material: Aluminum S/N: Pathfinder  
 Shock Source: LSC L/N: none LSC Core Load: 22 GR/FT Explosive Material: CH-6  
 Sheath: Aluminum Actual Length Used: 4'  
 Accelerometer MFG: PCB Model: 350XXX

Loc.	Model	S/N	Loc.	Model	S/N	Loc.	Model	S/N	Loc.	Model	S/N
1	D02	43026	2	C02	31340	3	C02	31338	4	D02	43028
5	D02	43029	6	C02	31333	7	C02	40292	8	D02	43179
9	D02	43180	10	C02	40295	11	C02	31336	12	D02	43181
13	B02	11439									

Composite Aluminum LSC panel severance: (Yes/No) (Yes) delaminated LSC panel and severed.  
 Post-test visually inspected observations: Bolts and accels did not loose torque. Several layers of the LSC panel delaminated toward the composite sandwich panel. The cut end of the LSC panel had 1 layer completely separate.



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
820 of 832

ET40 / Vibration, Acoustics, and Shock Team		
Composite Materials Pyroshock Development Test	NESC-DEV-13-037	Revision: Baseline
Group III - Tests 19 to 28, Group I - Retests 1 to 4	Date: 10/21/2013	Page 19 of 24

### TEST DATA SHEET, cont.

Group: III - Test No.: 21 Panel #21 Date: 12-4-2008 Test Article Desc.: IM7/TC350 Composite Sandwich Panel, see test plan for ply layup, 3'x6', Al Honeycomb & Tape Face Sheets Test Article Configuration: hanging  
 Test Article Drawing #: 97M00200-022 PANEL TESTS 19-28 Material: IM7/TC350  
 PID# 0346A021  
 Test Article Drawing #: 97M00202 Material: Aluminum S/N: Pathfinder  
 Test Article Drawing #: 97M00203-MOD Material: Aluminum S/N: Pathfinder  
 Test Article Drawing #: 97M00204-MOD-2-22 Material: Aluminum S/N: Pathfinder  
 Shock Source: LSC L/N: none LSC Core Load: 22 GR/FT Explosive Material: CH-6  
 Sheath: Aluminum Actual Length Used: 4'  
 Accelerometer MFG: PCB Model: 350XXX

Loc.	Model	S/N	Loc.	Model	S/N	Loc.	Model	S/N	Loc.	Model	S/N
1	C02	31334	2	D02	43026	3	D02	43028	4	C02	31331
5	C02	31328	6	D02	43029	7	D02	43179	8	C02	31351
9	C02	31330	10	D02	43180	11	D02	43181	12	C02	40274
13	B02	11439									

Aluminum LSC panel severance: (Yes/No)

Post-test visually inspected observations: No loose bolts or nuts.

Group: III - Test No.: 22 Panel #22 Date: 11-25-2013 Test Article Desc.: IM7/TC350 Composite Sandwich Panel, see test plan for ply layup, 3'x6', Rohacell Foam and Fabric Face Sheets Test Article Configuration: hanging  
 Test Article Drawing #: 97M00200-023 PANEL TESTS 19-28 Material: IM7/TC350  
 PID# 0346A022  
 Test Article Drawing #: 97M00202 Material: Aluminum S/N: Pathfinder  
 Test Article Drawing #: 97M00203-MOD Material: Aluminum S/N: Pathfinder  
 Test Article Drawing #: 97M00204-MOD-2-10 Material: Aluminum S/N: Pathfinder  
 Shock Source: LSC L/N: none LSC Core Load: 10 GR/FT Explosive Material: RDX  
 Sheath: Aluminum Actual Length Used: 4'  
 Accelerometer MFG: PCB Model: 350XXX

Loc.	Model	S/N	Loc.	Model	S/N	Loc.	Model	S/N	Loc.	Model	S/N
1	D02	43026	2	C02	31340	3	C02	31338	4	D02	43028
5	D02	43029	6	C02	31338	7	C02	40292	8	D02	43179
9	D02	43180	10	C02	40295	11	C02	31336	12	D02	43181
13	B02	11439									

Aluminum LSC panel severance: (Yes/No)

Post-test visually inspected observations: No loose bolts. A1 and A2 18 in-lbs, A3-A12 20-25 in-lbs





# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
821 of 832

ET40 / Vibration, Acoustics, and Shock Team		
Composite Materials Pyroshock Development Test	NESC-DEV-13-037	Revision: Baseline
Group III - Tests 19 to 28, Group 1 - Retests 1 to 4	Date: 10/21/2013	Page 20 of 24

### TEST DATA SHEET, cont.

Group: III - Test No.: 23 Panel #23 Date: 4-18-2014 Test Article Desc.: IM7/TC350 Composite Sandwich Panel, see test plan for ply layup, 3'x6', Al Honeycomb & Fabric Face Sheets  
 Test Article Configuration: hanging  
 Test Article Drawing #: 97M00200-024 PANEL TESTS 19-28 Material: IM7/TC350  
 PID# 0346A023  
 Test Article Drawing #: 97M00202 Material: Aluminum S/N: Pathfinder  
 Test Article Drawing #: 97M00203-MOD Material: Aluminum S/N: Pathfinder  
 Test Article Drawing #: 97M00204-MOD-2-10 Material: Aluminum S/N: Pathfinder  
 Shock Source: LSC L/N: none LSC Core Load: 10 GR/FT Explosive Material: RDX  
 Sheath: Aluminum Actual Length Used: 4'  
 Accelerometer MFG: PCB Model: 350XXX

Loc.	Model	S/N	Loc.	Model	S/N	Loc.	Model	S/N	Loc.	Model	S/N
1	C02	31334	2	D02	43026	3	D02	43028	4	C02	31331
5	C02	31328	6	D02	43373	7	D02	43179	8	C02	31351
9	C02	31330	10	D02	43180	11	D02	43181	12	C02	40274
13	B02	11439									

Aluminum LSC panel severance: (Yes/No) (No) Approx. 1/2 panel was severed.  
 Post-test visually inspected observations: Bolts and accels did not loose torque.

Group: III - Test No.: 24 Panel #24 Date: 4-22-2014 Test Article Desc.: IM7/TC350 Composite Sandwich Panel, see test plan for ply layup, 3'x6', Al Honeycomb & Fabric Face Sheets  
 Test Article Configuration: hanging  
 Test Article Drawing #: 97M00200-025 PANEL TESTS 19-28 Material: IM7/TC350  
 PID# 0346A024  
 Test Article Drawing #: 97M00202 Material: Aluminum S/N: Pathfinder  
 Test Article Drawing #: 97M00203-MOD Material: Aluminum S/N: Pathfinder  
 Test Article Drawing #: 97M00204-MOD-2-22 Material: Aluminum S/N: Pathfinder  
 Shock Source: LSC L/N: none LSC Core Load: 22 GR/FT Explosive Material: CH-6  
 Sheath: Aluminum Actual Length Used: 4'  
 Accelerometer MFG: PCB Model: 350XXX

Loc.	Model	S/N	Loc.	Model	S/N	Loc.	Model	S/N	Loc.	Model	S/N
1	D02	43026	2	C02	31340	3	C02	31338	4	D02	43028
5	D02	43373	6	C02	31333	7	C02	40292	8	D02	43179
9	D02	43180	10	C02	40295	11	C02	31336	12	D02	43181
13	B02	11439									

Aluminum LSC panel severance: (Yes/No) (Yes)  
 Post-test visually inspected observations: Bolts and accels did not loose torque.



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
822 of 832

ET40 / Vibration, Acoustics, and Shock Team		
Composite Materials Pyroshock Development Test	NESC-DEV-13-037	Revision: Baseline
Group III - Tests 19 to 28, Group I - Retests 1 to 4	Date: 10/21/2013	Page 21 of 24

### TEST DATA SHEET, cont.

Group: III - Test No.: 25 Panel #25 Date: 6-10-2014 Test Article Desc.: IM7/TC350 Composite Sandwich Panel, see test plan for ply layup, 3'x6', Al Honeycomb & Fabric Face Sheets Test Article Configuration: hanging  
 Test Article Drawing #: 97M00200-026 PANEL TESTS 19-28 Material: IM7/TC350  
 PID# D346A025  
 Test Article Drawing #: 97M00202 Material: Aluminum S/N: Pathfinder  
 Test Article Drawing #: 97M00203-MOD-COMPOSITE Material: Composite S/N: Fabric  
 Test Article Drawing #: 97M00204-MOD-2-22 Material: Aluminum S/N: Pathfinder  
 Shock Source: LSC L/N: none LSC Core Load: 22 GR/FT Explosive Material: CH-6  
 Sheath: Aluminum Actual Length Used: 4'  
 Accelerometer MFG: PCB Model: 350XXX

Loc.	Model	S/N	Loc.	Model	S/N	Loc.	Model	S/N	Loc.	Model	S/N
1	C02	31334	2	D02	43026	3	D02	43028	4	C02	31331
5	C02	31328	6	D02	43273	7	D02	43179	8	C02	31351
9	C02	31330	10	D02	43180	11	D02	43181	12	C02	40274
13	B02	11439									

Composite ~~Aluminum~~ LSC panel severance: ( Yes / No )  
 Post-test visually inspected observations: Bolts and accels. did not loose torque.

Group: III - Test No.: 26 Panel #26 Date: 12-18-2013 Test Article Desc.: IM7/TC350 Composite Sandwich Panel, see test plan for ply layup, 3'x6', Rohacell Foam and Tape Face Sheets Test Article Configuration: hanging  
 Test Article Drawing #: 97M00200-027 PANEL TESTS 19-28 Material: IM7/TC350  
 PID# 0346A026  
 Test Article Drawing #: 97M00202 Material: Aluminum S/N: Pathfinder  
 Test Article Drawing #: 97M00203-MOD-COMPOSITE Material: Composite S/N: Tape 5P-5  
 Test Article Drawing #: 97M00204-MOD-2-22 Material: Aluminum S/N: Pathfinder  
 Shock Source: LSC L/N: none LSC Core Load: 22 GR/FT Explosive Material: CH-6  
 Sheath: Aluminum Actual Length Used: 4'  
 Accelerometer MFG: PCB Model: 350XXX

Loc.	Model	S/N	Loc.	Model	S/N	Loc.	Model	S/N	Loc.	Model	S/N
1	D02	43026	2	C02	31340	3	C02	31338	4	D02	43028
5	D02	43029	6	C02	31333	7	C02	40292	8	D02	43179
9	D02	43180	10	C02	40295	11	C02	31336	12	D02	43181
13	B02	11439									

Composite ~~Aluminum~~ LSC panel severance: ( Yes / No )  
 Post-test visually inspected observations: No loose accels or bolts.



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
823 of 832

ET40 / Vibration, Acoustics, and Shock Team		
Composite Materials Pyroshock Development Test	NESC-DEV-13-037	Revision: Baseline
Group III - Tests 19 to 28, Group I - Retests 1 to 4	Date: 10/21/2013	Page 22 of 24

### TEST DATA SHEET, cont.

Group: III - Test No.: 27 Panel #27 Date: 6-11-2014 Test Article Desc.: IM7/TC350 Composite Sandwich Panel, see test plan for ply layup, 3'x6', Rohacell Foam and Fabric Face Sheets Test Article Configuration: hanging  
 Test Article Drawing #: 97M00200-028 PANEL TESTS 19-28 Material: IM7/TC350  
 PID# 0346A027  
 Test Article Drawing #: 97M00202 Material: Aluminum S/N: Pathfinder  
 Test Article Drawing #: 97M00203-MOD-COMPOSITE Material: Composite S/N: Fabric  
 Test Article Drawing #: 97M00204-MOD-2-10 Material: Aluminum S/N: Pathfinder  
 Shock Source: LSC L/N: none LSC Core Load: 10 GR/FT Explosive Material: RDX  
 Sheath: Aluminum Actual Length Used: 4'  
 Accelerometer MFG: PCB Model: 350XXX

Loc.	Model	S/N	Loc.	Model	S/N	Loc.	Model	S/N	Loc.	Model	S/N
1	C02	31334	2	D02	43026	3	D02	43028	4	C02	31331
5	C02	31328	6	D02	43373	7	D02	43179	8	C02	31351
9	C02	31330	10	D02	43180	11	D02	43181	12	C02	40274
13	B02	11439									

Composite ~~Aluminum~~ LSC panel severance: (Yes/No) (No)  
 Post-test visually inspected observations: Bolts and accel. did not loose torque.

Group: III - Test No.: 28 Panel #28 Date: 1-24-2014 Test Article Desc.: IM7/TC350 Composite Sandwich Panel, see test plan for ply layup, 3'x6', Al Honeycomb & Tape Face Sheets Test Article Configuration: hanging  
 Test Article Drawing #: 97M00200-029 PANEL TESTS 19-28 Material: IM7/TC350  
 PID# 0346A028  
 Test Article Drawing #: 97M00202 Material: Aluminum S/N: Pathfinder  
 Test Article Drawing #: 97M00203-MOD-COMPOSITE Material: Composite S/N: Tape  
 Test Article Drawing #: 97M00204-MOD-2-10 Material: Aluminum S/N: Pathfinder  
 Shock Source: LSC L/N: none LSC Core Load: 10 GR/FT Explosive Material: RDX  
 Sheath: Aluminum Actual Length Used: 4'  
 Accelerometer MFG: PCB Model: 350XXX

Loc.	Model	S/N	Loc.	Model	S/N	Loc.	Model	S/N	Loc.	Model	S/N
1	D02	43026	2	C02	31340	3	C02	31338	4	D02	43028
5	D02	43373	6	C02	31333	7	C02	40292	8	D02	43179
9	D02	43180	10	C02	40295	11	C02	31336	12	D02	43181
13	B02	11439									

Composite ~~Aluminum~~ LSC panel severance: (Yes/No) (No)  
 Post-test visually inspected observations: The majority of the panel was cut almost through. There was also delamination.



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
824 of 832

ET40 / Vibration, Acoustics, and Shock Team		
Composite Materials Pyroshock Development Test	NESC-DEV-13-037	Revision: Baseline
Group III - Tests 19 to 28, Group I - Retests 1 to 4	Date: 10/21/2013	Page 23 of 24

### TEST DATA SHEET, cont.

Group: I (retest of #10) - Test No.: 01 Panel #10 Date: 1-16-2014 Test Article Desc.: IM7/TC350 Solid Tape Composite Panel, 3'x6'x0.2"  
 Test Article Configuration: hanging  
 Test Article Drawing #: 97M00200-GRP I-TEST 10 Material: IM7/TC350 PID# 0328A010  
 Test Article Drawing #: 97M00202 Material: Aluminum S/N: Pathfinder  
 Test Article Drawing #: 97M00203-MOD Material: Aluminum S/N: Pathfinder  
 Test Article Drawing #: 97M00204-MOD-2-10 Material: Aluminum S/N: Pathfinder (A test)  
 Shock Source: LSC L/N: none LSC Core Load: 10 GR/FT Explosive Material: RDX (25)  
 Sheath: Aluminum Actual Length Used: 4'  
 Accelerometer MFG: PCB Model: 350XXX

Loc.	Model	S/N	Loc.	Model	S/N	Loc.	Model	S/N	Loc.	Model	S/N
1	C02	31334	2	D02	43026	3	D02	43028	4	C02	31331
5	C02	31328	6	D02	43027	7	D02	43179	8	C02	31351
9	C02	31330	10	D02	43180	11	D02	43181	12	C02	40274
13	B02	11439									

Aluminum LSC panel severance: ( Yes  No ) 2 small blow throughs in the middle of the plate  
 Post-test visually inspected observations: Bolts and accels. did not loose torque.

Group: I (retest of #4) - Test No.: 02 Panel #4 Date: 12-12-2013 Test Article Desc.: IM7/TC350 Solid Fabric Composite Panel, 3'x6'x0.3"  
 Test Article Configuration: hanging  
 Test Article Drawing #: 97M00200-GRP I-TEST 4 Material: IM7/TC350 PID# 0320A004  
 Test Article Drawing #: 97M00202 Material: Aluminum S/N: Pathfinder  
 Test Article Drawing #: 97M00203-MOD Material: Aluminum S/N: Pathfinder  
 Test Article Drawing #: 97M00204-MOD-2-22 Material: Aluminum S/N: Pathfinder  
 Shock Source: LSC L/N: none LSC Core Load: 22 GR/FT Explosive Material: CH-6  
 Sheath: Aluminum Actual Length Used: 4'  
 Accelerometer MFG: PCB Model: 350XXX

Loc.	Model	S/N	Loc.	Model	S/N	Loc.	Model	S/N	Loc.	Model	S/N
1	D02	43026	2	C02	31340	3	C02	31338	4	D02	43028
5	D02	43029	6	C02	31333	7	C02	40292	8	D02	43179
9	D02	43180	10	C02	40295	11	C02	31330	12	D02	43181
13	B02	11439									

Aluminum LSC panel severance: (  Yes ) No )  
 Post-test visually inspected observations: No loose bolts. No loose accels, except A5, which had 20-25 in-lbs after the test. All insert bolts loose from panel while removing accel.



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
825 of 832

ET40 / Vibration, Acoustics, and Shock Team		
Composite Materials Pyroshock Development Test	NESC-DEV-13-037	Revision: Baseline
Group III - Tests 19 to 28, Group I - Retests 1 to 4	Date: 10/21/2013	Page 24 of 24

### TEST DATA SHEET, cont.

Group: I (retest of #2) - Test No.: 03 Panel #2 Date: 12-16-2013 Test Article Desc.: IM7/TC350 Solid Fabric Composite Panel, 3'x6'x0.2"  
 Test Article Configuration: hanging  
 Test Article Drawing #: 97M00200-GRP I-TEST 2 Material: IM7/TC350 PID# 0320A002  
 Test Article Drawing #: 97M00202 Material: Aluminum S/N: Pathfinder  
 Test Article Drawing #: 97M00203-MOD Material: Aluminum S/N: Pathfinder  
 Test Article Drawing #: 97M00204-MOD-2-22 Material: Aluminum S/N: Pathfinder  
 Shock Source: LSC L/N: none LSC Core Load: 22 GR/FT Explosive Material: CII-6  
 Sheath: Aluminum Actual Length Used: 4'  
 Accelerometer MFG: PCB Model: 350XXX

Loc.	Model	S/N	Loc.	Model	S/N	Loc.	Model	S/N	Loc.	Model	S/N
1	C02	31334	2	D02	43026	3	D02	43028	4	C02	31331
5	C02	31338	6	D02	43029	7	D02	43179	8	C02	31351
9	C02	31330	10	D02	43180	11	D02	43181	12	C02	40274
13	B02	11439									

Aluminum LSC panel severance:  Yes /  No


Post-test visually inspected observations: Bolts and accels did not loose torque.

Group: I (retest of #9) - Test No.: 04 Panel #9 Date: 1-23-2014 Test Article Desc.: IM7/TC350 Solid Tape Composite Panel, 3'x6'x0.3"  
 Test Article Configuration: hanging  
 Test Article Drawing #: 97M00200-GRP I-TEST 9 Material: IM7/TC350 PID# 0326A009  
 Test Article Drawing #: 97M00202 Material: Aluminum S/N: Pathfinder  
 Test Article Drawing #: 97M00203-MOD Material: Aluminum S/N: Pathfinder  
 Test Article Drawing #: 97M00204-MOD-2-22 Material: Aluminum S/N: Pathfinder  
 Shock Source: LSC L/N: none LSC Core Load: 22 GR/FT Explosive Material: CH-6  
 Sheath: Aluminum Actual Length Used: 4'  
 Accelerometer MFG: PCB Model: 350XXX

Loc.	Model	S/N	Loc.	Model	S/N	Loc.	Model	S/N	Loc.	Model	S/N
1	D02	43026	2	C02	31340	3	C02	31338	4	D02	43028
5	D02	43373	6	C02	31333	7	C02	40292	8	D02	43179
9	D02	43180	10	C02	40295	11	C02	31336	12	D02	43181
13	B02	11439									

Aluminum LSC panel severance:  Yes /  No

Post-test visually inspected observations: No loose accels or bolts. A6 held torque but started debanding at the end of the torque check. A7 had 15 in-lb. & A9 had 20 in-lbs.

	<p align="center"><b>NASA Engineering and Safety Center Technical Assessment Report</b></p>	<p>Document #: <b>NESC-RP-12-00783</b></p>	<p>Version: <b>1.0</b></p>
<p>Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b></p>		<p>Page #: 826 of 832</p>	

**NESC-DEV-13-037**  
**Composite Materials**  
**Shock Test**  
  
**Equipment List**



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-12-00783**

Version:  
**1.0**


Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
827 of 832

### NESC-DEV-13-037 Equipment List

Description	Manufacturer	Model/Version	ID/Serial Number	Location	Cal Due Date
Shock Analysis Tool	ET40	1.2.5			Verified 5/21/2009
TCAM256	Nicolet	7.20			Verified 7/26/2012
Torque Wrench (tests 1-10)	Proto	6012	M644973		3/16/2014
Torque Wrench (tests 1-4,7,10)	Proto	6062C	M659926		3/30/2014
Torque Wrench (tests 1-4)	Snap-Or	TEC3FUA	M634527		3/12/2014
Torque Wrench (tests 13,14)	Snap-Or	TEC3FUA	M634527		11/9/2014
Torque Wrench (tests 5-12)	Precision Instruments	44620	M658783		5/29/2014
Torque Wrench (test 11)	Snap Or	TL25 FUA	M627361		5/29/2014
Torque Wrench (test 12)	Proto	6066C	M658395		5/21/2014
Torque Wrench (tests 13,14)	Proto	6006F	M650749		10/3/2014
Power Supply (tests 1-7)	Endevco	2793	M652262	Channels 1-15	1/10/2014
Power Supply (tests 8-15)	Endevco	2793	M652262	Channels 1-15	1/8/2015
Data Acquisition System	Nicolet	BE256LE	2011288	Channels 2, 8, 10-15	8/6/2014
Channel 2	Nicolet	614CB	001-2	A1	8/6/2014
Channel 3	Nicolet	614CB	001-3	A2	8/6/2014
Channel 4	Nicolet	614CB	001-4	A3	8/6/2014
Channel 5	Nicolet	614CB	002-1	A4	8/6/2014
Channel 6	Nicolet	614CB	002-2	A5	8/6/2014
Channel 7	Nicolet	614CB	002-3	A6	8/6/2014
Channel 8	Nicolet	614CB	002-4	A7	8/6/2014
Channel 10	Nicolet	614CB	003-2	A8	8/6/2014
Channel 11	Nicolet	614CB	003-3	A9	8/6/2014
Channel 12	Nicolet	614CB	003-4	A10	8/6/2014
Channel 13	Nicolet	614CB	004-1	A11	8/6/2014
Channel 14	Nicolet	614CB	004-2	A12	8/6/2014
Channel 15	Nicolet	614CB	004-3	A13	8/6/2014
Accelerometer	PCB	350B02	11439	A13 (tests 1-12)	4/29/2014
Accelerometer	PCB	350B02	11439	A13 (tests 13,14)	6/5/2015
Accelerometer	PCB	350C02	31334	Set 1 A1 (tests 1,4,6,8)	4/23/2014
Accelerometer	PCB	350C02	31334	Set 1 A1 (tests 11,13,14)	1/22/2015
Accelerometer	PCB	350C02	31331	Set 1 A4 (tests 1,4,6,8)	4/24/2014
Accelerometer	PCB	350C02	31331	Set 1 A4 (tests 11,13,14)	1/22/2015
Accelerometer	PCB	350C02	31328	Set 1 A5 (tests 1,4,6,8)	4/24/2014
Accelerometer	PCB	350C02	31328	Set 1 A5 (tests 11,13,14)	1/22/2015
Accelerometer	PCB	350C02	31351	Set 1 A8 (tests 1,4,6,8,11)	4/24/2014
Accelerometer	PCB	350C02	31351	Set 1 A8 (tests 13,14)	6/5/2015
Accelerometer	PCB	350C02	31330	Set 1 A9 (tests 1,4,6,8,11)	4/24/2014
Accelerometer	PCB	350C02	31330	Set 1 A9 (tests 13,14)	6/5/2015
Accelerometer	PCB	350C02	40274	Set 1 A12 (tests 1,4,6,8,11)	4/24/2014
Accelerometer	PCB	350C02	40274	Set 1 A12 (tests 13,14)	6/5/2015
Accelerometer	PCB	350C02	31340	Set 2 A2	4/23/2014
Accelerometer	PCB	350C02	31338	Set 2 A3	4/24/2014
Accelerometer	PCB	350C02	31333	Set 2 A6	4/24/2014
Accelerometer	PCB	350C02	40292	Set 2 A7	4/24/2014
Accelerometer	PCB	350C02	40295	Set 2 A10	4/24/2014
Accelerometer	PCB	350C02	31336	Set 2 A11	4/24/2014
Accelerometer	PCB	350D02	43026	Set 1 A2, Set 2 A1 (tests 1-8)	4/23/2014
Accelerometer	PCB	350D02	43026	Set 1 A2, Set 2 A1 (tests 9-14)	1/22/2015
Accelerometer	PCB	350D02	43028	Set 1 A3, Set 2 A4 (tests 1-8)	4/23/2014
Accelerometer	PCB	350D02	43028	Set 1 A3, Set 2 A4 (tests 9-14)	1/22/2015
Accelerometer	PCB	350D02	43029 (tests 1-7)	Set 1 A6, Set 2 A5	4/23/2014
Accelerometer	PCB	350D02	43373 (tests 8-14)	Set 1 A6, Set 2 A5	10/17/2014
Accelerometer	PCB	350D02	43179	Set 1 A7, Set 2 A8 (tests 1-8)	4/22/2014
Accelerometer	PCB	350D02	43179	Set 1 A7, Set 2 A8 (tests 9-14)	1/22/2015
Accelerometer	PCB	350D02	43180	Set 1 A10, Set 2 A9 (tests 1-8)	4/23/2014
Accelerometer	PCB	350D02	43180	Set 1 A10, Set 2 A9 (tests 9-14)	1/22/2015
Accelerometer	PCB	350D02	43181	Set 1 A11, Set 2 A12 (tests 1-8)	4/23/2014
Accelerometer	PCB	350D02	43181	Set 1 A11, Set 2 A12 (tests 9-14)	1/22/2015

	<b>NASA Engineering and Safety Center Technical Assessment Report</b>	Document #: <b>NESC-RP-12-00783</b>	Version: <b>1.0</b>
Title: <b>Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading</b>		Page #: 828 of 832	

**NESC-DEV-13-037**  
**Composite Materials**  
**Shock Test**  
  
**Data Acquisition Setups**





# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
829 of 832

Date: 11-05-2013  
Time: 08:54:26

TEAM256 SETTINGS

TESTS 1,4,6

\*\*\*\*\* GLOBAL SETTINGS \*\*\*\*\*

Storage Path: C:\TEAMPRO  
Filename: Data  
File Number: 001  
Settings Path: C:\TEAM256  
Settings File: NESC319.SET  
Export Path: D:\ATEST\NESC\_5\NEST3-19\RAWDAT-1  
Export Format: FAMOS  
Average Blocks: No  
Between Cursors: No

\*\*\*\*\* RECORDER SETTINGS \*\*\*\*\*

BEL

Frequency A : 1.0000 MHz(Internal)  
Pre Trigger : 48000 Samples (48.00 ms)  
Segment A : 1000576 Samples (1.001 s)  
Number of Blocks : 1  
Digital Event Channels : 0  
Analog Channels :

Nr.	Name	Min	Max	Units	Coup.	Amp.	Filter	Trigger
1	XXX_1	-6.000	6.000	kg's pk	GND	+	33.00 k	Off
2	NES_2	-28.85	28.85	kg's pk	DC	+	33.00 k	Basic
3	NES_3	-30.93	30.93	kg's pk	DC	+	33.00 k	Basic
4	NES_4	-31.25	31.25	kg's pk	DC	+	33.00 k	Basic
5	NES_5	-27.78	27.78	kg's pk	DC	+	33.00 k	Basic
6	NES_6	-28.04	28.04	kg's pk	DC	+	33.00 k	Basic
7	NES_7	-30.30	30.30	kg's pk	DC	+	33.00 k	Basic
8	NES_8	-30.61	30.61	kg's pk	DC	+	33.00 k	Off
9	XXX_9	-6.000	6.000	kg's pk	GND	+	33.00 k	Off
10	NES_10	-28.04	28.04	kg's pk	DC	+	33.00 k	Off
11	NES_11	-27.03	27.03	kg's pk	DC	+	33.00 k	Off
12	NES_12	-31.58	31.58	kg's pk	DC	+	33.00 k	Off
13	NES_13	-30.61	30.61	kg's pk	DC	+	33.00 k	Off
14	NES_14	-27.27	27.27	kg's pk	DC	+	33.00 k	Off
15	NES_15	-8.929	8.929	kg's pk	DC	+	33.00 k	Off
16	ROC_16	-55.56	55.56	kg's pk	DC	+	33.00 k	Off
17	ROC_17	-55.56	55.56	kg's pk	DC	+	33.00 k	Off
18	ROC_18	-55.56	55.56	kg's pk	DC	+	33.00 k	Off
19	ROC_19	-55.56	55.56	kg's pk	DC	+	33.00 k	Off
20	ROC_20	-55.56	55.56	kg's pk	DC	+	33.00 k	Off

Engineering Units Scaling

XXX_1	0	+	1.0000	k * Voltage (g's pk)
NES_2	0	+	9.6154	k * Voltage (g's pk)
NES_3	0	+	10.309	k * Voltage (g's pk)
NES_4	0	+	10.417	k * Voltage (g's pk)
NES_5	0	+	9.2593	k * Voltage (g's pk)
NES_6	0	+	9.3458	k * Voltage (g's pk)
NES_7	0	+	10.101	k * Voltage (g's pk)
NES_8	0	+	10.204	k * Voltage (g's pk)
XXX_9	0	+	1.0000	k * Voltage (g's pk)
NES_10	0	+	9.3458	k * Voltage (g's pk)
NES_11	0	+	9.0090	k * Voltage (g's pk)
NES_12	0	+	10.526	k * Voltage (g's pk)
NES_13	0	+	10.204	k * Voltage (g's pk)
NES_14	0	+	9.0909	k * Voltage (g's pk)
NES_15	0	+	8.9286	k * Voltage (g's pk)
ROC_16	0	+	9.2593	k * Voltage (g's pk)
ROC_17	0	+	9.2593	k * Voltage (g's pk)
ROC_18	0	+	9.2593	k * Voltage (g's pk)
ROC_19	0	+	9.2593	k * Voltage (g's pk)
ROC_20	0	+	9.2593	k * Voltage (g's pk)

Trigger Settings :

Auto Trigger: Off



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
830 of 832

Date: 11-19-2013  
Time: 09:39:35

TEAM256 SETTINGS

TESTS 2,3,5,7

\*\*\*\*\* GLOBAL SETTINGS \*\*\*\*\*

Storage Path: C:\TEAMPRO  
Filename: Data  
File Number: 001  
Settings Path: C:\TEAM256  
Settings File: NRS320.SET  
Export Path: D:\ATEST\NESC\_5\NESC13-20\RAWDAT-1  
Export Format: FAMOS  
Average Blocks: No  
Between Cursors: No

\*\*\*\*\* RECORDER SETTINGS \*\*\*\*\*

BE1

Frequency A : 1.0000 MHz (Internal)  
Pre Trigger : 48000 Samples (48.00 ms)  
Segment A : 1000576 Samples (1.001 s)  
Number of Blocks : 1  
Digital Event Channels : 0  
Analog Channels :

Nr.	Name	Min	Max	Units	Coup.	Amp.	Filter	Trigger
1	XXX_1	-6.000	6.000	kg's pk	GND	+	33.00 k	Off
2	NES_2	-30.93	30.93	kg's pk	DC	+	33.00 k	Basic
3	NES_3	-31.58	31.58	kg's pk	DC	+	33.00 k	Basic
4	NES_4	-30.00	30.00	kg's pk	DC	+	33.00 k	Basic
5	NES_5	-31.25	31.25	kg's pk	DC	+	33.00 k	Basic
6	NES_6	-30.30	30.30	kg's pk	DC	+	33.00 k	Basic
7	NES_7	-28.57	28.57	kg's pk	DC	+	33.00 k	Basic
8	NES_8	-28.30	28.30	kg's pk	DC	+	33.00 k	Basic
9	XXX_9	-6.000	6.000	kg's pk	GND	+	33.00 k	Off
10	NES_10	-30.61	30.61	kg's pk	DC	+	33.00 k	Off
11	NES_11	-31.58	31.58	kg's pk	DC	+	33.00 k	Off
12	NES_12	-28.30	28.30	kg's pk	DC	+	33.00 k	Off
13	NES_13	-27.78	27.78	kg's pk	DC	+	33.00 k	Off
14	NES_14	-30.61	30.61	kg's pk	DC	+	33.00 k	Off
15	NES_15	-8.929	8.929	kg's pk	DC	+	33.00 k	Off
16	ROC_16	-55.56	55.56	kg's pk	DC	+	33.00 k	Off
17	ROC_17	-55.56	55.56	kg's pk	DC	+	33.00 k	Off
18	ROC_18	-55.56	55.56	kg's pk	DC	+	33.00 k	Off
19	ROC_19	-55.56	55.56	kg's pk	DC	+	33.00 k	Off
20	ROC_20	-55.56	55.56	kg's pk	DC	+	33.00 k	Off

Engineering Units Scaling

XXX_1	0 +	1.0000	k * Voltage (g's pk)
NES_2	0 +	10.309	k * Voltage (g's pk)
NES_3	0 +	10.526	k * Voltage (g's pk)
NES_4	0 +	10.000	k * Voltage (g's pk)
NES_5	0 +	10.417	k * Voltage (g's pk)
NES_6	0 +	10.101	k * Voltage (g's pk)
NES_7	0 +	9.5238	k * Voltage (g's pk)
NES_8	0 +	9.4340	k * Voltage (g's pk)
XXX_9	0 +	1.0000	k * Voltage (g's pk)
NES_10	0 +	10.204	k * Voltage (g's pk)
NES_11	0 +	10.526	k * Voltage (g's pk)
NES_12	0 +	9.4340	k * Voltage (g's pk)
NES_13	0 +	9.2593	k * Voltage (g's pk)
NES_14	0 +	10.204	k * Voltage (g's pk)
NES_15	0 +	8.9286	k * Voltage (g's pk)
ROC_16	0 +	9.2593	k * Voltage (g's pk)
ROC_17	0 +	9.2593	k * Voltage (g's pk)
ROC_18	0 +	9.2593	k * Voltage (g's pk)
ROC_19	0 +	9.2593	k * Voltage (g's pk)
ROC_20	0 +	9.2593	k * Voltage (g's pk)

Trigger Settings :  
Auto Trigger: Off



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

**Empirical Model Development for Predicting Shock Response on  
Composite Materials Subjected to Pyroshock Loading**

Page #:  
831 of 832

3

Date: 01-16-2014  
Time: 10:09:26

TEAM256 SETTINGS

TESTS 8, 11, 13, 14

\*\*\*\*\* GLOBAL SETTINGS \*\*\*\*\*

Storage Path: C:\TEAMPRO  
Filename: Data  
File Number: 001  
Settings Path: C:\TEAM256  
Settings File: NESR10.SET  
Export Path: D:\ATEST\NESC\_5\NESR1-10\RAWDAT-1  
Export Format: FAMOS  
Average Blocks: No  
Between Cursors: No

\*\*\*\*\* RECORDER SETTINGS \*\*\*\*\*

BEL

Frequency A : 1.0000 MHz(Internal)  
Pre Trigger : 48000 Samples (48.00 ms)  
Segment A : 1000576 Samples (1.001 s)  
Number of Blocks : 1  
Digital Event Channels : 0  
Analog Channels :

Mr. Name	Min	Max	Units	Coup.	Amp.	Filter	Trigger
1 XXX_1	-6.000	6.000	kg's pk	GND	+	33.00 k	Off
2 NES_2	-28.85	28.85	kg's pk	DC	+	33.00 k	Basic
3 NES_3	-30.93	30.93	kg's pk	DC	+	33.00 k	Basic
4 NES_4	-31.25	31.25	kg's pk	DC	+	33.00 k	Basic
5 NES_5	-27.78	27.78	kg's pk	DC	+	33.00 k	Basic
6 NES_6	-28.04	28.04	kg's pk	DC	+	33.00 k	Basic
7 NES_7	-31.91	31.91	kg's pk	DC	+	33.00 k	Basic
8 NES_8	-30.61	30.61	kg's pk	DC	+	33.00 k	Off
9 XXX_9	-6.000	6.000	kg's pk	GND	+	33.00 k	Off
10 NES_10	-28.04	28.04	kg's pk	DC	+	33.00 k	Off
11 NES_11	-27.03	27.03	kg's pk	DC	+	33.00 k	Off
12 NES_12	-31.58	31.58	kg's pk	DC	+	33.00 k	Off
13 NES_13	-30.61	30.61	kg's pk	DC	+	33.00 k	Off
14 NES_14	-27.27	27.27	kg's pk	DC	+	33.00 k	Off
15 NES_15	-8.929	8.929	kg's pk	DC	+	33.00 k	Off
16 ROC_16	-55.56	55.56	kg's pk	DC	+	33.00 k	Off
17 ROC_17	-55.56	55.56	kg's pk	DC	+	33.00 k	Off
18 ROC_18	-55.56	55.56	kg's pk	DC	+	33.00 k	Off
19 ROC_19	-55.56	55.56	kg's pk	DC	+	33.00 k	Off
20 ROC_20	-55.56	55.56	kg's pk	DC	+	33.00 k	Off

Engineering Units Scaling

XXX_1	0	+	1.0000	k * Voltage (g's pk)
NES_2	0	+	9.6154	k * Voltage (g's pk)
NES_3	0	+	10.309	k * Voltage (g's pk)
NES_4	0	+	10.417	k * Voltage (g's pk)
NES_5	0	+	9.2593	k * Voltage (g's pk)
NES_6	0	+	9.3458	k * Voltage (g's pk)
NES_7	0	+	10.638	k * Voltage (g's pk)
NES_8	0	+	10.204	k * Voltage (g's pk)
XXX_9	0	+	1.0000	k * Voltage (g's pk)
NES_10	0	+	9.3458	k * Voltage (g's pk)
NES_11	0	+	9.0090	k * Voltage (g's pk)
NES_12	0	+	10.526	k * Voltage (g's pk)
NES_13	0	+	10.204	k * Voltage (g's pk)
NES_14	0	+	9.0909	k * Voltage (g's pk)
NES_15	0	+	8.9286	k * Voltage (g's pk)
ROC_16	0	+	9.2593	k * Voltage (g's pk)
ROC_17	0	+	9.2593	k * Voltage (g's pk)
ROC_18	0	+	9.2593	k * Voltage (g's pk)
ROC_19	0	+	9.2593	k * Voltage (g's pk)
ROC_20	0	+	9.2593	k * Voltage (g's pk)

Trigger Settings :

Auto Trigger: Off



# NASA Engineering and Safety Center Technical Assessment Report

Document #:  
**NESC-RP-  
12-00783**

Version:  
**1.0**

Title:

## Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading

Page #:  
832 of 832

9

TEAM256 SETTINGS

TESTS 9, 10, 12

Date: 01-23-2014  
Time: 11:26:54

\*\*\*\*\* GLOBAL SETTINGS \*\*\*\*\*

Storage Path: C:\TEAMPRO  
Filename: Data  
File Number: 001  
Settings Path: C:\TEAM256  
Settings File: NESR109.SET  
Export Path: D:\ATEST\NESC\_5\NESR1-09\RAWDAT-1  
Export Format: FAMOS  
Average Blocks: No  
Between Cursors: No

\*\*\*\*\* RECORDER SETTINGS \*\*\*\*\*

BEL

Frequency A : 1.0000 MHz(Internal)  
Pre Trigger : 48000 Samples (48.00 ms)  
Segment A : 1000576 Samples (1.001 s)  
Number of Blocks : 1  
Digital Event Channels : 0  
Analog Channels :

Nr.	Name	Min	Max	Units	Coup.	Amp.	Filter	Trigger
1	XXX_1	-6.000	6.000	kg's pk	GND	+	33.00 k	Off
2	NES_2	-30.93	30.93	kg's pk	DC	+	33.00 k	Basic
3	NES_3	-31.58	31.58	kg's pk	DC	+	33.00 k	Basic
4	NES_4	-30.00	30.00	kg's pk	DC	+	33.00 k	Basic
5	NES_5	-31.25	31.25	kg's pk	DC	+	33.00 k	Basic
6	NES_6	-31.91	31.91	kg's pk	DC	+	33.00 k	Basic
7	NES_7	-28.57	28.57	kg's pk	DC	+	33.00 k	Basic
8	NES_8	-28.30	28.30	kg's pk	DC	+	33.00 k	Basic
9	XXX_9	-6.000	6.000	kg's pk	GND	+	33.00 k	Off
10	NES_10	-30.61	30.61	kg's pk	DC	+	33.00 k	Off
11	NES_11	-31.58	31.58	kg's pk	DC	+	33.00 k	Off
12	NES_12	-28.30	28.30	kg's pk	DC	+	33.00 k	Off
13	NES_13	-27.78	27.78	kg's pk	DC	+	33.00 k	Off
14	NES_14	-30.61	30.61	kg's pk	DC	+	33.00 k	Off
15	NES_15	-8.929	8.929	kg's pk	DC	+	33.00 k	Off
16	ROC_16	-55.56	55.56	kg's pk	DC	+	33.00 k	Off
17	ROC_17	-55.56	55.56	kg's pk	DC	+	33.00 k	Off
18	ROC_18	-55.56	55.56	kg's pk	DC	+	33.00 k	Off
19	ROC_19	-55.56	55.56	kg's pk	DC	+	33.00 k	Off
20	ROC_20	-55.56	55.56	kg's pk	DC	+	33.00 k	Off

Engineering Units Scaling

XXX\_1 0 + 1.0000 k \* Voltage (g's pk)  
NES\_2 0 + 10.309 k \* Voltage (g's pk)  
NES\_3 0 + 10.526 k \* Voltage (g's pk)  
NES\_4 0 + 10.000 k \* Voltage (g's pk)  
NES\_5 0 + 10.417 k \* Voltage (g's pk)  
NES\_6 0 + 10.638 k \* Voltage (g's pk)  
NES\_7 0 + 9.5238 k \* Voltage (g's pk)  
NES\_8 0 + 9.4340 k \* Voltage (g's pk)  
XXX\_9 0 + 1.0000 k \* Voltage (g's pk)  
NES\_10 0 + 10.204 k \* Voltage (g's pk)  
NES\_11 0 + 10.526 k \* Voltage (g's pk)  
NES\_12 0 + 9.4340 k \* Voltage (g's pk)  
NES\_13 0 + 9.2593 k \* Voltage (g's pk)  
NES\_14 0 + 10.204 k \* Voltage (g's pk)  
NES\_15 0 + 8.9286 k \* Voltage (g's pk)  
ROC\_16 0 + 9.2593 k \* Voltage (g's pk)  
ROC\_17 0 + 9.2593 k \* Voltage (g's pk)  
ROC\_18 0 + 9.2593 k \* Voltage (g's pk)  
ROC\_19 0 + 9.2593 k \* Voltage (g's pk)  
ROC\_20 0 + 9.2593 k \* Voltage (g's pk)

Trigger Settings :

Auto Trigger: Off

REPORT DOCUMENTATION PAGE				Form Approved OMB No. 0704-0188	
<p>The 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 Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.</p> <p><b>PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.</b></p>					
1. REPORT DATE (DD-MM-YYYY) 01-07-2015		2. REPORT TYPE Technical Memorandum		3. DATES COVERED (From - To) April 2012 - April 2015	
4. TITLE AND SUBTITLE Empirical Model Development for Predicting Shock Response on Composite Materials Subjected to Pyroshock Loading <i>Appendices</i>				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S) Gentz, Steven J.; Ordway, David O.; Parsons, David S.; Garrison, Craig M.; Rodgers, C. Steven; Collins, Brian W.				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER 869021.05.05.09.13	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) NASA Langley Research Center Hampton, VA 23681-2199				8. PERFORMING ORGANIZATION REPORT NUMBER  L-20592 NESC-RP-12-00783	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) National Aeronautics and Space Administration Washington, DC 20546-0001				10. SPONSOR/MONITOR'S ACRONYM(S)  NASA	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S) NASA/TM-2015-218781/Volume II/Part 2	
12. DISTRIBUTION/AVAILABILITY STATEMENT Unclassified - Unlimited Subject Category 24 Composite Materials Availability: NASA STI Program (757) 864-9658					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT The NASA Engineering and Safety Center (NESC) received a request to develop an analysis model based on both frequency response and wave propagation analyses for predicting shock response spectrum (SRS) on composite materials subjected to pyroshock loading. The model would account for near-field environment (~9 inches from the source) dominated by direct wave propagation, mid-field environment (~2 feet from the source) characterized by wave propagation and structural resonances, and far-field environment dominated by lower frequency bending waves in the structure. This document contains appendices to the Volume I report.					
15. SUBJECT TERMS NASA Engineering and Safety Center; Shock response spectrum; Pyroshock loading; Model development					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			STI Help Desk (email: help@sti.nasa.gov)
U	U	U	UU	837	19b. TELEPHONE NUMBER (Include area code) (757) 864-9658