



WICHITA STATE
UNIVERSITY
NATIONAL INSTITUTE
FOR AVIATION RESEARCH

Report No: CAM-RP-2013-020 Rev N/C
Report Date: April 16, 2019

NIAR Impact Testing Investigation Report For Hexcel 8552 IM7 Unidirectional Prepreg 190 gsm & 35%RC

NCAMP Test Report Number: CAM-RP-2013-020 Rev N/C

Report Date: April 16, 2019

Testing Facility:

National Institute for Aviation Research
Wichita State University
1845 N. Fairmount
Wichita, KS 67260-0093

Prepared by:

Soo Han Loo

Edited by:

Michelle Man, Katherine Carney



Table of Contents

1. Scope	3
2. Summary	3
3. Analysis of setup.....	4
4. Revision	9



1. Scope

The purpose of this report is to provide a supplementary to the Hexcel 8552 IM7 Qualification data report, CAM-RP-2009-015 Rev B (or later revisions) and its subsequent Equivalency programs that were completed in 2008. The CAI data that was generated in the initial effort has been found to be erroneous due to a setup error that has since been investigated, summarized, and documented in this report. References to this supplementary document have been placed in reports where the CAI have been tested incorrectly. If no reference exists within individual data reports, the CAI was tested correctly and no error occurred.

2. Summary

Statistical analysis of an equivalency program conducted in 2012/2013 indicated an unusual disparity in the CAI data when compared to the 2008 qualification program dataset. This led to an investigation that concluded the use of an erroneous test setup during the 2008 qualification and equivalency test program. A trial conducted using the same material during the investigation confirmed that the 2012/2013 equivalency was tested with the correct set up, producing accurate test data.

In general, data from an erroneous impact setup could exhibit a smaller rebound energy on the "Load vs Displacement" curve and lower rebound velocity if the impact energy is improperly transferred. Setups of this nature would result in a smaller impact damage area and a higher recorded compression strength. The identified erroneous test setup in this case is as described, with the details provided below.

The following discusses the test discrepancy and subsequently the cause for omission of the CAI data. When available, the data for retested samples will be published in the qualification report.

All Hexcel 8552 IM7 Tape data was reviewed by a trained technician and the erroneous impact setup was limited to the following programs:

- 2008 Hexcel 8552 IM7 Tape Qualification Program
- 2008 Hexcel 8552 IM7 Tape Equivalency Program

3. Analysis of setup

The impact setup was erroneous due to the use of a shorter extender where the tip of the impactor tup barely reached the top of the support base when the entire crosshead assembly rested on the brakes. Figure 1 illustrates the incorrect setup used where some of the impact energy was absorbed by the breaks during impact and resulted in a smaller damage area.

A correct impact setup, illustrated in Figure 2, would require utilization of a longer extender that would allow the impactor tup to go past the top of the support base for a complete energy transfer to the coupon before the crosshead assembly reaches the brakes.

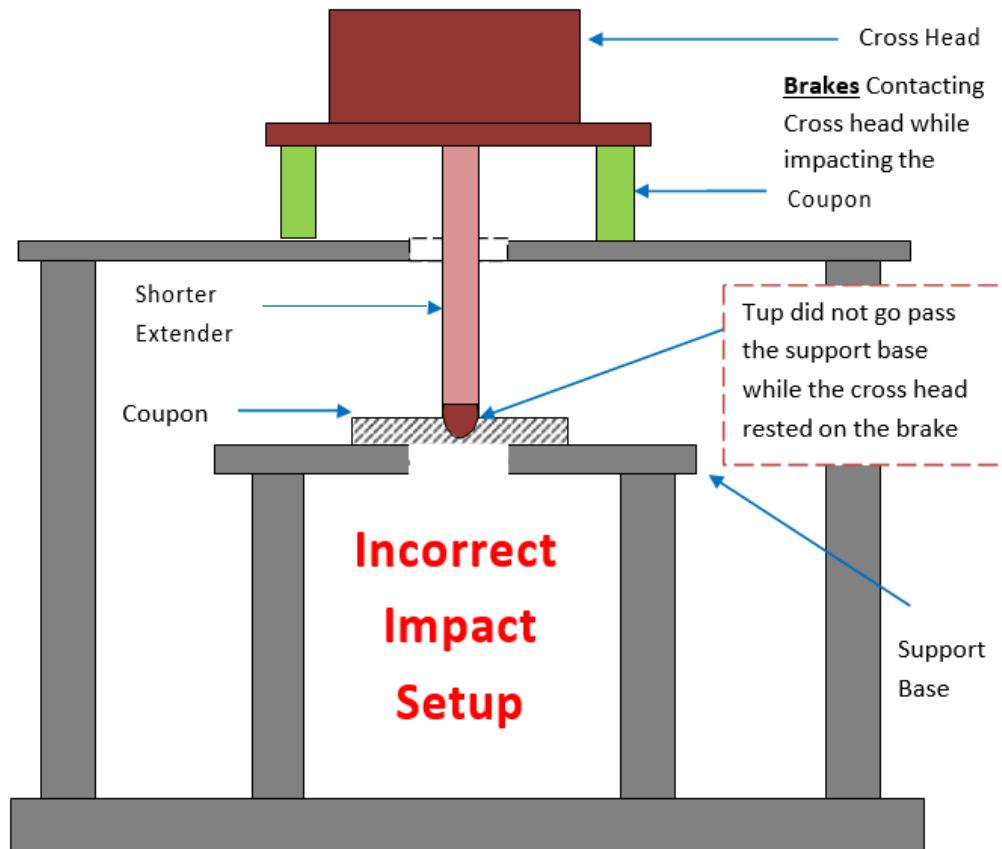


Figure 1 – **Incorrect** Impact Setup for 2008 Qualification/Equivalency program

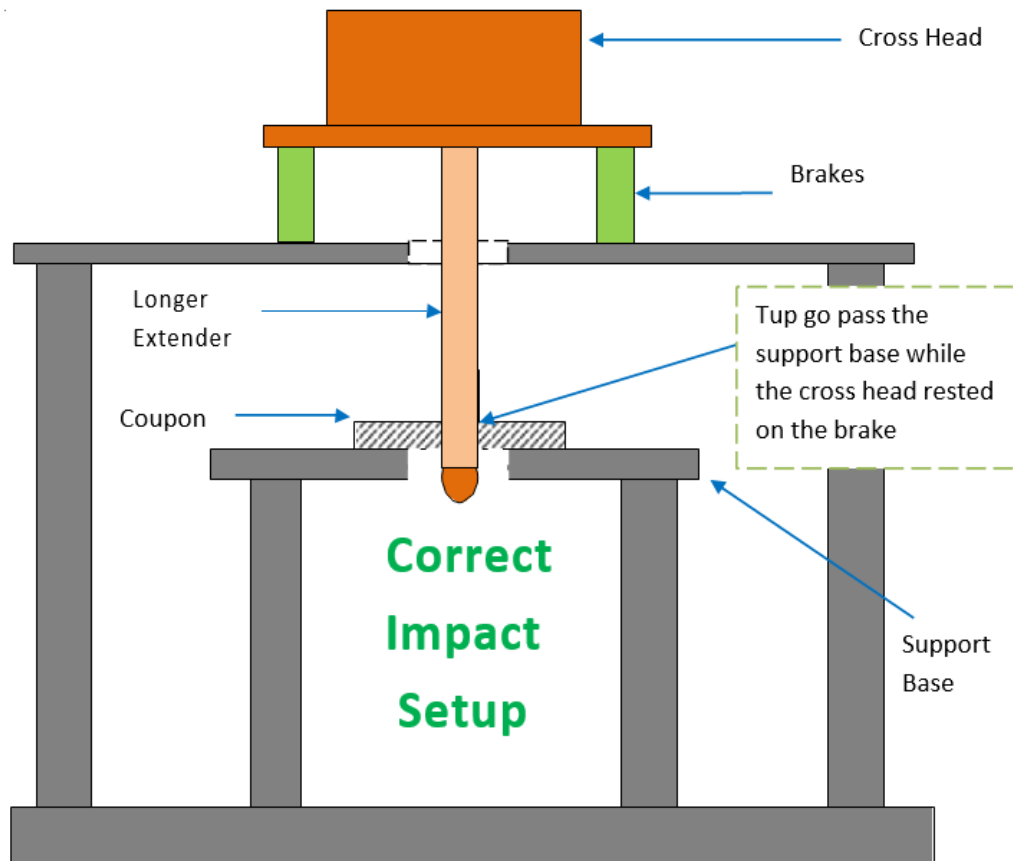


Figure 2 - **Correct** Impact Setup for 2013 Trial CAI and Equivalency Program

Additional indicators of the erroneous setup include a difference in the drop weight recorded, area under the rebound energy curve, and the rebound velocity.

With the shorter extender impact setup, the entire crosshead assembly struck the brakes when the impactor tup hit the CAI specimen. The impact energy was absorbed by the breaks instead of transferring completely to the CAI specimen. Due to this dampening, a lower drop weight was recorded. Figure 3 shows a measured drop weight of 13.45 lbf compared to 13.81 lbf in Figure 4, which is what should have been recorded if a correct, longer extender was used. Impact tests performed using remnant material from the 2008 program yielded results comparable to the 2012/2013 test data.

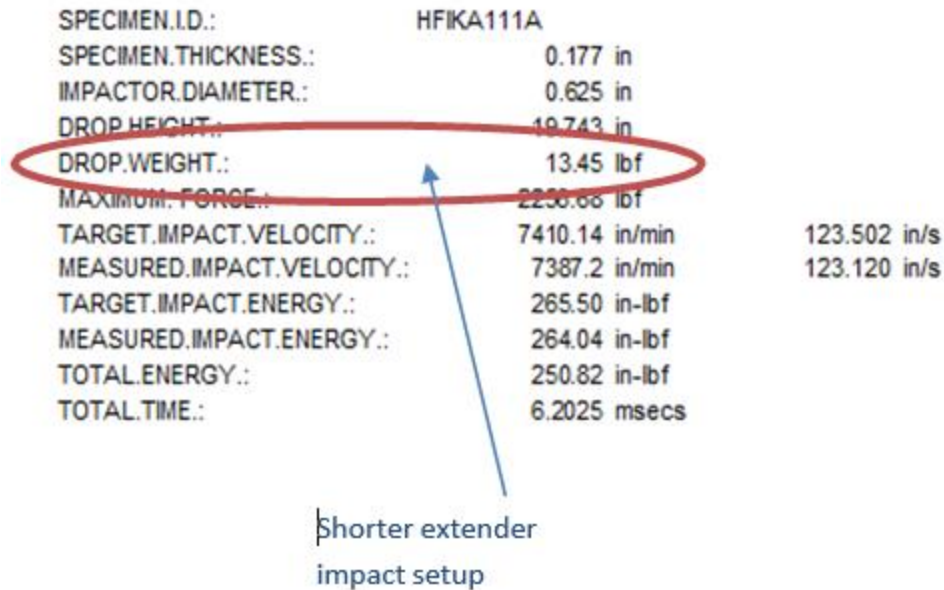


Figure 3 - Incorrect Impact Setup Data

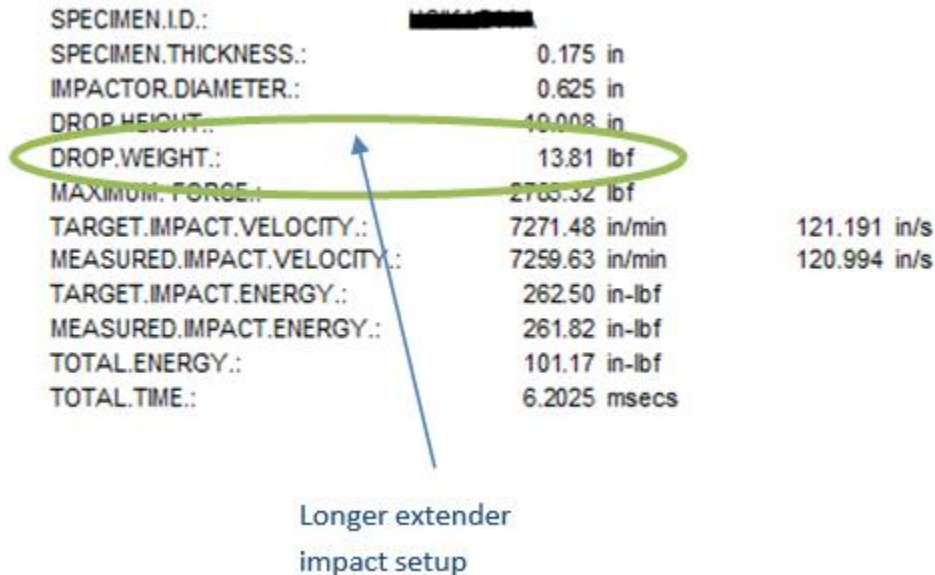


Figure 4 - Correct Impact Setup Data

If the energy is partially absorbed by the brakes, the resulting rebound energy and velocity will also be reduced, which is what was observed in the 2008 qualification. Figure 5 shows the plots and resultant impact damage area. The impact damage is observed to be smaller, thus yielding a larger strength when tested in compression.



When a correct impact setup is used the impact energy is transferred to the specimens completely resulting in a larger rebound energy, and subsequently a higher rebound height and velocity. This is illustrated in Figure 6. With a complete transfer of velocity and energy, the resulting impact damage area will be larger, leading to a lower compressive strength.

Given that the outcome of a correct impact setup would result in a more conservative compressive strength result, the 2008 Qualification dataset is omitted from the reports.

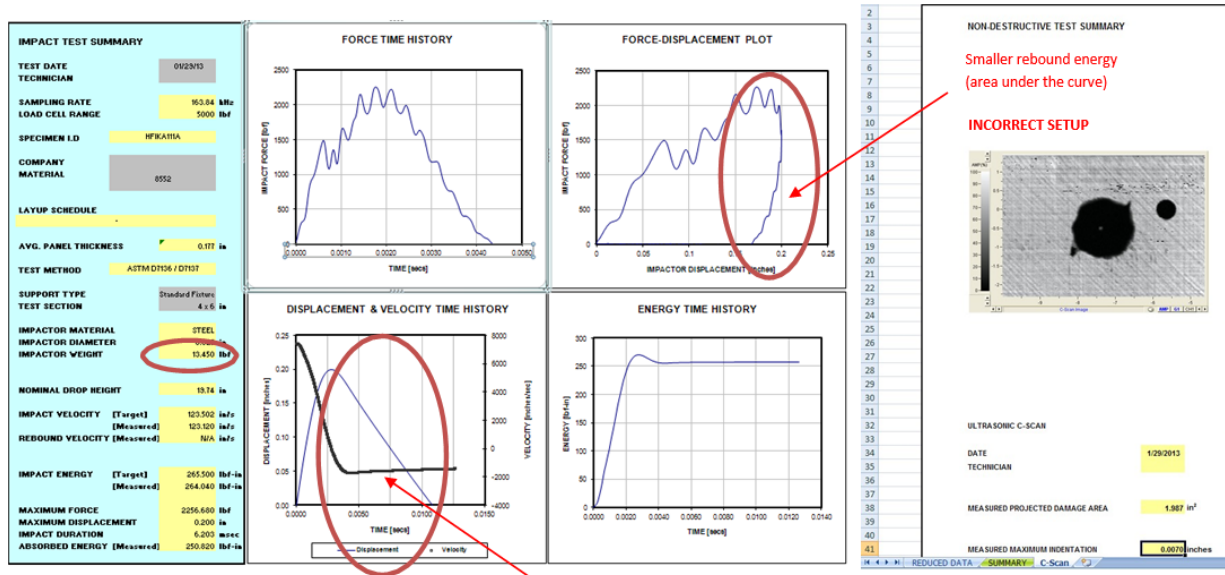
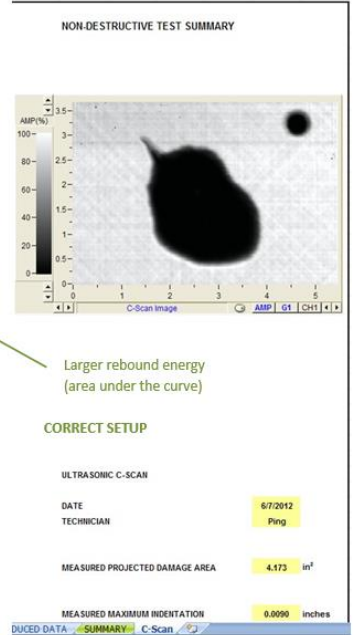
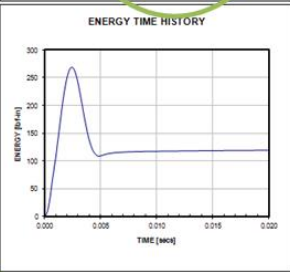
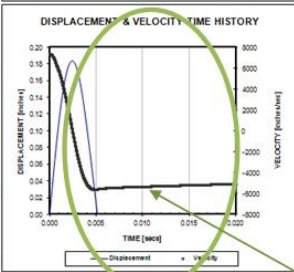
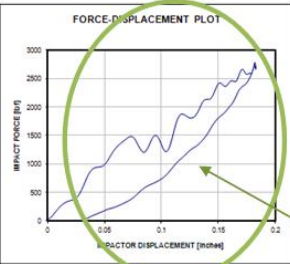
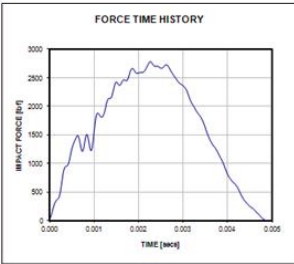


Figure 5 - Plots and C-Scan of 2008 Qualification sample



IMPACT TEST SUMMARY	
TEST DATE	06/07/12
TECHNICIAN	Ping
SAMPLING RATE	16.34 kHz
LOAD CELL RANGE	5000 lbf
SPECIMEN ID	
COMPANY	NCAMP Hocol F
MATERIAL	
LAYUP SCHEDULE	
AVG. PANEL THICKNESS	0.175 in
TEST METHOD	ASTM D156 / D157
SUPPORT TYPE	Standard Fixture
TEST SECTION	4 x 6 in
IMPACTOR MATERIAL	STEEL
IMPACTOR DIAMETER	0.646 in
IMPACTOR WEIGHT	13.810 lbf
NOMINAL DROP HEIGHT	13.01 in
IMPACT VELOCITY [Target]	121.91 in/s
[Measured]	120.334 in/s
REBOUND VELOCITY [Measured]	N/A in/s
IMPACT ENERGY [Target]	262.500 lbf-in
[Measured]	261.820 lbf-in
MAXIMUM FORCE	2785.320 lbf
MAXIMUM DISPLACEMENT	0.184 in
IMPACT DURATION	6.203 msec
ABSORBED ENERGY [Measured]	101.170 lbf-in



Higher rebound velocity - CORRECT SETUP

Figure 6 - Plots and C-Scan for 2013 Equivalency sample



4. Revision

Revision	Date	Description
NC	03/14/2013	Initial Draft
NC	04/16/2019	Update report format, editorial changes for clarification of content