



Composite Materials Technology Center

June 12, 2013

## Strongwell – Chatfield Division

ASTM D790 Flexural, D2344 Short Beam Shear,

D695 Compression, and D256 Notched IZOD;

Tested at Room Temperature and  $\sim -160^{\circ}\text{C}$

COMTEC Job# 050113-01

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Steven Terfehr  
*Sr. COMTEC Engineering Intern*

Matt Benson

A handwritten signature in black ink, appearing to read "Matt Benson".

*Director of COMTEC*



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### Sample Information

#### *Received:*

- QTY 25 Flex D790 Specimens
- QTY 25 Short Beam Shear D2344 Specimens
- QTY 25 Compression D695 Specimens
- QTY 25 IZOD D256 Specimens

#### *Test Coupon Preparation:*

- Customer Prepared

### Testing Parameters

*Instrument(s):* Instron Series 3369 and Wiedemann Baldwin Impact testers

*Test Method:* Flex (D790), Short Beam Shear (D2344), Compression (D695), and IZOD (D256)

*Test Operators:* David Kujak, Tyler Phelps, Steven Terfehr

*Test Date:* 05/30/2013 – 06/07/13

*Test Conditions:* RT and depressed temp of at least -160C

*Test Temperature:* 72.1°F

*Test Humidity:* 55% RH

*Testing Capacity:*

*Instron Series 3369: D790 and D2344 – 2000 lb; D695 – 10,000*

*Baldwin Impact Tester, Serial 1099; Dial Display: 16 ft./lbs. (8x)*

*Calibration:* Both were verified on 09/17/12 (due 9/30/13) per ASTM E 23-07 Annex A2 by Instron Corp.



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### Testing Procedure

Flex (D790), Short Beam Shear (D2344), Compression (D695), and IZOD (D256) specimens were tested at room temperature (~21°C) and depressed temperature (~-160°C)

#### *Room Temperature Testing Procedure:*

- Standard ASTM protocols were used on all of the room temperature testing.

#### *Depressed (Cryo) Temperature Testing Procedure:*

- Standard ASTM protocols were used on all of the depressed temperature testing.
- Strongwell requested the depressed temperature testing be performed at least -160 °C. Strongwell's customer was interested in failure potential if their grating was exposed to a Liquefied natural gas spill.
  - Liquefied natural gas (LNG) is natural gas in its liquid form, it condenses at -161° Celsius (-259° F).
- COMTEC performed the following conditioning procedure on all four of the depressed temperature tests:
  - Specimens were submerged in a Liquid Nitrogen (LN2) bath for 1 hour prior to measurement.
  - Specimens were measured and recorded (thickness and width) then placed back into LN2 for an hour.
  - Specimens were removed from the bath one by one and immediately placed in the appropriate test fixture.
  - The samples were then tested one at a time after they had been taken directly from the LN2 bath.



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### Testing Results

- See attached Instron generated test reports (QTY 8 total)

#### *Summary Table of Testing Results:*

<b>Test Method</b>	<b>Property</b>	<b>Temp</b>	<b>Results (Average)</b>
<b>Compression</b> <i>ASTM D695</i>	Compressive Stress at Yield (Ksi)	21°C	54.6
		<b>-160°C</b>	<b>55.3</b>
<b>Flex</b> <i>ASTM D790</i>	Flexural Stress at Max Load (Ksi)	21°C	91.2
		<b>-160°C</b>	<b>95.6</b>
<b>Short Beam Shear</b> <i>ASTM D2344</i>	Short Beam Shear Strength (Psi)	21°C	4977.8
		<b>-160°C</b>	<b>5834.1</b>
<b>Izod</b> <i>ASTM D256</i>	Impact Strength (ft*lb/in)	21°C	67.2
		<b>-160°C</b>	<b>72</b>