



ARMORCORE

BULLET RESISTANT FIBERGLASS PANELS

UL 752 Level 3 Submittal Package

- ArmorCore Brochure
- Level 1 Data Sheet
- UL 752 Specifications & Paragraphs
- UL 752 Weapons Definitions
- Level 1 Specification
- UL Level 1 Conformity Assessment
- UL Levels 1-8 Test Results
- ASTM E119-98 One-Hour Fire Resistance Test
- Forced Entry Test
- Manufacturer's Installation Recommendations
(including Wall Assembly Diagram)
- ArmorCore SDS
- ISO 9001:2015
- F-5 Tornado
- Miami-Dade Hurricane Test
- Leed Info
- R-Value
- Wicking Test
- Warranty Policy

**Build
For**

Life 



ARMORCORE

BULLET RESISTANT FIBERGLASS PANELS

Security Against Ballistic Threats

ArmorCore® panels deliver superior protection against bullets and blast fragments. Panels capture the ballistic projectiles in a process called ply-delamination without ricochet or spalling.

Our unique design makes **ArmorCore**® one of the safest, most inexpensive, and easy to work with ballistic protection solutions available for both new construction and remodeling projects.

Through a proprietary manufacturing process combining woven-roving fiberglass with resin, **ArmorCore**® panels are precision-assembled and cured in a press with heat and pressure, maintaining quality and consistency.

Typically concealed behind drywall or woodwork, **ArmorCore**® panels are an affordable and easy-to-install solution for ballistic protection.










They are light-weight and can be installed with conventional tools. **ArmorCore**® can be cut in the field using a diamond-grit blade, and can be adhered with self-tapping drywall screws or construction adhesive.

Unique benefits of **ArmorCore**® panels include:

- **UL listed at all 8 levels of the UL 752 standard**
- **Easy to install with conventional tools**
- **Effective delay against forced entry**
- **Low wicking – preventing build-up of mold**
- **Non-toxic materials – no formaldehyde**
- **Available in panel sizes up to 5' x 10'**
- **Custom water-jet panel cutting available**



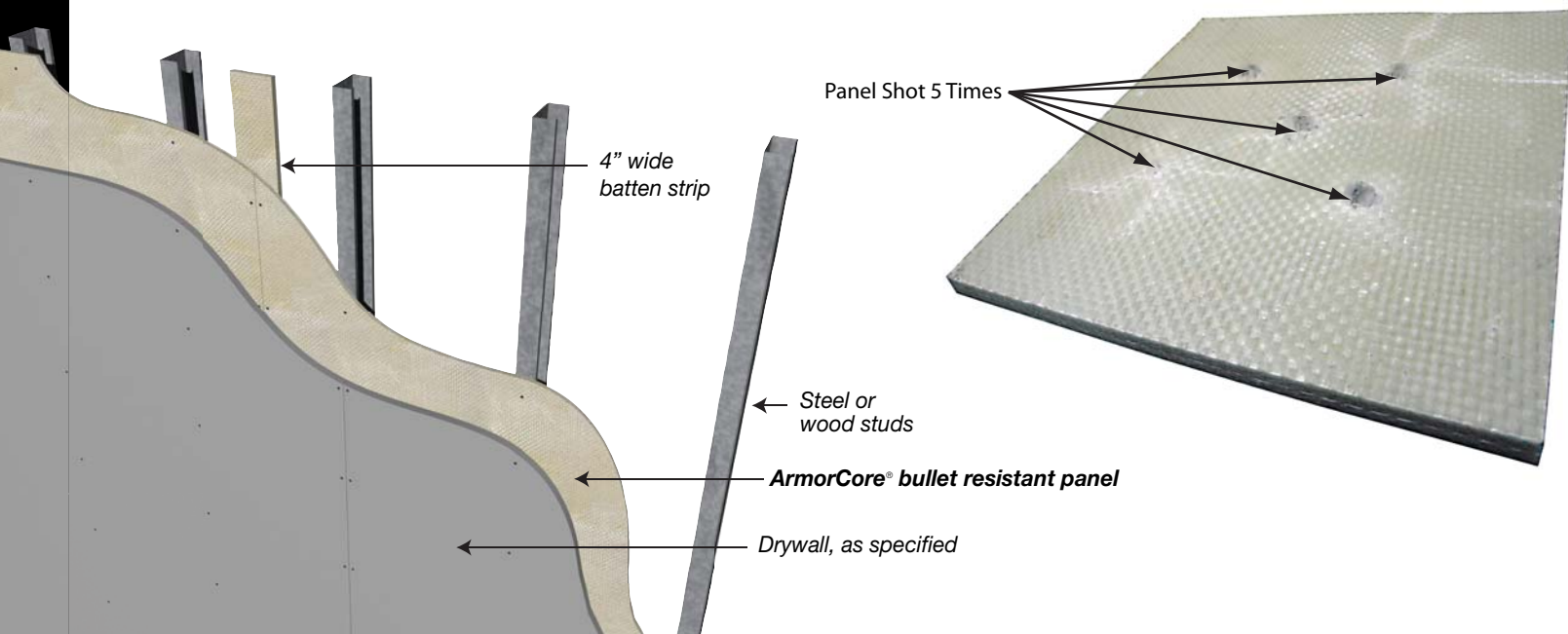
UL 752 Protection Level

Level / UL Rating	UL	Thickness	Weight Lbs/Sq. Ft.	Ammunition	Grain	(g)	Minimum fps	Velocity ft/s	No. of Shots per sq. ft.	UL 752 Paragraph
 Level 1	UL	1/4"	2.8	9mm full metal cooper jacket with lead core	124	8	1175	358	3	4.3
 Level 2	UL	5/16"	3.7	.357 magnum jacketed lead soft point	158	10.2	1250	381	3	4.4
 Level 3	UL	7/16"	4.9	.44 magnum lead semi-wadcutter gas checked	240	15.6	1350	411	3	4.5
 Level 4	UL	1 3/8"	14	.30 caliber rifle lead core	180	11.7	2450	774	1	4.6
 Level 5	UL	1 7/16"	15	7.62mm rifle lead core full copper jacket, military ball	150	9.7	2750	838	1	4.7
 Level 6	UL	3/8"	4.2	9mm full metal copper jacket with lead core	124	8	1400	427	5	4.8
 Level 7	UL	1 1/8"	12	5.56mm rifle full metal copper jacket, military ball	55	3.56	3080	939	5	4.9
 Level 8	UL	1 7/16"	15.5	7.62mm rifle lead core full metal copper jacket, military ball	150	9.7	2750	838	5	4.10
 Supplementary Shotgun				12-gauge rifled slug	437	28.3	1585	483	3	4.11
				12-gauge 00 lead buckshot (12 pellets)	650	42	1200	366		

ArmorCore® carries a one-hour fire rating compliant to ASTM E119-00 (Fire Testing of Building Construction and Materials)

ArmorCore® Level 3 panels carry a Class IV Forced Entry Protection rating, per ASTM F1233-98.

Maximum velocity is 110% of the minimum velocity. All ArmorCore products are rated by the above UL752 standard for bullet resisting equipment. Test results are available upon request for air cannon tests, fragment projectile testing, and other ballistic standards including NIJ 0108.01



Stringent testing against a variety of threats, wide-ranging capabilities, swift turn-around times and low costs make ArmorCore® panels the preferred product for defensive architecture.

Commercial Property

A wide range of commercial facilities face ballistic threat, most often those dealing with sensitive materials or quantities of cash. **ArmorCore®** panels are highly effective within counter and wall systems to provide personnel protection from ballistic attack.

- Banks and Credit Unions
- Convenience Stores
- Check Cashing Facilities
- Data Centers



Health Care

Health Care facilities face unique security threats, and commonly turn to the protection of **ArmorCore®** panels. From armed robbery for drugs to attack on patients, defense against ballistic threat begins with **ArmorCore®**.

- Hospitals
- Clinics
- Pharmacies

Residential Security

Manufactured to meet the stringent ASTM "Forced Entry Protection" standards, **ArmorCore®** panels are an ideal choice for residential Safe Rooms defending against room entry from bullets, as well as sledgehammers, cutting tools and even a propane torch!

Test results of **ArmorCore®** Level 3 panels by the Wind Engineering Research Center at Texas Tech University indicated that **ArmorCore®** can withstand a 15 lb. 2x4 wood board cannon-fired at a force consistent with a "large missile" typical of an EF-5 tornado, for effective storm shelter construction.



Government Property

Facilities at all levels of government need to consider protection against ballistic attack. From Federal courthouses to county jails and local school board chambers, **ArmorCore®** panels provide affordable security within walls, lecterns and desks.

- Courthouses / Court Rooms
- Embassies & Consulates
- Public Safety Facilities
- Educational Facilities



Military Applications

The successful protection of U.S. military personnel by **ArmorCore®** panels has been a source of particular pride for our company. Bullet and mortar-blast resistant panels, fashioned specifically for troop transports and base facilities, have saved a number of soldiers as they have defended our nation.

- Humvees and other Transport Vehicles
- Dining Halls
- Military Housing
- Base Entrances
- Chinook 47 Helicopters
- LCAC Navy Vessels

The Industry Leader

Since 1996, **Waco Composites**, has operated with one sole purpose: producing the highest quality fiberglass ballistic-resistant panels, with the best and most efficient processes in the industry, while providing superior customer service.

Waco Composites, now leads the industry in ballistic panel design and fiberglass product development. Our team's experience includes design and development of ballistic resistant panels for a wide range of applications: commercial, governmental, educational and military. Our emphasis has always been in research and development and a rigorous quality assurance program with continuous testing of our products to ensure the highest degree of product integrity.

Our in-house testing facilities make **Waco Composites**, unique in the industry, and provide us the capability of quickly developing custom products to meet specific customer requirements.

Along with consistent ballistic testing, documentation and attention to detail are part of the **Waco Composites Quality Assurance Program**. Waco Composites is an **ISO 9001-2015** registered company.

Superior Customer Service

Waco Composites, is dedicated to the highest level of customer service. One detail of this effort is to always have phone calls answered by a sales professional (not a recording) during business hours. Every order and inquiry is treated with sincere attention.



Our approach to customer service is also reflected in our order delivery. We have built a reputation for speedy turn-around time, shipping most orders within twenty-four hours.

Every employee of **Waco Composites**, is committed to excellence in performance, knowing that any **ArmorCore®** panel may play a role in protecting someone from harm.

For Product Details, Specifications and Pricing:

Call us at: **866-688-3088**

Or visit our website: **www.ArmorCore.com**



Waco Composites, LLC
302 S. 27th Street
Waco, TX 76702



ARMORCORE

BULLET RESISTANT FIBERGLASS PANELS

UL752 Level 3

PANEL SIZES: 3' x 8', 3' x 9', 3' x 10'
4' x 8', 4' x 9', 4' x 10'
5' x 8', 5' x 9', 5' x 10'
Custom sizes available

NOMINAL WEIGHT: 4.9 lbs per square foot

NOMINAL THICKNESS: 7/16"

PRODUCT APPLICATIONS:

ArmorCore Bullet Resistant Panels can be used in walls, furniture, doors, vehicles and as blast protection barriers. They can be covered with drywall or laminate so as not to impact aesthetics.

Commercial

- Banks and credit unions
- Convenience stores
- Check cashing facilities
- Data centers

Government

- Courthouses/courtrooms
- Prisons
- Administrative offices
- Public safety facilities

Healthcare

- Hospitals and clinics
- Pharmacies

Residential

- Safe rooms
- Storm shelters

Military

- Transport vehicles
- Housing
- Base entrances

OTHER PRODUCTS AVAILABLE:

ArmorCore® Bullet Resistant Fiberglass Panels are manufactured at all 8 Levels of UL752 Standards and NIJ0108.01 specifications.

SUBMITTALS:

Submittals and samples are available upon request.

PERFORMANCE LEVEL:

- UL752 Standard for Bullet Resisting Equipment – Level 3 Paragraph 4.5
- National Institute of Ballistic Standards NIJ0108.01– Level IIIA
- One Hour Fire Rating Per ASTM E119-98
- Class IV Forced Entry Protection Rating Per ASTM F1233-98

AMMUNITION TESTED:

.44 magnum lead semi-wadcutter gas checked – 240 grain, 15.6 grams, minimum 1350 feet per second.

PRODUCT INFORMATION:

The panels are made of multiple layers of woven roving ballistic grade fiberglass cloth impregnated with a thermoset polyester resin and compressed into flat rigid sheets. The production technique and materials used provide the controlled internal delamination to permit the capture of a penetrating projectile.

PRODUCT BENEFITS:

- Easy to install
- Effective delay against forced entry
- Low wicking – preventing buildup of mold
- Nontoxic materials – no formaldehyde

UNIQUE TO WACO COMPOSITES:

- ISO 9001-2015 registered
- Superior customer service
- Continuous product testing to ensure ballistic integrity
- Factory CNC water jet cutting

PRODUCT INSTALLATION:

We suggest using a diamond-grit blade for cutting the material. A TSD180D 7" Tenryu or DiamondX Cutter circular blade is available for purchase through our office. Panels may be attached using self-tapping drywall screws or construction adhesive. Pre-drilling may be required for thicknesses 1.125" or greater. With proper pre-preparation, panels can be painted with oil or water based paints. Installation instructions are available upon request.

All joints need to be reinforced by a 4" batten strip.

WARRANTY POLICY:

All ArmorCore materials and workmanship shall be warranted against defects for a period of ten (10) years from the date of receipt at the project site. We will repair or replace ArmorCore Panels at our discretion, found upon our inspection, to be defective in material or our workmanship for up to ten (10) years from the date of receipt at the project site.

Build For Life.



UL 752 Protection Levels

Level / UL Rating	Nominal Thickness	Nominal Weight lbs/sq. ft	Ammunition	Grain	(g)	Minimum fps	Velocity m/s	No. of Shots	UL 752 Paragraph
Level 1	1/4"	2.6 psf	9mm full metal copper jacket with lead core	124	8	1175	358	3	4.3
Level 2	5/16"	3.6 psf	.357 magnum jacketed lead soft point	158	10.2	1250	381	3	4.4
Level 3	7/16"	4.8 psf	.44 magnum lead semi-wadcutter gas checked	240	15.6	1350	411	3	4.5
Level 4	1-3/8"	13.9 psf	.30 caliber rifle lead core	180	11.7	2450	774	1	4.6
Level 5	1-7/16"	14.8 psf	7.62mm rifle lead core full metal copper jacket, military ball	150	9.7	2750	838	1	4.7
Level 6	3/8"	3.9 psf	9mm full metal copper jacket with lead core	124	8	1400	427	5	4.8
Level 7	1-1/8"	11.7 psf	5.56mm rifle full metal copper jacket, with lead core	55	3.56	3080	939	5	4.9
Level 8	1-7/16"	15.2 psf	7.62mm rifle lead core full metal copper jacket, military ball	150	9.7	2750	838	5	4.10
Supplementary Shotgun			12-gauge rifled slug	437	28.3	1585	483	3	4.11
			12-gauge 00 lead buckshot (12 pellets)	650	42	1200	366		

Maximum Velocity is 110 percent of minimum velocity.

ASTM Testing

Level	ASTM F1233-98 Standard Test Method for Forced Entry Testing of Materials/Assemblies	ASTM E119-98 Standard Test for One- Hour Fire-Rating of Building Construction and Materials	ASTM E 90-97 Standard Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions
1	-	-	-
2	-	-	-
3	Yes	Yes	-
4	Yes	Yes	Yes
5	Yes	Yes	Yes
6	-	Yes	-
7	Yes	Yes	-
8	Yes	Yes	Yes



ARMORCORE

BULLET RESISTANT FIBERGLASS PANELS

UL 752 Specification Descriptions

Paragraph 4.3

Level 1 – Protection against hand guns of medium power, such as the 9mm, Super 38 Automatic, and the like, with muzzle energy of 380-460 foot-pounds (515-624J).

Paragraph 4.4

Level 2 – Protection against hand guns of high power, such as the .357 Magnum, and the like, with muzzle energy of 548-663 foot-pounds (743-899J).

Paragraph 4.5

Level 3 – Protection against hand guns of super power, such as the .44 Magnum, and the like, with muzzle energy of 971-1175 foot-pounds (1317-1593J).

Paragraph 4.6

Level 4 – Protection against high-power hunting and sporting rifles, such as the 30-06, and the like, with muzzle energy of 2580-3120 foot-pounds (3498-4929J).

Paragraph 4.7

Level 5 – Protection against military ball full metal copper jacket ammunition fired from a hunting rifle such as the 308 Winchester or a military rifle with muzzle energy of 2519-3048 foot-pounds (3416-4133J).

Paragraph 4.8

Level 6 – Protection against multiple shots from a submachine-gun, such as a 9 mm Uzi, and the like, with muzzle energy of 540-653 foot-pounds (732-885J).

Paragraph 4.9

Level 7 – Protection against multiple shots from a military assault rifle, such as the M-16, and the like, with muzzle energy of 1158-1402 foot-pounds (1570-1901J).

Paragraph 4.10

Level 8 – Protection against multiple shots from a military assault rifle, such as an M-14, and the like, with muzzle energy of 2519-3048 foot pounds (3416-4133J).

Paragraph 4.11

SUPPLEMENTARY SHOTGUN – A supplementary test using a rifled lead slug with muzzle energy of 2438-2950 foot-pounds (3306-4000J) and 00 lead buckshot with a muzzle energy of 2078-2415 foot-pounds (2818-3275J), fired from a 12-gauge shotgun. Products shall be tested with both loads. Products complying with this test may have the suffix “SG” added to the rating designation.

SECTION: 13 4713 – UL 752 – LEVEL 3 BULLET-RESISTANT FIBERGLASS PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions.

1.2 REFERENCES

- A. Underwriters Laboratories:
 - 1. UL 752 Specifications and Ammunition, 11th Edition, Standard for Bullet Resisting Equipment published September 9, 2005, revised December 21, 2006, Level 3
- B. National Institute of Justice Ballistic Standards:
 - 1. NIJ Standard 0108.01 – Type III-A
- C. American Society for Testing and Materials:
 - 1. ASTM E119-98 Standard Test for One-Hour Fire-Rating of Building Construction and Materials
 - 2. ASTM F1233-98 Standard Test Method for Forced Entry Testing of Materials/Assemblies

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 13 4713 and the SPECIAL CONTRACT REQUIREMENTS (Submit for approval prior to fabrication samples, brochures, specifications):

- A. **UL LISTING Verification** and **UL752 Current Test Results** as provided by Underwriters Laboratories.
- B. Printed data in sufficient detail to indicate compliance with the contract documents.
- C. ASTM E119-98 One-Hour Fire Rating of Building Construction and Materials.
- D. ASTM F1233-98 Standard Test Method for Forced Entry Testing of Materials/Assemblies.
- E. Manufacturer's Instructions for installation of Bullet Resistant Fiberglass Panels.

1.4 DESIGN

- A. Through the design, manufacturing technique and material application the Bullet Resistant Fiberglass shall be of the "non ricochet type." This design is intended to permit the encapture and retention of an attacking projectile lessening the potential of a random injury or lateral penetration.

1.7 DELIVERY, HANDLING, AND STORAGE

- A. Deliver the materials to the project with the manufacturer's **UL LISTED Labels** intact and legible.
- B. Handle the material with care to prevent damage. Store the materials inside under cover, stack flat and off the floor.

1.8 WARRANTY

- A. All materials and workmanship shall be warranted against defects for a period of two (2) years from the date of receipt at the project site.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Acceptable Manufacturers:

1. Waco Composites, Ltd., Waco, TX 76710, fax: 254-752-3634, 254-752-3622
email: sales@armorcore.com

2.2 MATERIAL

- A. The panels shall be made of multiple layers of woven roving ballistic grade fiberglass cloth impregnated with a thermoset polyester resin and compressed into flat rigid sheets. The production technique and materials used shall provide the controlled internal delamination to defeat the penetrating projectile.
- B. Bullet Resistant Fiberglass panels: 7/16" nominal thickness, and 4.8 lbs. per sq. ft. nominal weight.

2.3 SECURITY LEVEL

- A. The Bullet Resistant Fiberglass will be warranted to meet the requirements of UL752
Level 3.

PART 3 - EXECUTION

3.1 SUPPORTING MEMBERS

- A. Prior to installing the bullet resistive material the contractor shall verify that all supports have been installed as required by the contract documents and the architectural drawings.

3.2 JOINTS

- A. All joints shall be reinforced by a back-up layer of bullet resistive material. The bullet resistance of the joint, as reinforced, shall be at least equal to that of the panel. Minimum width of reinforcing layer at joint shall be 4-inches (2" on each panel or a 2" minimum overlap).

3.3 APPLICATION

- A. Armor shall be installed in accordance with the manufacturer's printed recommendations. Armor panels shall be adhered using an industrial adhesive, mastic, screws or bolts. Method of application shall maintain the bullet resistive rating at junctures with the concrete floor slab, the concrete roof slab, the bullet resistive door frames, the bullet resistive window frames, and all required penetrations.

END OF SECTION 13 4713



Northbrook Division

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Customer service: 1 877 854 3577

January 4, 2006

Waco Composites I Ltd.
Mr. W. C. Hampton
481-A Texas Central Pky.
PO Box 21223
Waco, TX 76702

Our Reference: File BP8910, Vol. 1
Tag No(s). F283180 through F283185 & F283200

Subject: Conforming Follow-Up Test Results On Bullet-Resisting
Metals and Plastics, CCN: CNLW

Dear Mr. Hampton:

The Follow-Up Service Testing has been completed on the Armor Core Levels 1, 3, 4, 5, 6, 7 & 8 selected by our UL Representative at your Waco, TX factory on September 29, 2005 and received at our testing office on November 28, 2005.

The results of the testing conform with the provisions of the Follow-Up Service Program.

Your continued cooperation in maintaining conformance with the applicable test requirements is appreciated.

If we can be of any further assistance, please do not hesitate to contact us.

Very truly yours,

Debra Villarreal

Deborah Villarreal, (Ext. 43392)
Project Handler II
Follow-Up Testing Group
E-mail: Deborah.L.Villarreal@us.ul.com
Fax: (847) 313-3392

Reviewed by:

Lee Cetrone (DV)

Lee Cetrone
Section Manager II
Follow-Up Testing Group

File BP8910
Project 99NK09073

April 1, 1999

REPORT

On

BULLET-RESISTING MATERIALS AND PLASTICS

Waco Composites
Waco, TX

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the above named company to reproduce this Report provided it is
reproduced in its entirety.

DESCRIPTION

PRODUCT COVERED:

Bullet resisting fiberglass material Models ArmorCore Level 1 rated Level 1, ArmorCore Level 2 rated Level 2, ArmorCore Level 3 rated Level 3, ArmorCore Level 4 rated Level 4, ArmorCore Level 5 rated Level 5, ArmorCore Level 6 rated Level 6, ArmorCore Level 7 rated Level 7 and ArmorCore Level 8 rated Level 8.

ENGINEERING CONSIDERATIONS (NOT FOR FIELD REPRESENTATIVE'S USE):

The products covered are bullet-resisting plastic armor materials intended for use indoors or outdoors. These materials are intended to be used in bullet-resisting enclosures, armored vehicles and teller fixtures. This material is a fiber reinforced plastic comprised of a number of fabric plies bonded with a rigid plastic resin.

CONSTRUCTION DETAILS:

General - ArmorCore is a fiberglass reinforced plastic material consisting of multiple layers of Woven Roving fiberglass cloth impregnated with a thermoset polyester resin and compressed into rigid flat sheets.

<u>Model</u>	<u>Rating</u>	<u>Thickness (in.), min.</u>
ArmorCore Level 1	Level 1	0.288
ArmorCore Level 2	Level 2	0.404
ArmorCore Level 3	Level 3	0.478
ArmorCore Level 4	Level 4	1.341
ArmorCore Level 5	Level 5	1.4375
ArmorCore Level 6	Level 6	0.375
ArmorCore Level 7	Level 7	1.125
ArmorCore Level 8	Level 8	1.4375

Minimum Size - The minimum overall dimensions shall not be less than 12 by 12 in.

Marking - Each product shall be marked with the manufacturer's name and/or identifying symbol, date of manufacture, model number, and bullet-resisting rating.

TEST RECORD NO. 1

SAMPLE:

Four samples of Models ArmorCore Level 1, Level 2 and Level 3 material rated for Level 1, Level 2, and Level 3, respectively, were submitted by the manufacturer and subjected to the following test program.

General – The ammunition used for the investigation was:

Level 1 – 124 grain (8g) 9mm full metal copper jacket with lead core, minimum velocity 1175 fps (358 mps)

Level 2 – 158 grain (10.2g) .357 Magnum jacketed soft point, minimum velocity of 1250 fps (381 mps)

Level 3 – 240 grain (15.6g) .44 Magnum lead semi-wadcutter gas checked, minimum velocity of 1350 fps (411 mps)

All tests were conducted at close range, approximately 15 ft (4.6 m), using the ammunition and weapon specified. The test samples were mounted in a rigidly fixed frame, with 1/8 in. (3.2 mm) thick corrugated cardboard indicator panels placed approximately 18 in. (467 mm) behind the protected side of each test sample. During the test, each bullet velocity was monitored and recorded.

The samples were subjected to two different shot patterns: 2-shot and 3-shot.

The 2-shot pattern consists of two shots fired at the approximate center of the test sample, with the shots spaced between 1-1/4 to 1-3/4 in. (31.8 to 44.5 mm) apart. For both the single-shot and 2-shot pattern, spalling of bullet-resisting material from the protected side of the test sample is acceptable. However, there shall be no penetration of the projectile through the material such that damage to the indicator panels occurs, nor breaking apart of the sample which allows an unobstructed path for additional projectiles through the sample.

The 3-shot pattern consists of three shot spaced 4-1/2 in. (102-12.7 mm) apart in a triangular pattern in the approximate center of the test sample. With this shot pattern, there shall be no penetration of the projectiles through the test sample, nor spalling of the material on the protected side of the test sample, to the extent that fragments embed in or damage the cardboard indicators.

OUTDOOR RATING:

METHOD

Four samples were subjected to various ambient conditions. Two separate samples at room temperature, $22 \pm 3^{\circ}\text{C}$ ($72 \pm 5^{\circ}\text{F}$), were subjected to the 2-shot and 3-shot patterns. A third sample, after exposure to a temperature of 49°C (120°F) for a period of 3 h to the complete sample, and a fourth sample after exposure to -32°C (-25°F) to the side receiving the shots for a period of 3 h were subjected to the 3-shot pattern. The sample were tested immediately following the exposure to the indicated temperature conditions.

The velocity of each bullet was recorded during the test. The velocity values as recorded for multiple shot tests consist of the first value of the 2-shot pattern being the top point, and the second being the bottom point, the first value of the 3-shot pattern is the top point of the triangle, with the next values going in a clockwise direction around the triangle.

RESULT

Acceptable results were recorded for all shot patterns at all ambient conditions as outlined above.

ARMORCORE (LEVEL 1)

Bullet Velocities (fps)	First	Second	Third
2-Shot	1265	1295*	
3-Shot (Room Temperature)	1244	1196	1262
3-Shot (High Temperature)	1267	1267	1221
3-Shot (Low Temperature)	1250	1231	1251

ARMORCORE (LEVEL 2)

Bullet Velocities (fps)	First	Second	Third
2-Shot	1293	1283	
3-Shot (Room Temperature)	1395	1343	1336
3-Shot (High Temperature)	1294	1286	1316
3-Shot (Low Temperature)	1270	1342	1375

ARMORCORE (LEVEL 3)

Bullet Velocities (fps)	First	Second	Third
2-Shot	1455	1443	
3-Shot (Room Temperature)	1422	1426	1437
3-Shot (High Temperature)	1422	1437	1417
3-Shot (Low Temperature)	1435	1435	1432

* - Excessive velocity. However, no spalling or penetration of the projectile. Therefore, fair shot.

TEST RECORD NO. 2

SAMPLES:

Three samples of Model ArmorCore Level 4 material rated for Level 4 were submitted by the manufacturer and subjected to the following test program.

BALLISTIC TEST:

Level 4 – The ammunition used for the investigation was 180 grain (11.7 g) .30 caliber rifle lead core soft point, minimum velocity of 2540 fps.

All tests were conducted at close range, approximately 15 ft (4.6 m), using the ammunition and weapon specified. The test samples were mounted in a rigidly fixed frame, with 1/8 in. (3.2 mm) thick corrugated cardboard indicator panels placed approximately 18 in. (467 mm) behind the protected side of each test sample. During the test, each bullet velocity was monitored and recorded.

The samples were subjected to a 1-shot test.

The 1-shot pattern consists of a single shot in the approximate center of the test sample. With this shot pattern, there shall be no penetration of the projectile through the test sample, to the extent that fragment embed in or damage the cardboard indicators.

OUTDOOR RATING:

METHOD

Three samples were subjected to various ambient conditions. One sample at room temperature, $22 \pm 3^{\circ}\text{C}$ ($72 \pm 5^{\circ}\text{F}$), was subjected to a 1-shot pattern, center. A second sample, after exposure to a temperature of 49°C (120°F) for a period of 3 h to the complete sample, and a third sample, after exposure to -32°C (-25°F) to the side receiving the shot for a period of 3 h were subjected to the 1-shot pattern in the approximate center of the sample. The samples were tested immediately following the exposure to the indicated temperature conditions.

RESULTS

Acceptable results were recorded for all shot patterns at all ambient conditions as outlined above.

ARMORCORE (LEVEL 4)

Bullet Velocities (fps)

Single Shot – Center (Room Temperature)	2577
Single Shot – Center (High Temperature)	2588
Single Shot – Center (Low Temperature)	2609

CONCLUSION

Sample of the products covered by this Report have been found to comply with the requirements covering the class and the products are judged to be eligible for listing and Follow-Up Service. The manufacturer is authorized to use the Laboratories' Mark on such products which comply with the Follow-Up Service Procedure and any other applicable requirements of Underwriters Laboratories Inc. Only those products which properly bear the Laboratories' Mark are considered as Listed by Underwriters Laboratories Inc.

Report by:
C. A. Prosser
Engineering Assistant

Reviewed by:
R. L. Gray
Staff Engineer

TEST RECORD NO. 3

SAMPLES:

Samples of Models ArmorCore Level 5, -Level 6, -Level 7 and -Level 8 material rated for Level 5, Level 6,, Level 7 and Level 8, respectively, were submitted by the manufacturer and subjected to the following test program.

BALLISTICS TEST:

General - The ammunition used for the investigation was:

Level 5, Level 8 - 150 grain (9.7 g) 7.62 mm rifle lead core full metal copper jacket, military ball, minimum velocity 2750 fps (838 mps).

Level 6 - 124 grain (8.0 g) 9 mm full metal copper jacket with lead core, minimum velocity of 1400 fps (427 mps).

Level 7 - 55 grain (3.56 g) 5.56 mm rifle full metal copper jacket with lead core, minimum velocity of 3080 fps (939 mps).

All tests were conducted at close range, approximately 15 ft (4.6 m), using the ammunition and weapon specified. The test samples were mounted in a rigidly fixed frame, with 1/8 in. (3.2 mm) thick corrugated cardboard indicator panels placed approximately 18 in. (467 mm) behind the protected side of each test sample. During the test, each bullet velocity was monitored and recorded.

The Level 5 samples were subjected to a 1-shot pattern.

The 1-shot pattern consists of a single shot in the approximate center of the test sample. With this shot pattern, there shall be no penetration of the projectile through the test sample, nor spalling of the material on the protected side of the test sample, to the extent that fragments embed in or damage the cardboard indicators.

The Level 6, 7 and 8 samples were subjected to a 5-shot pattern.

The 5-shot pattern consists of five shots placed in a square pattern that is 4-1/2 by 4-1/2 in. (114 mm) located in the center of the test sample. With this shot pattern, there shall be no penetration of the projectile through the test sample, nor spalling of the material on the protected side of the test sample, to the extent that fragments embed in or damage the cardboard indicators.

OUTDOOR RATING(LEVEL 5 ONLY):

METHOD

Three samples were subjected to various ambient conditions. One sample at room temperature, $22 \pm 3^{\circ}\text{C}$ ($72 \pm 5^{\circ}\text{F}$), one sample after exposure to a temperature of 49°C (120°F) for a period of 3 h to the complete sample, and one sample after exposure to -32°C (-25°F) to the side receiving the shots for a period of 3 h were subjected to the 1-shot pattern. The samples were tested immediately following the exposure to the indicated temperature conditions.

The velocity of each bullet was recorded during the test.

RESULTS

Acceptable results were recorded for all shot patterns at all ambient conditions as outlined above.

ARMORCORE - LEVEL 5

<u>Shot Pattern</u>	<u>Velocity</u> (fps)
1-Shot (High Temperature)	2788
1-Shot (Low Temperature)	2817

ARMORCORE - LEVEL 6

<u>Shot Number</u>	<u>Velocity</u> (fps)
Shot 1	1425
Shot 2	1465
Shot 3	1457
Shot 4	1445
Shot 5	1434

ARMORCORE - LEVEL 7

<u>Shot Number</u>	<u>Velocity</u> (fps)
Shot 1	3184
Shot 2	3205
Shot 3	3220
Shot 4	3229
Shot 5	3171

ARMORCORE - LEVEL 8

<u>Shot Number</u>	<u>Velocity</u> (fps)
Shot 1	2816
Shot 2	2886
Shot 3	2806
Shot 4	2811
Shot 5	2788

Test Record Summary:

The results of this investigation indicate that the products evaluated comply with the applicable requirements and, therefore, such products are judged eligible to bear UL's Mark as described on the Conclusion Page of this Report.

Test Record by:
CYNDI PROSSER
Senior Engineering Associate

Reviewed by:
TIM FRITZ
Engineering Team Leader



Sample Tag No.: F230455991
Labware Project No.: 1001839940
File No.: BP8910
Vol No.: 1
Issued Date: 2023-03-17

Follow-Up Sample Test Report

Applicant: WACO COMPOSITES, A DIV OF SPECIALTY COMPOSITES GROUP LTD

Address: 302 S 27TH ST
WACO
TX 76710
United States

Party Site Number: 816002

Manufacturer: WACO COMPOSITES, A DIV OF SPECIALTY COMPOSITES GROUP LTD

Address: 302 S 27TH ST
WACO
TX 76710
United States

Party Site Number: 816002

Product Category: CNLW

Category Name: Bullet-Resisting Metals and Plastics

Model Number(s): ArmorCore Level 3

Sample Selection Date: 2023-02-14

UL Contact: JACINDA ROSE via email at Jacinda.Rose@ul.com

Number of pages in this package 8 [including additional pages]
 (Fill in when using printed copy as record)

CLIENT INFORMATION (Optional)	
Manufacturer Name	Waco Composites, A Div Of Specialty Composites Group Ltd
Manufacturer Subscriber No. /Party Site No.	816002

AUDIT INFORMATION:	
Description of Tests	<input checked="" type="checkbox"/> Per Standard No. <u>UL 752</u> Edition <u>11th</u> <input checked="" type="checkbox"/> Per Procedure Appendix Vol. <u>1</u> Sec Letter <u>A</u> Issued or Revised Date for the referenced Appendix <u>2018-08-08</u>
<input checked="" type="checkbox"/> Tests Conducted by ¹	Allan Conrad 02820
<input type="checkbox"/> UL Staff conducting or witnessing testing (WTDP only) <input type="checkbox"/> UL Staff supervising UL Staff in training	
<input type="checkbox"/> Authorized Signatory (TPTDP)	_____ Printed Name Signature. Include date for TPTDP

TESTS TO BE CONDUCTED:		
Test No.	Test Name	<input type="checkbox"/> Comments/Parameters <input type="checkbox"/> Tests Conducted by ² <input checked="" type="checkbox"/> Comply/Does Not Comply ³ <input type="checkbox"/> Link to separate data files ⁴
1	BALLISTICS TEST - BULLET RESISTING MATERIALS	RESULTS COMPLY

Instructions -
 1 - When all tests are conducted by one person, name can be inserted here instead of including name on each page containing data.
 2 - When test conducted by more than one person, name of person conducting the test can be inserted next to the test name instead of including name on each page containing data. Test dates may be recorded here instead of entering test dates on the individual datasheet pages.
 3 - Indication of compliance is optional. See the datasheet for each test for compliance.
 4 - Link to separate data files for a test can be inserted here. The link must be to a server that is accessible to UL staff, that provides for backup, required retention periods and a path, including file name that does not change and result in a broken link. Not applicable to DAP.

If noncompliant test results are obtained, provide this data to a qualified project handler for further processing.

Special Instructions -

Unless specified otherwise in the individual Methods, the tests shall be
 ULS-00752-COGT-Datasheet-2001 Form Issued: 2009-11-16
 Form Page 1 Form Revised:

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Only those products bearing the UL Mark should be considered as being covered by UL.

conducted under the following ambient conditions. Confirmation of these conditions shall be recorded at the time the test is conducted.

Ambient Temperature, C _____ ± _____ Relative Humidity, % _____ ± _____ Barometric Pressure, mBar _____ ± _____

File BP8910 Sample Tag F230455991 Page 3
 Tested by: _____ Date 2023-03-17

TEST LOCATION: (To be completed by Staff Conducting the Testing)	
<input checked="" type="checkbox"/> UL or Affiliate	<input type="checkbox"/> WTDP <input type="checkbox"/> TPTDP
Company Name: UL SOLUTIONS	
Address: 333 PFINGSTEN RD., NORTHBROOK, ILLINOIS, 60062	

TEST EQUIPMENT INFORMATION

UL test equipment information is recorded on Meter Use.

UL test equipment information is recorded on <<insert location and local laboratory equipment system identification.>>

Inst. ID No.	Instrument Type	Test Number +, Test Title or Conditioning	Function /Range	Last Cal. Date	Next Cal. Date

+ - If Test Number is used, the Test Number must be identified on the data sheet pages or on the Data Sheet Package cover page.

The following additional information is required when using client's or rented equipment. The Inst. ID No. below corresponds to the Inst. ID No. above.

Inst. ID No.	Make/Model/Serial Number/Asset No.

TEST SAMPLE IDENTIFICATION:

The table below is provided to establish correlation of sample numbers to specific product related information. Refer to this table when a test identifies a test sample by "Sample No." only.

Sample Card No.	Date Received	[] Test No.+	Sample No.	Manufacturer, Product Identification and Ratings
5792864	2023-02-16	1	1	ArmorCore Level 3 Lot Number: 23033113B Date Manufactured: 2023-02-03 QTY: (2) 12" X 12"

+ - If Test Number is used, the Test Number or Numbers the sample was used in must be identified on the data sheet pages or on the Data Sheet Package cover page.
 ++ - If the samples are from a manufacturer or location other than the testing location.

[] This document contains data or information using color and if printed, should be printed in color to retain legibility and the information represented by the color.

Tested by: _____

Date 2023-03-17

BALLISTICS TEST - BULLET RESISTING MATERIALS

UL752 Section 17

METHOD

Material type	Material Manufacturer	Ballistics Rating (Level)
FIBERGLASS		3

The tests were conducted at a range of 15 feet (4.6 m) using a test barrel or weapon and the ammunition specified in Table 3.1 of UL 752. Each test sample of material was mounted in a rigidly fixed frame. During testing room ambient was maintained at $22 \pm 3^{\circ}\text{C}$ ($72 \pm 5^{\circ}\text{F}$). Corrugated cardboard indicators, approximately 1/8 inch (3.2 mm) thick, were placed a distance of approximately 18 inches (457 mm) behind the protected side of the test sample.

Sample	Material Type	Shot Pattern
[] 1	Metallic or Non-metallic Material -	Room Temperature $22 \pm 3^{\circ}\text{C}$ ($72 \pm 5^{\circ}\text{F}$) [] Five shot pattern (Level 6, 7 or 8) [] Three shot pattern (Level 1,2 or 3) [] One shot pattern (Level 4 or 5)
[] 2	Non-metallic Material - indoor use	Prior to testing one sample was conditioned at 13°C (55°F) for 3 hours. [] Three shot pattern (Level 1,2 or 3) [] One shot pattern (Level 4 or 5)
[] 3	Non-metallic material - outdoor use	Prior to testing the attack side of the sample was conditioned at minus $32 \pm 3^{\circ}\text{C}$ (minus $26 \pm 5^{\circ}\text{F}$) for 3 hours while the other side was conditioned at $22 \pm 3^{\circ}\text{C}$ ($72 \pm 5^{\circ}\text{F}$). [] Three shot pattern (Level 1,2 or 3) [] One shot pattern (Level 4 or 5)
[] 4	Non-metallic Material - indoor use	Prior to testing sample was conditioned at 35°C (95°F) for 3 hours. [] Three shot pattern (Level 1,2 or 3) [] One shot pattern (Level 4 or 5)
[X] 5	Non-metallic Material - outdoor use	Prior to testing the entire sample was conditioned at $49 \pm 3^{\circ}\text{C}$ ($120 \pm 5^{\circ}\text{F}$) for 3 hours. [X] Three Shot Pattern (Level 1,2 or 3) [] One Shot Pattern (Level 4 or 5)

One Shot Pattern	One shot was fired at the approximate center of the test sample.
Three Shot Pattern	Three shots were fired at the approximate center of the test sample with the shots spaced $4 \pm 1/2$ inch (102 ± 12.7 mm) apart in a triangular pattern The measurement between each shot was made from the center of the impact of each shot on the test sample.
Five Shot Pattern	Five shots were fired in a square pattern that was $4-1/2$ by $4-1/2$ inches (114 by 114 mm) located in the center of the sample. The first of the five shots was placed in the upper left hand corner; the second shot was placed in the upper right hand corner; the third shot was placed in the lower right hand corner; the fourth shot was placed in the lower left hand corner; the fifth shot was placed at the center of the square. A tolerance of $\pm 1/2$ inch (12.7 mm) was allowed.

BALLISTICS TEST - BULLET RESISTING MATERIALS (CONT'D) UL752 Section 17

RESULTS

Room Ambient Temperature, °C	23
Distance between Corrugated cardboard indicators and protected side of the test sample, in.	18

Sample No	Shot number	Measured Bullet Velocity (ft/s)	Distance between shots, in (1-2)	Distance between shots, in (2-3)	Distance between shots, in (3-4)	Distance between shots, in (4-1)
1	1		-	-	-	-
1	2			-	-	-
1	3				-	-
1	4					-
1	5					

Sample No	Shot number	Measured Bullet Velocity (ft/s)	Distance between shots, in (1-2)	Distance between shots, in (2-3)	Distance between shots, in (3-1)
2	1			-	-
2	2		-	-	-
2	3		-	-	-
3	1			-	-
3	2		-	-	-
3	3		-	-	-
4	1			-	-
4	2		-	-	-
4	3		-	-	-
5	1	1449	4.5	-	-
5	2	1442	-	4.5	-
5	3	1433	-	-	4.5

Sample No.	Location of pattern / shot	Was pattern acceptable? Y=yes, N=no	Observations (penetration, embedded fragments, openings)
1			
2			
3			
4			
5	TOP, BR, BL	YES	NS, NP

BALLISTICS TEST - BULLET RESISTING MATERIALS (CONT'D) UL752 Section 17

Conditioning temperature, °C	Sample No	Conditioning Start Time, (hr:min)	Conditioning End Time, (hr:min)
49	5792864	7:45AM	10:45AM

Notes:

NP - No penetration of the projectile through the test sample

NS - No spalling of material on the protected side of the test sample to the extent that fragments of the projectile or assembly embedded into or damaged the cardboard indicators.

Note 1 - For unsupported edge test, spalling of bullet-resisting material is acceptable

Note 2 - For two shot pattern, spalling of bullet-resisting material from the protected side of the test sample is acceptable under this test condition.

[X] REQUIREMENTS		
there shall be 1) no penetration of the projectile through the test sample, and 2) no spalling of material on the protected side of the test sample to the extent that fragments embed into or damage the cardboard indicators, and 3) no opening of sufficient size to permit insertion of the muzzle of a standard weapon designed to use the ammunition used for the test completely through the sample.		[Complies]

File BP8910

Sample Tag F230455991

Page 8

Tested by: _____

Date 2023-03-17

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ASTM E19-98

[PDF Version](#) [Back](#)

ASTM E119-98 Fire Tests of Building Construction and Materials* Waco Composites I, Ltd. Bullet-Resistant FRP Panel

Project No. 16410-108710

ONE-HOUR FIRE RESISTANCE TEST OF A NONBEARING STEEL STUD WALL WITH 1/2" TYPE X GYPSUM ON THE EXTERIOR AND 1/2" TYPE X GYPSUM WALLBOARD OVER WACO COMPOSITES FRP PANEL ON THE INTERIOR

*Modified in that the sample size was less than 100 ft.² and the fire test was Performed from the interior side only.

May 2, 2001

Prepared for:
Waco Composites I, Ltd.
481-A Texas Central Parkway
Waco, TX 76712

By:
Omega Point Laboratories, Inc.
16015 Shady Falls Road
Elmendorf, Texas 78112-9784

INTRODUCTION

"The performance of walls, columns, floors, and other building members under fire exposure conditions is an item of major importance in securing constructions that are safe, and that are not a menace to neighboring structures nor to the public. Recognition of this is registered in the codes of many authorities, municipal and other. It is important to secure balance of the many units in a single building, and of buildings of like character and use in a community; and also to promote uniformity in requirements of various authorities throughout the country. To do this it is necessary that the fire-resistive properties of materials and assemblies be measured and specified according to a common standard expressed in terms that are applicable alike to a wide variety of materials, situations, and conditions of exposure.

Such a standard is found in the methods that follow. They prescribe a standard exposing fire of controlled extent and severity. Performance is defined as the period of resistance to standard exposure elapsing before the first critical point in behavior is observed. Results are reported in units in which field exposures can be judged and expressed/

The methods may be cited as the "Standard Fire Tests," and the performance or exposure shall be expressed as "2-h," "6-h," "1/2-h" etc.

When a factor of safety exceeding that inherent in the test conditions is desired, a proportional increase should be made in the specified time-classification period.

The ASTM E119 test procedure is identical or very similar to the following standard test methods:

UL 263 UBC 7-1
NFPA 251
ANSI A2.1

1. Scope

1.1 The test methods described in this fire-test-response standard are applicable to assemblies of masonry units and to composite assemblies of structural materials for buildings, including bearing and other walls and partitions, columns, girders, beams, slabs, and composites slab and beam assemblies for floors and roofs. They are also applicable to other assemblies and structural units that constitute permanent integral parts of a finished building.

1.2 It is the intent that classifications shall register performance during the period of exposure and shall not be construed as having determined suitability for use after fire exposure.

1.3 This standard should be used to measure and describe the properties of materials, products, or assemblies in response to heat and flame under controlled laboratory conditions and should not be used to describe or appraise the fire hazard or fire risk of materials, products, or assemblies under actual fire conditions. However, results of this test may be used as elements of a fire risk assessment which takes into account all of the factors which are pertinent to an assessment of the fire hazard of a particular end use.

Note 1 — A method of fire hazard classification based on rate of flame spread is covered in ASTM Method E84, Test for Surface Burning Characteristics of Building Materials.

1.4 The results of these tests are one factor in assessing fire performance of building construction and assemblies. These methods prescribe a standard fire exposure for comparing the performance of building construction assemblies. Application of these test results to predict the performance of actual building construction requires careful evaluation of test conditions.

1.5 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

1.6 *This standard does not purport to address all of the safety concerns if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitation prior to use.*

4. Significance and Use

4.1 This test method is intended to evaluate the duration for which the types of assemblies noted in 1.1 will contain a fire, or retain their structural integrity or exhibit both properties dependent upon the type of assembly involved during a predetermined test exposure.

4.2 The test exposes a specimen to a *standard fire exposure* controlled to achieve specified temperatures throughout a specified time period. In some instances, the *fire exposure may be* followed by the application of a *specified standard* fire hose stream. The exposure, however, may not be representative of all fire conditions which may vary with changes in the amount, nature and distribution of fire loading, ventilation, compartment size and configuration, and heat sink characteristics of the compartment. It does, however, provide a relative measure of fire performance of comparable assemblies under these specified fire conditions. Any variation from the construction or conditions (that is, size, method of assembly, and materials) that are tested may substantially change the performance characteristics of the assembly.

4.3 The test standard provides for the following:

4.3.1 In walls, partitions and floor or roof assemblies;

4.3.1.1 Measurement of the transmission of heat.

4.3.1.2 Measurement of the transmission of hot gases through the assembly, sufficient to ignite cotton waste.

4.3.1.3 For load bearing elements, measurement of the load carrying ability of the *test specimen* during the test exposure.

4.3.2 For individual load bearing assemblies such as beams and columns: Measurement of the load carrying ability under the test exposure with some consideration for the end support conditions (that is, restrained or not restrained).

4.4 The test standard does not provide the following:

4.4.1 Full information as to performance of assemblies constructed with components or lengths other than those tested.

4.4.2 Evaluation of the degree by which the assembly contributes to the fire hazard by generation of smoke, toxic gases, or other products of combustion.

4.4.3 Measurement of the degree of control or limitation of *the passage of smoke* or products of combustion through the assembly.

4.4.4 Simulation of the fire behavior of joints between building elements such as floor-wall or wall-wall, etc., connections.

4.4.5 Measurement of flame spread over surface of tested element.

4.4.6 The effect of fire endurance of conventional openings in the assembly, that is electrical receptacle outlets, plumbing pipe, etc., unless specifically provided for in the construction tested.

16. Conditions of Acceptance - [Loadbearing Walls]

16.1 Regard the test as successful if the following conditions are met:

16.1.1 The wall or partition shall have sustained the applied load during the fire endurance test without passage of flame or gases hot enough to ignite cotton waste, for a period equal to that for which classification is desired.

16.1.2 The wall or partition shall have sustained the applied load during the fire and hose stream test as specified in Section 11, without passage of flame, of gases hot enough to ignite cotton waste, or of the hose stream. The assembly shall be considered to have failed the hose stream test if an opening develops that permits a projection of water from the stream beyond the unexposed surface during the time of the hose stream test.

16.1.3 Transmission of heat through the wall or partition during the fire endurance test shall not have been such as to raise the [average] temperature on its unexposed surface more than 250°(139°C) above its initial temperature.

18. Conditions of Acceptance - [Nonloadbearing Walls]

18.1 Regard the test as successful when the following conditions are met:

18.1.1 The wall or partition has withstood the fire endurance test without passage of flame or gases hot enough to ignite cotton waste, for a period equal to that for which classification is desired.

18.1.2 The wall or partition shall has [sic] withstood the fire and hose stream test as specified in Section 10, without passage of flame, of gases hot enough to ignite cotton waste, or of passage of water from the hose stream. The assembly shall be considered to have failed the hose stream test if an opening develops that permits a projection of water from the stream beyond the unexposed surface during the time of the hose stream test.

18.1.3 Transmission of heat through the wall or partition during the fire endurance test shall not have been such as to raise the [average] temperature on its unexposed surface more than 250°F (139°C) above its initial temperature.

The E119 standard further states:

7.4 Where the conditions of acceptance place a limitation on the rise of temperature of the unexposed surface, the temperature end point of the fire endurance period shall be determined by the average of the measurements taken at individual points; except that if a temperature rise of 30% [325°F above initial temperature] in excess of the specified limit occurs at any one of these points, the remainder shall be ignored and the fire endurance period judged as ended.

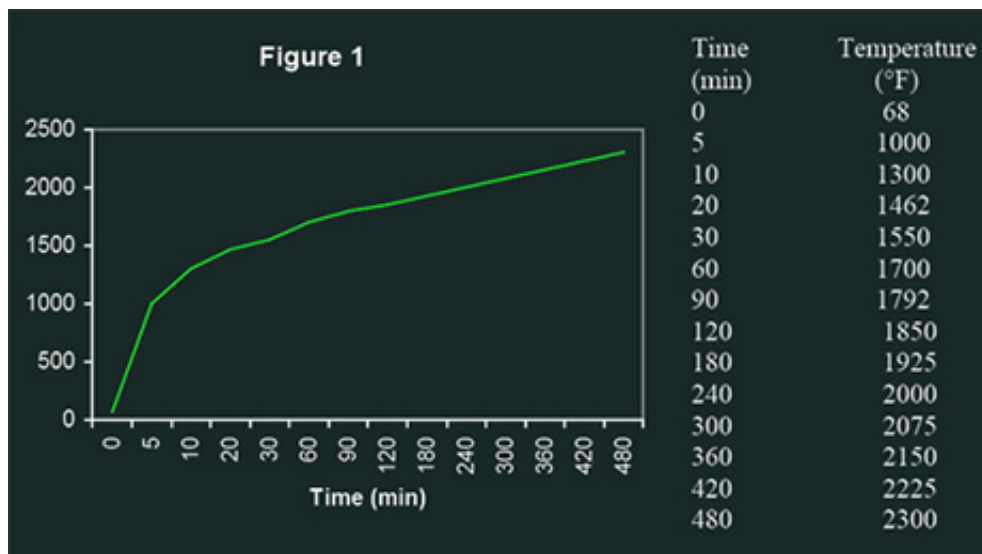
TEST PROCEDURE

SMALL SCALE VERTICAL FURNACE

The small scale vertical furnace is 48 in. wide, 48 in. high and 2 ft deep, with six inch thick sides. The furnace consists of a structural steel frame, clad in sheet metal, and insulated with six inches of ceramic fiber insulation. The furnace is equipped with nine self-inspiring burners, evenly distributed across the rear wall and adjusted to run with no input air. This results in a diffuse, yellow flame which closely simulates those found in a real fire.

Fired by propane, this furnace is capable of meeting both the ASTM E119 and UL1709 (high rise) heating curves, and its capable of running only at slightly negative pressures. The temperature within the furnace is determined to be the mathematical average of thermocouples located symmetrically within the furnace and positioned six inches away from the exposed face of the test specimen. The materials used in the construction of these thermocouples are those suggested in the test standard. During the performance of a fire exposure test, the furnace temperatures are monitored at least every 15 seconds and displayed for the Furnace operator to allow control along the specified temperature curve. All data is saved to disk every 60 seconds.

The fire exposure is controlled to conform with the standard time-temperature curve shown in Figure 1, as determined by the table below:



The furnace interior temperature during a test is controlled such that the area under the time temperature curve is within 10% of the corresponding area under the standard time temperature curve for 1 hour or less tests, 7.5% for those less than 2 hours and 5% for those tests of 2 hours or more duration.

Temperatures of Unexposed Surfaces

Temperatures of unexposed surfaces are monitored using 24 gauge, Type K thermocouples placed under 6 in. x 6 in. x 0.4 in. thick dry, felted pads as described in the standard. Temperature readings are taken at not less than nine points on the surface, at intervals not exceeding 1.0 minute. The temperature on the unexposed surface of a test specimen during the test is taken to be the average value of all thermocouples.

Applied Load

If required, this test method may be used to expose a horizontal or vertical assembly to fire while maintaining a live load on test specimen. This is accomplished by applying a uniform load hydraulically, with actuators designed for that purpose.

Fire Endurance Test

The fire exposure is continued on the specimen with its applied load if applicable, until failure occurs, or until the specimen has withstood the test conditions for the desired fire endurance rating.

Hose Stream Test

11.1 Where required by the conditions of acceptance, subject a duplicate specimen to a fire exposure test for a period equal to one half of that indicated as the resistance period in the fire endurance test, but not for more than 1 h, immediately after which subject the specimen to the impact, erosion, and cooling effects of a hose stream directed first at the middle and then at all parts of the exposed face, changes in direction being made slowly.

11.2 Exemption — The hose stream test shall not be required in the case of constructions having a resistance period, indicated in the fire endurance test, of less than 1 h.

11.3 Optional Program — The submitter may elect, with the advice and consent of the testing body, to have the hose stream test made on the specimen subjected to the fire endurance test and immediately following the expiration of the fire endurance test.

11.4 Stream Equipment and Details — The stream shall be delivered through a 2 ½-in. (64-mm) hose discharging through a National Standard Playpipe of corresponding size equipped with a 1 1/8-in. (28.5-mm) discharge tip of the standard-taper smooth-bore pattern without shoulder at the orifice. The water pressure and duration of the application shall be as prescribed in Table 1.

TABLE 1 Conditions For Hose Stream Test

Resistance Period	Water Pressure at Base of Nozzle, psi (kPa)	Duration of Application, Min/100 ft ² (9m ²)	Exposed area
8 h and over	45 (310)	6 4 h and over if less than 8 h	45 (310)
5 2 h and over if less than 4 h	30 (207)	2 ½	1 1/2 h and over if less than 2 h
30 (207)	1 ½	1 h and over if less than 1 ½ h	30 (207)
1	Less than 1h, if desired	30 (207)	1

11.5 Nozzle Distance — The nozzle orifice shall be 20 ft (6-m) from the center of the exposed surface of the test specimen if the nozzle is so located that when directed at the center its axis is normal to the surface of the test specimen. If otherwise located, its distance from the center shall be less than 20 ft by an amount equal to 1 ft (305-mm) for each 10 deg of deviation from the normal.

Correction Factor

When the indicated resistance period is ½ h or over, determined by the failure criteria of the standard, a correction shall be applied for variation of the furnace exposure from that prescribed, where it will affect the classification/ This is to be done by multiplying the indicated period by two thirds of the difference in area between the curve of average furnace temperature and the standard curve for the first three fourths of the period and dividing the product by the area between the standard curve and a base line of 68°F(20°C) for the same part of the indicated period, the latter area increased by 3240°F min to compensate for the thermal lag of the furnace thermocouples during the first part of the test. For a fire exposure in the test higher than standard, the indicated resistance period shall be increased by the amount of the correction. For a fire exposure in the test lower than standard, the indicated resistance period shall be similarly decreased for fire exposure below standard. The correction is accomplished by mathematically adding the correction factor, C, to the indicated resistance period.

The correction can be expressed by the following equation:

$$C = \frac{2I (A - A_s)}{3 (A + L)}$$

where: C = correction in the same units as I,

I = indicated fire-resistance period

A = area under the curve of indicated average furnace temperature for the first three fourths of the indicated period.

A_s = area under the standard furnace curve for the same part of the indicated

period, and

L = lag correction in the same units as A and A_s (54°F·h or 30°C·h) (3240°F·min or 1800°C·min)

TEST SPECIMEN CONSTRUCTION

The test specimen identification is as provided by the client and Omega Point Laboratories, Inc. accepts no responsibility for any inaccuracies therein. Omega Point did not select the specimen and has not verified the composition, manufacturing techniques or quality assurance procedures.

The test assembly consisted of a 48" x 48" steel stud wall spaced 24" o.c. and constructed of 3/8" steel studs (20 GA) attached to 3-5/8" steel runners (20 GA) using 7/16" long pan framing screws at each location. The unexposed side of the

wall was covered with a single piece of ½" thick Type X gypsum wallboard attached to the studs using 1-¼" long self tapping drywall screws spaced 12" o.c. The exposed side of the wall was clad with a single 3/8" thick FRP panel described as " multiple plies of woven roving fiberglass impregnated with a thermosetting polyester resin". The panel was attached to the studs using 1-¼" long self tapping drywall screws spaced 12" o.c. Another layer of ½" thick Type X gypsum wallboard was then placed over the panel and fastened to the studs using 1-7/8" long self-tapping drywall screws spaced 24" o.c. The completed assembly was then mounted against the front of our small-scale vertical furnace and the test was begun.

TEST RESULTS AND OBSERVATION

The wall assembly was placed in front of the Laboratory's test furnace on April 25, 2001. The ambient temperature at the start of the test was 80°F, with a relative humidity of 50%. Throughout the fire test, the pressure differential between the inside of the furnace (measured at a point 1/3 of the way down from the top center of the wall specimen) and the laboratory ambient air was maintained at -0.03 inches of water column, which resulted in a neutral pressure at the top of the test article.

Observations made during the test are as follows:

- Time (min : sec) Observation
- 0:00 Furnace fired at 3:25 p.m.
- 0:35 Gypsum paper turning dark
- 0:50 Ignition of the paper
- 1:10 Paper ash flaking away from the exposed surface
- 8:00 Exposed surface turning light
- 15:00 No visible change
- 25:00 No visible change
- 35:00 No visible change
- 45:00 Light smoke issuing from the top of the unexposed surface
- 60:00 Furnace extinguished and assembly moved into position for the hose stream test
- 62:15 Hose stream test begins
- 62:25 Hose stream test ended. All of the gypsum wallboard was knocked off the exposed surface and a few of the outer layers of the FRP panel were hanging from the exposed surface. The hose stream did not penetrate the entire panel and did not allow passage of water through the unexposed layer of gypsum wallboard. Upon closer inspection, it appear that heat intense enough to scorch the fabric had penetrated through the outer five layers. There were a total of 16 or 17 layers of fabric in the panel.

A table showing the maximum temperatures reached on each of the unexposed side thermocouples during the 60-minute fire exposure is presented below:

TC#	1	2	3	4	5	Average
Max Temp (°F)	203	207	208	200	199	203
Max Allowable	404	404	404	403	403	329

The wall withstood the fire endurance test without passage of flame or gases hot enough to ignite cotton waste, for the 60-minute fire test.

Transmission of heat through the wall during the fire endurance test did not raise the average temperature on the unexposed surface more than 250° above the initial average temperature, nor any individual temperature more than 325°F above each individual thermocouples initial reading.

Calculation of Time Correction

The E119 standard requires that a correction factor be applied for variation of the furnace exposure from that prescribed, where it will affect the classification. This calculation has been determined, as indicated below, to be less than 30 seconds, and so will not affect the sixty-minute classification, which is reported to the nearest integral minute.

Correction to indicated time:	0.04	Minutes
Where:	3	Seconds
Indicated fire resistance:	60	minutes
Area under first ¼ of test curve:	58338	(°F·min)
Area under first ¼ E119 curve:	58269	(°F·min)
Lab correction:	3240	(°F·min)

CONCLUSIONS

The test specimen identification is as provided by the client and Omega Point Laboratories, Inc. accepts no responsibility for any inaccuracies therein. Omega Point did not select the specimen and has not verified the composition, manufacturing techniques or quality assurance procedures.

The wall assembly constructed and tested as described herein, achieved a fire resistance rating of 60 minutes when tested with the fire against the interior surface only, when tested in accordance with ASTM Method E119-98 Fire Test of Building Construction and Materials as a nonbearing wall assembly.

H.P. WHITE LABORATORY, INC.

3114 Scarboro Road
Street, Maryland 21154-1822
Telephone: (410) 838-6550
Facsimile: (410) 838-2802
Email: info@hpwhite.com
www.hpwhite.com



9 February 2006
(HPWLI 10035-01A)

Waco Composites I, Ltd.
481-A Texas Central Parkway
P.O. Box 21223
Waco, Texas 76702-1223

Attention: David Breeland

Gentlemen:

In accordance with your instructions, H.P. White Laboratory, Inc. conducted forced entry resistance testing of one rigid fiberglass sample, identified as Model ArmorCore UL Level 3 (see enclosed data record for construction description), received 9 January 2006 via United Parcel Service.

Testing was conducted in accordance with your instructions, and the modified forced entry resistance provisions of ASTM F1233-98. Forced entry resistance testing was to begin with Sequence 1, and was to be terminated at body passage. Ballistic resistance testing was not conducted. Table I presents a summary of the enclosed data records.

TABLE I. SUMMARY OF FORCED ENTRY RESULTS

Class	Sequence	Description	Results
I	01	Ball Peen Hammer	1. Abrading of surface fibers.
II	02-07	Ball Peen Hammer, Sledge Hammer & 1-1/2 inch Pipe, CO2 Extinguisher & Sledgehammer, Propane Torch & Ripping Bar	1. Abrading of surface fibers.
III	08-16	120 lb Ram, Sledgehammer & 4 inch Pipe, Sledgehammer, Propane Torch & Ripping Bar, Hammer & Chisel, Gasoline, Sledgehammer & Angle Iron, Sledgehammer	1. 1.5 x 1 inch through-hole. 2. Contraband passage. (a)
IV	17-27	120 lb Ram, Sledgehammer & 4 inch Pipe, Sledgehammer, Propane Torch & Wood Maul, Sledgehammer, Ripping Bar, Fire Axe, Hammer & Chisel, Acetone, Sledgehammer	1. 2.5 x 1 inch through-hole. 2. 6 inch extended through slice.
V	28-32	120 lb Ram, Sledgehammer & 4 inch Pipe, Sledgehammer, Propane Torch & Fire Axe	1. 9 x 6 inch through-hole. 2. Body passage. (b)
(a) Pursuant to ASTM F1233-98, Paragraph 9.2.4.1.			
(b) Pursuant to ASTM F1233-98, Paragraph 9.2.4.2.			

Waco Composites I, Ltd.
Attention: David Breeland
(HPWLI 10035-01A)
9 February 2006
Page 2

Based upon the data presented in Table I, the Model ArmorCore UL Level 3 rigid fiberglass sample submitted for testing SATISFIED the contraband passage requirement of ASTM F1233-98, Class II, Paragraph 9.2.4.1.

Based upon the data presented in Table I, the Model ArmorCore UL Level 3 rigid fiberglass sample submitted for testing SATISFIED the body passage requirement of ASTM F1233-98, Class IV, Paragraph 9.2.4.2.

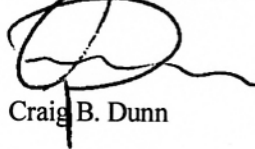
This conclusion is based on data obtained from having tested only the sample submitted, and should NOT be interpreted as an endorsement by H.P. White Laboratory, Inc. of the continuing quality, or performance, of any other items of the same, or similar, design.

Please find photographs and videotape coverage (VHS format) of the testing enclosed herein.

In accordance with your instructions, the test sample is being returned via United Parcel Service. Should you have any questions regarding this matter, or if we may be of any further service, please do not hesitate to contact us.

Very truly yours,

H. P. WHITE LABORATORY, INC.

A handwritten signature in black ink, appearing to read 'Craig B. Dunn', is written over the typed name. The signature is stylized and somewhat cursive.

Craig B. Dunn

CBD/mw
Enclosures

Installation Instructions



Before Getting Started- Health & Safety Precautions:

ArmorCore® Bullet Resistant Panels are classified as Laminated FRP (Fiber Reinforced Plastic) products. It is important for installers of Fiberglass products to be properly supplied with the basic health and safety information and personal protective equipment, such as:

1. **MSDS** for **ArmorCore** © products
2. **Gloves**- cotton or leather gloves to provide protection from cuts and abrasions associated with handling, drilling or cutting fiberglass materials. Nitrile/Latex gloves can also be used to prevent skin irritation due to fiberglass, but provide little cut or abrasion protection. Cotton gloves should have PVC black dots to provide adhesion (grip) to the panels.
3. **Dust/Particle masks or respirators** to provide respiratory protection against dust associated with cutting or drilling fiberglass materials. One product on the market is the Moldex 2300 Dust and Mist Respirator. Refer to OSHA regulation Part 29 CFR 1910.134 for proper fit and use of respirators.
4. **Protective Eyewear**, especially when cutting sanding or drilling fiberglass materials. Refer to OSHA regulation Part 29 CFR 1910.133 for proper selection and fit of safety glasses, goggles and face shields.
5. **Protective Wear** to be worn over clothing to provide protection from fibrous dust that can settle in the clothing or on the skin when cutting, sanding or drilling fiberglass materials. DuPont makes a protective wear material called Tyvek that is used in sleeves, shirts, bibs and full body suits available through different manufacturers. STOKO sells a barrier cream (STOKO Emulsion) that can be applied before working with fiberglass that can help prevent skin irritation. The above listed items should be worn if workers will be cutting, sanding or drilling.
6. **Ventilation** – Mechanical fans or dust collection equipment are useful in reducing dust irritation. If fans are used, always place the person between the fan and the panel being machined so that any dust produced will be forced away from personnel.





Introduction:

The following recommendations are designed to assist in the installation of ArmorCore® bullet resistant fiberglass panels, as well as to preserve the ballistic protection the panels are designed to provide. Different elements of working with the product are addressed, in addition to some tips to consider when ordering the product.

Panel Sizes and Cutting :

Waco Composites manufactures **ArmorCore®** panels in any combination of 3', 4' & 5' widths by 8', 9' & 10' lengths. Our sales team can optimize a cut list into the most efficient panels sizes for your project. Parts can be cut to any 2-dimensional size prior to shipping, using our CNC Water Jet Cutters. In the field, ArmorCore® panels can be cut with a diamond-grit blade. TSD 180D, manufactured by Tenryu, or a DiamondX Cutter are both quality 7" circular blades available through Waco Composites. For electrical boxes and other small openings, a diamond grit blade (available through most builder's supply in the ceramic tile section) on a reciprocating saw should be sufficient.

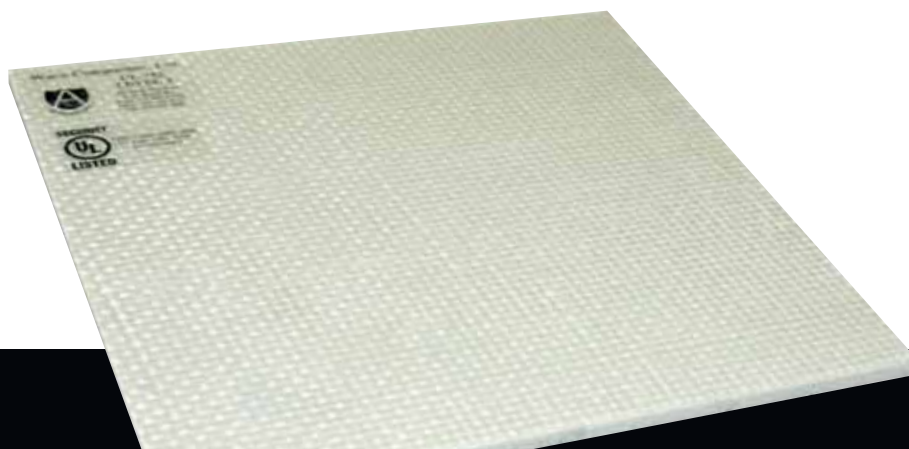
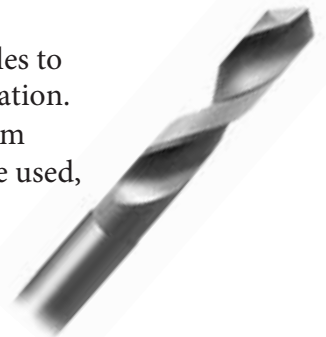


In addition to wearing protective clothing, a fan can be placed behind the cutting area to help blow away fiberglass particles.



Fastening and Drilling:

ArmorCore® panels may be attached using self-tapping drywall screws. When attaching a panel to a stud wall on which drywall will be the exterior surface, simply use enough screws to hold the panel to the studs, then come back with a complete screw pattern to the studs when hanging the drywall on top. If a different appliqué is to be used over the **ArmorCore®** panels and a flush surface is required, a counter-sink hole may be used before adding the screws. Panels up to 1-1/8" and thicker may require pre-drilling the fastener holes to prevent the screw heads from breaking, as well as to facilitate the installation. It is recommended that you use a carbide or cobalt tip drill bit at medium speed with medium pressure. Low carbon (high-speed steel) bits may be used, but will typically have a shorter lifespan.





ArmorCore® panels can be used without treatment when placed with in a wall. If **ArmorCore®** panels will be a decorative surface, then the following methods can be used:

Peel Ply/ Cleaning/ Sanding:

A clean surface free of grit and oily residue is required prior to gluing or painting **ArmorCore®** panels. One method to achieve this finish is known as “peel ply.” At the request of the customer at the time of order, a peel ply layer can be used in the manufacturing process. This thin extra layer is removed in the field immediately prior to working with the product. This leaves a clean, very slightly textured finish ready for treatment.

Cleaning the panel can also be accomplished by wiping the surface with Acetone. Minimize the amount of time the panel is exposed to solvent, avoiding soaking.

Sanding is another means of preparation. 120-grit sandpaper at medium pressure can be used to lightly “roughen-up” the surface.

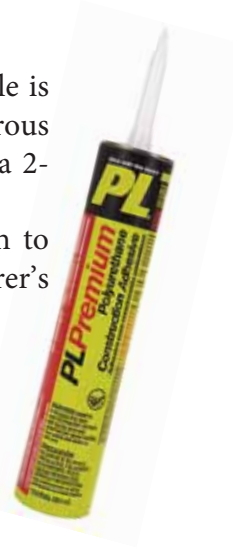
Adhesives and Laminating:

ArmorCore® panels can also be attached with the use of adhesives. One product available is PL Premium Polyurethane Construction Adhesive. For stronger adhesion to non-porous substrates, such as aluminum, steel and stainless steel, or bonding one panel to another, a 2-part Methyl Methacrylate (MMA) adhesive may be utilized, such as Plexus MA 320.

Laminates can be applied with standard contact adhesives and should be thick enough to avoid transfer of texture to the finished surface. Apply adhesive per manufacturer’s instructions.

Painting:

Once **ArmorCore®** panels have been prepared with one of the above methods, they can be painted with either an oil or water-based paint. An automotive urethane works well as a “high-end” solution. For any external application that requires panels to be exposed to the elements, a paint with a UV inhibitor should be used to protect the product from long-term UV ray exposure.



Wall Assembly:

For typical wall and millwork installations, a 4" wide batten strip of the same level material should be specified at the butt-joints to provide a minimal 2" overlap from one panel to the next, or each side of the joint. Batten strips are available as separate items from Waco Composites, or can be cut in the field from raw panels.

The **ArmorCore**® batten strips can be attached directly to the panels and should be used where any vertical or horizontal joints occur. Battens are not required where a 90° corner occurs, in which case a panel should simply overlap to the next panel at the corner (*see diagram*).

By having the panel joints between the studs, the battens can be attached without pushing out the wall further. In the case of electrical cut-outs, an additional 12" high piece of the same level of **ArmorCore**® material may be installed from the stud-to-stud, as close as possible to the hole (*see diagram*).

Contact:

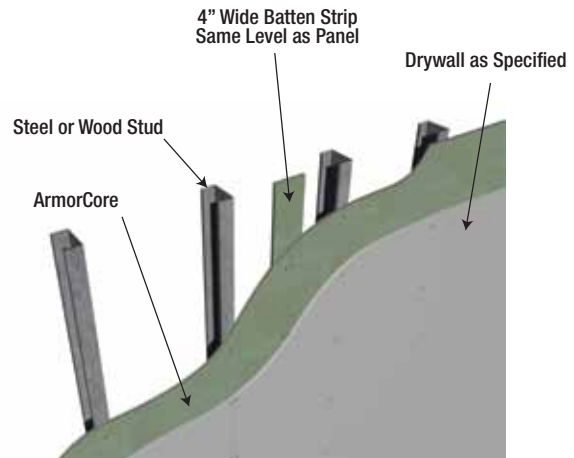
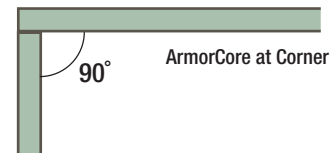
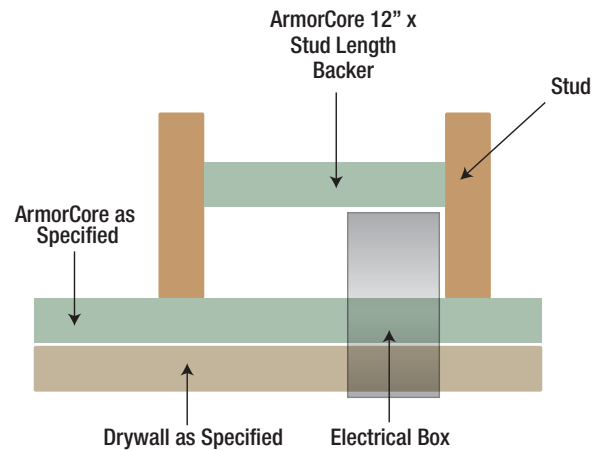
For mechanical properties or engineering questions, contact:

Warren Hampton: wchampton@armorcore.com

For all other questions, contact:

Warren Hampton: wchampton@armorcore.com

Melissa Jones: mjones@armorcore.com



Call us at: **866-688-3088**
Or visit our website: www.ArmorCore.com



Section 1 - Identification

Company: Specialty Composites Group LLC/DBA – Waco Composites
Manufacturer: Waco Composites
Product: ARMORCORE/Bullet Resistant Fiberglass Panels
Uses: Anti-Ballistic sheathing in millwork, walls or vehicles

Contact Phone: 254-752-3622
Address: 302 S. 27th Street
 P.O. Box 20008
 Waco Texas 76702

Section 2 – Hazards Identification

Warning


When product is sawed, drilled or cut in any manner that creates dust, skin irritation can occur.
Dust can irritate eyes and cause skin irritation and itching.
 Respiratory mask recommended when creating dust to avoid a respiratory tract irritation.
 See section 7 for handling product.

Panel sheet may be heavy, mechanical means maybe required to move this product.
 Panels vary in size, thickness and weight. Leather gloves are recommended for handling.

Section 3 – Composition/Information on Ingredients

Chemical Identity	Concentration	CAS	PIN Number	LD 50 Species	LC 50 Species
				Route	Route
Continuous Filament Fiber Glass	76%		N/A	N/A	N/A
Cured Polyester Thermosetting Resin	24%		N/A	N/A	N/A

Section 4 – First-Aid Measures

Eye contact – Flush eyes with water for 15 minutes, if irritation persists seek medical attention.
Ingestion – If swallowed seek medical attention.
Skin contact – Rinse contact areas with water, then wash with mild soap.
Inhalation – If irritation persists, seek medical attention.

Section 5 – Fire-Fighting Measures

Fire: Extinguish with water/CO₂, Dry chemical extinguishers.
Special Firefighting: Self-contained breathing apparatus (SCBA) and full fire-fighting protective clothing.
Explosion Sensitivity – None **Upper or Lower Flammable Limit** – None
Flashpoint (“C) Method – None **Auto Ignition Temperature** (“C)-- None

Section 6 – Accidental Release Measures

Solid Product - Panel Sheets. Able to be picked up, swept up and dispose in accordance to laws and regulations.

Section 7 – Handling and Storage

Handling procedures and equipment – Leather gloves or work gloves. When creating dust from this product wear respirator mask, safety glasses or goggles and protective clothing. Larger panels may require mechanical means to move.
Storage requirements – Stack on pallets inside under cover. For outside storage place on pallets and cover, keep panels out of direct sunlight and prevent long-term exposure to U/V rays. **Waste Disposal** – Inert solid product.
Disposal should be in accordance with applicable regional, national and local laws and regulations.

**Section 8 – Exposure Controls/Personal Protection**

Personal Protective Equipment – When creating dust, Tyvek suit, dust/particle mask, leather gloves, safety glasses.

Respiratory – Particle Mask or Mist Respirator

Footwear – Boots or shoes

Section 9 – Physical and Chemical Properties

Physical State - Solid Product

Specific Gravity - 1.6 – 2.08

Appearance – White/Light Green

Odor - Little or no odor

Vapor Density – Solid

Vapor Pressure – Solid

Particle Size – Varies

Solubility in Water - Insoluble

Melting Point - N/A

Freezing Point – N/A

Boiling Point – N/A

Evaporation Rate – N/A

Flash Point – N/A

Section 10 – Stability and Reactivity

Stability - Stable-Solid material

Incompatible Materials – Oxidizers, strong acids and bases

Conditions of Reactivity – Stable at normal storage conditions. Avoid heating above 450 F degrees

Hazardous Decomposition Products – Combustion may produce carbon monoxide, carbon dioxide and irritating or toxic vapors and gases.

Section 11 – Toxicological Information

Route of Entry – Primary route is inhalation of fibrous dust. **Skin and eye contact** – Irritant **Inhalation** – Negligible

Skin Absorption or Ingestion – None **Dust Exposure** – Causes irritation to the eyes, itching and dryness of the skin.

Exposure Limits – Protect Skin

Irritancy to Product – None known

Synergistic Products N/A

Section 12 – Ecological Information

No known significant effects or critical hazards.

Section 13 – Disposal Considerations

No special disposal requirements/inert solid waste

Disposal should be in accordance with applicable regional, national and local laws and regulations.

Section 14 – Transport Information

Make sure product is tied in and secured to shipping bed and covered to protect from sunlight.

Section 15 – Regulatory Information

All components are listed. Product becomes inert prior to sales. See section 2-7 & 8 for PPE, handling & protection.

Section 16 – Other Information

This document has been prepared in accordance with the SDS requirements of the OSHA hazard communication Standard 29 CFR 1910.1200. All information came from the original MSDS for this product.

CERTIFICATE OF REGISTRATION

Management Certification

MCNA
of North America

This is to certify that the
Quality Management System of:

Specialty Composites Group, LLC
dba Waco Composites

302 S. 27th Street
Waco, TX 76710-7454
USA

has been assessed and found complying with the requirements of

ISO 9001:2015

Approval is hereby granted for registration providing the
Certification rules and conditions are observed at all times.

Certification Scope:

Manufacture of bullet resistant panels

Certificate Number: 0809003

Issue Date: 23-Jan-2024

Audit Date: 22-Nov-2023

Original Registration Date: 3-Mar-2009

Expiration Date: 16-Feb-2027

Thomas W. Harris

On Behalf of:

Management Certification NA



SAFE ROOMS AND TORNADO PROTECTION

Several years ago, we received numerous inquiries from design professionals about the potential use of ArmorCore® Bullet Resistant Panels for the construction of “safe rooms” for protection during hurricanes and tornados.

Waco Composites, contacted the Wind Engineering Research Center at Texas Tech University, a testing center that partners with the Federal Emergency Management Agency (FEMA) to test many different building materials for their suitability to withstand wind damage from hurricanes and tornados.

Of particular interest is the ability of a given material to defeat or resist “missiles,” which refers to debris and other objects picked up by the wind and moved with enough force to damage and even penetrate windows, doors, walls and other parts of a building. The stronger the wind, the larger and heavier the missiles it can carry, increasing the risk of severe damage.

ArmorCore® UL 752 Level 3 panels (1/2” thick and 5.0 lbs per sq. ft.) at 4’ x 4’ were submitted to the Wind Engineering Research Center at Texas Tech University for testing to see how well they could resist an airborne missile typical of an F5 strength tornado. The results clearly indicated that ArmorCore® bullet resistant panels are well suited for safe room construction, provided the overall structural system that supports the ArmorCore® panels is adequate.

Following is the project report on the Investigation of Wind Projectile Resistance of Waco Composites, ArmorCore® UL572 Level 3 Panels. Videos of the actual test are available upon request.



Project Report on:

**INVESTIGATION OF WIND PROJECTILE RESISTANCE OF
WACO COMPOSITES, INC.
ARMORCORE® UL 752 LEVEL 3 PANELS.**

Submitted to:

Waco Composites, Inc.
481-C-Texas Central Parkway
P.O. Box 21223
Waco, Texas, 76702-1223

Research and Development Performed by:

The Wind Science and Engineering Research Center
Texas Tech University
Box 41023
Lubbock, Texas 79409-1023

Investigators:

Ernest W. Kiesling, Ph.D., P.E.
Russel R. Carter, E.I.T.

October 3, 1999

OVERVIEW

Waco Composites initiated contact for testing of ArmorCore® UL752 Level 3 by the Wind Science and Engineering (WISE) Research Center at Texas Tech University to assess the missile shielding ability of the composite panels. The panels were 4' x'4' x ½" mounted to wood studs spaced at 16" on center. The panels were attached to the studs with 3" x ¼" diameter self-tapping screws spaced at 6" on center the length of the studs. The panel was placed in front of the reaction frame and impacted with the tornado test missile. The specifics about each test and results follow.

The missile criterion used for the tests was a 15 pound 2x4 in. wood stud traveling along the board's longitudinal axis, striking the panel perpendicular to the panel face. The tornado test criterion uses this missile traveling at 100-mph which corresponds to a 250-mph wind and is the criterion used in designing for occupant protection. Additional margins of safety are inherent in the criterion since there is a very small probability that a missile will be traveling along its axis and will strike a wall perpendicular to its surface.

MISSILE SHOT 1 – 101.0 mph

The missile impacted near the center of the panel between the studs. The panel had a permanent deformation 1/4" (0.25 inches) at the point of impact. The panel began to delaminate as indicated by the lines of delamination originating from the point of impact. The non impact surface began to show signs of delamination. This was concentrated from the point of impact to the screw at the bottom of the panel.



MISSILE SHOT 2 – 102.6 mph

The missile impacted the same place as Missile Shot 1 in order to determine the ability of the material to resist the missile after delamination of the panel had occurred. The impact propagated the expansion of the delaminated line evident in the region of the impact surface. Other areas of delamination away from the point of impact also began to be more evident.



CONCLUSIONS

The ArmorCore® UL752 Level 3 panel is able to resist perforation of the 15 pound 2x4 traveling at 100 mph. Further testing would be required to determine the minimum number of layers of weave required to resist the missile. The amount of energy transferred from the panel to the main structural system caused the wood studs to split and break. For a structure clad in ArmorCore® to resist the combined effects of debris impact and severe wind load, a stronger structural system will be required. Once a structural system is designed, testing would be performed to determine the system meets debris impact performance criteria.

ARMORCORE-WACO COMPOSITES MIAMI-DADE TEST REPORT

SCOPE OF WORK

TAS 201, TAS 202, TAS 203, ASTM E330, ASTM E1886 AND ASTM E1996 TESTING ON UL752-
LEVEL 1 PANEL

REPORT NUMBER

Q9471.01-801-18-r0

TEST DATE(S)

02/09-10/24

ISSUE DATE

04/30/24

RECORD RETENTION END DATE

02/10/34

MIAMI-DADE COUNTY NOTIFICATION NO.

ATI 1312401

LABORATORY CERTIFICATION NO.

22-0428.10

PAGES

17

DOCUMENT CONTROL NUMBER

RT-R-AMER-Test-2816 (10/12/23)

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Tyler Westerling
Quality Assured by: Tyler Westerling

2024.04.30 10:11:33 -07'00'





Total Quality. Assured.

TEST REPORT FOR ARMORCORE-WACO COMPOSITES

Report No.: Q9471.01-801-18-R0

Date: 04/30/24

1909 10th Street, Suite 100
Plano, Texas 75074
Telephone: 469-814-0687
www.intertek.com/building

REPORT ISSUED TO

ARMORCORE-WACO COMPOSITES

302 S. 27th St
Waco, TX 76710

SECTION 1

SCOPE

Architectural Testing, Inc. (an Intertek company) dba Intertek Building & Construction (B&C) was contracted by Armorcore-Waco Composites to perform TAS 201, TAS 202, TAS 203, ASTM E330, ASTM E1886 and ASTM E1996 testing in accordance with Miami-Dade County requirements on their UL 752 Level 1 Panel. Results obtained are tested values and were secured by using the designated test method(s). Testing was conducted at the Intertek B&C test facility in Plano, TX. This report does not constitute certification of this product nor an opinion or endorsement by this laboratory.

SECTION 2

SUMMARY OF TEST RESULTS

The specimen(s) tested met the performance requirements set forth in the protocols.

Product Type: Fiberglass Panel

Series/Model: UL 752 Level 1 Panel

SPEC.	TEST PROTOCOL	DESIGN PRESSURE
1	TAS 202/ASTM E330	+100 / -100 psf
1	TAS 201/203 (Large Missile)	+100 / -100 psf
1	ASTM E1186/1996 (Large Missile)	+100 / -100 psf
2	TAS 201/203 (Large Missile)	+100 / -100 psf
1	ASTM E1186/1996 (Large Missile)	+100 / -100 psf
3	TAS 201/203 (Large Missile)	+100 / -100 psf
1	ASTM E1186/1996 (Large Missile)	+100 / -100 psf

For INTERTEK B&C:

COMPLETED BY: Jeffrey Crump, FMPC
 Laboratory Manager –
TITLE: Building & Construction
SIGNATURE: 
Digitally Signed by: Jeffrey Crump
DATE: 04/18/24

REVIEWED BY: Tyler Westerling, P.E.
TITLE: Operations Manager
SIGNATURE: 
Digitally Signed by: Tyler Westerling
DATE: 04/18/24

JC:cm

SECTION 3

TEST METHOD(S)

The specimens were evaluated in accordance with the following:

- TAS 201-94, Impact Test Procedures**
- TAS 202-94, Criteria for Testing Impact & Non Impact Resistant Building Envelope Components Using Uniform Static Air Pressure**
- TAS 203-94, Criteria for Testing Products Subject to Cyclic Wind Pressure Loading**
- ASTM E330-14, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.**
- ASTM E1886-19, Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials**
- ASTM E1996-20, Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes**

SECTION 4

MATERIAL SOURCE/INSTALLATION

Test specimens were provided by the client. Representative samples of the test specimen(s) will be retained by Intertek B&C for a minimum of ten years from the test completion date.

Then specimen was installed into a pine test buck.

LOCATION	ANCHOR DESCRIPTION	ANCHOR LOCATION
Interior and Exterior of Panel	Panel is secured inbetween one 2 x 4 on each side. 2 x 4 attached to surrounding test buck	2 x 4 attached to test buck with #8 x 2" coarse thread screws.

SECTION 5
EQUIPMENT

Cannon: Constructed from steel piping utilizing compressed air to propel the missile

Missile: 2x4 Southern Pine

Timing Device: Electronic beam type

Cycling Mechanism: Computer controlled centrifugal blower with electronic pressure measuring device

Deflection Measuring Device: Linear transducers

SECTION 6
LIST OF OFFICIAL OBSERVERS

NAME	COMPANY
Jeffrey Crump	Intertek B&C
Jovica Cijuk	Intertek B&C

SECTION 7
TEST SPECIMEN DESCRIPTION

Product Type: Fiberglass Panel

Series/Model: Bullet Resistant Fiberglass Panels

Product Size(s):

OVERALL AREA:	WIDTH		HEIGHT	
	millimeters	inches	millimeters	inches
2.2 m ² (24.0 ft ²)				
Overall Size	914	36	2438	96
Thickness	6.35	1/4		

Panel Construction:

MATERIAL	DESCRIPTION
Fiberglass	Multiple layers of woven roving ballistic grade fiberglass cloth impregnated with a thermoset polyester resin and compressed into flat rigid sheets

TEST REPORT FOR ARMORCORE-WACO COMPOSITES

Report No.: Q9471.01-801-18-R0

Date: 04/30/24

SECTION 8
TEST RESULTS

Protocol TAS 202-94 and ASTM E330, Static Air Pressure

Test Date(s): 02/09/24 through 02/10/24

The temperature during testing was 22°C (71°F). The results are tabulated as follows:

Test Specimen #1: Preload and Design Load per TAS 202

LOAD (psf)	INDICATOR LOCATION	DEFLECTION (in.)		PERMANENT SET (in.)	
		MEASURED	ALLOWED	MEASURED	ALLOWED
+75.00 50% of Test Pressure	1	.05	N/A	.00	N/A
	2	.90	N/A	.00	N/A
	3	.20	N/A	.00	N/A
+100.00 Design Pressure	1	.06		.00	
	2	1.12		.01	
	3	.12		.00	
-75.00 50% of Test Pressure	1	.04	N/A	.00	N/A
	2	1.13	N/A	.01	N/A
	3	.15	N/A	.00	N/A
-100.00 Design Pressure	1	.04		.00	
	2	1.26		.01	
	3	.07		.01	

LOAD (psf)	INDICATOR LOCATION	PERMANENT SET (in.)	
		MEASURED	ALLOWED
+150.00 Test Pressure	1	.01	
	2	.03	.19
	3	.01	
-150.00 Test Pressure	1	.00	
	2	.02	.19
	3	.01	

Note 1: Positive and negative uniform static load test loads were held for 30 seconds.

Note 2: Tape and film were not used to seal against air leakage during structural testing.

Note 3: See Sketch #1 for indicator locations. Deflection/permanent set reported is the overall deflection between three points (longest unsupported span) which accounts for support movement.

TEST REPORT FOR ARMORCORE-WACO COMPOSITES

Report No.: Q9471.01-801-18-R0

Date: 04/30/24

Protocol TAS 201-94 and ASTM E1886/1996, Large Missile Impact Procedures

Test Date(s): 02/09/24 through 02/09/24

The temperature during testing was 22°C (71°F). The results are tabulated as follows:

Test Specimen #1

IMPACT #	MISSILE WEIGHT (lbs.)	MISSILE LENGTH (in.)	MISSILE VELOCITY (ft./sec.)	DEFLECTION	
				INSTANTANEOUS (in.)	PERMANENT (in.)
1	9	96	50	1.0	0
2	9	96	50	.50	0

Test Specimen #2

IMPACT #	MISSILE WEIGHT (lbs.)	MISSILE LENGTH (in.)	MISSILE VELOCITY (ft./sec.)	DEFLECTION	
				INSTANTANEOUS (in.)	PERMANENT (in.)
1	9	96	50	.50	0
2	9	96	50	1.25	0

Test Specimen #3

IMPACT #	MISSILE WEIGHT (lbs.)	MISSILE LENGTH (in.)	MISSILE VELOCITY (ft./sec.)	DEFLECTION	
				INSTANTANEOUS (in.)	PERMANENT (in.)
1	9	96	50	1.0	0
2	9	96	50	.50	0

Note 4: See Sketch #2 – 4 for impact locations.

Protocol TAS 203-94 and ASTM E1886/1996, Cyclic Wind Pressure Loading

Test Date(s): 02/13/24 through 02/14/24

The temperature during testing was 22°C (71°F). The results are tabulated as follows:

Test Specimen #1: Cyclic Test Spectrum and Average Cycle Time per TAS 203

DESIGN PRESSURE	STAGE		
	1	2	3
+100.0 /-100.0 psf			
POSITIVE PRESSURE RANGE (psf)	0 – 50	0 – 60	0 – 130
AVERAGE CYCLE TIME (sec.)	1.9	2.2	1
NUMBER OF CYCLES	600	70	1
	4	5	6
NEGATIVE PRESSURE RANGE (psf)	0 – 50	0 – 60	0 – 130
AVERAGE CYCLE TIME (sec.)	2.3	2.6	1
NUMBER OF CYCLES	600	70	1

TEST REPORT FOR ARMORCORE-WACO COMPOSITES

Report No.: Q9471.01-801-18-R0

Date: 04/30/24

Test Specimen #1: Positive Cyclic Load per TAS 203

INDICATOR LOCATION	MAXIMUM DEFLECTION (in.)	PERMANENT SET (in.)	PERCENT RECOVERY	
			MEASURED %	ALLOWED %
2	1.41	.02	98%	> 90

Test Specimen #1: Negative Cyclic Load per TAS 203

INDICATOR LOCATION	MAXIMUM DEFLECTION (in.)	PERMANENT SET (in.)	PERCENT RECOVERY	
			MEASURED %	ALLOWED %
2	1.48	.02	99%	> 90

Test Specimen #2: Cyclic Test Spectrum and Average Cycle Time per TAS 203

DESIGN PRESSURE	STAGE		
+100.0 /-100.0 psf	1	2	3
POSITIVE PRESSURE RANGE (psf)	0 – 50	0 – 60	0 – 130
AVERAGE CYCLE TIME (sec.)	2.1	2.5	1
NUMBER OF CYCLES	600	70	1
	4	5	6
NEGATIVE PRESSURE RANGE (psf)	0 – 50	0 – 60	0 – 130
AVERAGE CYCLE TIME (sec.)	2.6	2.8	1
NUMBER OF CYCLES	600	70	1

Test Specimen #2: Positive Cyclic Load per TAS 203

INDICATOR LOCATION	MAXIMUM DEFLECTION (in.)	PERMANENT SET (in.)	PERCENT RECOVERY	
			MEASURED %	ALLOWED %
2	1.42	.02	98%	> 90

Test Specimen #2: Negative Cyclic Load per TAS 203

INDICATOR LOCATION	MAXIMUM DEFLECTION (in.)	PERMANENT SET (in.)	PERCENT RECOVERY	
			MEASURED %	ALLOWED %
2	1.48	.02	99%	> 90

TEST REPORT FOR ARMORCORE-WACO COMPOSITES

Report No.: Q9471.01-801-18-R0

Date: 04/30/24

Test Specimen #3: Cyclic Test Spectrum and Average Cycle Time per TAS 203

DESIGN PRESSURE	STAGE		
	1	2	3
+100.0 /-100.0 psf			
POSITIVE PRESSURE RANGE (psf)	0 – 50	0 – 60	0 – 130
AVERAGE CYCLE TIME (sec.)	1.9	2.2	1
NUMBER OF CYCLES	600	70	1
	4	5	6
NEGATIVE PRESSURE RANGE (psf)	0 – 50	0 – 60	0 – 130
AVERAGE CYCLE TIME (sec.)	2.3	2.6	1
NUMBER OF CYCLES	600	70	1

Test Specimen #3: Positive Cyclic Load per TAS 203

INDICATOR LOCATION	MAXIMUM DEFLECTION (in.)	PERMANENT SET (in.)	PERCENT RECOVERY	
			MEASURED %	ALLOWED %
2	1.40	.02	98%	> 90

Test Specimen #3: Negative Cyclic Load per TAS 203

INDICATOR LOCATION	MAXIMUM DEFLECTION (in.)	PERMANENT SET (in.)	PERCENT RECOVERY	
			MEASURED %	ALLOWED %
2	1.39	.02	99%	> 90

Note 5: See Sketch #1 for indicator locations. Deflection/permanent set reported is the overall deflection between three points (longest unsupported span) which accounts for support movement.

SECTION 9

CONCLUSIONS

The large missiles impacted each intended target. Each impact location was carefully inspected. No signs of penetration, rupture, or opening after the large missile impact test were observed; as such, each test specimen satisfies the large missile requirements of TAS 201 and ASTM E1996. Upon completion of testing, specimens tested for TAS 201-94 and ASTM E1996-20 met the requirements of Section 1626 of the Florida Building Code, Building.

No signs of failure were observed in any area of the test specimen during the TAS 202 testing; as such, the test specimen satisfies the requirements of TAS 202. Upon completion of testing, specimens tested for TAS 202-94 met the requirements of Section 1620 of the Florida Building Code, Building.

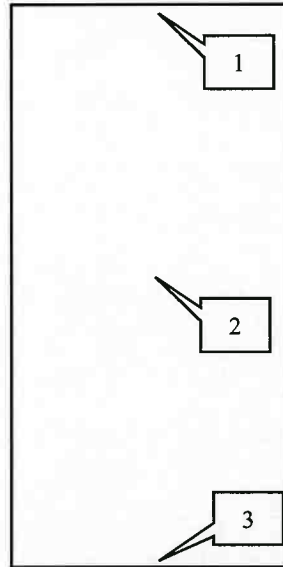
AND

No signs of failure were observed in any area of the test specimens during the cyclic load test; as such, the test specimens satisfy the cyclic load requirements of TAS 203 and ASTM E1886-19. Upon completion of testing, specimens tested for TAS 203-94 and ASTM E1886-19 met the requirements of Section 1625 of the Florida Building Code, Building.

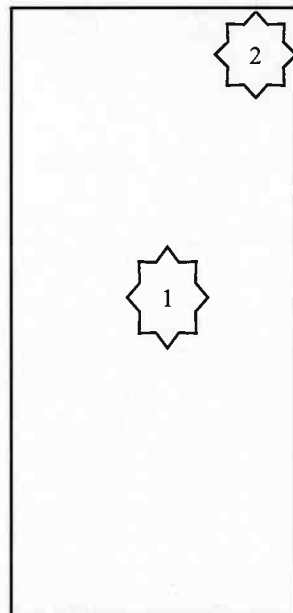
Unless differently required, Intertek reports apply the "Simple Acceptance" rule, also called "Shared Risk approach," of ILAC-G8:09/2019, Guidelines on Decision Rules and Statements of Conformity.

SECTION 10

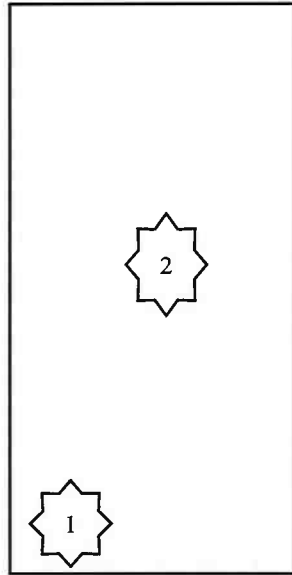
SKETCH(ES)



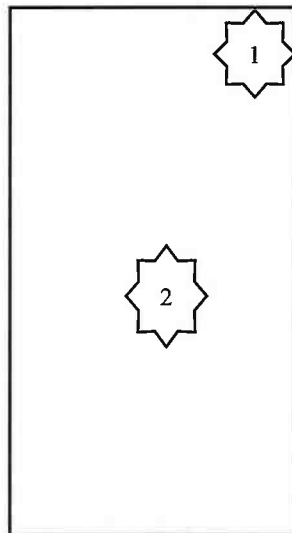
Sketch No. 1
TAS 202 Indicator Locations



Sketch No. 2
Test Specimen #1 TAS 201 Impact Locations



Sketch No. 3
Test Specimen #2 TAS 201 Impact Locations



Sketch No. 4
Test Specimen #3 TAS 201 Impact Locations

SECTION 11
PHOTOGRAPHS



Photo No. 1
Armorcore UI 752 Level 1 Panel

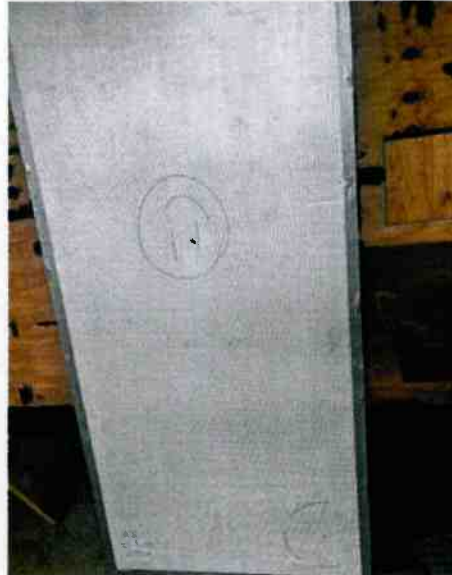


Photo No. 2
Armorcore UI 752 Level 1 Panel Post Impact

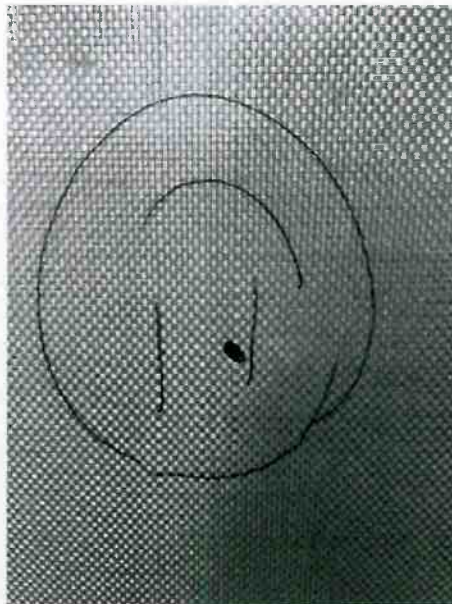


Photo No. 3
Armorcore UI 752 Level 1 Panel Impact 1



Total Quality. Assured.

TEST REPORT FOR ARMORCORE-WACO COMPOSITES

Report No.: Q9471.01-801-18-R0

Date: 04/30/24

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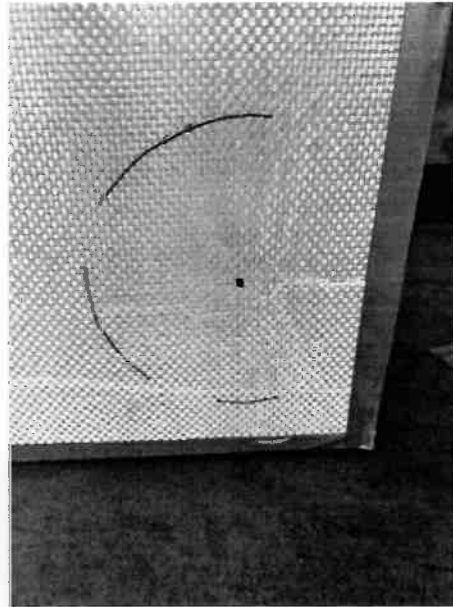


Photo No. 3
Armorcore UI 752 Level 1 Panel Impact 2



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TEST REPORT FOR ARMORCORE-WACO COMPOSITES

Report No.: Q9471.01-801-18-R0


Date: 04/30/24

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SECTION 12
DRAWINGS

The test specimen drawings have been reviewed by Intertek B&C and are representative of the test specimen(s) reported herein. Test specimen construction was verified by Intertek B&C per the drawings included in this report. Any deviations are documented herein or on the drawings.

Mechanical Properties

<i>Test</i>	<i>Method</i>	<i>Results</i>						
Tensile Tests:								
0° Tensile Strength	ASTM D5083	54,800 psi						
0° Tensile Elongation	ASTM D5083	1.95%						
0° Tensile Modulus	ASTM D5083	3.73 Msi						
90° Tensile Strength	ASTM D5083	46,120 psi						
90° Tensile Elongation	ASTM D5083	2.70%						
90° Tensile Modulus	ASTM D5083	3.21 Msi						
Flexural Tests:								
0° Flexural Strength	ASTM D790	22,030 psi						
0° Flexural Modulus	ASTM D790	3.24 Msi						
90° Flexural Strength	ASTM D790	20,580 psi						
90° Flexural Modulus	ASTM D790	3.21 Msi						
 <table border="1" data-bbox="1052 1304 1304 1388"> <tr> <td>Report #:</td> <td>Q9471.01-801-18</td> </tr> <tr> <td>Date:</td> <td>04/30/24</td> </tr> <tr> <td>Verified by:</td> <td>J. Crump</td> </tr> </table>			Report #:	Q9471.01-801-18	Date:	04/30/24	Verified by:	J. Crump
Report #:	Q9471.01-801-18							
Date:	04/30/24							
Verified by:	J. Crump							
Short Beam Shear Tests:								
0° Short-Beam Shear	ASTM D2344	1750 psi						
90° Short-Beam Shear	ASTM D2344	1880 psi						
Compression Tests:								
0° Compression	ASTM D695	13,440 psi						
90° Compression	ASTM D695	11,690 psi						
Specific Gravity	ASTM D792	2.08						

*0° = Longitudinal Direction
*90° = Transverse Direction



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TEST REPORT FOR ARMORCORE-WACO COMPOSITES

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SECTION 13

REVISION LOG

REVISION #	DATE	PAGES	REVISION
0	04/30/24	N/A	Original Report Issue



ARMORCORE

BULLET RESISTANT FIBERGLASS PANELS

LEED INFORMATION

MR Credit 4.1: Recycled Content

MATERIALS AND RECYCLED CONTENT

Post-Consumer Material – Waste material generated by households or by commercial, industrial and institutional facilities in their role as end-users of the product, which can no longer be used for its intended purpose.

Pre-Consumer Material – Material diverted from the waste stream during the manufacturing process. Excluded is re-utilization of materials such as rework, regrind or scrap generated in a process and capable of being reclaimed within the same process that generated it.

LEED CONTRIBUTION FROM ARMORCORE® By WACO COMPOSITES:
Unfortunately, at this time there is no recycled material in ArmorCore® Bullet Resistant Fiberglass Panels.

MR Credit 5.1: Regional Materials

Requirements – Use building materials or products that have been extracted, harvested or recovered, as well as manufactured, within 500 miles of the project site for a minimum of 10% (based on cost) of the total materials value. If only a fraction of a product or material is extracted/harvested/recovered and manufactured locally, then only that percentage (by weight) shall contribute to the regional value.

MR Credit 5.2: Regional Materials

Requirements – Use building materials or products that have been extracted, harvested or recovered, as well as manufactured, within 500 miles of the project site for an additional 10% beyond MR Credit 5.1 (total of 20%, based on cost) of the total materials value. If only a fraction of a product or material is extracted/harvested/recovered and manufactured locally, then only that percentage (by weight) shall contribute to the regional value.

LEED CONTRIBUTION FROM ARMORCORE® By WACO COMPOSITES:
Our manufacturing plant is located at 302 S. 27th St., Waco, TX 76710

EQ Credit 4.1: Low-Emitting Materials: Adhesives & Sealants Intent

Reduce the quantity of indoor air contaminants that are odorous, irritating and/or harmful to the comfort and well-being of installers and occupants.

LEED CONTRIBUTION FROM ARMORCORE® By WACO COMPOSITES:
This credit applies to all adhesives and sealants needed for the building interior (defined as inside the weatherproofing system and applied on-site).

ARMORCORE BY WACO COMPOSITES TEST REPORT

SCOPE OF WORK

ASTM C518 - 2021; STEADY-STATE THERMAL TRANSMISSION PROPERTIES BY MEANS OF THE HEAT FLOW METER APPARATUS ON UL752 LEVEL 3 BULLET RESISTANT FIBERGLASS

REPORT NUMBER

105710306MID-001REV1

TEST DATE(S)

02/05/24 - 02/07/24

ISSUE DATE

02/09/24

[REVISED DATE]

02/14/24

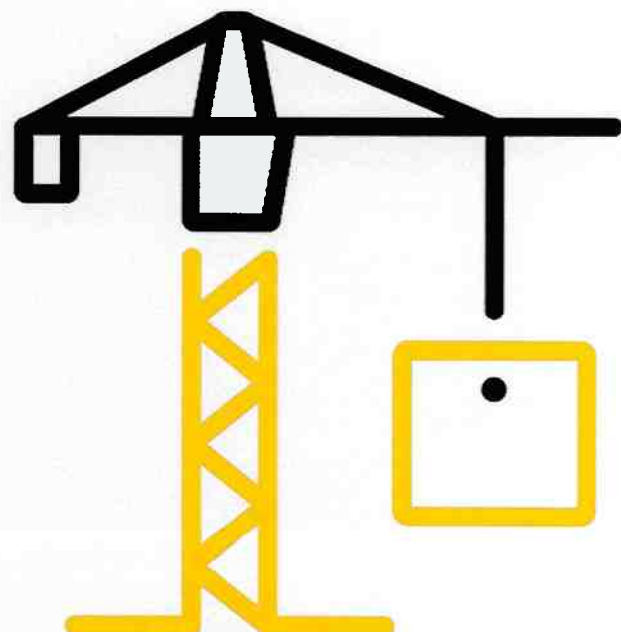
PAGES

4

DOCUMENT CONTROL NUMBER

GFT-OP-10c (09/29/20)

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TEST REPORT FOR ARMORCORE BY WACO COMPOSITES

Report No.: 105710306MID-001REV1

Date: 02/09/24

REPORT ISSUED TO

ARMORCORE BY WACO COMPOSITES

PO Box 20008

Waco, TX 76702-0008

SECTION 1

SCOPE

Intertek Testing Services NA, Inc. dba Intertek Building & Construction (B&C) was contracted by Armorcore by Waco Composites to perform testing in accordance with ASTM C518 - 2021; *Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus*, on their UL752 Level 3 Bullet Resistant Fiberglass. Results obtained are tested values and were secured by using the designated test method(s). Testing was conducted at Intertek test facility in Middleton, WI.

Unless differently required, Intertek reports apply the "Simple Acceptance" rule also called "Shared Risk approach," of ILAC-G8:09/2019, Guidelines on Decision Rules and Statements of Conformity.


Intertek B&C will service this report for the entire test record retention period. The test record retention period ends four years after the test date. Test records, such as detailed drawings, datasheets, representative samples of test specimens (where required by Certification or Accreditation bodies), or other pertinent project documentation, will be retained for the entire test record retention period.

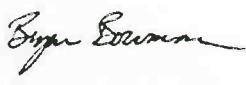
SECTION 2

SUMMARY OF TEST RESULTS

The standard has no specified performance requirements. The Thermal Resistance per inch is 3.71 Hr-ft²-°F/Btu/in (25.69 m²-K/W/m).

For INTERTEK B&C:

COMPLETED BY:	Sandy Osborne
TITLE:	Lab Technician I
SIGNATURE:	
DATE:	02/09/24

REVIEWED BY:	Bryan Bowman
TITLE:	Associate Engineer
SIGNATURE:	
DATE:	02/09/24

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TEST REPORT FOR ARMORCORE BY WACO COMPOSITES

Report No.: 105710306MID-001REV1

Date: 02/09/24

SECTION 3

TEST METHOD(S)

The specimens were evaluated in accordance with the following:

ASTM C518 - 2021; Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus Test Method-Year

ASTM D1622 – 2020; Standard Test Method for Apparent Density of Rigid Cellular Plastics

SECTION 4

MATERIAL SOURCE/INSTALLATION

Test samples were provided by the client. The results outlined in this report apply to the sample as received. Samples were received at the Middleton Evaluation Center on January 26, 2024 in good condition verified by Sample ID# MID2401261024-001.

SECTION 5

EQUIPMENT

The measure of uncertainty cannot be determined due to the thinness of the material. The samples were tested horizontally in a testing chamber sealed from ambient on all sides. The heat flow direction is vertically downward with 4" by 4" heat flux transducers on both the hot and cold surfaces of the sample.

EQUIPMENT			
DESCRIPTION - ASSET #:	6" Caliper - 1542	CALIBRATION DUE:	1/10/2025
DESCRIPTION - ASSET #:	24" Caliper-1394	CALIBRATION DUE:	4/5/2024
DESCRIPTION - ASSET #:	Ohaus Scale - 62074	CALIBRATION DUE:	10/5/2024
DESCRIPTION - ASSET #:	Temp/Humidity Sensor - 1456	CALIBRATION DUE:	3/7/2024
DESCRIPTION - ASSET #:	Temp/Humidity Sensor - Samp Rm 1451	CALIBRATION DUE:	3/7/2024

EQUIPMENT			
DESCRIPTION - ASSET #:	Thermal Chamber -Netzch HMF436 - 1266	VBU:	2/5/2024
DESCRIPTION - ASSET #:	Temp/Humidity Recorder- 1455	CALIBRATION DUE:	3/7/2024
DESCRIPTION - ASSET #:	Temp/Humidity Recorder- Samp Rm-1451	CALIBRATION DUE:	3/7/2024
DESCRIPTION - ASSET #:	Reference Standard - 1450d #274-3		

SECTION 6

TEST PROCEDURE

Testing was conducted in accordance with Section 7-Procedure of the standard. There were no deviations from the standard.

SECTION 7

TEST CRITERIA

The standard has no specified performance requirements regarding pass/fail criteria.

TEST REPORT FOR ARMORCORE BY WACO COMPOSITES

Report No.: 105710306MID-001REV1

Date: 02/09/24

SECTION 8

TEST SPECIMEN DESCRIPTION

A single panel approximately 12" x 12" x 0.5" of fiberglass composite material off-white in color was provided. Specimens were conditioned a minimum of 24 hours at 23 ± 2°C and 50 ± 10% Relative Humidity prior to testing.

SECTION 9

TEST RESULTS

SPECIMEN MEASUREMENTS							
Specimen	Length (mm)	Width (mm)	Depth (mm)	Depth	Weight	Density	
	Avg.	Avg.	Avg.	Avg. (in)	(kg)	(kg/m ³)	(lbs/ft ³)
1	304.04	304.21	11.81	0.4650	2.26790	2075.91	129.60

Test Information	Thermal Conductivity (K Value)		Thermal Resistance (R Value)		Thermal Resistance (R/in)	Thermal Resistance (R/m)	Thermal Conductance (U)	Heat Flux (q)
	Btu-in/hr-ft ² -°F	W/m-K	Hr-ft ² -°F/Btu	m ² -K/W	Hr-ft ² -°F/Btu/in	m ² -K/W/m	W/m ² -K	W/m ²
Run 1	0.276756	0.03992	1.68343	0.2965	3.61	25.05	3.37	72.60
Run 2	0.272464	0.03930	1.70812	0.3008	3.67	25.45	3.32	71.58
Run 3	0.260845	0.03762	1.78612	0.3146	3.83	26.58	3.18	68.53
Average	0.270022	0.03894	1.72589	0.3039	3.71	25.69	3.29	70.90

Test Information	Duration of the Measurement	Measured Thickness		Delta Temperature		Mean Temperature		Temperature Gradient	
	min	in	m	°F	°C	°F	°C	°F/in	°K/m
Run 1	0:56:21	0.466	0.011834	38.74	21.52	76.26	24.59	84.79	44.12
Run 2	0:57:22	0.465	0.011821	38.76	21.53	75.99	24.44	83.90	43.84
Run 3	0:58:08	0.466	0.011834	38.80	21.56	76.18	24.54	84.18	43.93
Average	0:57:17	0.466	0.011830	38.77	21.54	76.14	24.52	84.29	43.96

SECTION 10

CONCLUSION

The standard has no specified performance requirements.

SECTION 11

REVISION LOG

REVISION #	DATE	SECTION	REVISION
0	02/09/24	N/A	Original Report Issue
1	2/13/24	Cover, 1	Per client changed company name from Specialty Composites Group, LLC to Armorcore by Waco Composites

Certificate of Analysis Moisture Absorption of Fiberglass Panel Materials

Epoxy Specific VS Starch Oil Sizing

1. Test Description

Waco Composites Ltd. worked alongside of the Baylor University Department of Engineering to compare the moisture absorption characteristics of two types of fiberglass used to produce Antibalistic panels. Fiberglass properties are vastly influenced by the sizing used when manufacturing the material. This test determined the wicking properties of the Epoxy specific sized fiberglass found in ArmorCore® as well as the same properties for Starch Oil sized fiberglass.

2. Method

Two samples of each material were prepared by cutting samples out of larger sheets made in regular production cycles. These samples were prepared so that they had similar cross sections and lengths as well as similar fiber grain alignment. Each sample was then weighed. Two tests were then performed.

First, a sample of each material were placed upright in a container and filled with water until each sample was halfway submerged. After an extended period of time, both samples attained saturation and were then removed and weighed. This test limits the amount of surface area exposed to the water and is therefore the better test of the two for evaluating wicking properties.

Second, the other two samples were fully submerged in water and also allowed to soak to saturation. They also were then removed and weighed. This test is designed to highlight the potential amount of water retention per weight of both materials. Both tests were repeated several times and the percent increase in weight was recorded.

3. Results

The ArmorCore® panels absorbed substantially less water in both tests than the Starch Oil Equivalent. The recorded average values are included below

Sample #	Test	Material	% Wt Increase
1	Submerged	E-Specific	0.96
2	Submerged	Starch Oil	2.10
3	Not Submerged	E-Specific	0.53
4	Not Submerged	Starch Oil	0.87

TABLE 1 - TEST DATA



TO: Wayne Hampton
FROM: Chris Bailey
DATE: May 5, 2008
SUBJECT: Moisture Absorption in ArmorCore (rough draft)

Introduction:

I was asked to determine the moisture absorption properties of ArmorCore by Waco Composites and a competitor's composite. Samples of both were submerged and the weight gain was measured. From this, the percentage weight gain was calculated.

Method:

Test specimens were bars cut about 3" long, 1/2" wide, and 1/4- 1/2" thick. Both the ArmorCore samples and competitor's samples were cut in the same direction.

The initial weights of the samples were measured. Samples were allowed to soak to saturation. One sample of each brand placed upright, half-submerged in a separate tub. After a sufficiently long time, each sample was weighed and the percentage weight gain calculated. This was performed several times and the average values calculated.

Results:

I found that the ArmorCore samples submerged absorbed around 1% of their weight in water. The competitor's samples absorbed around 2%.

As for the upright samples, water diffused up the beam through capillary action. This effect is quite complicated and I do not have sufficient tools to analyze the diffusion completely. However, the data shows, once again, that the competitor's samples will absorb more water.

Percent Weight Absorption

Material	Avg. Percent Absorption
ArmorCore- Submerged	0.96
Competitor- Submerged	2.10
ArmorCore- Not submerged	0.53
Competitor- Not submerged	0.87

The competitor's brand consistently soaked in twice as much water as ArmorCore. However, the amount of moisture absorbed was a small portion of the weight of the material.

This experiment does not evaluate the effect moisture absorption has on the mechanical properties of the materials.



Waco Composites Warranty Policy

This warranty statement is issued to the original purchaser and applies only to ArmorCore® Bullet Resistant Fiberglass Panels which have been used for their intended purpose, within designed capacities, and not subject to abuse, misuse, and/or improper installation.

All ArmorCore materials and workmanship shall be warranted against defects for a period of ten (10) years from the date of substantial completion.

We will repair or replace ArmorCore Panels at our discretion, found upon our inspection, to be defective in material or our workmanship for up to ten (10) years from the date of substantial completion.