



Why use "Glass" in a FEMA shelter

You're in a crowded tornado shelter, full of crying children. You have been in there for nearly half an hour. You need to know what's going on. You wait as long as you can – they are starting to scream – communication is down. You open the door to "just take a peek" – just as the tornado hits.

You needed first hand situational awareness – you needed glass. "But how can glass be strong enough for a tornado?" you ask. "I'd rather have concrete and steel."

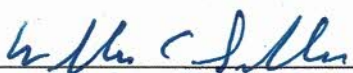
The Wind Science Laboratory in Austin, Texas, travels to the site of every storm to calculate peak wind loads and strength of impacts during the storm. They then add a 20% safety factor on top of these numbers. These calculations are then transformed into laboratory tests which can be performed to equal what they have seen in the field. Every item used in construction of shelters must pass these same testing standards – including glass. By the way, the impact tests represent 5,000 times more energy than standard hurricane testing – very impressive!

"But any glass this strong would be hard to see through." Some is, but our FEMA clear IGU glazing has a Visible Light Transmittance of 74%, and the 15-pound 2 X 4 traveling at 100 mph just bounces off – very impressive indeed!

We are now testing a new concept for FEMA glazed doors, focusing on minimum changes to standard door designs. This will make manufacturing and installation simpler – eventually lowering cost. We expect these doors to function just like a "normal" door – and, of course, they will use the same high-visibility impact glazing as our windows.

So, don't be afraid to use "glass" in tornado shelters. The level of protection is the same as any other construction products used on the shelters, the shelter does not need to look like a "dungeon" attached to the side of a beautiful building, and the visibility offers real-time situational awareness – which can – in the end – make all of the difference in the world.

Camp LeJeune (Figure 1) was our first FEMA window installation, which also required explosion protection. The FEMA shelter (Figure 2) presented a unique challenge with a 58-foot-tall EF-5 window wall system. Figure 3 illustrates FEMA glazing in another EOC (note the date stamp). The beachfront hotel in Ft. Lauderdale (Figure 4) survived a Category 5 hurricane (Wilma) and was open the next day. The EOC in Tampa, FL (Figure 5), used the first EF-5 glazed door every installed. Our latest installation is the High School gymnasium in Hennessey, OK (Figure 6). This doubles as a basketball court for the "Fighting Eagles" as well as the community tornado safe room. It features a conventional-looking storefront entrance and windows on all sides, providing a 360° view of the situation outside without jeopardizing safety – very well done.



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Figure 1. Camp LeJeune, VA, Pre-trial Facility

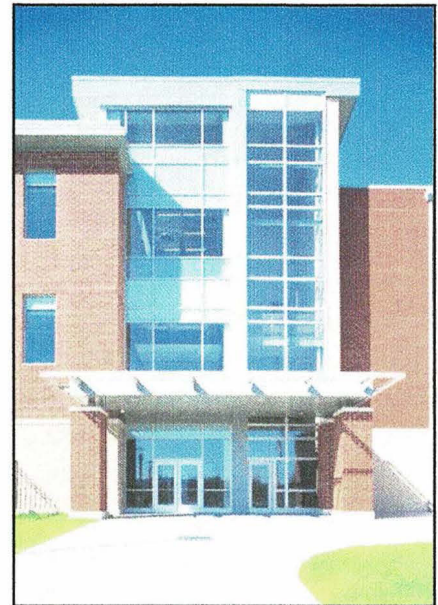


Figure 2. Penn. Emergency Management (PEMA)



Figure 3. Emergency Ops Center, Seminole, FL

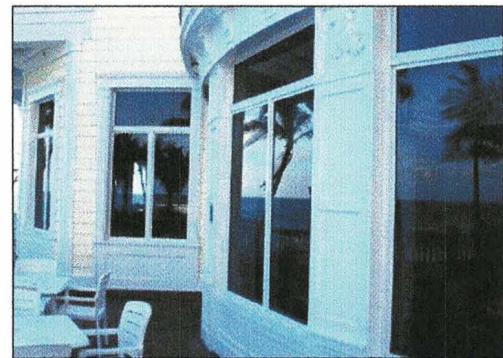


Figure 4. Beachfront Hotel, Ft. Lauderdale, FL



Figure 5. St. Charles Emergency Operations Building, LA

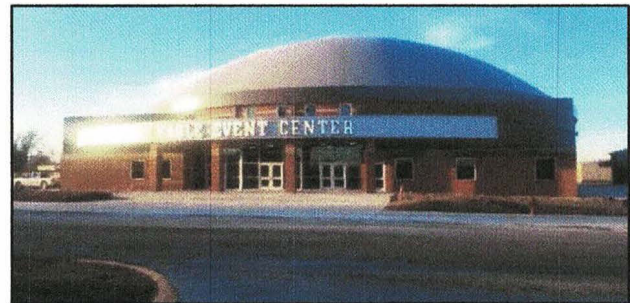


Figure 6. Gym/FEMA Shelter, Hennessey, OK

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Specifications

- **Windows**
- **Doors**
- **Glazing**

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Now Fully Tested per ICC 500-2014

FEMA SHELTER COMPLIANT PER ICC-500/FEMA 361				
CITADEL PRODUCTS 5000 SERIES WINDOW				
Threat	Threshold Level	Requirements	Testing Protocol	Results
Hurricane	210 mph wind zone*	Large Missile Impact 9# @ 125 mph**	ASTM E 1886	Pass
		Pressure Cycling @ +110/-130 psf (9000 cycles)	ASTM E 1886	Pass
Tornado	EF-5 Tornado***	Structural Design Pressure @ ±250 psf	ASTM E 330	Pass
		Structural Test Pressure @ 1.2(250) ±300 psf	ASTM E 330	Pass
		Large Missile Impacts 15# @ 100 mph	ASTM 1886	Pass
Air/Water	Environment	Air Infiltration @ 1.57 psf		<0.01 cfm/ft ²
		Air Infiltration @ 6.24 psf		<0.01 cfm/ft ²
		Water Infiltration @ 20.0 psf		Pass
Ballistic Resistance	9 mm Lugar (7 shots)	ISO 17025 Level 6	ANSI/UL 752-2005	Pass

* Category 5 hurricanes start above 156 mph (meets new standard for FEMA hurricane shelter)

**Actual Impacts 15# @ 100 mph

***Fully compliant with FEMA 361-2015 requirements

Window Features

- < Fully compliant with ICC 500-2014 & FEMA 361-2015
- < Storefronts and curtain walls available with mullions
- < Largest single size tested 40 sq. ft.
- < Smallest single size tested 4 sq. ft.
- < Available with ballistic protection LEVEL VI
- < Transparent glazing (74% VLT)
- < Fully tested up to 210 mph hurricane FEMA shelter



Window Design

- < Window perimeter frame is 2" X 5"
- < Window intermediate vertical mullion is 2" X 10"
- < Fully concealed fasteners and hair line joints
- < 6063-T6 alloy and temper
- < Anodized or painted finishes
- < Accepts 3/4" to 2" thick glazing
- < Window anchoring requirements by certified PE

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Survivalite Impact Systems

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CITADEL PRODUCTS 5000 SERIES WINDOW				
Threat	Threshold Level	Requirements	Testing Protocol	Results
Tornado	EF-5 Tornado	Structural Design Pressure @ ± 250 psf	ASTM E 330	Pass
		Structural Test Pressure @ $1.2(250) = \pm 300$ psf	ASTM E 330	Pass
		Large Missile Impacts 15# @ 100 mph	ASTM 1886	Pass
Air Infiltration	6.24 PSF	.039 cfm/sq.ft.	ASTM E 331-04	Pass
Water Infiltration	37.5 PSF	15 min. Duration	ASTM E 332-00	Pass
Forced Entry	300 lbs.	300 lb. point load @ specified locations	AAMA 1304	Pass

* Category 5 hurricanes start above 156 mph (meets new standard for FEMA hurricane shelter)

**Actual Impacts 15# @ 100 mph

Door Features

- < Double doors up to 8 ft. X 8 ft.
- < Single doors down to 3 ft. X 7 ft.
- < Panic Bar activates **ALL** latches
- < ADA threshold: 1/2 inch
- < Compatible with electronic latches, openers and closers
- < No center mullion
- < Transparent glazing (74% VLT) provided by SAF-GLAS



Door Design

- < Rough opening up to 100" X 100"
- < 7" deep receptor frame
- < 6065-T6 alloy and temper
- < Shipped fully assembled ready for installation
- < Anodized or painted finishes
- < Door anchoring requirements by certified PE

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SAF-GLAS, LLC SPECIFICATION FOR GLASS CLAD POLYCARBONATE

1-5/8" Tornado , Physical Attack, Bomb, BR and Terror Glass

The intent of this specification is to clearly define the correct product and protocol. A format and specific data are named in this text to aid in the specification of a chosen product.

Product description: Ballistic, Saf-Glas GCPC, Tornado Hurricane, Physical Attack, Bomb blast resistant.

Frame per specification supplied, glass make to be: { $\frac{1}{4}$ " clear H.S. glass x $\frac{1}{4}$ " ANN glass x $\frac{1}{4}$ " ANN glass x 13/16" SAF-GLAS Tornado TNT: 1-5/8"}

Saf-Glas is a glass clad polycarbonate consisting of one or more plies of polycarbonate, two or more plies of patented bonding film, glass and / or glass ceramic. Saf-Glas thickness of product ranges from $\frac{1}{4}$ " through 3-1/2". Saf-Glas GCPC is fabricated as a defense against bullet, bomb blast, forced entry, fire, hurricane, typhoon, tornado, earthquake or any other threat of a man-made or natural origin. Saf-Glas can be also laminated for photovoltaic solar cell, hologram and for all other nano tech products utilizing glass.

Saf-Glas Standard Composition: [Glass x Bonding Film x Polycarbonate x Bonding Film x Glass]

1. Glass thickness: [2.5mm].
2. Glass type: [HS]
3. Glass color: [Clear] offered by float glass manufacturers.
4. Coatings: [N/A].
5. Glass Ceramic: [N/A].
6. Bonding Film: [Saf-Glas Patented]
7. Bonding Film Thickness: [0.025"].
8. Bonding Film Color: [Clear].
9. Polycarbonate Thickness: [0.25" , 0.75"].



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10. Polycarbonate Color: [Clear].

Interlayer Performance Data:

- 1. Tensile Strength: 10,400 psi [ASTM D-638]**
- 2. Tensile Modulus: 351,000 psi [ASTM D-638]**
- 3. Flexural Strength: 14,200 psi [ASTM D-790].**
- 4. Flexural Modulus: 351,000 psi [ASTM D-790].**

References:

[ASTM International] American Society for Testing and Materials

Applicable ASTM Standards: [C 1036], [C 1048], [C 1172], [C 1349], [C 1376], [C 1464], [E 1300]

[GANA] Glazing Association of North America; [Full manual inclusive of table IV & 01-0300].

[ANSI] American National Standards Institute; [ANSI Z97.1 – 2004].

[ASCE] American Society of Civil Engineering; [ASCE 7-98].

[CPSC] Consumer Product Safety Standard; [16 CFR 1201].

[UL] Underwriters Laboratories; [UL -9].

[HP White] Human impact

[ASTM F – 1642] Air blast Loading Dept of the Army

[GSA] Air blast Loading “D” & Quantico Arena Handgrenade / Claymore mine.

[USACE-SEM] Security Engineering

[PAS RANGE] .38 mm hand gun

[FEMA] Tornado

[NIJ] BR Level (3A) 762 NATO



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[PAS RANGE BR] 7.62 NATO, AK 47

Format:

- 1. General project submittal requirements to levels, pressures or other.**
- 2. Specified product data and approvals.**
- 3. Samples (2) 12" x 12" square.**

Quality Assurance Standards:

- 1. Miami Dade County Quality Assurance Manual.**
- 2. Wilfred Baker Engineering Files GSA Blast 1-4.**
- 3. HP White Laboratories .**
- 4. OSHA Guide lines manufacturing**
- 5. FEMA**

Qualification:

- 1. Provide test reports for specified product to meet or exceed requirement.
{Hurricane, Bomb Blast, Physical Attack}.**
- 2. Warranty specification.**
- 3. Compatibility of materials regarding the assembly.**

Storage:

- 1. Stored goods pursuant to fabricated guidelines and warranty supplied upon order.**
- 2. Stored goods in a well ventilated shaded area under roof and out of weather.**



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3. **Store goods no longer than (30) days.**

Performance Values:

1. **Visible Light Transmittance: 74%**
2. **U – Value: .39**
3. **Solar Heat Gain Coefficient: .64**
4. **Shading Coefficient: 0.83**
5. **Solar Trans: 54%**
6. **STC Rating: 41dB**
7. **Weight per square foot: 8.1 lbs / sq. ft..**

Warranty:

1. **Specified duration and terms (20) years.**

Glazing Installation:

1. **Sealants type: GE 4000 or equal.**
2. **Tape type: Preformed butyl, 110-15 Shore A hardness or equal.**
3. **Gaskets type: Neoprene, silicone or equal.**
4. **Setting blocks type: EPDM or silicone blocks, 40-50 Shore A durometer hardness.**
5. **Spacers type: Neoprene, EPDM or silicone spacers, 40-50 Shore A durometer hardness.**
6. **Edge blocks type: Neoprene or equal.**
7. **Cleaners, Primers and sealers: Neutral non aggressive, see manufacturers recommendations for each application.**