2016 EDITION

Handbook of FIRE-RATED GLASS for schools

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THE RULES HAVE CHANGED.

For decades, traditional wired glass has been the most common fire-rated glass product specified for schools in North America.

It provides economical and reliable fire protection, and for years was the only product available that could do the job. The catch is it can't tolerate much impact. When traditional wired glass breaks, the wires can form snags that are capable of inflicting serious injury.

So, while buildings codes typically restrict the use of low-impact safety glazing products in high traffic areas, the absence of a fire-rated glazing material with the desired impact safety performance led to an exemption. Building code officials deemed wired glass suitable for use in areas requiring fire protection and high-impact safety protection.

The good news is choosing fire safety over impact safety is no longer a tradeoff building and design professionals need to take. With the introduction of clear, wireless fire-rated glazing materials that provide superior fire and impact protection, the International Code Council (ICC) decided to lift the long-standing impact exemption for wired glass in the International Building Code (IBC). In 2003, the IBC restricted traditional polished wired glass from hazardous locations in schools, athletic facilities and daycares. As of the 2006 IBC, the restriction has extended to include hazardous locations in all types of buildings.

This change had far-reaching implications. More stringent fire and life safety standards and clear, fire-rated glazing alternatives have revolutionized the way fire-rated glazing is used in schools. The following pages answer some of the most common questions raised as a result of these developments.

FIRE-RATED GLAZING 101

What distinguishes fire-rated glass from ordinary glass?

Like most glass, fire-rated glazing allows light and visibility for aesthetic or security reasons. But fire-rated glass does something more: It has been tested to act as a barrier to the spread of flames and smoke. In the world of fire protection, this is known as "compartmentation."

Unlike sprinklers or other "active" protection systems, fire-rated glass does not require activation in order to protect against fire. If there is a power failure, a loss of water pressure, or a human error that interferes with the sprinklers working properly, fire-rated glass will not be affected and will continue to perform as needed. Staying in place during a fire may sound like a fairly simple task, but no ordinary glass can do it.

What testing does glass have to pass to earn a fire rating?

To receive a fire rating, glass must first pass a fire test. In this test, the glass and framing are installed in a test furnace at an independent test laboratory, such as Underwriters Laboratories, Inc.® (UL). The fire is ignited and temperatures are measured on the surface of the glass. After only 5 minutes, temperatures in the furnace reach nearly 1,000° F (ordinary window glass can withstand temperatures of approximately 250° F.) After one hour, they reach nearly 1,700° F. Ratings are given based on the length of time the glass remains intact, from 20 minutes to 3 hours.

At the conclusion of the fire test, to achieve a rating greater than 20 minutes, the glass must pass a mandatory hose stream test during which testing labs spray the glass with water from a two-man fire hose. This tests the ability of the glass and framing system to stay in place if impact pressure or thermal shock cause structural damage. It also helps prove the glass will stay in its protective position to block flames and deadly smoke, if subjected to the cooling effects of water from sprinklers or fire extinguishers. According to NFPA 257, "the cooling, impact, and erosion effects of the hose stream provide important tests of the integrity of the specimen being evaluated."

When using glass in fire-rated locations, is impact safety glass always required?

No. Building codes clearly define where impact safety glass is required, such as doors, sidelites and windows near the floor, as discussed in the following section, “Cracking the Code.” In these areas, any fire-rated glass product would also need to be impact safety-rated.

In areas where human contact is not a concern (e.g., transoms, some windows), glass with an impact rating is not required. For these applications, fire-rated glass products are available without impact safety ratings. They generally cost less than glazing that provides both fire and impact protection.

However, keep in mind that schools are high activity areas that can present abnormal situations. A window in the middle of a school wall that doesn’t technically require impact safety ratings may still fall victim to the energy of students pushing and shoving. Therefore, it may be best to err on the side of caution and use an impact safety-rated product even when codes don’t demand it.

CRACKING THE CODE

What does the IBC say about impact safety today?

The 2012 International Building Code (IBC) clarifies impact loads, required impact tests and hazardous locations for glass. Since sections 2406.1, 2406.2 and 2406.4.1 through 2406.4.7 do not list wired glass as an exemption, traditional wired glass is not allowed in safety impact areas.

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IBC 2012 SECTION 2406 SAFETY GLAZING

2406.1 Human impact loads: Individual glazed areas, including glass mirrors, in hazardous locations as defined in Section 2406.4 shall comply with Sections 2406.1.1 through 2406.1.4.

2406.2 Impact test: Where required by other sections of this code, glazing shall be tested in accordance with CPSC 16 CFR 1201. Glazing shall comply with the test criteria for Category II, unless otherwise indicated in Table 2406.2 (1).

2406.4 Hazardous location: The locations specified in Sections 2406.4.1 through 2406.4.7 shall be considered specific hazardous locations requiring safety glazing materials.

What does the IBC consider to be a hazardous location for glazing?

The IBC clearly defines hazardous locations where impact safety glass is required in section 2406.4. Common applications for high-impact glass are doors, sidelites, glass located near the floor, and other “hazardous locations.”

THE TESTING GROUND

What test determines whether glass provides impact safety?

The impact safety test. During this test, a piece of glass is mounted in a vertical frame. A punching “speed” bag is filled with 100 pounds of lead shot (similar to BB’s found in shotgun shells).

This very heavy bag is hung from a cable and swung, in pendulum fashion, from various heights to impact the glass. The velocity of the bag, at high impact levels (CPSC 16CFR 1201 Category II), corresponds to the impact of a full grown adult running into the glass. To qualify for an impact safety rating, glass must either not break, or break in a safe manner (e.g., no large shards).

Are there different levels of impact safety for glazing materials?

Yes. This issue is extremely important in schools and relates to the impact safety test and the level from which the impact bag is dropped. The various impact ratings are very revealing. Let's start with the most common level of impact safety and work our way to lower levels.

48-inch drop

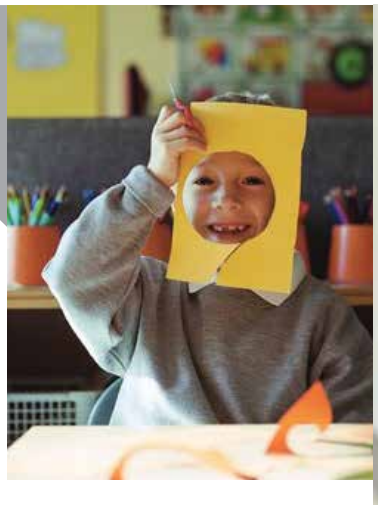
This represents 400 ft. /lb. of impact, and is called "Category II" by the U.S. CPSC (Consumer Products Safety Commission). It is the highest level of required impact safety. This represents the impact of a full-grown adult running into the glass, and receiving insignificant or no injury. With few exceptions, all tempered or laminated safety glass in use today falls into this category. More important, there are numerous products available today that meet this impact rating and also offer high levels of fire protection.

18-inch drop

This represents 150 ft. /lb. of impact, and is called "Category I" by the CPSC. Glass that can only meet this test is limited to a maximum size of 9 square feet per lite. The 18-inch drop approximates the impact from an 85 lb. child running into the glass.

12-inch drop

This represents 100 ft. /lb. of impact and was created as an exception for wired glass. This impact level, which could only protect very small children, is now prohibited from use in ALL types of buildings (including educational facilities) as of the 2006 IBC.



BEYOND IMPACT SAFETY

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If, due to the International Building Code (IBC), I'm no longer using traditional wired glass in hazardous areas, what products are available?

There are two primary categories of alternatives to wired glass: "fire-protective" glazing and "fire-resistive" glazing. Let's start with fire-protective glazing, the original type of fire-rated glazing.

Fire-protective glazing

Fire-protective glazing defends against the spread of flames and smoke for its designated fire rating period. Depending on the product, it is available with fire ratings from 20 to 90 minutes (up to 3 hours in small door lites), up to Category II impact requirements and in large sizes.

Today, there are several fire-protective glazing products with or without wires that make outstanding alternatives to traditional wired glass. Material options include advanced wired glass with a surface-applied film or fire-rated glass ceramics. They fit in standard fire-rated frames and provide exceptional surface clarity for enhanced visibility between interior spaces.

Since many fire-protective glazing products can be cut and labeled locally throughout North America, availability is nearly immediate.

Fire-resistive glazing

Fire-resistive glazing adds an extra line of defense by also limiting the transfer of heat through the glass. This safeguard makes it suitable for use in walls, doors and other fire-rated assemblies designated to block the passage of excessive heat, hot gases or flames. Many fire-resistive glazing products also meet the Category II impact requirements.

Because fire-resistive glazing is tested to the same standards as solid barrier walls, it is not limited to 25 percent of the opening (as is fire-protective glass). This allows for virtually unlimited expanses of glass and eliminates the need for opaque materials such as masonry or gypsum in areas that require fire-rated walls.

Fire-resistive glass products are generally multi-laminates incorporating many layers of glass with fire-resistive interlayers. Numerous compatible fire-resistive-rated framing options are available, including those with a slender profile and sleek aesthetic.

THINK AHEAD

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What special considerations should be taken into account when choosing fire-rated glazing for schools?

Schools are unique in the construction industry because they raise several issues that typically do not arise with other occupancies.

High Activity

Educational facilities are subject to greater activity than a typical office building. The frequent movement of students throughout the day means that impact safety must be a high priority.

Abuse

School hallways and common areas are often defaced, either intentionally or unintentionally. The fire-rated glazing chosen should be durable. Products relying on a surface film for impact safety may not be the best choice for these locations (consider the effects of daily cleaning from janitorial crews, or frequent impact from students).

Maintenance

For building and life safety (not to mention legal considerations), damaged products must be replaced or repaired in short order. Be sure the product you choose will be durable and available locally.

Longevity

Schools are expected to operate for many years. Since school construction and maintenance budgets are tight, it is very important that building products stand up over time.

Why not just apply a safety film to wired glass in hazardous locations?

As mentioned before, schools are more prone to abuse than many other types of facilities. Even the toughest films can be marred, cut or peeled. The film can be damaged by vandals, unintentionally by maintenance personnel or just daily use.

When the film is damaged, it not only is unsightly -- it can impair the performance ability of the product and render the impact ratings invalid. It's also important to note that not all surface-applied film is fire-rated. If you do choose to use a filmed product, make sure

Choose safety over savings in fire-rated exit corridors

In certain instances, the IBC grants an exemption for one-hour, fire-rated exit corridors in educational occupancies and does not require fire-rated materials when automatic sprinklers are in place.

The theory is that shifting money from building compartmentation to sprinklers is an effective and affordable way to protect students and teachers against fire. However, not adding fire-rated materials to exit corridors eliminates crucial backup protection in instances where sprinklers do not perform as intended.

According to National Fire Protection Association (NFPA) data, sprinklers fail approximately one-in-ten times. Since passive fire-rated materials like fire-resistant-rated glass do not require activation to perform as intended, they can work to control a fire's spread with – or without – sprinkler systems.

In the event that a sprinkler fails to perform as intended during a fire, these materials help ensure students and faculty can safely pass through the hall and out the door.

With communities desiring safe school environments, isn't the minimal cost increment worth the improved protection for students and faculty?

it has been tested for fire and impact, and is listed by an independent testing agency.

We are not opposed to the use of surface-applied film, we even sell a fire-rated product that has a film applied for impact safety. However, for maintenance reasons, we do not recommend its use in high traffic areas such as schools.

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CHOOSE FIRE-RATED GLASS & FRAMING THAT MAKES THE GRADE

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What specific products do you recommend for consideration in schools requiring fire protection?

To select the best fire-rated glazing product for a given school, we recommend breaking down applications by their required fire and impact safety protection, performance and design standards.

Fire protection

In non-impact areas required to provide fire protection, we recommend FireLite® fire-rated glass ceramic. At only 3/16" thick, it easily fits into new or existing fire-rated frames to integrate with design schemes and save labor costs from custom orders. It can be cut locally throughout the U.S. and Canada for quick delivery.

Fire protection and impact safety

For high traffic, "hazardous" locations that previously used wired glass to provide fire protection, we recommend FireLite Plus®. It meets the CPSC 16 CFR 1201 (Category II) impact requirements. The high impact laminating materials are sandwiched between two lites of clear glass ceramic, so both exposed surfaces are durable. FireLite Plus can also be cut with normal glass cutting tools, which means it can be delivered quickly from school maintenance personnel or local glazing contractors.

WireLite® NT is another alternative. This 1/4" thick product is composed of wired glass and a high performance, fire-rated surface-applied film that allows it to meet Category I and II impact levels—which earlier forms of wired, fire-rated glass were not able to do. As with any glass product using a surface-applied film, a best practice is to install it in areas where heavy use or high traffic will not mar or damage its surface-applied film.

Protection against heat transfer

For areas requiring fire-resistance-rated construction (materials that block heat transfer during a fire), we recommend Pilkington Pyrostop®. It is available in a broad range of make-ups for interior and exterior use, with ratings from 45- to 120-minutes. It passes the fire and hose stream tests and blocks significant amounts of heat. This extra layer of defense can buy extra time for students and faculty to safely exit busy educational facilities even if a fire should rage on the opposite side of the glass. In addition, since Pilkington Pyrostop offers up to Category II impact safety ratings, it is suitable for fire-resistant applications requiring impact safety protection.

When using fire-resistance-rated glazing such as Pilkington Pyrostop, it's important to remember the selected framing must also function as a barrier to heat transfer and meet ASTM E- 119 and UL 263 test requirements. The IBC requires all glass and frame components to have the same or greater ratings than the required code minimums to ensure the entire assembly provides the same level of defense during a fire. TGP offers a broad range of sleek, fire-rated frames that meet ASTM E-119 and UL 263 standards, including Fireframes® Heat Barrier Series, Fireframes® Aluminum Series, Fireframes® Hardwood Series and Fireframes® Curtainwall Series.

Bullet resistance

In fire-rated applications where bullet resistance is desirable to improve school safety, we recommend Pilkington Pyrostop fire-resistant glass. It is available with up to Level III bullet resistance ratings, without the flammability issues that may come from some security glazing products in fire conditions. The composite layers in many traditional bullet-resistant glass are flammable, potentially causing further injury and property damage in a fire.

Daylight

In schools where it is important to support student and teacher well-being through daylighting design, we recommend using advanced glazing products like Pilkington Pyrostop that pass the test standards for solid walls and are not restricted to 25 percent of the total wall area. Building teams can use such glazing in interior and exterior floor-to-ceiling, wall-to-wall or multi-story curtain wall applications while protecting students and property from the high heat generated by building fires. For more efficient solar energy management, it is available with fire-rated insulated glass units (IGUs) incorporating tinted or low emissivity glass.

Fire-rated glass floor systems are also available to transmit daylight in applications requiring a code-approved fire barrier between floors. Products such as the Fireframes ClearFloor® System can facilitate views and increase admissible daylight while supporting structural loads and blocking flames, smoke and heat.

Fire-rated frame aesthetics

Building and design teams can now select from numerous fire-rated glazing systems that align with a school's overall design theme. Whether it is important to complement non-fire-rated frames or make a design statement, we recommend selecting slender fire-rated framing systems with well-defined corners and crisp edges. Options include the Fireframes® Heat Barrier Series, Fireframes® Designer Series, Fireframes® Aluminum Series, Fireframes® Hardwood Series and Fireframes® Curtainwall Series. The narrow-profile frames can be custom painted or powder coated to match virtually any color scheme, and are available with finished stainless steel or aluminum custom cover caps to provide design professionals with even greater aesthetic flexibility.

In areas where a frame-free exterior surface is desirable, we recommend the Fireframes SG Curtainwall® Series. Its toggle retention system becomes completely hidden once installed, creating a seamless, uninterrupted surface appearance.

THE RIGHT INVESTMENT

Aren't the newer fire-rated products more expensive?

The initial investment for the newer, high performance glazing materials is greater than traditional wired glass. The old saying, "you get what you pay for" holds true: As with most things in life, the greater the level of performance desired, the greater the cost. But you should also consider the life of the product after it is installed. Schools are designed to last more than 30 years.

As discussed, products with surface applied films will require more maintenance over that time. For fire-rated glazing, it's better to base your decision on long term safety and durability rather than initial purchase price alone. Specifying the lowest cost option up front can leave open the door for costly accidents, injuries or repairs down the road.

PRODUCT COMPARISON CHART

	Product	Maximum fire rating	Offers impact safety	Passes hose stream test	Blocks heat transfer during fire	Complies with energy codes	Compatible with TGP framing	Provides acoustic barrier	Advantages/ Disadvantages
THIN	Fireglass® 20	20 min.	✓				✓		+ Moderate initial investment - Cannot withstand thermal shock
	Traditional Wired Glass	45 min.		✓			✓		+ Least expensive option - Institutional appearance - Lower impact resistance - Limited sizes
	WireLite®	45 min.		✓			✓		+ Moderate initial investment
	WireLite® NT	90 min.	✓	✓			✓		+ Surface-applied fire-rated film + Cat I and II impact safety + Withstands thermal shock + Passes hose stream test - Possible abuse to surface film
	FireLite®	90 min.		✓			✓		+ Heat resistance of ceramic - Low impact resistance
	FireLite® NT	3 hrs.*	✓	✓			✓		+ Surface-applied fire-rated film + High impact resistance** - Possible abuse to surface film
	FireLite Plus®	3 hrs.*	✓	✓			✓		+ Durable laminated construction + High impact resistance**
	FireLite® IGU	3 hrs.*	✓	✓		✓	✓	✓	+ Energy efficient + Acoustic barrier + Wide choice of appearances
THICK	Pilkington Pyrostop®	2 hrs.*	✓	✓	✓	✓+	✓	✓	+ Floor to ceiling glass designs + Reduces heat transfer + Tested as a wall - Can be heavy

** For doors. Consult product literature for maximum ratings in other openings.*
*** Meets CPSC 16CFR1201 (Cat I or II)*
+ In an IGU make-up

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