NATIONAL GLASS ASSOCIATION with GANA

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Fire-Rated Glazing 101

Introduction to Fire-Rated Glazing

Fire-rated glazing systems offer benefits to building occupants and design beyond protection from accidental fire. Fire-rated glass provides the benefit of daylight, transparency, and additional security – meeting fire-safety and life-safety requirements while providing aesthetically pleasing views.

Fire-Rated Glazing Basics

Fire-rated glazing is unique in that it is specifically designed to control the spread of flame, smoke, hot gases and, if necessary, heat transfer from one area of a building to another. It performs critical life safety functions by allowing building occupants to safely exit a building in the event of fire, while allowing first responders to enter the building.

All fire-rated glazing is tested, listed and labeled under the follow-up services of nationally recognized testing laboratories. In order to have their products be listed and labeled as fire-rated glass, manufacturers must submit their products to a certified laboratory to be (i) fire tested for periods lasting from 20 minutes to 3 hours, (ii) thermal transfer tested, if necessary, and (iii) hose stream tested in most cases. If the product passes the required tests, the test lab awards it a listing and label either as fire-protection or a fire-resistance rated glass.

Fire Protective vs. Fire Resistive: The Difference

Two different classifications exist for fire-rated glass. The key to understanding fire-rated glazing lies in knowing the difference between *fire-protective (or fire- protection rated)* and *fire-resistant (or fire-resistance rated).* This terminology is very important because it conveys the fire performance level of the glass relative to applicable code requirements. In addition, these terms are referenced (by special letter designations), both on the laboratory label that is affixed to the glass and in Tables found in Section 716 of the 2021 International Building Code (IBC). Matching the performance level found on the label affixed to the glass and in the Tables found in the IBC enables architects, glaziers, code officials and other stakeholders to be sure that the correct fire-rated glass is being used in the right location.

Fire protective glazing is tested to NFPA 257/UL 9 in fire window assemblies and NFPA 252/UL 10C and UL 10B in fire door assemblies. Fire window and fire door assemblies are referred to in the IBC as "opening protectives." Fire windows and fire doors can be designed using fire-rated glass to prevent the passage of smoke, flames, hot gases, and, if necessary, heat or thermal transfer.

All fire-rated glass is subjected to a fire endurance test. This determines the length of time (in minutes or hours) that the fire-rated assembly will withstand the fire of a test furnace which can exceed 1900 degrees F. The fire in a test furnace follows a fixed time and temperature curve designed to simulate an actual fire in which temperatures rise quickly, then

gradually increase over time. To be listed and labeled, the glass and its entire assembly must remain intact for the full duration of the test which can last from 20 minutes to 3 hours, depending on the type of listing required.

Immediately following the fire endurance test, the glazing assembly is subjected to a hose-stream test, where the water pressure is 30-45 psi, depending on the fire rating. Water from a fire hose play pipe strikes the assembly in a prescribed pattern and duration, depending on the size, from 20 feet away. If the glass remains in place without exceeding the allowable limit of openings, it passes the test. Most, but not all, fire-rated glazing applications require the hose stream test. In the U.S., in 20-minute fire door assemblies installed in 1-hour fire partitions e.g. corridor walls and smoke barriers the protective glazing shall be exempt from the hose stream test. In Canada, all fire-rated glass must pass the hose stream test.

Fire-resistive glazing is tested as a "wall" assembly pursuant to ASTM E119/UL 263. Like opaque fire-rated construction materials, fire-resistance rated glass is designed to prohibit the passage of smoke, flame, hot gases, *and* the radiant heat from a fire.

Just like fire-protective glazing, fire-resistant glass is subjected to a fire endurance test and a hose stream test. The difference is that during the fire endurance test, thermocouples are placed on the surface of the glass on the non-fire side to measure the heat transmitted through the glass. The average temperature calculated from these readings cannot exceed 250 degrees F, nor exceed an individual temperature rise of 325 degrees F, above the initial starting temperature for the entire duration of the test. It should be noted that neither ASTM E119 nor the IBC distinguish between a fire-resistant glass wall and a fire-resistant opaque wall. Consequently, although it may be used in fire window and fire door assemblies, if evaluated for these end use applications, fire-resistance rated glazing tested to ASTM E119/UL 263 is treated by the IBC as a fire-resistance rated wall, not an opening protective.

Key Takeaway

The ability to limit heat transfer is a critical distinction between fire-protective and fire-resistant. *Fire-rated products are application driven as much as they are code driven. The duration rating should not be the sole feature determining code compliance.* Fire-protective glazing is subject to various size and application limitations in the IBC because it does not prevent heat transfer. Where fire protective glazing is limited or prohibited by code, fire resistant glazing can be considered when evaluated for the end use condition.

Fire-Rated Glazing Standards

- Fire tests applicable to fire door systems- NFPA 252 *Standard Methods of Fire Tests of Door Assemblies*, UL 10C *Standard for Positive Pressure Fire Tests of Door Assemblies*, or UL 10B *Fire Tests of Door Assemblies*.
- Fire tests applicable to windows, glass block, and other light-transmitting assemblies- NFPA 257 *Standard on Fire Test for Window and Glass Block Assemblies* or UL 9 *Standard for Fire Tests of Window Assemblies*.
- Fire-resistance rated wall test determines how long the product can contain a fire, as well as its ability to limit temperature rise on the unexposed surface to no more than 250 ºF above the starting ambient temperature- ASTM E119 *Standard Test Methods for Fire Tests of Building Construction and Materials* or UL 263 *Fire Tests of Building Construction and Materials*.
- Installation and maintenance standard regulating the assemblies used to protect fire doors and openings against the spread of flames and smoke- NFPA 80 *Standard for Fire Doors and Other Opening Protectives*.

Challenge: Congestion/Urbanization

In areas where buildings are built close together, horizontal fire spread from building to building is a concern. Fire-rated glazing can be used to address that concern in the exterior walls of buildings constructed near lot lines, the center lines of roadways or nearby buildings. Typically, one- and two-hour fire- ratings are required, depending on the fire separation distance, building height and occupancy type (see International Building Code (IBC) Table 705.8 *Maximum Area of Exterior Wall Openings on Fire Separation Distance and Degree of Opening Protection* for more information). The use of fire-rated glazing in exterior walls can prevent the spread of fire horizontally from one building to the next. Moreover, fire-rated glazing systems in these exterior wall applications can be designed using narrow framing profiles to complement overall building facade designs.

Fire resistive glazing assemblies that meet ASTM E119 are not considered opening protectives and can be used for areas where fire-resistance rated walls are required. This is why fire resistant glazing can be used even in zero lot line applications. Fire resistant glazing can also be used to exceed the area limitation for protected openings.

Challenge: Visual Mismatch of Fire-Rated and Non-Rated Glazing Systems

A variety of fire-rated framing solutions are available to satisfy a broad range of aesthetic requirements. Some fire-rated framing systems may cause aesthetic discrepancies compared to non-rated glazing systems, impeding sightlines, and limiting transparency. Fire-rated glazing suppliers offer varying profiles for fire-rated framing systems and can incorporate custom cover caps and surface finishes to more closely match surrounding curtain wall and door applications to ensure a smooth visual integration with non-rated assemblies.

Challenge: Door Hardware

Projects that include complicated hardware such as access control products may negate the fire rating of some fire-rated systems. Fire-rated glazing suppliers can assist in specifying fire-rated door hardware to integrate intricate hardware and ensure fire-rated glazing and hardware needs are met.

Challenge: Operable Windows

Fire-rated glazing suppliers can assist in specifying fire-rated operable windows to ensure fire-rated glazing and hardware needs are met.

Challenge: Daylighting and Views

Glass is essential to the wellbeing of occupants. However, ordinary window glass cannot withstand the high heat generated from structural building fires, necessary in areas of egress. Traditional opaque fire-rated materials like concrete and gypsum board block both daylight and views. A fire-rated wall assembly with fire-resistive glazing can enhance daylighting design freedom. Building design teams can incorporate large expanses of glass meeting fire-rated building codes without being limited to smaller windows and viewing panes in doors.

Fire-rated glazing can:

- elevate design with a modern look and feel.
- provide clear and unobstructed views of the outside.
- contribute to wayfinding, which becomes critical during active shooter events and other security threats.
- enhance daylight transfer and visibility which promotes occupant well-being, reduces absenteeism and accidents, and increases productivity and mental performance.

The following studies show how daylight, in particular, benefits students:

- The ***Policy Insights from the Behavioral and Brain Sciences*** found that daylight can help create environments in which students learn better over the course of an academic year.
- According to the ***U.S. Department of Education***, "A 2003 study found that classrooms with the most daylighting had a 20 percent better learning rate in math, and a 26 percent improved rate in reading, compared to classrooms with little or no daylighting."
- ***National University of Malaysia***, "Students who attend schools with good daylighting exhibited enhanced health, well-being, and student performance based on the result of test scores."

Challenge: Insulating Glass Unit (IGU)

A fire-rated IGU can be constructed to include other glass types to achieve multiple functionalities without negating the fire rating, when listed and labeled for this application. For example, a fire-rated IGU could incorporate acid-etched, patterned or printed imaging for decorative installations. Improved energy efficiency could be achieved by incorporating high-performance low-e glass into a fire-rated IGU.

Acoustics

Fire-rated glazing manufacturers generally evaluate their products for acoustic sound reduction. Additional noise mitigation may be achieved by incorporating the required fire-rated glazing into a laminate and/or insulating glass units.

Challenge: Multiple Threats

Fire-rated glazing can be combined with many types of additional protection including smoke, heat transfer, forced-entry, ballistics, blast, and windstorm. When multifunctional products are created, it is important that the characteristics of one product does not negate the performance of the other. For example, security glazing may have difficulty passing the fire endurance test to qualify as fire-rated glazing due to construction specifications for security glazing. System-based approvals are becoming more prevalent than component-based approvals. Refer to the product's listing to ensure compliance to all required tests. Consult the product manufacturer for further information.

Security Glazing

While building codes require the use of fire-rated glazing in specific applications, they **do not** currently mandate the use of security glazing. Security glazing can include forced entry resistance, and ballistics resistance and/or blast resistance. However, the industry is working to tighten regulations and manufacturers are working to develop multifunctional products to meet these needs. Refer to Glass Technical Paper FB43-14 *Security Glazing* for information about security glazing makeup and testing.

For educational facilities, specifically, the Partner Alliance for Safer School (PASS) Guidelines were developed by the Security Industry Association and the National Systems Contractors Association to answer questions from the education community about what can be done to better secure K-12 schools and how these security projects can be funded (http://passk12.org/). Refer to Glass Technical Paper FB71-21 *School Security Glazing* for details about testing glazing for school security applications.

Windstorm

In areas where hurricanes, tornadoes and other natural disasters are a concern, solutions that incorporate fire-rated glass and systems exist.

Additional Resources

- ASTM F3561 *Standard Test Method for Forced-Entry-Resistance of Fenestration Systems After Simulated Active Shooter Attack*
- NGA Glass Technical Paper FB16-07 *Bullet Resistant Glazing*
- NGA Glass Technical Paper FB43-14 *Security Glazing*
- NGA Glass Technical Paper FB71-21 *School Security Glazing*
- NGA/PGCI *Protective Glazing Manual*
- NGA *Laminated Glazing Reference Manual*

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