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A CSI Award-Winning Publication

Conspectus's Tech Tips received the national Communications Award from the Construction Specifications Institute.

ABSTRACT:

Building codes have become much more specific about how fire-rated glass must be selected, and what types of fire-rated glass may be used in a variety of applications. Knowing and understanding the different product categories and their applications is necessary for complying with code.

FILING:

UniFormat™
C1010.20 - Interior Glazed Partitions
C1020 - Interior Windows
C1030 - Interior Doors

MasterFormat®
08 88 13 - Fire-Resistant Glazing

KEYWORDS:

Glass, Glazing, Fire Protective, Fire Resistant, Fire Ratings, UL, IBC

REFERENCES:

International Building Code, 2015 edition.

16 CFR 1201 - Safety Standards for Architectural Glazing Materials

UL Online Certifications Directory

ASTM E 119 Standard Test Methods for Fire Tests of Building Construction and Materials

Background

Opaque walls and doors do a great job of separating spaces and preventing a fire from spreading from one area of a building to another. Building officials have long recognized this, and codes require separations survive a fire for a given number of hours, depending on the separation's purpose. Transparent walls and door lites in fire-rated walls are frequently beneficial to meet a project's design intent or function. These transparent walls and doors must perform the same function in a fire as the walls and doors they are replacing.

The earliest glass to be used in fire-rated assemblies was polished wire glass, which began being used over a century ago. Wire glass is made of two lites of glass laminated on either side of a wire grid. The wire holds the glass in the opening, preventing the spread of smoke and flames from one side to the other long enough for the glass to earn a 45-minute fire rating. The death knell for polished wire glass, however, was its lack of impact resistance. Glass in doors and borrowed lites within 18 inches of walking surfaces must pass CPSC 16 CFR 1201 Category II testing standard, meaning it must withstand an impact load of 400 ft./lb. Wire glass is nowhere close, and is prohibited in almost all applications.* Replacement products were developed that met impact safety standards as well as fire ratings.

* The City of Chicago Building Code still requires wire glass for fire rated applications.

Fire-Rated Glass

By Elias Saltz, CSI, CCS, SCIP

Fire Resistant vs Fire Protective

There are two categories of fire-rated glass recognized by building codes: fire protective and fire resistant. Fire protective (or fire-protection-rated) glass will confine a fire and smoke as determined by tests, but will not prevent heat from radiating through the glass. Fire resistant (or fire-resistance-rated) glass will confine fire and smoke, as well as prevent the passage of excessive heat and hot gases. To be categorized as a fire resistant wall, a glazing assembly (glass and frame) must not reach 250 degrees F on the non-fire side for the duration of the test.

For temperature rise doors (60 or 90 minutes), the radiant heat on the non-fire side must not exceed 450 degrees F over ambient in the first 30 minutes. Fire resistant glass tested to ASTM E 119 is the only glass that can limit radiant heat, so fire resistant glass is used in temperature rise doors to exceed 100 sq. inches in the door vision area.

The Hose Stream Test

The hose stream test was developed in the late 1890s as a way to measure the structural integrity of building materials during fire events. At the time, brittle cast or wrought iron was a common building material, and its failure could injure firefighters. It was not designed to test fire rated glass and it is not required as a test for glass outside of the United States and Canada.

The intention of requiring the test is to indicate the integrity of the rated assembly during a fire event, but not to replicate the effects of firefighting tactics. Most glass manufacturers question the benefit of requiring the hose stream test, but despite that, it remains in the code for most applications.

IBC Section 716

All applications of fire rated glazing are covered in IBC Section 716 "Opening Protectives." The code covers how glazing assemblies must be marked and what test methods must be used to evaluate the glass (Table 716.3), and how the various glass types may be applied (Table 716.5), including the following tests:

- Wall assembly, ASTM E 119 or UL 263: requires fire resistance.
- Fire window assembly, NFPA 257 or UL 9, including hose stream test, but not fire resistance
- Fire door assembly, NFPA 252 or UL 10B or UL 10C, with or without fire resistance and with or without hose stream test.

Here's a basic breakdown of which products meet code for various applications. Assume that hose stream testing is required for all of them unless otherwise stated:

- **Borrowed lites, transoms or sidelites in fire walls, fire separations and exit enclosures, 1 hour rating or greater:** Fire resistive glazing of same hourly rating as wall in which glass is installed. There is no reduction as there is for doors. Fire protective glass is never permitted. Maximum size of glass as tested by manufacturer.
- **Doors in 3- and 4-hour walls except horizontal exits:** Fire resistive glazing, same rating as wall.

No available products currently provide a 3 or 4 hour rating.

- **Doors in 2-hour walls:** Fire protective glass no more than 100 square inches in area **OR** fire resistive glass to maximum size tested by manufacturer, 90-minute rating.
- **Doors in 1-hour exit enclosures:** Fire protective glass no more than 100 square inches **OR** fire resistive glass to maximum size tested by manufacturer, 60-minute rating.
- **Doors in 1-hour partitions:** Fire protective glass to maximum size tested by manufacturer, 20-minute or 45-minute rating to match that of door. No hose stream test for 20-minute doors.

Fire Protective Glass Products

Three fire-protective glass product types are available on the market: specialty tempered glass, glass ceramic and wire glass.

Specially tempered glass is fire protective but not radiant heat resistant, and passes impact testing. Some products are hose stream tested.

Glass ceramic products are fire protective but not radiant heat resistant, and do pass hose stream testing. When paired with a safety film, they are impact resistant. When first introduced, glass ceramic products had a noticeable amber tint, but improvements have made them nearly clear.

Wire glass is a fire protective product but not heat resistant, and does pass hose stream testing. When paired with a safety film, wire glass is impact resistant.

Fire Resistive Glass Products

Two fire resistive glass products are available on the market: specially laminated glass and fire resistive tempered units.

Specially laminated glass are formed by multiple layers of annealed glass with clear intumescent interlayers. When exposed to fire, the interlayers expand and char, creating an insulating barrier that retards the passage of radiant heat. More layers of annealed glass are required to achieve higher ratings. Currently, the longest rating available is 120 minutes, and the lites are approximately 2-1/8" thick for interior applications. The glass can be tinted or low-iron.

Fire resistive tempered units are formed using two pieces of tempered glass with a clear, intumescent interlayer. During a fire, the lite exposed to the fire breaks, and the clear intumescent interlayer reacts to the fire to form an insulating barrier that retards the passage of radiant heat. Currently, the longest rating available is 120 minutes, and the lites are approximately 1-1/2" thick for interior applications. The glass can be tinted or low-iron.

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