Wired Glass for Industrial Applications

In recent years, there has been an increased usage of large, wired glass windows in hot mill applications, with the presumption that it is "safety glass" for hazardous conditions. In this article, the history of wired glass safety testing and standards will be discussed, as well as the unique challenges presented by applying wired glass as a safety precaution in industrial scenarios such as a hot mill.

The U.S. Department of Commerce's Safety Commission first tested wired glass in the late 1970s. The test simulated a 150-lb. man running through the wired glass in a door. Testing indicated a high fatality rate due to an effect the investigators referred to as "rebound." Rebound can be defined as a reflexive reaction that jerks a hand or other body part back through the glass after penetration, which greatly increases the severity of trauma. Based on the investigators' findings, the federal government established restrictions in 1979 on the usage of traditional wired glass to a maximum of 100 square inches in doors.

Today, the U.S. Occupational Safety and Health Administration (OSHA) requires safety glass to be installed toward the operator in all manned enclosures. This safety glass can be tempered glass that breaks in a dice pattern or a laminated glass that prevents shards of glass from penetrating the opening. OSHA has also instituted the "42 inch rule," which requires a safety bar or sash mullion approximately 42 inches from the floor for application above ground level for fall protection.

Along with these stricter standards, there have been many improvements in the manufacturing of wired glass since the Safety Commission testing of the 1970s. One area of change in the last few decades has been safety codes for wired glass. In an April 2011 article by Diana San Diego, director of marketing for Safti First, the author notes that in 2003, the International Builders Code (IBC) removed the 1977 exemption for traditional wired glass.[1] In the 2004 IBC supplement and the 2006 IBC code, restrictions were taken a step further — traditional wired glass is no longer exempt from meeting safety standards when used in any potentially hazardous location. This applies to all new construction and in all types of occupancies. (Note: IBC targets code for residential and commercial buildings. Currently, there are no separate building codes cited for industrial use applications.)

The new safety wired glass produced today claims to be economical and meets all the commercial fire-protective glazing and safety standards. New safety wired glass, such as Safti First's SuperLite™ I-W brand, meets Consumer Product Safety Commission (CPSC) impact safety requirements, while traditional wired glass (non-safety) cannot meet this impact standard and is no longer used throughout the majority of the United States. This new safety wired glass incorporates a safety film and meets both fire and CPSC impact safety requirements. The IBC's code history does not entirely ban traditional (non-safety) wired glass; it is still used in fire windows in non-hazardous locations but is limited to 25% of the wall area. However, the data, testing and ratings used for these standards are for commercial glazing applications and do not include industrial use.

One issue in using commercial safety wired glass in hot mill industrial applications that is not

Hazards are ever-present in the steel plant environment, and a heightened awareness and emphasis on safety is a necessary priority for our industry. This monthly column, coordinated by members of the AIST Safety & Health Technology Committee, focuses on procedures and practices to promote a safe working environment for everyone.

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Comments are welcome.
If you have questions about this topic or other safety issues, please contact safetyfirst@aist.org. Please include your full name, company name, mailing address and email in all correspondence.

addressed in current research is the thermal properties of glass and wire. Glass and metal have different expansion coefficients, and this adversely affects the product as it rapidly heats and cools. This dissimilar expansion rate greatly increases the likelihood of the wired glass breaking at a higher rate than tempered safety glass due to thermal stress. The typical meltshop experiences extreme heating and cooling environments not tested by OSHA or CPSC. Additionally, a typical molten metal application may produce an excessive force during a reaction well over the test rating for commercial glazing. Every cited research on codes for "new" safety wired glass is based on the published information on wired glass testing for residential and commercial applications. No testing was found for hot metal industrial applications. This is of little help when designing for protection for an operator in a molten metal explosion, such as that associated with steel furnaces.

Industrial wired glass also requires stricter testing than commercial applications. As San Diego wrote in her 2011 report, "In 1977, the CPSC developed 16 CFR 1201 to protect people from injuries due to accidental impact with glazing in certain locations. This meant that glazing used in hazardous locations such as doors and sidelites had to meet a minimum Category I impact test that stipulated 150 ft-lbs of impact and limited glazing area to 9 square feet (1,296 square inches). A more stringent Category II impact test that stipulated 400 ft-lbs of impact also was established for glazing areas that exceeded that size, such as patio doors." In contrast, MacPherson & Co. tests industrial impact glass in thousands of foot-pounds, not hundreds. For example, a 7/8-inch industrial impact composite glass is tested for at least 3,000 ft.-lbs. The tests used a 42-lb. dart with a 1-inch diameter nose dropped from heights ranging from 28 to 80 ft. An 80-ft. drop generates 3,360 ft-lbs of impact force.

Figure 1 illustrates this test on commercial-grade laminated safety glass, commonly referred to as "bullet-resisting" glass. The dart easily and cleanly goes through the glass on the first drop. As long as the dart did not directly hit the operator, he or she would survive this impact, unlike traditional wired glass where the shards of glass could make this kind of impact a

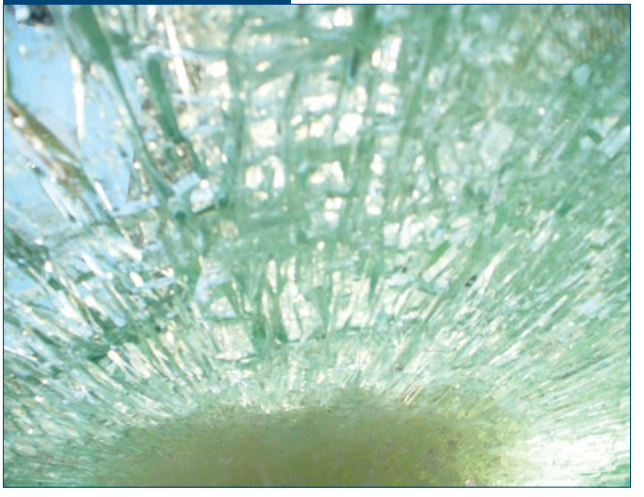
Figure 1

Impact testing on commercial laminated impact safety glass.

Figure 2

Testing on industrial composite impact safety glass.

Figure 3



Operator-side layer view of the industrial composite impact safety glass following testing.

fatality. The "new" wired glass with lamination has been tested for 400 ft-lbs.

Figure 2 depicts the same test with industrial-grade composite impact safety glass. Here, the dart crumbles the dart-side layer of glass, but the dart does not penetrate completely. Figure 3 shows the same test glass from the operator-side layer. The operator-side layer remains intact.

Although the new wired glass is laminated to correct the issues of the traditional wired glass, MacPherson and Co. still does not recommend wired glass to be used in or near hot metal industrial applications.

Acknowledgment

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Reference

1. D. San Diego, "Wired Glass Still a Misunderstood Product," www.glassmagazine.com/article/commercial/wired-glass-still-misunderstood-product-118017, published 22 April 2011. ✦