Important Technical Considerations Influencing the Wider Application of Fire-Resistant Glasses. A Review of the Central Importance of International Standards

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2 = European standards
3 = Insulation and integrity
4 = Radiant heat, fire protection
5 = Insulation
6 = Radiant heat

There is strong growth in modern building design in the use of fire-resistant glasses - in some projects in large quantities and complicated multi-functional performance specifications where the demands on the glass are high (e.g. Sir Norman Foster's Reichstag building in Berlin, figure 1). This trend, and its ongoing development, is dependent on a strong system of product and performance standards. In this respect, the new set of CEN standards provide a good jumping off point. But, these alone are not sufficient: it is the underlying principle of good operating practice that the standards are based on and encompass that really show the way forward.

The Reichstag Building in Berlin

An Example of the Versatility of High Perfomance Fire-Resistant Glazing

(Source: Pilkington, Pilkington **Pyrostop™** and Pilkington **Pyrodur™**)

Figure 1.

We can now start to see the light at the end of the tunnel. The European standardisation process is reaching towards the end, at least of the first phase, in the search for a common basis that removes technical barriers to trade across the European community. The result will be pan-European standards that define common performance and test criteria. For fire-resistant glasses comes a new furnace test procedure based on a different temperature measurement method, formalised product performance categories (figure 2), initial product type testing, third party evaluation of conformity to the standards - which includes independent overview of product and process control -, rules for the direct application of materials based on individual test results, and more complicated rules, currently under deep debate, for extended applications based on a series of test results. Standards relating to applications in facades and roofs are also in consideration. In addition, there is a growing debate on an alternative approach to fire safety based on the principles of fire safety

CEN Product Classification

Proposed new CEN product classification scheme for fire resistant glazings

E	15t	20T	30	45t	60	90	120	180t	240t
EW		20	30		60				
EI	15	20	30	45	60	90	120	180	240

t = only for doors T = only for partitions

E (étanchéité) = integrity
W = limited transmittance of radiant heat
I (isolation) = thermal insulation ($T-T_0 < 140$ or 180 K, respectively)

Additional Classifications:
C (self-closing) for doors
M (mechanical stability) for walls
R for load-bearing walls
S for protection against smoke

Mixed classification possible, e.g. E 30/EI 15

Figure 2.

engineering, with a view to developing an international governing standard. In the absence of clearly defined qualifying criteria for practitioners, this is surely a need.

Any Change?

At first sight the whole standardisation process, and the volume and complexity of output, appears daunting. The masses of closely written paperwork certainly can only add to that impression.

It would be a major mistake, however, to think that everything is suddenly going to change. That is far from the case. Look below the surface. In fact, the reality is the opposite: the CEN network of new standards effectively seeks nothing more than to capture and formalise what has become basic good practice in the use of fire-resistant glasses, as established by practitioners and the leading suppliers since the new generation of high performance fire-resistant glasses was first introduced over 22 years' ago. Pilkington has been at the head of that development from the beginning. The standards should reflect this good practice: the CEN process is essentially one of codification and systematisation, which has involved industry and fire specialists through the CEN committee system.

The overall result is to throw a focused spotlight on both fitness for purpose and the technical approval process, and performance, of fire-resistant glasses. The outcome can only be good. After all, fire kills and has tremendous power to destroy. Fire is fundamentally unpredictable; there are in practice no standard fires, and the occurrence of fire and its ferocity cannot be absolutely predicted. What we can do is assess the likelihood of fire, anticipate the threat and risk, and take precautions as necessary guided by regulation. If ever there were an area where attention to standards, and their application, is required then surely it must be that of securing fire protection for life and property in buildings.

Product Testing

The introduction of the new furnace test based on temperature control using a plate thermocouple has as its basic rationale the need for better consistency of testing from one test furnace to another, and from one test to another. That this was considered a fundamental need by the testing fraternity is a tacit acknowledgement that testing consistency and the required rigorousness was not entirely achieved under the old testing regimes operated from one test house to another. The introduction of the plate thermocouple is intended to remove as much inconsistency and variability as possible. There simply has to be a common basis of testing and of carrying out the requirements of the test standard for no other reason that standards are working documents in which people implicitly place their trust - in particular, those whom the standards are intended to protect, who will have no idea as they go about their daily business that the required protective measures are in place. It is implicit that the standards are applied and followed correctly. There will therefore be a particular onus of care on the shoulders of the fire test houses in applying the new test standards, and on the group of notified bodies in ensuring that the procedures followed from one test house to another are consistent. Clearly, there has to be a common basis of application of the standards - in effect, a control process of testing the testers to ensure uniformity of approach and application.

Performance

The product performance categories now formally include radiant heat, but only as a supplementary property in addition to the main categories of insulation plus integrity and integrity alone. There is nothing new here. Radiant heat from fires is well recognised as a potent cause of fire spread and as a danger to life, and has been so considered virtually since the start of technical studies on fires and fire safety. Radiant heat is qualitatively important in practice. It's physiological effects on body tissue are well documented by several sources. The results are not pleasant; exposure of only a few seconds can be fatal (figure 3 and 4). The problem is, and has always been, that it is very difficult to achieve a consistent measurement and comparison of radiant heat

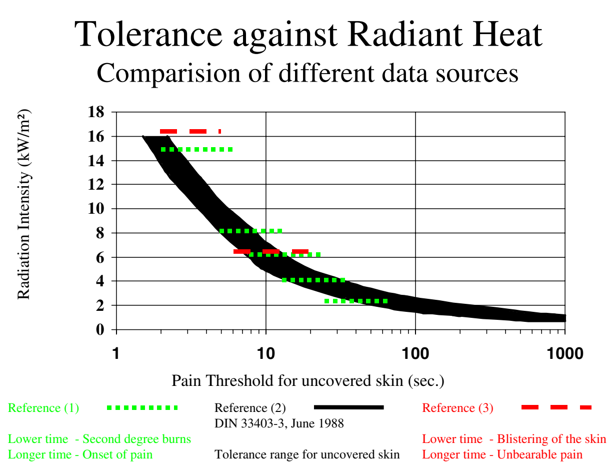

Figure 3.

levels from different glasses. The technology of measurement is not well established, and the supporting theory depends on the source of radiant heat being uniform in intensity with a black body distribution of wavelengths. For glasses that remain transparent in a fire there are variable

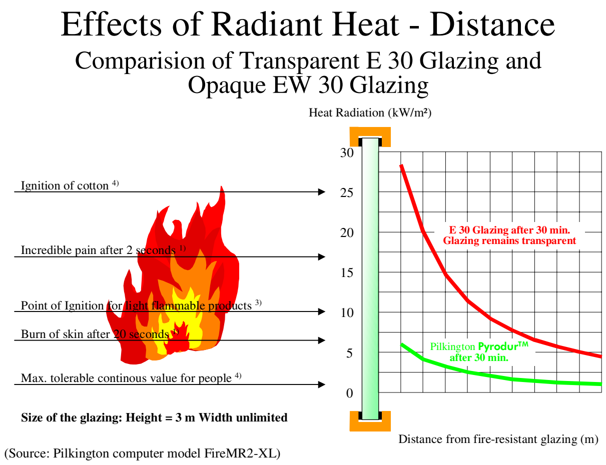

Figure 4.

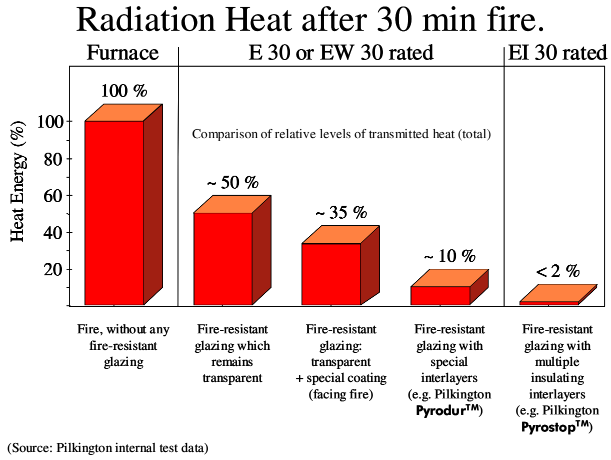

Figure 5.

furnace effects, which are automatically included in the measurement. Whilst it is possible to achieve internal test consistency within one laboratory based on defined practice, achieving consistency of comparison across laboratories is something else, and not readily achieved. When the recognised difficulties associated with the type and calibration of transducer, the geometry of the test arrangement, the area of the test glass in the field of view of the radiometer are also taken into account then the reluctance of national authorities across most of Europe to include quantified regulatory criteria in this respect can readily be understood.

In fact, the quantitative comparison of radiant heat measurements, given the inherent difficulty of comparison and consistency, is not needed in applying regulations and standards: the traditional insulation test criteria and the tried, tested and trusted insulating interlayer fire-resistant glass technologies already provide an effective solution. The surface temperature qualifying criteria for insulation performance ensure that the radiant heat flux from insulation-rated glasses is well below those levels necessary to caused non-piloted ignition of common combustible materials, such as furnishings and fittings, or to cause life-threatening burns. The new CEN test EN 1363-2 recognises this in that it does *not* require the measurement of radiant heat from such qualifying glasses, because the surface temperatures are too low. The same is not the case for those integrity-rated glasses that remain clear during a fire. In these cases, there is no effective opaque barrier to radiant heat. That means that such glasses allow a large proportion of radiant heat to pass through them, even if the absorption in the glass and reflection from a surface heat-reflecting coating may serve to attenuate the transmitted heat to some degree. The levels of transmitted heat can still be dangerously high compared to those glasses with an opaque, insulating interlayer (even with one or two such layers) (figure 5).

If the reduction and elimination of radiant heat is a design requirement then the safest solution is to use a qualifying insulating with integrity fire-resistant glass. Such a glass is Pilkington Pyrostop™. If integrity is a regulatory need then go for a fire-resistant glass based on an intumescent interlayer, or similar, technology that can at least reduce radiant heat to relatively lower risk levels. An example is Pilkington Pyrodur™.

Application

As a fire-resistant material, glass is unique. There is no other material which shows the particular combination of transparency, for open building design, yet high performance fire-resistance that allows the accepted norms of protective fire safe compartmentation to be achieved. These attractive design features and product properties have been recognised by specifiers and users alike in the widespread application of fire-resistant glass.

As part of this, it is axiomatic for fire professionals that fire-resistant materials and systems must function effectively as intended when called upon to do so in a fire. A particularly good technology is required, but this alone is not sufficient. In common expression, fire-resistant glasses must be fail safe - which means that independently of the approval tests, the glasses must function faithfully as intended after installation in their chosen application to maintain a fire-resistant barrier, as part of a fire-rated assembly, even if the edges or surfaces should become damaged. The key watchwords for suppliers and installers are therefore attention to detail to achieve performance honesty, quality, reproducibility, reliability and consistency. Such attention to detail, with an eye on the intended purpose, is essential in securing the required level of confidence of

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users, building owners and specifiers alike. Together with these considerations, the new CEN standards will play an important role - as an essential foundation for the wider application of fire-resistant glazed systems.

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