# Heating up, holding down costs

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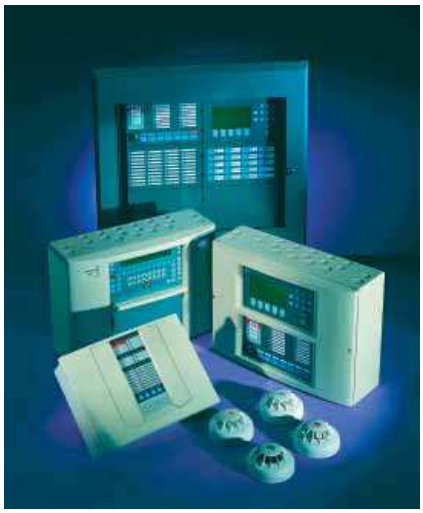
For developing countries and emerging economies, like China and India, ISO/TC 21 standards provide a suite of standards to assist regulators and developers to adopt minimum equipment and system performance requirements. The use of the standards affords an improved level of safety to building occupants and building sustainability – particularly as developing countries are more vulnerable to fire due to their poor regulation and enforcement.



*Fire detection and alarm system equipment.*
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**"The use of the standards affords an improved level of safety to building occupants and building sustainability."**

China is already showing its commitment to ISO fire detection standards. The National Supervision and Test Center for Fire Electronic Product Quality in Shenyang, China, has received its accreditation certificate from the China National Accreditation Board for Laboratories to assess fire detection equipment for compliance with ISO 7240. CNAL is the peak body in China for laboratory assessment. As a member of the International Laboratory Accreditation Cooperation, the CNAL accreditation now enables manufacturers from around the world to obtain internationally acceptable attestation reports for ISO fire detection and alarm system equipment.

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# Heating up, holding down costs

*by Dr. Hakim Elmahdy, Convenor of ISO/TC 163/WG 2,*
Thermal properties of windows

In recent years, global efforts have been focused on promoting sustainable communities and, in particular, on the sustainable built environment. Among the major international initiatives to address these issues was the recently concluded World Sustainable Building Conference in Tokyo, Japan.

There are many national and international efforts developing programmes aimed at achieving sustainability in every aspect of our lives. It has been recognized, time and again, that achieving such a goal is crucial, not only for our present economic and social well being, but also in meeting and securing the welfare of future generations.

As an international standards developing organization, ISO has taken the lead to provide tools for researchers,

designers, specifiers, manufacturers and consumers to assess, design and manufacture components that contribute to energy efficiency and sustainability.

## Assessing thermal performance

For years, fenestration products – among them windows, doors and skylights – were recognized as major elements of the building envelope that significantly contribute to the overall building energy loss during the heating season. It is estimated that about 30 % of the total energy loss from buildings is attributed to those building envelope components. As a result, considerable attention was given to increasing their thermal characteristics by improving design, better material properties and performance assessment tools.

Understanding the behavior of building envelope components, depends primarily on the availability of scientific knowledge and technical analysis of the different aspects, as well as the environment surrounding the building envelope components. In a normal heating season, for example, fenestration products separate two different environmental conditions that drive the potential for heat loss. Good component design allows the maintenance of comfortable living conditions in the indoor environment, while minimizing the heat loss through the building envelope component. Similarly, a superior component design would achieve a durable and long lasting building envelope component, in addition to maintaining a comfortable living environment.

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Assessment of the different performance criteria of fenestration products requires a set of tools that determine:

- Thermal characteristics;
- Water penetration;
- Air leakage;
- Condensation resistance;
- Sound transmission;
- Structural integrity; and,
- Long term performance, and other related performance criteria.

The development of such a set of tools requires extensive knowledge of the component behavior and design, as well as of material properties, when subjected to different and adverse environmental conditions.

## State-of-the-art calculation procedures

Several experts representing different ISO technical committees related to windows, doors and skylights came together to form one of the most dynamic and productive working groups within the ISO community.

ISO technical committee ISO/TC 163, *Thermal performance and energy use in built environment,* working group WG 2, *Thermal transmission properties of windows*, is a joint effort of selected experts from ISO/ TC 160, *Glass in buildings*, ISO/TC 162, *Doors and windows,* and ISO/TC 163. The working group was created to develop the state-of-the-art detailed calculation procedures to determine the thermal transmission properties of windows, doors and skylights, based on their component materials, respective properties and assembly configuration.

The working group was confronted by a number of technical challenges, among them the increasing complexity of fenestration product design, once seen as a simple assembly of one or two sheets of glass mounted in a sash or frame of a dissimilar material (e.g., wood, vinyl, metal or glass fiber). Today, fenestration products have sophisticated designs and advanced technological features, such as low emissivity or solar spectrally selective coatings on glass, insulated (or warm edge) spacer bars, ventilated windows,

## About the author

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varieties of shading devices, providing consumers with many more choices and improving the performance of the fenestration products.

It was evident for ISO/TC 163/WG 2 that the development of relevant standards had to address every possible fenestration design supplied by product manufacturers. The theoretical, practical and technical challenges involved in developing a useable tool to address all issues related to the determination of performance indices were formidable. However, with the cooperation of a number of ISO technical committees and experts representing several countries, it was possible for ISO/TC 163/WG 2 to develop such a tool.

The result was the first International Standard (ISO 15099) for use by fenestration product designers, computer simulation developers and others who might be interested in assessing the performance of fenestration products.

## One-stop-shop for fenestration product designers

Published in 2003, ISO 15099:2003, *Thermal performance of windows, doors and shading devices: detailed calculations,* provides comprehensive and detailed calculation procedures to determine the thermal transmission properties and heat transfer through complex fenestration products incorporating shading devices.

The standard addresses almost every aspect related to the thermal transmission of fenestration products, no matter what the degree of complexity it possesses. For example:

**Multiple glazing layers**: including conventional and advanced insulating spacer bar systems, gas filling (e.g., air, argon, krypton, xenon, or mixtures of any combination) in the glazing cavity, and any type of low emissivity coating on any glazing layer;

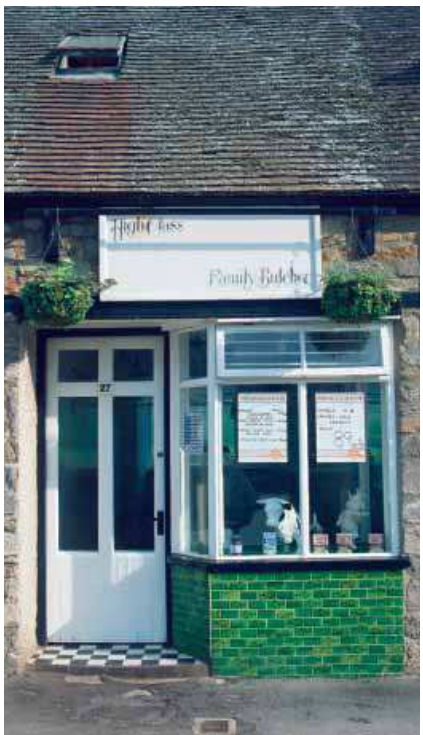
**Shading device**: analytical models to determine the surface temperatures, solar heat transmission, optical properties and other thermal characteristics of shading devices. The calculation procedures also deal with diffuse-diffuse, direct-direct, direct-diffuse transmission, absorptance and reflectance of these shading devices;

**Frame effects**: the overall characterization of the performance of fenestration products would not be complete without the inclusion of the effects of frame and sash members on the product. These effects have considerable impact on the overall heat transmission through fenestration products, particularly when advanced frame profiles and hybrid designs (e.g., multiple materials) are implemented;

**Ventilated air cavities and grooves**: this includes cavities connected to internal or external environments; and,

**Radiation heat transfer**: this includes detailed radiation heat transfer calculations using two-dimensional element-to-element view factors, and simplified three dimensional radiation methods.

**"The working group was created to develop the state-of-the-art detailed calculation procedures to determine the thermal transmission properties of windows, doors and skylights."**






## Assessing product performance and lowering costs

Traditionally, the evaluation of the performance indices of fenestration products was achieved by subjecting the products to a series of tests in a controlled environment (i.e., laboratory testing). Such a process represents a considerable financial burden on product manufacturers, when seeking product performance rating or for compliance with building codes and local or municipal regulations. Usually, the cost associated with product evaluation is passed on to the consumers.

In the last decade, the trend in assessing product performance evaluation has shifted to the use of calculations and analytical tools, when such tools are available and when they have been shown to produce results that are consistent with test results of the products under consideration. As a result, several computer programmes are now available for fenestration products performance evaluation and some of those are referenced in national and International Standards. ISO 15099 provides algorithms used for modeling the fenestration products. The goal is to ensure that all software developers use the same algorithms in ISO 15099, so that the results would be consistent and universally acceptable, particularly when trade barriers are being eliminated and products cross international borders with considerable ease.

ISO 15099 goes beyond the determination of the thermal performance of fenestration products. It offers window and doors designers and specifiers a tool to assess the product long-term performance based on their choice of materials. The result is likely to impact the energy use and operating cost of a building.

## Looking into the future

The activities of ISO TC 163/WG 2 did not stop at the completion of ISO 15099. There is a new work item for the development of an energy rating protocol that could benefit fenestration product manufacturers, consumers and building code officials. This protocol will be based on the existing common practices and will certainly incorporate elements from ISO 15099.