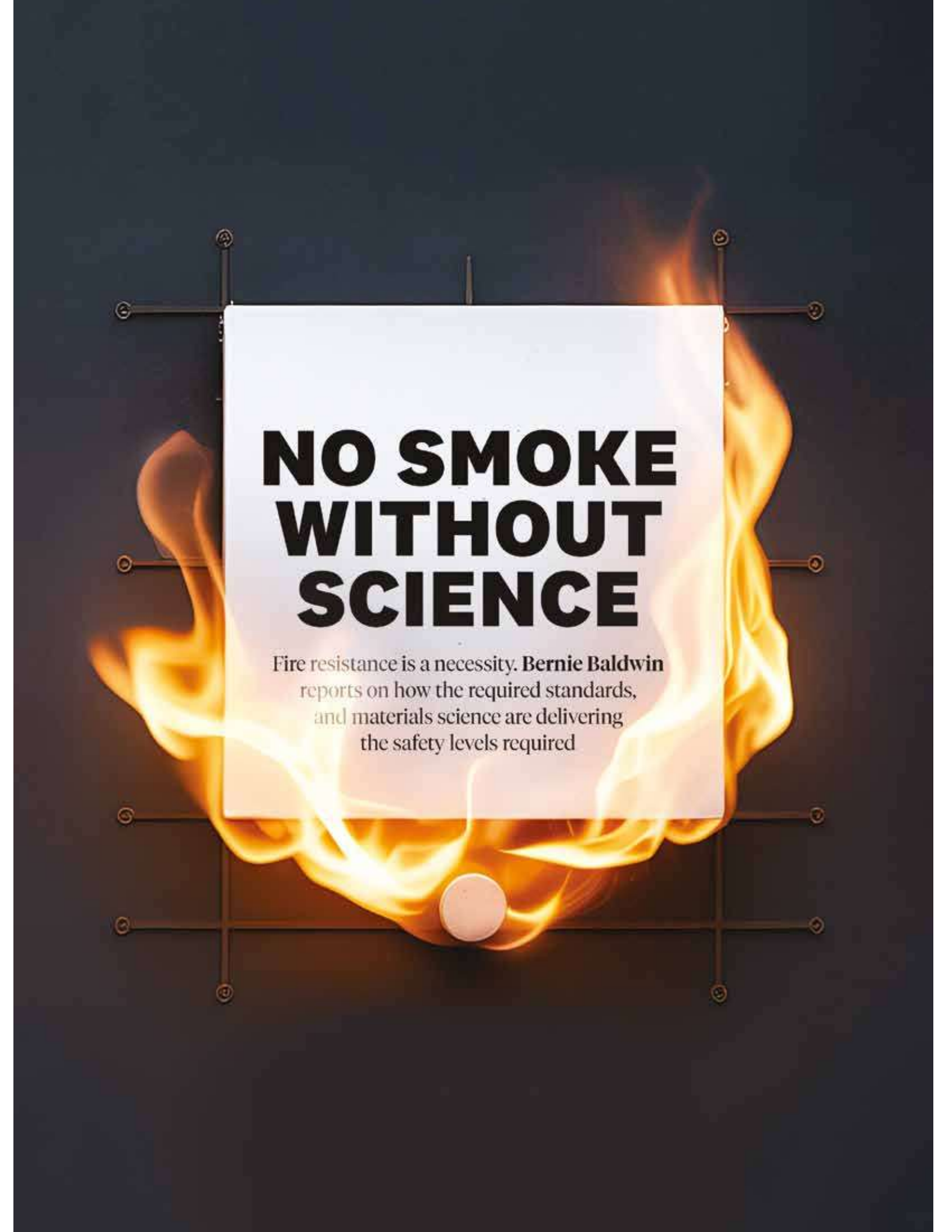


NO SMOKE WITHOUT SCIENCE

Fire resistance is a necessity. **Bernie Baldwin** reports on how the required standards, and materials science are delivering the safety levels required

"Safety is no accident" declares a well-known and oft-used aviation proverb. While often used in relation to aircraft maintenance, it is just as pertinent to the task of making an aircraft as fire resistant as possible.

Within the cabin, there is a range of materials – foams, fabrics, composites, metals – which need to be as fire resistant as possible. In addition to protecting passengers, they must also provide comfort, which is a considerable challenge.

Luzius Rickenbacher is the CEO of Lantal, where fire resistance is engineered into products from the very beginning of their development. "We provide seat and curtain fabrics, carpets and leather solutions for aircraft cabins, where flammability performance is one of the key requirements," he notes. "For us, the challenge is not only passing certification at first installation but also ensuring that the material continues to meet these requirements throughout its entire operational lifecycle.

"Aircraft interiors are exposed to cleaning chemicals, abrasion, UV exposure, humidity and intensive passenger use over many years. That means flammability must be combined with long-term durability and ageing resistance," Rickenbacher continues. "It is not only about preventing ignition, but also about controlling flame spread, smoke generation and heat release in accordance with regulatory standards and OEM requirements."

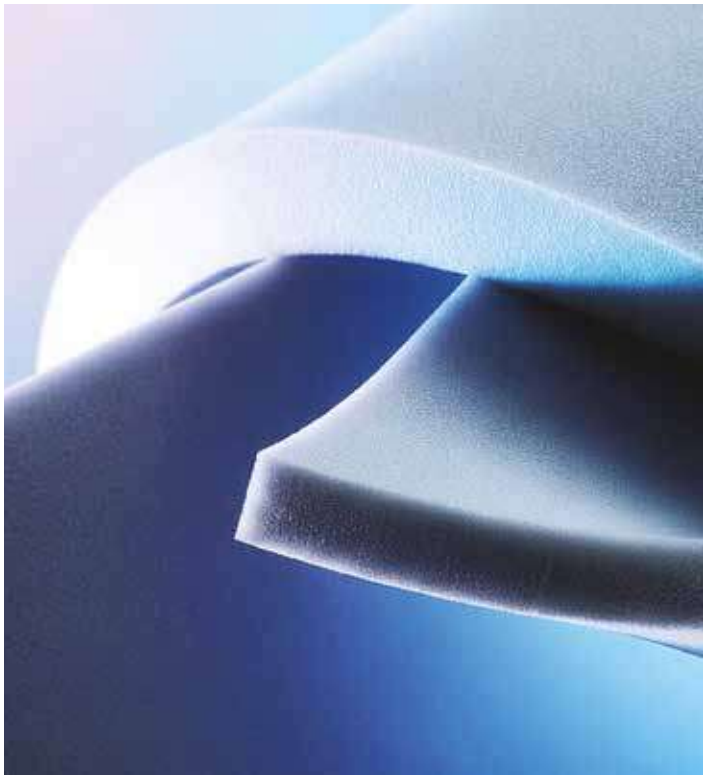
The CEO explains that this is the reason why Lantal operates its own Airbus- and ISO17025/NADCAP-accredited laboratory. "It allows us to develop and validate products internally with very short feedback loops between testing and R&D, helping us better understand how materials behave not only in certification testing, but also under real cabin conditions over time," he remarks. "We also see flammability expertise as something that should benefit the wider industry. That is why Lantal offers flammability testing services and training programmes for other customers and industry partners."

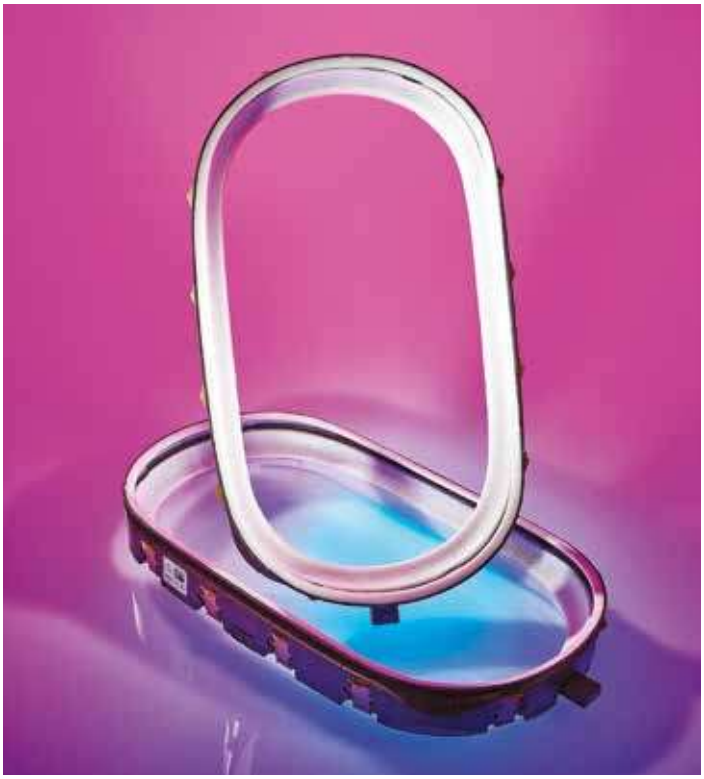
"CABIN MATERIALS ARE PART OF THE AIRCRAFT'S PASSIVE SAFETY SYSTEM. THEY ARE ALWAYS PRESENT AND WORKING IN THE BACKGROUND WITHOUT REQUIRING ANY ACTIVATION"

Lantal CEO Luzius Rickenbacher

At Replin by Hainsworth, there is a similar story. "Fire performance is never an afterthought, it is engineered into the very fibre of our products," states technical innovation manager Angela Augusto. "Most of our cabin fabrics are built around wool, which is flame retardant by nature. Wool's high nitrogen and moisture content means it is difficult to ignite, self-extinguishes when a flame source is removed and, critically, does not melt or drip, eliminating the risk of secondary burns.

▲ Zotek F offers all of the properties of MGR SoftWall, but with a reduced weight





▲ Zotek window seal gaskets
▼ Exact Group Cerakote

"This is a fundamental advantage over many synthetic alternatives. Our passenger seating, pilot seating, curtains and vertical surface ranges all leverage this inherent protection as their foundation, with construction carefully engineered – yarn twist, weave density and fibre blend – to further slow flame spread and optimise char formation," she adds.

No smoking

"Where enhanced fire performance is required, our vertical surface fabrics incorporate meta-aramid fibres from the same family as well-known brands such as Nomex, blended with wool to achieve the heat release performance demanded by OSU (Ohio State University) heat release calorimeter testing," Augusto continues. "Meta-aramids are particularly well-suited to this application: they offer excellent thermal stability, do not melt or drip, and contribute to the low heat release and low smoke characteristics that are critical for vertical surface compliance."

Angel Hernanz Arbeloa, CCO at Neotex, explains that fire resistance is not just engineered from the initial material selection but also validated on the final product. "There is no single solution that applies to every case. The approach depends on the nature of the material, its function within the cabin and the final configuration in which it will be installed," he comments.

"In the case of foams used in seating systems, flame-retardant components are usually incorporated into the material formulation itself or combined with specific fire-blocking layers," Hernanz adds. "In such applications, fire performance does not depend on one single element, but on the complete system made up of the foam, potential barrier layer, outer textile, seams and other seat components."

According to Hernanz, innovation at Neotex is mainly taking place in solutions that combine safety, lower weight and improved environmental performance. "This includes inherently flame-retardant fibres, halogen-free formulations, lower-impact coatings or finishes, recycled materials compatible with aerospace requirements, and textile constructions that can reduce weight without compromising performance," he reports.

Insperial carpets

Insperial Group, the parent company to ADHETEC, MGR Foamtex and Perrone, is another to report fire resistance being engineered into its materials from the outset, be they genuine leather, synthetic leather, decorative laminates,

21%

Normal air contains around 21% oxygen; wool's natural LOI of 25%-26% means it needs more oxygen than is present in the atmosphere to sustain combustion, making it inherently self-extinguishing

Alcantara or soft wall stack-ups. "Rather than relying on surface treatments, we use inherently flame-retardant constructions, such as meta-aramid fibres which remain stable under heat and help form a protective barrier," confirms Alexis Gabillon, the group's CEO.

"This delivers consistent, long-term flammability performance without the risk of additives degrading or washing out over time. This also extends to our final assembly products including MGRSoftWall by MGR Foamtex," he continues. "Our engineering team takes a very careful and pragmatic approach to defining and determining the properties of all materials used, as well as how those materials interact with one another in order to reduce risk and improve consistency."

Also stating the maxim that fire performance must be designed in from the start is Igna van Der Weide, head of product management at Zotefoams. "Our Zotek F material, used in a wide range of aerospace applications, combines high-performance polymers with a controlled closed-cell foam structure. This means that the material delivers consistent, repeatable behaviour after forming, bonding and installation," she notes.

"The main innovation we're seeing now is at the system level. Advanced foams can help designers and engineers combine several functions, including insulation, acoustic performance, rigidity and comfort, while avoiding heavier multi-layer assemblies. That matters in cabins, where weight reduction is important, but fire performance remains non-negotiable," she emphasises.

Regulatory requirements are ubiquitous across aviation and for cabin materials there are plenty to which they must adhere, all of which affect the final products, as van Der Weide explains.

"THERE IS NO SINGLE SOLUTION THAT APPLIES TO EVERY CASE. THE APPROACH DEPENDS ON THE NATURE OF THE MATERIAL, ITS FUNCTION WITHIN THE CABIN AND THE FINAL CONFIGURATION IN WHICH IT WILL BE INSTALLED"

Neotex CCO Angel Hernanz

"Certification standards shape material choices from a very early stage. Materials must meet strict, critical requirements around flammability, heat release, smoke and toxicity, depending on the application," she says. "Materials science determines how that performance holds up. Density, thickness, cell structure, adhesives and coverings can all affect behaviour, so both the sheet material and finished assembly must be validated.

Materials in the cabin obviously extend beyond textiles and foams. And the structural composites and coatings found there also need to be fire resistant. The Exact Group provides with just such materials to OEMs and Tier 1 partners.

Ronan Callan, the company's director of operations, explains that fire resistance in all aircraft cabin materials Exact Group supplies is engineered through certification-led design, where regulatory requirements drive selection of foams, adhesives, laminates, coatings, and structural composites to meet strict flammability, smoke toxicity and heat-release standards.

"Recent innovations in cabin materials are transforming the industry," he says. "For instance, through our use of Cerakote, an advanced single-coat surface technology, we are providing our customers with advanced fire-resistance, enhanced compliance and performance, while delivering durable, low-toxicity surface protection, maintaining aesthetics, reducing weight and improving the passenger experience.

"Emerging innovations also include recycled thermoplastics and lower-toxicity geopolymer and mineral-based composites, replacing traditional carbon-fibre panels," Callan adds. "These developments enable manufacturers to lower cabin weight, reduce carbon footprint, and improve sustainability, all while meeting – and in

▲ Product testing at Lantal
◀ Exact Group facility 1

some cases exceeding – stringent EASA and FAA requirements."

These cabin materials are engineered and rigorously tested to meet those tough certification standards. "Fire-resistant additives are incorporated into formulations to improve heat release, smoke and toxicity performance. Components undergo qualification testing simulating inflight conditions, including vibration, thermal cycling, humidity, pressure changes, UV exposure and mechanical wear," Callan reports.

"For Tier 1 manufacturers, certification is costly, with any failure requiring redesign and/or requalification. Materials must withstand cleaning agents and disinfectants over long service life," he adds. "The challenge is maintaining fire safety performance over 10-20 years despite UV degradation, abrasion, contamination, repairs and repeated cleaning, while balancing weight, aesthetics, maintainability and sustainability."

Hernanz points out that while many flame-retardant solutions for cabins are designed to maintain their behaviour throughout the life of the product, certain factors can affect the performance of the material or the finished product. "These may include incompatible cleaning products, inappropriate washing processes, prolonged exposure to UV radiation, abrasion, liquids, contaminants, ageing, humidity or post-treatments not considered in the original certification. Validation must therefore consider not only the initial fire behaviour, but also the stability of the product after maintenance and use," he proclaims.

Insperial Group's Gabillon explains that by engineering flame resistance into the base materials, fire-retardant properties are not reliant on coatings or finishes. "This makes the final product far more resistant to degradation, ensuring consistent performance throughout its service life."

"LOW-SMOKE, LOW-TOXICITY MATERIALS ARE NOT SIMPLY A REGULATORY REQUIREMENT; THEY ARE A HUMANITARIAN IMPERATIVE"

Replin by Hainsworth technical innovation manager CCO Angela Augusto

The resulting applications of this materials science and engineering are important in cabin fire situations and post-crash scenarios, as Gabillon remarks. "Fire-resistant materials are critical in these situations because they help control how a fire develops and spreads. Our materials are designed to slow the surface spread of flame and interrupt the combustion process through effects such as controlled charring and reduced oxygen availability," he says. "In practical terms, these materials buy valuable time when it matters most."

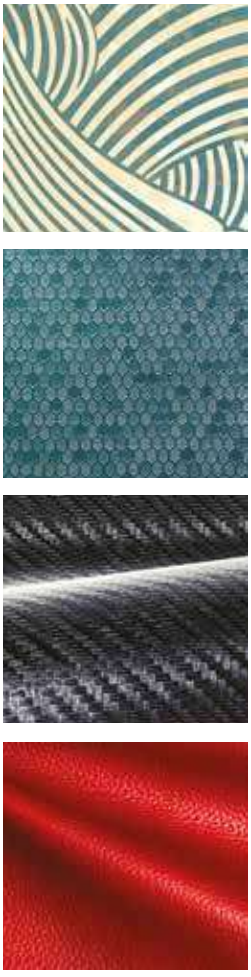
Flashover point

In a cabin fire situation, time is everything, according to Lantal CEO Rickenbacher. "Cabin materials are part of the aircraft's passive safety system. They are always present and working in the background without requiring any activation," he observes. "Better-performing materials can help prevent a localised fire from escalating rapidly and provide valuable additional time during an emergency situation."

Research into survivable accidents consistently shows that the time between initial ignition and flashoveris the critical window for passenger evacuation, reports Replin by Hainsworth's Augusto. "Fire-resistant cabin materials directly extend that window. A fabric that self-extinguishes, resists flame spread and produces low levels of toxic smoke can make the difference between a survivable and unsurvivable situation," she emphasises.

"This is measured by what is known as the Limiting Oxygen Index (LOI), essentially a measure of how much oxygen a material needs to keep burning. Normal air contains around 21% oxygen; wool's natural LOI of 25%-26% means it needs more oxygen than is present in the atmosphere to sustain combustion, making it inherently self-extinguishing." Augusto states.

"In a smoke-filled cabin, passenger disorientation and toxic gas inhalation are major causes of incapacitation. So low smoke, low toxicity materials are not simply a regulatory requirement: they are a humanitarian imperative," concludes Augusto. ●



▲ Inspiral Group's fire retardant range
◀ Passengers are largely unaware of fire engineering