Silicone ally

Rogers is helping operators to conform to the highest FST standards - through the use of silicone materials

Transit authority decision-makers can find themselves in challenging situations with respect to increasingly stringent rail car standards and the capabilities needed for compliance. While each standard has its own distinctions of flame, smoke and toxicity (FST) requirements, some more severe than others, each is positioned to measure three basic characteristics of a material, component, or structure – flame spread or propagation, the emittance of hazardous gases, and the density of smoke generated in a fire.

"These three characteristics can be converted into basic passenger safety provisions," says Ken Kozicki of Rogers Corporation's High Performance Foams Division. "First, in the event of a fire, the source of ignition must not be further fuelled by the materials of the seats, floors, sidewall, headlines or any of the various gaskets and seals. Second, should there be any faint smoking or smouldering, the resultant fumes should not be hazardous to breathing. And finally, in the unfortunate situation when smoke is in continuous generation, the volume of smoke should remain below levels that could infringe upon the safe and orderly egress of the vehicle."

Kozicki says these criteria are crucial in any mass transit system, and absolutely imperative in underground, high-speed and commuter networks where the opportunity for egress may not be immediate and passengers may be forced to remain in the coaches for a longer time.

How compliant a rail car and its contributing materials need to be is dependent upon its determined classification. "At the leading edge of what may be considered the most stringent are ratings such as the UK's Cat 1a (BS 6853) or France's M1F1 (NFF 16-101)," says Kozicki. "R-values will be more commonly discussed upon the ratification of the European norm specification. Other standards, such as those more prevalent in the Americas – ASTM 162 and 662 – have their own nuances toward pass or fail. Regardless, however, of the standard, region, classification or actual requirements, the message here is that transit authorities need not authorise or issue waivers to standards that may seem unattainable."

Kozicki says that materials that need to meet the Cat 1a or M1F1 ratings include upholstery and foams used for seat cushions; rubbers and other elastomeric compounds used for gaskets, seals and flooring constructions; and vibration- and acoustic-insulating materials adhered to side and ceiling panels. "Many traditional materials are not able to comply with Cat 1a or M1F1," he says. "As a result, specification decision-makers may further evaluate possible FST scenarios, and decide to adjust the ratings to Cat 1b or M2F2, for example, as a better fit to the usage of the vehicle and train."

ABOVE AND LEFT: Rogers Bisco silicone used for seat cushioning

Seat cushions

However, a viable option, Kozicki suggests, is the specification of silicone materials for any of the above-mentioned applications. Silicone alternatives have long been used throughout rail cars, predominantly as seals for exterior-mounted HVAC units and as gap-fillers between mounted interior components.

"It is just recently that advanced silicone foam and composite materials, meeting Cat 1a and M1F1, have become available for seat cushions, floating floor constructions and IP-rated enclosures," says Kozicki. "Allowing designers and transit authorities the opportunity to effectively meet the stringent standard ratings is only one of the superior characteristics of silicone materials. Silicone bun stock foams have superior compression set properties, taking no greater than 5-10% degradation over a 10-year period when tested in accordance with ASTM D 1056."

And Kozicki contends that silicone materials can offer better performance in terms of comfort and vibration and acoustic management when compared to alternatives. "For example, a seat cushion fabricated from a graphite-filled polyurethane (PU) foam

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ABOVE:
Applications for Rogers' silicone include seat cushioning, floor systems and gaskets

with fire barriers may be able to meet Cat 1a or M1F1 but will certainly be compromised on comfort after as little as 18 months in service," he says. "The filled PU will take on a compression set and will also deteriorate into a dust-like substance because of abrasion between the graphite fillers and the cycling of the upholstery upon it. The compromised cushion, after a few months of service, will undoubtedly still provide some level of performance to the ridership, but will become a source of passenger dissatisfaction and a hindrance to the transit authority, resulting in a continuous stream of cushion replacements."

Floating floors

Another factor to consider is the comfort associated with a smooth and quiet ride. In terms of engineering, this is quantified as isolation transmissibility or acoustic and noise budgets.

"The main source of structure-borne noise originates with the transfer of vibrations from the undercarriage to the interior of the rail car," comments Kozicki. "Floating floor systems offer the most advanced mechanism to mitigate vibration and to assist with the control of the noise budget. The floor is also a critical location for the potential spread of flame propagation. Category 1a or M1F1 should never be compromised relative to flooring constructions, including the isolation pads."

Therefore, Kozicki says, silicone can also be useful as a flooring material. "Not only do silicone foam pads allow for compliance to the most stringent standards, but also, the fact that pads fabricated from continuous-roll silicone foam will take nothing more than a 5-10% set guarantees that the isolation and elastic tuning of the silicone foam's cell structure will have long-lasting performance."

So what makes silicone materials suitable for noise attenuation? "The best noise-blocking materials are those that have a high aerial density condensed into a thin layer or thickness, and are not rigid, stiff or unyielding," says Kozicki. "Here again, silicone solutions (such as HT200 and A2 from Rogers Corporation's Bisco silicone product portfolio) conform to the BS, NFF, ASTM and DIN criteria."

Gaskets

In today's world of highly sophisticated control systems, wireless connectivity and the demands of climate-controlled cabins, enclosures within each rail car may have to protect equipment from the ingress of water, debris, humidity and electromagnetic interference. "Certainly an enclosure is a 'system', and a gasket alone cannot be certified to a specific IP-rating," says Kozicki. "But a properly designed gasket, from a material that meets Cat 1a or M1F1, will provide the security and reliability for minimal MRO occurrences and further contribute to the overall rail car's ability to meet the FST ratings."

In conclusion, Kozicki is adamant that transit authority directors and engineers alike should not shy away from the highest standards because they think that materials may not be available to achieve conformance. "Waivers are not your only option," he says. "Once it is established that silicone elastomers such as Bisco silicones solutions are Cat 1a or M1F1 compliant, value can be further expanded to longevity of life, comfort, vibration and acoustic performance and the integrity of enclosure protection."

Kozicki also champions the importance of a holistic approach to systems. Rogers' applications engineers specialise in collaborating with engineers to design systems (floors, seats, enclosures and so on) to ensure that the most optimal materials are selected for the overall solution.