



THE SMARTER WAY



RAIL SYSTEMS *ENGLISH*



Innovative system solutions for

Today's freight and passenger rail systems pose a continuous array of new challenges for all the parties involved in public transport. This includes the operators, the vehicle manufacturers, system suppliers, approval authorities, assessors and legislative bodies. In this environment, fire safety has become an increasingly important topic. Vehicle manufacturers and operators face considerable tasks to ensure compliance with the many different regulations that apply to them.

In times of contradictory requirements between regulations and customer needs, innovative ideas and their implementation play an important role in dealing with the problems that arise during the approval process and the implementation of vehicle concepts.

This is why over a decade ago, FOGTEC Brandschutz GmbH & Co. KG put together a team of in-house rail transport specialists. The company has continually expanded and developed its competence in this area.

FOGTEC Brandschutz GmbH & Co. KG, based in Cologne, Germany, has become a worldwide leader in the provision of active fire safety system solutions for the rail vehicle market and underground transport systems. Our engineering and development team includes specialists from many different disciplines, enabling us to create customer-oriented solutions in our day-to-day customer support.

Today, our Rail Systems department is probably the largest rail vehicle-specific department in any fire safety company in the world. A unique factor is the department's knowledge of the areas of design, structure and application configuration, combined with extensive rail vehicle-specific expertise. FOGTEC also provides approval-specific expertise to its customers all over the world.

Taking into consideration the different national requirements, FOGTEC has developed a worldwide network to support vehicle manufacturers and operators and has established itself as a successful system supplier on all continents. This has been achieved not only with concepts and solutions developed specifically for our customers but



sustainable transport

also especially through a continuous stream of our own innovations. System developments with the associated approval processes for compensation solutions play a major role, in which FOGTEC Rail Systems has been a pioneer for all the market players for many years and has played a large part in promoting and structuring the testing and approval processes. FOGTEC was awarded innovation prizes in 2007 and 2009 for its work in these areas, and in 2011 was included in the "Encyclopedia of World Market Leaders." We focus our efforts on innovative approaches to replace existing regulatory requirements with active fire safety measures, thereby facilitating beneficial vehicle and transport concepts.

In addition to the commercial, design and weight-technical benefits of the FOGTEC system solutions, and apart from the primary focus on developing intelligent solutions to ensure personal safety, it is possible to achieve significant advantages through some regulatory requirements. The possible potential includes:

- Cross-border transport throughout Europe
- Reduced interruption to operations
- Higher availability of the vehicle fleet
- More design flexibility
- Reduction insurance premiums



Knowledge creates added value – and diminishes everyday problems

Since 2003, FOGTEC Rail Systems has supported its customers in the development of new vehicle concepts and the application of general fire safety requirements in existing vehicle platforms.

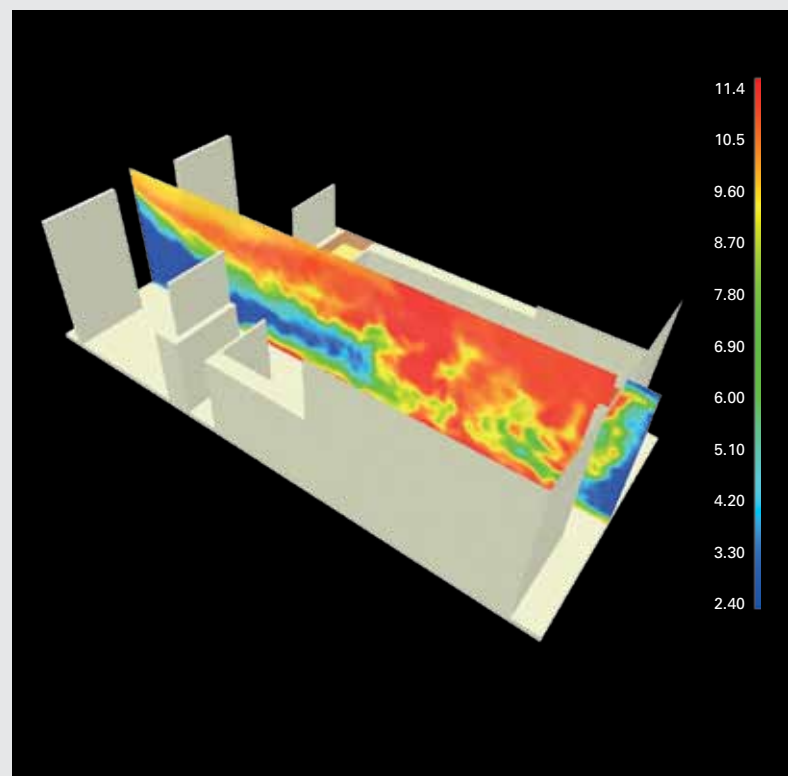
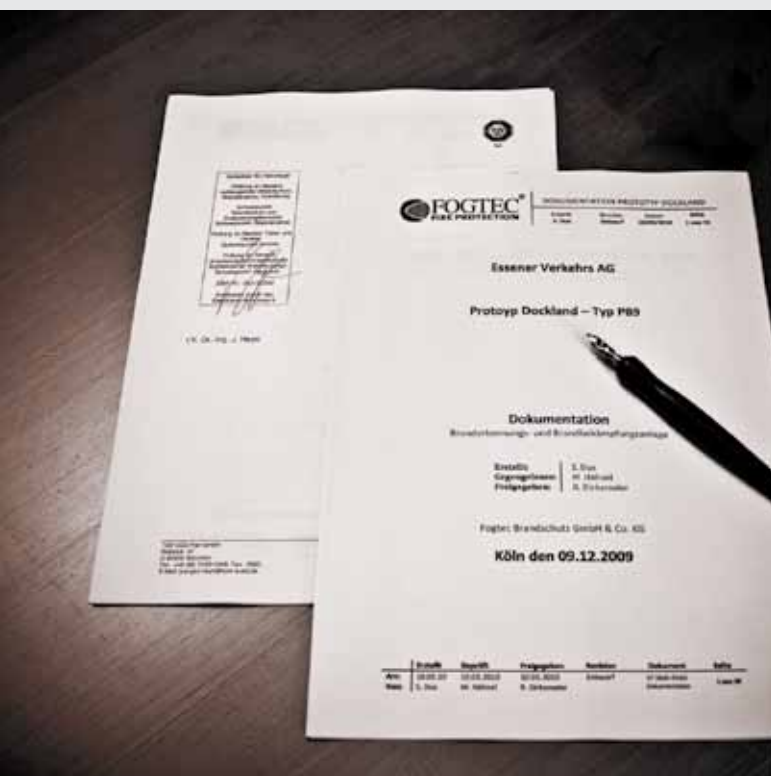
Because our worldwide activities require us to deal with different national (or local) regulations and requirements, we have acquired an outstanding level of knowledge of all aspects of fire safety. This extensive expertise can be provided to customers upon request, also independently of FOGTEC fire safety systems. In collaboration with the German Institute for Applied Fire Safety Research (Institut für angewandte Brandschutzforschung, IFAB) in Rostock, the consulting unit of FOGTEC Rail Systems offers a comprehensive portfolio of support for vehicle manufacturers and operators. The main support features are:

- General fire safety engineering for new vehicles and vehicle developments
- Fire risk analyses
- Fire safety concepts
- Evacuation concepts
- Verification using CFD simulations
- Verification using Smoke experiments
- True-to-life fire experiments
- Feasibility studies
- Reliability analyses and determination of life cycle costs for sub-systems

Because of the considerable increase in the significance and scope of fire safety in the approval of vehicle and operation concepts, vehicle manufacturers are usually unable to provide the necessary special knowledge and corresponding resources required. This is where the engineers from FOGTEC Rail Systems, in cooperation with IFAB, can provide resources and competences on short notice to take over tasks or provide support on all aspects of technical fire safety. In the case of more extensive projects, such as vehicle approvals or the development of new vehicle platforms, the engineers handling the tasks will be assigned to the vehicle manufacturer's or operator's location to ensure optimum communication and coordination.

The aim is not to take over the work of the notified body or the approval institution, but rather to do the groundwork, such as compiling fire safety concepts and fire risk analyses, to ensure that the approval process is a success. Thanks to our many years of experience and close cooperation with the acceptance bodies and the approval authorities, we keep the approval risks to a minimum and provide the assisting documentation at an early stage in the format required by the assessing body.

Our work in the many different regulatory and standardization committees is an important part of our activities, and enable us to keep our customers up to date with regard to any new developments in the industry.



From idea to implementation – everything from one source



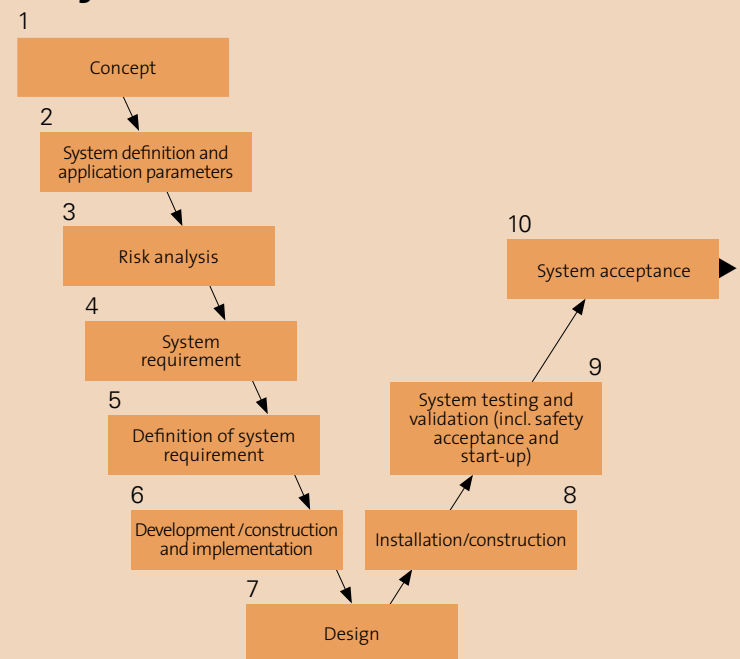
When it comes to finding technically and economically feasible solutions, the customer's specifications as well as national or local requirements and other special features must be taken into consideration. But it is also essential to take a holistic approach. In many cases, much more added value can be achieved through interfaces to other subsystems between the vehicle and the infrastructure, by combining individual subsystems or by using intelligent, innovative, modular building blocks, than would be possible by looking at everything individually.

It doesn't matter whether the motivation to integrate a fire safety system is based on regulatory requirements, a compensation measure or the operator's desire to avoid a repeat of a past incident. In principle, the process is always the same, based on IRIS or EN 50 126 requirements: The scope of the individual modules in the development process is determined in relation to the complexity of the system. The project monitoring that is always required with the individual milestones ensures a continuous reduction of the project risk on both the customer and supplier sides.

The project or application requirements derived from the customer's specifications are supplemented by the requirements and standards of the specific country and the requirements defined from experience. They represent the underlying basis for the entire concept. Additional requirements such as software and system certification (EN 50 128, EN 50 129) are also part of the routine business, as are the associated RAMS documents. In this connection, hazard and risk analyses can be carried out, not only for specific systems but also for the overall project as a whole. This makes it possible to strengthen the main objective by identifying at an early stage risks that could interfere with smooth processing later in the project.

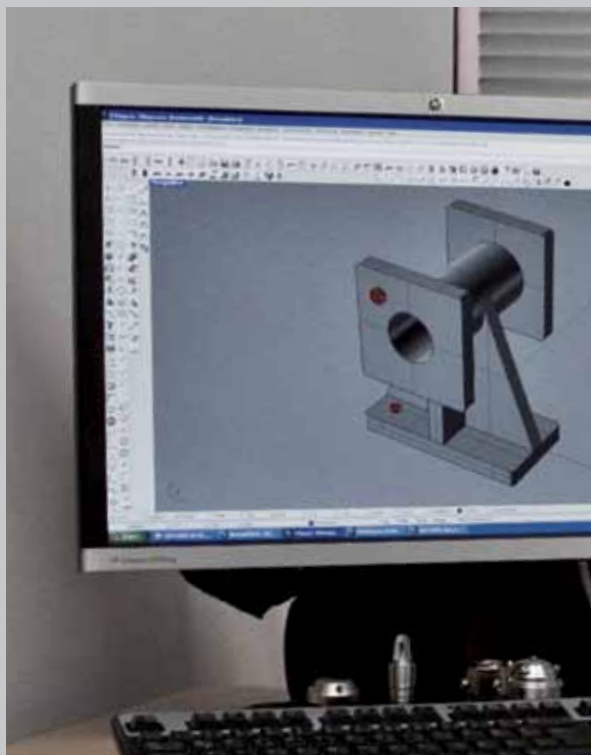
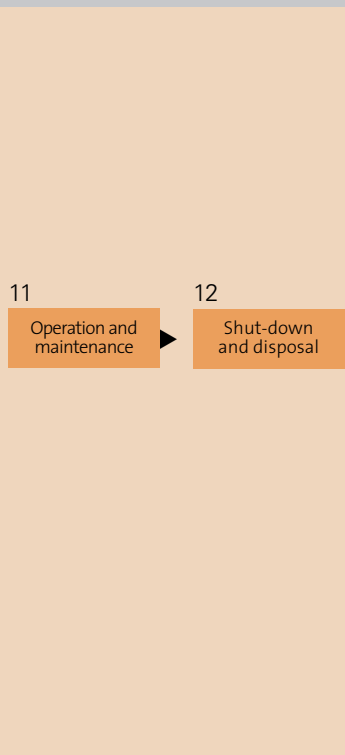
A team of software programming, electrical engineering and mechanical and hydraulic development experts ensures that the latest requirements are implemented with an eye toward optimised integration. The FOGTEC rail team was chosen with special

Project realisation



From specification

care to ensure all the necessary skills are covered. Specific knowledge about rail vehicles is the basic requirement. Our team includes specialists with experience from the operational side and also from the vehicle industry. Developments and application adaptations are supported parallel to the other processes by the RAMS/LCC department, making it possible to continuously measure the success with which targets are reached in terms of reliability, fault identification and availability. These are fundamental requirements for the system and software certifications (Safety Integrity Level, SIL) that are increasingly demanded these days.



to concept as a holistic approach to a solution

In addition, new trends in the rail vehicle industry are already taken into consideration in the groundwork. For example, aspects such as an eco-friendly design can already be integrated into the project management process. With constant support by quality management, which is based on IRIS and ISO 9001 requirements and is closely connected with the project management and development processes, the individual progress stages can be seen at all times and are documented in a comprehensive manner.

Modern 3D workstations are used in the design and development of system concepts to check integration, the installation spaces and the interfering contours wherever required. Developments to form production-optimized modules accelerate assembly and prefabrication times and also reduce storage space requirements for the vehicle manufacturer and operator. In

particular, the durability approval for larger support modules, such as for pressurized vessels, can not only be determined empirically, but also on the basis of the relevant standards with an FEM simulation model.



From design to assembly

The basic requirements for steel structures such as carrier modules were created with our own welding engineers, based on FOGTEC's certification as a specialist welding company. Over the last years, carrier modules for both overhead and under floor assembly have been developed, produced and delivered in series production.

The basis for the system design and concept development is FOGTEC's knowledge of the typical environmental impacts in rail transport and our specific fire safety expertise in the design of fire detection and fire fighting systems. It is the interplay of these two fundamental elements that allows us to design solutions specifically for rail vehicles that take into account safety, availability and ease of maintenance over the entire life cycle. The comprehensive validation process needed to ensure these properties reflects both the V model of EN 50 126 and that which has proven to be practical and feasible in the real process.

Smoke tests are an important way of providing the required evidence. They verify the design of the fire alarm system on the basis of actual smoke detection and thus provide the often-required proof that the design fulfills the legal requirements. The approval processes of the ARGE (Working Group Fire Detection) regulations, which are largely recognized throughout

the world, provide a standardized test procedure that has proven to be easy to implement and which provides a realistic scenario in practice. FOGTEC was one of the driving forces behind the creation of this practical standard process to provide reproducibility and reliability. FOGTEC uses specifically developed measurement instruments and not simple detectors with yes/no logic in order to document all the actual conditions and to guarantee the defined concept in the long term.

Based on these same regulations, FOGTEC regularly employs CFD simulation to provide proof for fire alarm systems that work according to the heat detection principle.

The effectiveness of a fire-fighting system is proven by true-to-life, full-scale fire tests; the currently applied test protocols are partly based on processes developed by FOGTEC as clear and reproducible guidelines. FOGTEC has carried out several hundred fire tests in its own laboratories and fire test facilities for a wide range of applications in rail transport technology, such as diesel engines, underfloor power packs, passenger compartments, sleeping coaches and more. For numerous projects, this large number of fire tests and experiments has served as the basis to provide clarification and proof of the effectiveness of the system



and to support application-specific system design documentation in accordance with the requirements of the responsible assessment body.

Finally, correct integration in the vehicle and full system functions may be checked together with the customer and the assisting assessors within the scope of the type test.

The compact design, the positive energy and weight balance as well as the corresponding specific solutions also make active fire safety systems a particularly beneficial solution for modernization projects. The fact that FOGTEC systems are relatively easy to retrofit has proven to be a benefit, especially for vehicle fleets that are being upgraded for renewed use, usually with more stringent fire safety requirements.

PRODUCT SERIES 1000 – The low-cost series



PRODUCT SERIES 3000 – The flexible all-rounder



Fire alarm engineering

Requirements for modern fire safety systems usually differ from one location to the next and can vary considerably between the vehicle manufacturer and operator. Finding the right balance between technical feasibility, compliance with regulatory requirements and sound economics demands a high level of flexibility and a wide range of system solutions.

This is why over the last years FOGTEC Rail Systems has developed four separate product lines fulfilling different technical requirements. Hence, FOGTEC offers a wide spectrum of rail specific solutions – from simple, inexpensive smoke switches to complex monitoring and communication systems that may be used even in the most extreme environmental conditions.

The complete spectrum of fire alarm engineering includes:

- Heat detectors, linear and point type
- Smoke detectors and smoke switches
- Smoke extraction systems
- Gas sensors
- Video analysis systems
- Communication modules and displays as HMI

PRODUCT SERIES 7000 – The special technologies



PRODUCT SERIES 9000 – The high-end version



Product series 1000 – The low-cost series

Advanced large-series products that enable system configuration from small single area solutions to cross-vehicle monitoring when used together with extensions of rail specific developments. The software-free system modules are characterized by their simple and low-cost design and can be supplemented with more complex modules with data interface.

Product series 3000 – The flexible all-rounder

A high degree of flexibility in the system design and with the data interface (CANOpen, Ethernet, RS 485, MVB) allows a system design that integrates other alarms and sub-systems based on the customer's requirements. At the heart of these systems are the specially developed operating panels with extensive diagnostics software, guided visualization and user-programmable displays to be used to service the system.

Product series 7000 – The special technology

Besides smoke extraction technology with different data interfaces, this series includes gas and infrared sensors as well as image analysis units for CCTV systems. The product portfolio of this product line is complemented by data gateways (e.g. implementation on WTB, Profibus, etc.), GSM remote access systems (e.g. troubleshooting from the control room or the service location) and a range of displays as human-machine interface for service and communication.

Product series 9000 – The high-end version

This product line derived from the aviation industry is at the high end of the performance spectrum. It is characterized by the lightweight design and low energy consumption of its components, as well as its very high degree of reliability and availability. With their intelligent connection concepts to other components and sub-systems, the system modules, which are designed to withstand the most extreme environmental conditions, allow system architecture with optimized cabling without any additional components. Many systems based on SIL 1 and SIL 2 have been implemented.

Fire fighting

Proven for innovative solutions

Active fire fighting has a long tradition at FOGTEC, as the company is the leading manufacturer of high-pressure water mist technology. This is the technology most commonly used in the rail vehicle sector. It is now used in vehicles on all continents.

Many parameters play a role in choosing the right extinguishing medium in the respective project. Apart from the defined risk areas and environmental aspects, the presence of people and vehicle-specific requirements also have to be considered (e.g. energy balance, weight balance, installation space). The overall project-specific consideration determines the type and design of the appropriate fire-fighting system for each individual project.

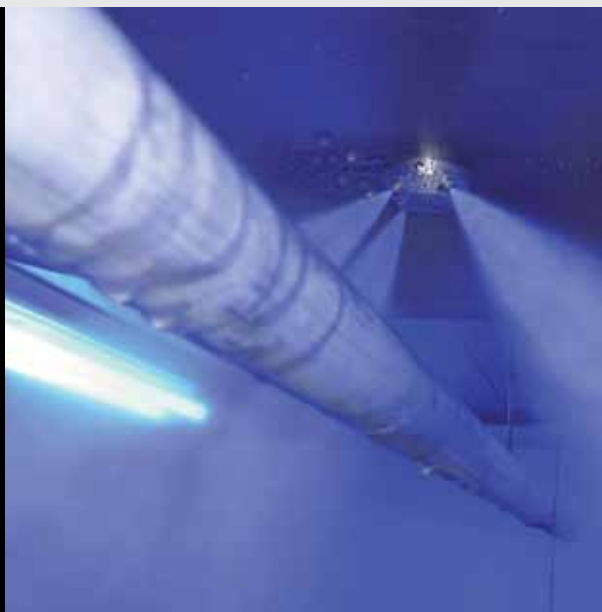
The design and dimensioning are proven and based on a number of full-scale fire tests, often with the support of independent experts. These fire tests are based on current guidelines, for which FOGTEC has been providing important input for almost ten years. Back then, the complete lack of standardized approval processes meant that new acceptance processes had to be developed to allow an assessment of these technologies.

A variety of extinguishing agents – the right one for every application

As a primary solution, FOGTEC offers five different extinguishing technologies that can be linked to the various fire alarm and communication systems. The latest generation of storage modules and section valves in combination with extensive monitoring functions allows local activation of systems only in the area where fire has been detected, and guarantees speedy fault diagnostics and identification.

High pressure water mist

The technology of atomizing water under high pressure has become very widespread in rail vehicle technology over the last years. It is used especially in passenger compartments, but also in diesel power packs, diesel and electric engines and in a variety of specialty vehicles. The special feature of this technology is that water is atomized into tiny droplets whose low mass is accelerated sufficiently to create the required water mist in the protected area. The tiny droplets in the direct vicinity of the fire partly evaporate as a result of the transfer of energy from the fire to the water and thus ensure cooling around the source of the fire. The housing effect reduces heat radiation and helps to reduce fire spreading from the initial fire source to neighboring components.



The extremely efficient cooling effect is also supported by local oxygen displacement at the source of the fire. The conversion of water mist to steam in the direct flame area causes a high absorption of energy and at the same time a considerable expansion in volume of the water. This displaces oxygen and reduces the local oxygen concentration. The high pressure level in this technology is used to accelerate the tiny mist droplets when they leave the nozzle so that they create a spray pattern. This plays an important role, for example, in passenger compartments (open doors at the station or after evacuation) and also in the enclosed under-floor area of diesel power packs.

Low pressure water mist

In some cases, the use of low-pressure water mist systems can be an economical alternative. However, compromises must be made when installing these systems due to the use of larger pipe diameters. The use of materials in lower-pressure systems can save costs in very small applications. This must be considered on a case-by-case basis, since the lower pressure level generates a different quality of mist that is not adequate for all applications.

Aerosol

Aerosol systems are a very cost-effective alternative for fighting fires in technical areas. A distinction is made between conventional cylinder systems and aerosol generators. In both cases very fine aerosol particles are used as an extinguishing agent, which put out the fire as the result of a physical reaction. The two available concepts differ in the way in which the extinguishing agent is stored or prepared. While the aerosol is stored in a ready-to-use form in the cylinder systems, aerosol generators use a chemical process to generate the extinguishing agent. This process is triggered by pyrotechnical activation and takes place within milliseconds.

Nitrogen

Nitrogen-based gas extinguishing systems are used mainly in enclosed technical areas, especially where electrical equipment is present. This medium reduces the potential damage to technical equipment to a minimum compared with other extinguishing agents, and can be used in vehicles throughout Europe because it is non-toxic. The generally very compact extinguishing systems are integrated into the structure of many vehicle concepts.



References – Fogtec systems



Regional traffic

FOGTEC systems protect many DMU and EMU traction vehicles used in regional traffic throughout the world. These systems are mainly used to compensate for regulatory specifications or to fulfil statutory or regulatory conditions. They are used in passenger compartments, technical areas and for diesel engines.



Short-distance public transport

FOGTEC systems are increasingly protecting vehicles in local public transport. This may be to compensate for constructional measures (infrastructure design) or because of regulations or customer requirements, but, FOGTEC systems are integrated into many different vehicle types all over the world.



Engines

With diesel or electric drive systems: FOGTEC systems are used in all engine concepts in large numbers on all continents. Innovative approaches to integration solutions, fully prefabricated modules and optimised module design guarantee the optimum solution for every type of engine.



worldwide in transportation

Special railways

Special conditions demand special solutions: Rack or cog railways, railways in tunnels, monorail or similar transport systems are increasingly subject to increased fire safety requirements. FOGTEC system solutions are integrated in new vehicles and in modernisation projects.



Double-deck carriages

Modern double-deck carriages are characterised by a high density of passengers – especially on the tracks in highly populated cities – narrow spaces, small installations spaces for components and difficult evacuation situations. This is where different product series of FOGTEC systems are used.



High-speed trains

The European high-speed rail network is merging and posing some new challenges for vehicle manufacturers and approval bodies. FOGTEC supplies systems for fire safety in cross-border trains, such as for Alstom AGV NTV in the Italian network, where apart from Italian regulations, the systems also fulfil TSI requirements.



GTEC[®]
ROTECTION



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