



Fire protection for road, metro and rail tunnels with the Sinorix™ high-pressure water mist system

[siemens.com/water-mist-fire-suppression](https://www.siemens.com/water-mist-fire-suppression)

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The rapid pace of urbanisation worldwide has significantly increased the demand for tunnel infrastructure, which plays a critical role in enabling safe and efficient travel for millions. As essential components of modern physical infrastructure, tunnels must be fully equipped to handle emergency situations, particularly fires, which pose serious risks to both human safety and structural integrity.

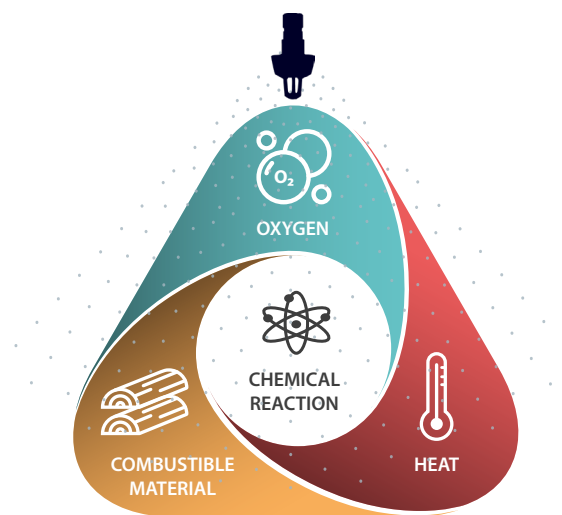
The **Sinorix** high-pressure water mist system from Siemens offers an advanced fire suppression solution designed specifically for tunnel environments. It enhances fire control effectiveness while prioritising the safety of people, minimising damage to tunnel structures, and maintaining operational continuity.

The intelligent use of water

How does it work?

Fire needs three elements of the “fire triangle” to ignite and burn: oxygen, heat and combustible material. The removal of any one of these elements will extinguish a fire.

The Sinorix high-pressure water mist system goes further. It attacks two elements of the fire triangle: oxygen and heat. The uniqueness of high-pressure water mist is that it combines the suppression effect of gas and sprinkler systems. In addition to removing oxygen like gas systems, it simultaneously cools the fire like a traditional sprinkler. The cooling effect additionally lowers the risk of re-ignition.



The power behind Sinorix

The Sinorix high-pressure water mist system integrates advanced fire suppression technology through a comprehensive set of components, including a high-pressure modular pump unit, section valves, specialized nozzles, press fittings, and a stainless-steel piping network. The system operates with precise technical specifications, delivering water droplets ranging from 10 to 200 microns under working pressures of 60 to 100 bars through a clean water delivery system.

When activated, the system releases micro droplets through specialized nozzles, creating rapid evaporation upon contact with fire. This process expands the water volume up to 1,700 times, simultaneously providing cooling effects and oxygen displacement at the fire source. The system's efficient operation ensures comprehensive fire protection while optimizing water usage.

Engineering excellence

Our fire safety engineering team delivers expert guidance grounded in in-depth knowledge of local regulations and hands-on experience. From initial design and installation to testing, commissioning, and ongoing maintenance, we support our clients at every stage through a global network of specialists. Our water mist systems are engineered to meet the highest standards of sustainability, aesthetics, and performance - while ensuring full compliance with all relevant regulations.

Sinorix high-pressure water mist

- advanced fire suppression system for tunnels

Whether it is a road, railway, or metro tunnel, Sinorix is the perfect solution for fire suppression.



Sinorix pump unit

- Water-lubricated high-pressure pump that is virtually maintenance-free
- Robust, resistant, and efficient
- Increased water flow and minimal starting peak current for pump unit with frequency converters
- Plug & play unit

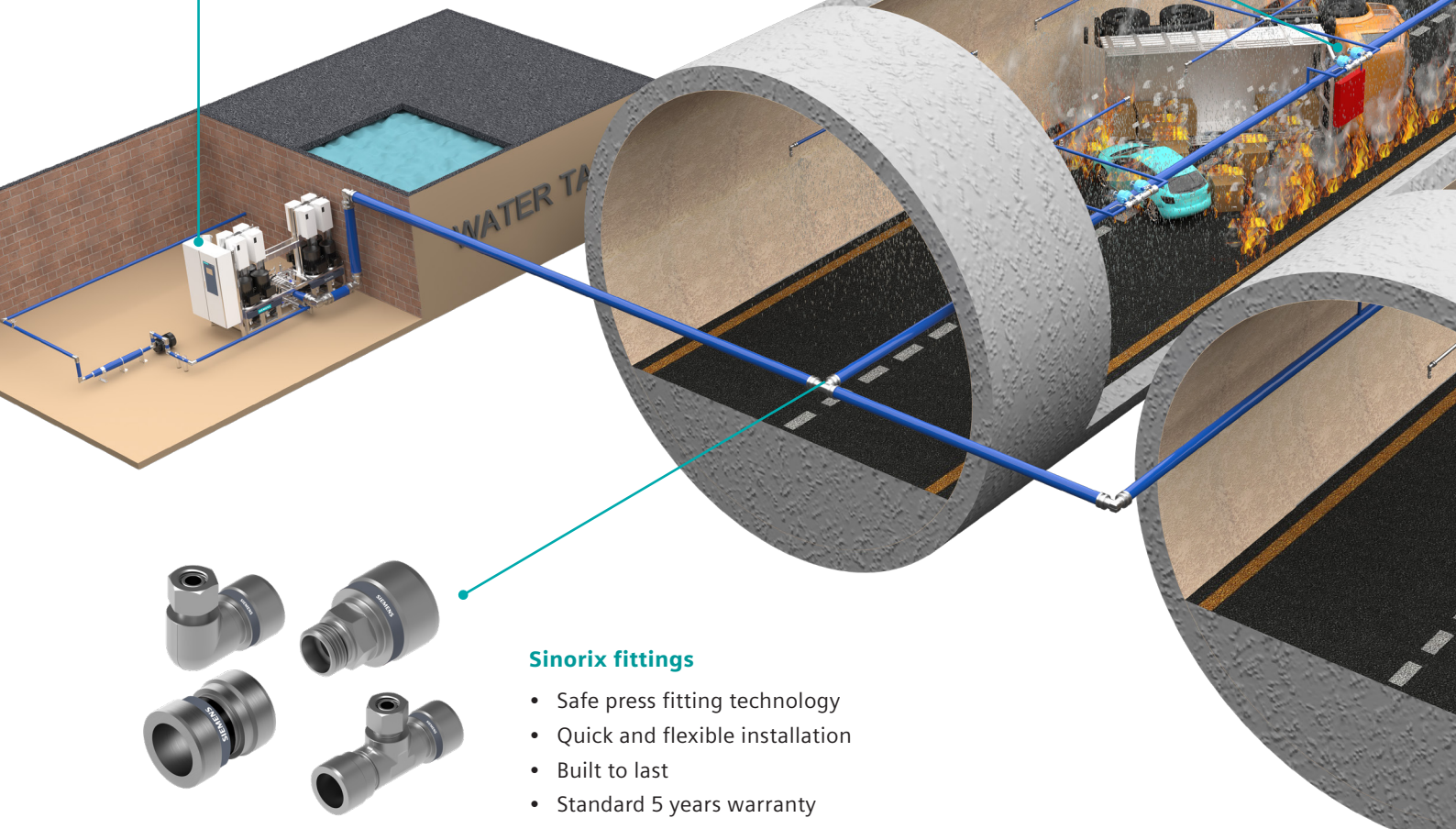
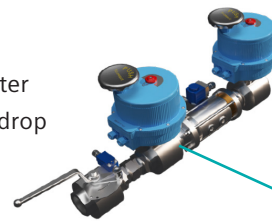
Sinorix pipes

- Lightweight and space-saving
- High-quality stainless steel
- Unique thin wall technology
- Standard 5 years warranty



Sinorix section valve

- Excellent performance: high water flow capacity at lower pressure drop
- Improved serviceability
- Modular design
- Remote testing option



Sinorix fittings

- Safe press fitting technology
- Quick and flexible installation
- Built to last
- Standard 5 years warranty

Sinorix fire hose reel cabinet

- Easy integration with the water mist system
- Up to 50m long and thin hose for easy handling and large coverage
- Tested against Class A fires (solid fuels) and Class B fires (flammable liquids)



Sinorix nozzles

- Low water consumption
- Reliable fire suppression
- Short installation time
- High spacing

Key benefits

- Effective fire control, suppression, and extinguishing
- Excellent cooling
- Facilitating the evacuation of people and safe firefighter intervention (ambient temperature)
- Reduced cost of ownership
- Reduced ventilation and passive fire design requirements
- Meeting the sustainable needs of modern tunnels
- Long product life cycle due to the highest-quality material used
- Economic benefits
 - Fewer nozzles required due to large nozzle spacing
 - Faster installation
 - Smaller water reservoir due to low water consumption
- The world's lowest water density for the same test class
- Safeguarding tunnel structures
- Easy system integration in retrofit projects

Full-scale tests for tunnels with excellent results

Our full-scale fire tests with fire loads of up to 250 MW are in accordance with **SOLIT²** and **NFPA502**, tested by **RISE Fire Research in Norway** (partially owned by RISE - Research Institutes of Sweden and SINTEF)- a fire technical competence centre and an accredited independent third party research institute.

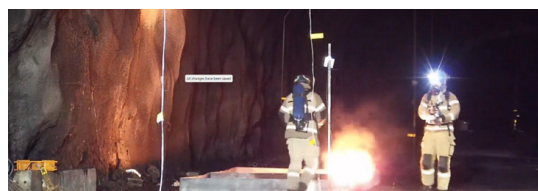


The unique engineered system and its components, which facilitate superior nozzle performance, meet and exceed the expected criteria as highlighted in SOLIT² and NFPA502. Sinorix high-pressure water mist is the system of choice for ensuring the safety of structures and human life, and preventing/minimising tunnel operation interruptions.

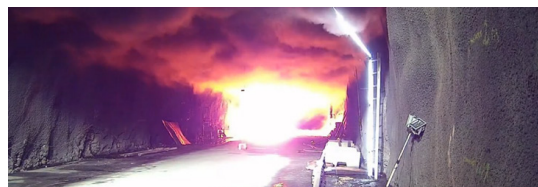
The Sinorix system is tested and certified for fires of both Class A (ordinary solid combustibles) and Class B (flammable liquids).



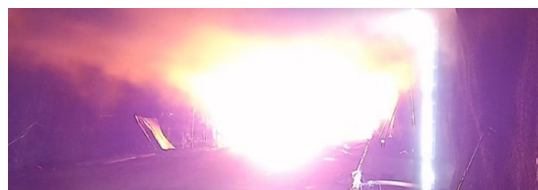
In addition to external approvals, the HSE&Q system in Siemens is audited and approved by DNV in accordance with ISO standards.



Fire started



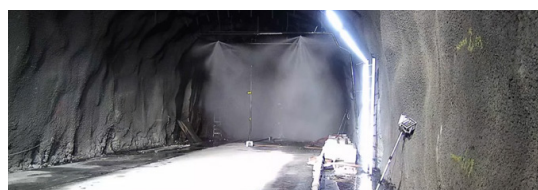
Backlayering progressing when water mist is not activated



Sinorix nozzles activating 2 min. after ignition



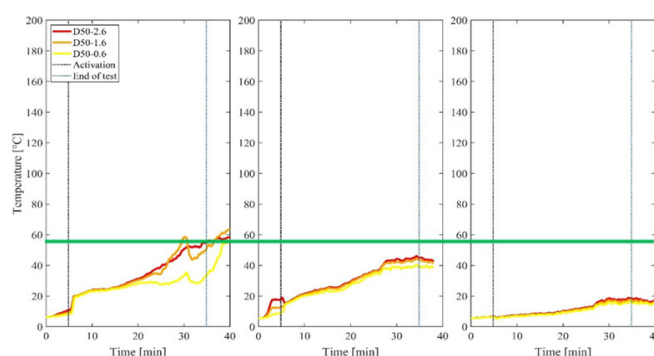
No backlayering 2 min. after Sinorix activation



Fire extinguished 13 min. after Sinorix activation

Using Computational Fluid Dynamics (CFD) to lead the way in the fire safety design and risk assessment of tunnels

Siemens has developed CFD models that replicate the results of full-scale fire tests. These models are applied to the real tunnel in order to document the water mist system's ability to control and suppress a potential fire inside the tunnel. The CFD model can also be used to analyse if the ventilation capacity could be reduced and whether the safety of people, fire brigades, and the structure is still adequate.



— Untenable temperature

Temperatures at 50 m downstream (D50) from the centre of the mock-up fire at 0.6 m, 1.6 m, and 2.6 m above ground level. Left graph: full-scale fire test; middle graph: CFD model validation; right graph: CFD simulation for the tunnel project in India.

It can be clearly seen that the temperatures in the evacuation zone were at tenable levels throughout the full-scale fire test, i.e. at least 10 minutes after the activation of the water mist. It can also be seen that the criterion for untenable conditions was not reached throughout the full-scale fire test. The CFD model validation replicated the trend from the full-scale fire test with 10–20% accuracy, so the model is considered a good, validated CFD model. For the tunnel project in India, the CFD simulation showed that the temperature in the evacuation zone can be kept well below untenable conditions thanks to the water mist system, as well as the tunnel being much larger than the one in which the full-scale fire test was conducted.



Proven experience across the world

Tunnel environments present some of the toughest fire safety challenges in modern infrastructure. Confined spaces, limited escape routes, high traffic volumes, and valuable assets require protection systems that are not only highly effective but also sustainable and cost-efficient.

Sinorix high-pressure water mist technology has proven itself in some of the world's most ambitious and complex tunnel projects. From Turkey to India, our systems ensure reliable protection for tunnel structures, people, and assets — setting new benchmarks in tunnel fire safety.

One example is a deep sub-sea metro tunnel reaching 120 meters below sea level. With no possibility of escape shafts due to soil conditions, fire safety became a critical design requirement. Sinorix provided an innovative solution: a compact, efficient system that safeguards passengers and infrastructure, while optimizing space and reducing total cost of ownership.

In India, Sinorix protects an 8.2 km dual-road tunnel within the 778 km expressway from Mumbai to Nagpur. Designed with sustainability in mind, the system uses significantly less water than conventional sprinklers, while delivering outstanding fire suppression. Alongside the suppression system, Siemens contributed engineering expertise, technical design, and on-site supervision to ensure seamless implementation.

These flagship projects demonstrate more than just technical capability — they highlight our commitment to shaping safer and more resilient tunnel infrastructures worldwide. Sinorix high-pressure water mist systems combine rapid fire suppression, minimal water consumption, reduced smoke and heat spread, and environmental responsibility.

With Siemens, tunnel operators gain the confidence of partnering with a global technology leader that delivers reliable, sustainable, and cost-effective solutions tailored to every tunnel's unique challenges.

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We create technology to transform the everyday, for everyone. Our world is changing at an unprecedented rate. Demographic change, urbanization, globalization, environmental change, resource efficiency, and digitalization are presenting new challenges and opportunities.

Siemens Smart Infrastructure addresses these topics by combining the real and the digital worlds.

Our technology transforms infrastructure, across buildings, electrification, and grids, at speed and scale, enabling collaborative ecosystems to accelerate our customers' digital journey to become more competitive, more resilient, and more sustainable.

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