

# Full Scale Tunnel Fire Testing

Thanks to our unique tunnel facilities, we can offer testing and verification of passive and active fire protection.



## What is full-scale tunnel fire testing?

In any type of testing, we try to reproduce real fire conditions: fire, smoke, ventilation systems, alarm systems, and dimensions. In many cases, tunnel tests are carried out on a smaller scale. In the case of fire testing in tunnels, they can be carried out at full scale if the facilities are available with sufficient characteristics for simulation.

## Tunnel safety testing

Our [Applus+ TST](#) technology and experimental centre located in Asturias (Spain) has a **testing tunnel** dedicated to reproducing **full-scale fire conditions** in confined areas, such as tunnels, galleries, mines, car parks, warehouses, and other underground infrastructures.

These full-scale tests are intended to validate the suitability of the fire protection measures to be incorporated into a facility, whether for a new construction project or for the improvement of safety installations in an operating tunnel, beyond the mandatory compliance tests.

This infrastructure makes it possible to evaluate the behaviour in real fire situations of:

- Ventilation and smoke extraction systems.
- [Fire detection systems](#).
- Fire extinguishing and fire control systems ([sprinklers](#), water mist, foam, etc.).
- Fire resistance of construction material components for tunnels.

- [Safety installations](#) such as light signals and occupant warning signs.
- Fire response of equipment and rolling stock.
- Work on rolling stock.
- Validation of theoretical CFD simulation [models and calculation of ventilation](#).

## Main characteristics of the tunnel

This is a semi-buried concrete cut-and-cover tunnel more than **600 metres long**, equivalent to a two-lane road tunnel or a railway tunnel. The installation incorporates two tunnel ventilation stations, an emergency and service gallery, four emergency exits and a 150-metre-long fire gallery.

- Length: 600 m
- Width at base 9.50 m
- Height with / without false ceiling 5.10 m / 8.12 m
- Cross section with / without false ceiling 44 m<sup>2</sup> / 66 m<sup>2</sup>
- Emergency gallery: 4 m wide x 2.50 m high
- Emergency exits: 4 (one every 150 m)
- Minimum radius of curvature: 400 m
- Longitudinal, semi-transverse and mixed ventilation systems
- Fire gallery (150m) with two fire zones and entrances at the same level, top and bottom
- Longitudinal slope: 1 %
- Cross slope: 2 %

## Ventilation systems

The tunnel has four different ventilation systems in order to be able to test the most common ventilation systems on the market:

- **Longitudinal ventilation:** 14 jet fans of 45 KW 8 (six fans installed in the tunnel).
- **Semi-transverse ventilation**
  - Two 355 KW axial fans, reversible and variable speed, with a combined capacity of 160 m<sup>3</sup>/s.
  - Removable false ceiling, located 5.17 m above the tunnel floor level
  - 21 motorised ventilation hatches, 2 m<sup>2</sup> in cross section
- **Mixed longitudinal and transversal systems**
- **Saccardo system:** Two axial fans of 355 KW (injection) and 315 KW (extraction), both with a flow rate of 120 m<sup>3</sup> /s.

It is also equipped with a **passive fire protection system** consisting of a 5 cm layer of fireproof concrete that allows it to withstand minor fires as well as large calorific powers of more than 200 MW.

## Passive fire protection systems

The tunnel is equipped with a passive fire protection system consisting of a 5 cm layer of fireproof concrete that can withstand fires of high heat output of more than 200 MW.

## Additional equipment

Our 600m tunnel also has the following equipment:

- **Water storage tank** with a total capacity of 600 m<sup>3</sup>.
- A 150 mm diameter **pressure pipe** on the **outside of the tunnel**, located at kilometre point 300 and fed by a pressure group working at a maximum pressure of 4 bar and with a capacity of 180 m<sup>3</sup>/h.
- 100 mm diameter **pressure pipe** located inside the tunnel, with hydrants every 50 metres. This installation can only be operated by the safety brigade and fire brigade during the tests.
- **Fibre optic network:** The tunnel control and data acquisition system is an essential part of the installation and is used both for the control and regulation of the various ventilation systems, fire pressure equipment and lighting, and for the acquisition and recording of data and images during the tests.
- **Waste collection system** with a 50 m<sup>3</sup> settling basin and water treatment plant.
- 250W **luminaires** every 15 m, on both gables.

## Training of firefighters and mine rescue brigades

In addition to testing fire protection systems, the Arplus+ TST test tunnel is an ideal training environment for **practical exercises and tunnel intervention manoeuvres**. Our experts have conducted training courses for firefighters and mine rescue teams in tunnel and gallery fires for different countries.

## Main projects carried out

Our testing facilities, due to their uniqueness, are a global reference in tunnel fire testing. Among the projects carried out in our facilities, the following protection system tests stand out:

### **Eurotunnel (Channel Tunnel, UK)**

We carried out tests on the water mist system of the German company FOGTEC, to verify its operation. During this project, a total of 5 full-scale fire testings were carried out, reaching fire powers of up to 200 MW, which is a milestone in this type of test, as tests had never been carried out on this scale for water mist systems.

### **MontBlanc Tunnel (France-Italy)**

During this project, a total of 23 tests were carried out to make decisions on different fixed water suppression systems from the German company FOGTEC. Different suppression systems were used

- Sprinklers
- Low pressure water mist
- High pressure water mist
- Foaming agents

### **M-30 Tunnel in Madrid (Spain)**

Specifically, we carried out fire tests in tunnels for the M30 metro project (CALLE 30). A total of 51 tests were carried out with real fire and different configurations, reaching fire powers of around 80 MW.

### **LTA Road Tunnel (Singapore)**

For this project, we conducted tests of suppression systems with VID low-pressure sprinklers. A total of 16 full-scale fire tests were conducted with wooden pallets. In addition, a half-hour free fire test was conducted, in which the highest fire power (250 MW) was achieved in a test of this type in the world to date.

## **Why choose Applus+ TST for full-scale tunnel fire testing?**

Applus+ TST's facilities are unique in the world, which allows us to position ourselves as experts. In fact, the tunnel is built specifically for the realisation of fire and ventilation situations in tunnels and for full-scale tests and simulations.

In addition, Applus+ TST is part of the [Applus+ Laboratories](#) global network of laboratories which has more than 30 years of experience in [fire testing](#) and is one of the leaders in Europe in the field of reaction to fire due to its equipment, volume of tests and scope of accreditations.