ROCS

Furrer+Frey®
Overhead contact lines

Rigid Overhead
Conductor-rail
Systems

Furrer+Frey Rigid Overhead Conductor-rail System (ROCS)

Robust, rapid, pivoting, retractable, elegant, highly conductive. In tunnels, in stations, in the open, on bridges, in workshops and depots.

Furrer+Frey has been creating overhead line solutions for decades. The company has always believed that there is more to great customer service than just technical expertise; successful design involves listening to customers and working closely with them to develop solutions that enhance safety, efficiency and the reliability of railway systems. This was the spur for us, at the beginning of the 1980s, to develop an alternative to the conventional overhead contact line. And the outcome was the Furrer+Frey Rigid Overhead Conductor-rail System.

- **Allows smaller tunnel cross-sections for new constructions**
- **Allows electrification of tunnels and stations originally built for steam or diesel traction.**
- **Offers high electrical cross-sections, so that additional feeders can be avoided.**
- **Fire resistance is significantly greater than that of a catenary system.**
- **Extreme operational reliability and requires little maintenance regardless of the operating voltage.**
- **Faster installation**

I 1 I

I 2 I

I 1 I
Typical hinged supports on DC application

I 2 I
Low encumbrance support, Axen tunnel

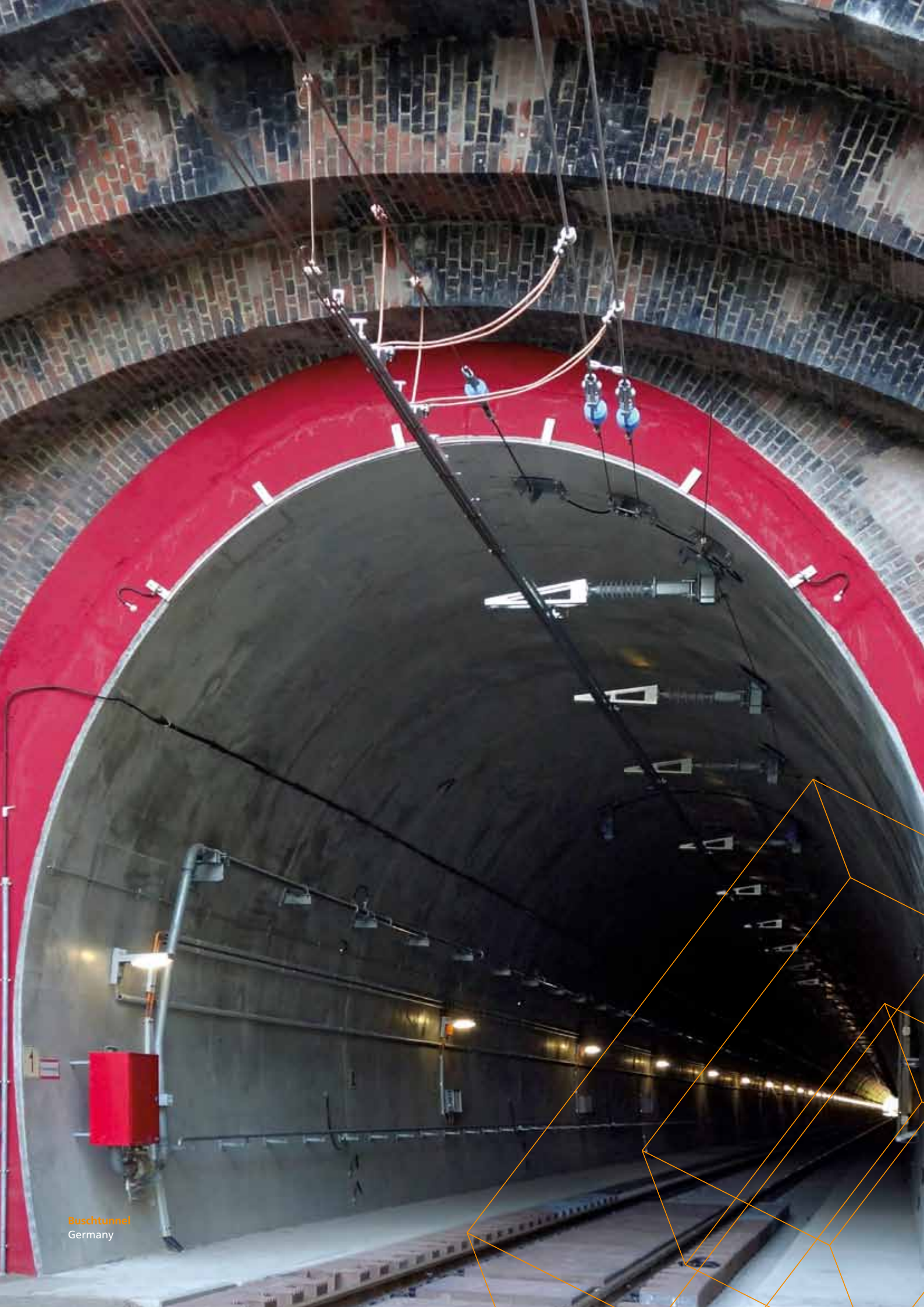
2000km
of conductor rail operational

300
projects in over
30
countries

300km/h
line speeds

Furrer+Frey Global ROCS projects

Algeria
Australia
Austria
China
Croatia
Czech Republic
Denmark
England
Finland
France
Germany
Greece
India
Italy
Luxembourg
Netherlands
New Zealand
Norway
Poland
Russia
Scotland
South Africa
South Korea
Spain
Sweden
Switzerland
Taiwan
Thailand
Turkey
Ukraine
United States



Buschtunnel
Germany

30 Years of Reliability

The Furrer+Frey rigid overhead conductor-rail system is renowned throughout the world for its superior standards of quality and reliability. Sound commercial sense, technical expertise and pioneering innovation have all contributed to ongoing enhancement of the system since it was invented. Our conductor rail profiles are made of aluminium alloy and meet all the demanding requirements of a modern overhead contact system.

Electrical, mechanical and fire resistance testing as well as actual operational experience have demonstrated that the Furrer+Frey rigid overhead conductor-rail performs reliably at speeds of up to 250 km/h and is also TSI compliant for 250 km/h line speeds.

Stanton tunnel train trial
UK

Vingelz tunnel with ballasted track
Switzerland | Line Speed 160km/h |

Stanton tunnel with ballasted track
UK | Line Speed 200km/h |

Elegant at Stations

Due to the intrinsic qualities of the system, the Furrer+Frey conductor-rail can easily adapt to any station structure. This capability allows the designers to work together with station designers and develop a solution which completely blends in with the station architecture.

Berlin Main Station

The team of architects that revitalized the building of the main station wanted to have an overhead contact line that adapts to the station architecture. The conductor-rail completely blends in with the station structure.

Salzburg Main Station

The team of architects that renovated the arched roof over the tracks looked for a new element for the overhead contact line and voted for rigid overhead conductor-rail.

Aukland Main Station

Furrer+Frey rigid overhead conductor-rail, nicely blending in with the rest of the station.

The conductor-rail also eliminates the need for registration arms near the platform. This improves electrical clearance to passengers, thus enhancing passenger safety.

Equally Effective for Open Track

Furrer+Frey's rigid overhead conductor-rail system has a lower life cycle cost than conventional overhead line equipment. This is owing to the higher reliability and reduced maintenance of the conductor-rail system. These qualities make it an effective solution for open track as well, particularly for small open sections between two tunnels and low clearance bridges.

Bourg-en-Bresse
Bellegarde

The conductor-rail over open track connects two tunnels over a short distance. The continuous conductor-rail reduces the number of changeovers between catenary and conductor-rail.

Sargans
Switzerland

Two successive low clearance arch bridges are equipped with Furrer+Frey conductor-rail to achieve electrification.

Low Clearance Long Bridge
Switzerland

Conductor-rail is an effective solution to low clearance bridges which can tend to have wiring complexities with conventional OLE

Making Depots Safer

Furrer+Frey's innovative moveable rigid overhead conductor-rail system for rail workshops and depots ensures that safe maintenance work can be carried out on rail vehicles, while enabling free access to the train roof. The system has been supplied and is operational in more than **120 depots worldwide**.

Based on our rigid overhead conductor-rail system, the moveable conductor-rail can be retracted away from the track, switched off and earthed, enabling obstruction-free access to the train roof and ensuring safe maintenance work on rail vehicles. An integrated control and communication system provides a proven safe and efficient way of controlling depot train movements.

Movable Conductor Rail Systems
Geneva, Switzerland

Movable Conductor Rail Systems, On Track & Retracted
Templemills Depot, UK

RHB Liftable Conductor Rail
Switzerland

Suitable for Lift, Bascule and Swing Bridges

The modular construction and un-tensioned nature of the Furrer+Frey rigid overhead conductor-rail system makes it the perfect solution in locations where the OLE needs to be regularly moved. Proven at a variety of moving bridges and construction sites worldwide.

Swing Bridge
France

Lifting Bridge
Sweden

Bascule Bridge
Germany

Evolution and Components

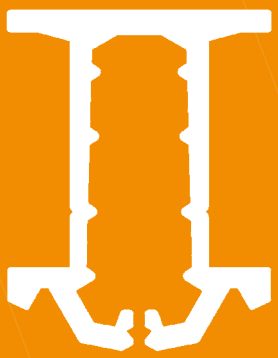
Development of The Conductor-Rail Profile

PROFILE **CR1**

PROFILE **CR2**

PROFILE **CR3HS**

PROFILE **CR4**



The box-shape profile has become more sophisticated as a result of experience gained over 30 years. We currently use the CR4 profile. The shape of the CR4 profile imparts improved performance in wet conditions.

Contact wires of between 100 and 161 mm^2 can be accommodated in the profile. A special anti-corrosion grease prevents ion exchange, thus permitting the use of copper contact wires.

Interlocking Joints

Conductor-rail profiles are jointed by using pairs of interlocking joints. The patented groove and rib system between conductor-rail profile and interlocking joint ensures that the joints are formed free of any kink. At the same time, it ensures optimum current transfer due to the numerous single-point and continuous linear contacts between the profile section and the interlocking joints. This has allowed the number of screws at the joint to be reduced from 16 to 8.

Support Structures

There are many types of support structures available, all of which have proven their worth in practice and which have been granted appropriate approvals. The support design can adapt to tunnel requirements and can be hinged type, gliding type or low encumbrance type.

Transition Bar

The rigid overhead conductor-rail system must be integrated in an existing catenary system. We have developed the transition bar in order to do this. The transition bar takes up and absorbs the oscillations from the contact wire of the catenary system and reinforces it with an increasing cross section onto the full profile of the rigid overhead conductor-rail. The transition bar provides a TSI compliant dynamic performance at the interface between conventional OLE and ROCS.

Section Insulators

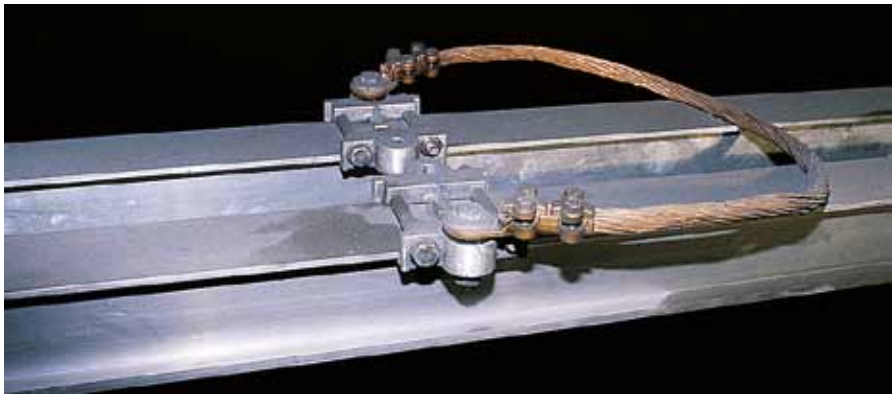
'Inline' section insulators for the conductor-rail. For speed > 140 km/h we use section insulators with special skids.

Protecting Plastic Covers

At particularly exposed, damp places the rigid overhead conductor-rail is protected against water by a plastic cover. Because of their open shape, the transition bars are always covered. In ramps the conductor-rail is equipped with a water deflector.

Electrical Connections

Flexible copper cables act as electrical connectors where there are breaks in the conductor-rail. We have developed current carrying clamps which complete the circuit for these circumstances. These clamps are also able to accept feeder cables.

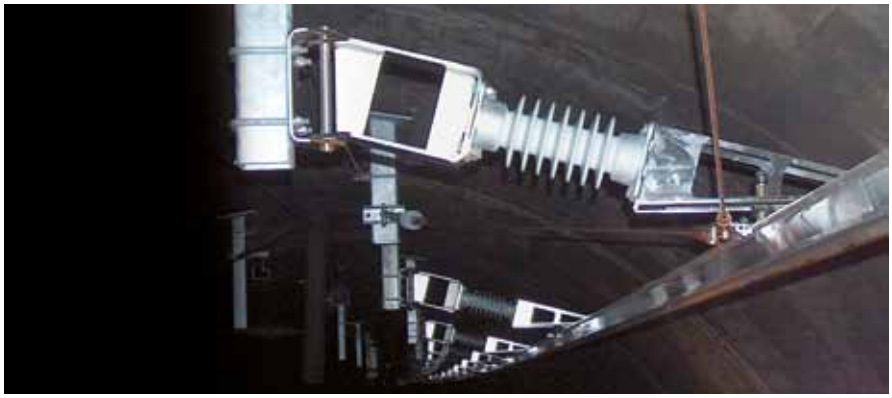


Expansion Joints

Like in a catenary system, temperature changes also produce changes in the length of the rigid overhead conductor-rail. Changes to its length are compensated for by expansion elements cut into the axis of the conductor-rail. These expansion joints allow the pantograph to run smoothly without mechanical or electrical interruption. Unlike parallel running conductor-rail type expansion gap, Expansion joints can function at full line speeds.

Turnouts and Crossovers

Where tracks branch off, the overhead conductor rail is run parallel to the conductor rail above the main track. In order to ensure the pantograph runs smoothly, the ends of the rigid overhead conductor-rails which branch off are bent up with a large radius.



Fixed Point Anchors

These perform the same function as a conventional OLE mid point anchor.

Anchoring the Catenary System in Tunnels or on External Structures

The endpoint anchors take up the tensile forces of the contact wire as it passes into the rigid overhead conductor-rail. Once inside the ends of the conductor-rail, the contact wire is installed without being subjected to tensile forces.

Assembly Aids

Drilling Equipment

A specialist Furrer+Frey drilling rig allows the high degree of accuracy and precision that are vital for high speed systems.

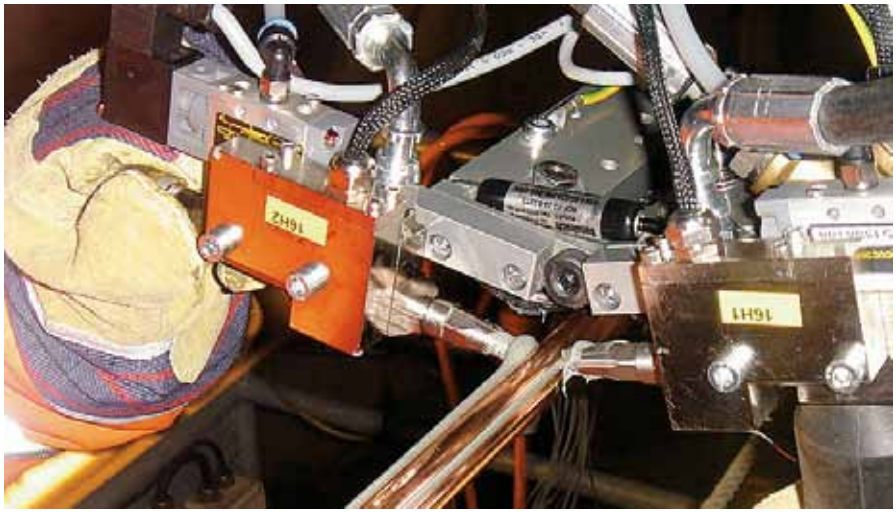
| 1 |
Furrer+Frey Drilling Rig at
Stanton Tunnel works, UK

Lifting Equipment for Conductor Rails

The conductor-rail profile sections can be delivered in special transportation racks. We have the appropriate lifting equipment for raising the conductor-rail profile section up to the desired contact wire height.

Contact Wire Insertion Device

The contact wire insertion device is used to insert the contact wire into the profile of the rigid overhead conductor-rail. The spreader wheels open up the profile locally and the central height device lifts the contact wire up to the height of the clamping point. After the insertion device has passed by, the profile closes elastically and clamps the contact wire. The contact wire insertion device can also be used to replace parts of the contact wire or to replace it completely at the end of its life cycle.



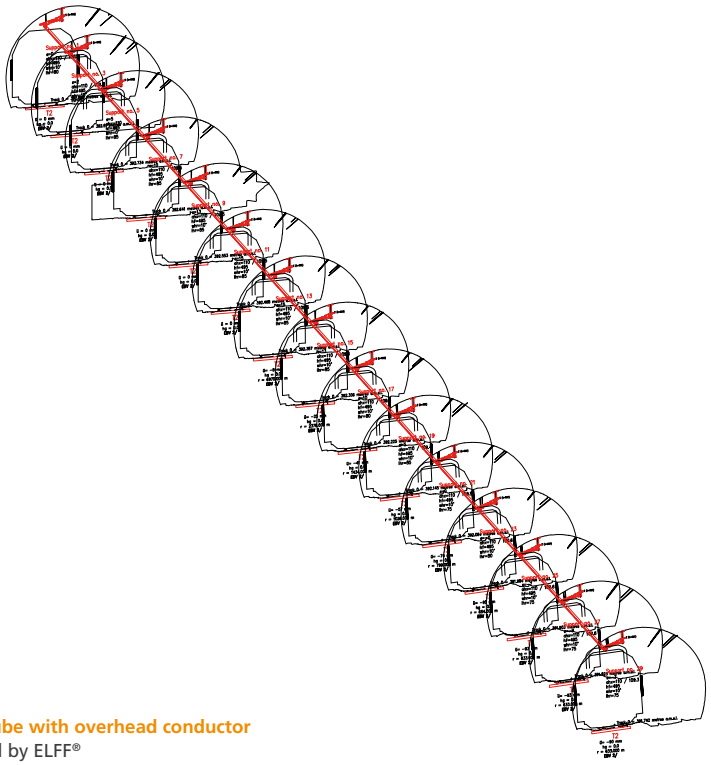
Greasing Device

As long as there is no moisture between the aluminium profile and the copper wire, there is no risk of corrosion. We prevent this, first with drip holes in the profile so that no condensation can form inside the profile. Then, we completely fill the grooves in the contact wire with grease. The grease is applied in the same working process before the contact wire is inserted. We have developed special greasing devices for this task.

Planning a Furrer+Frey ROCS

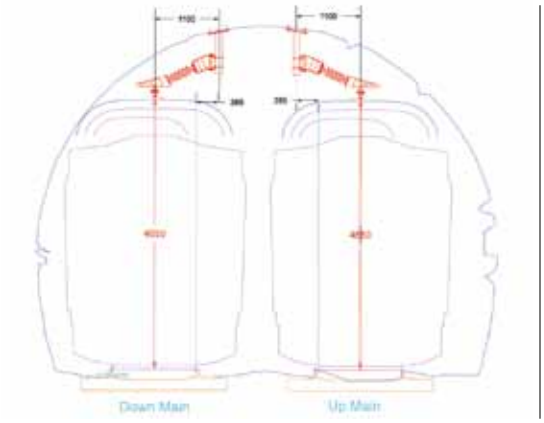
The rigid overhead conductor-rail system, as designed by us, permits a very large degree of planning freedom. Depending on train speeds, the distance between supports is 7 to 12 meters. Track radii of 120 m can be managed without difficulty using standard elements. Below this figure, the conductor rails are pre-bent using a special process; this makes radii of 20 metres possible and this has already been achieved in practice.

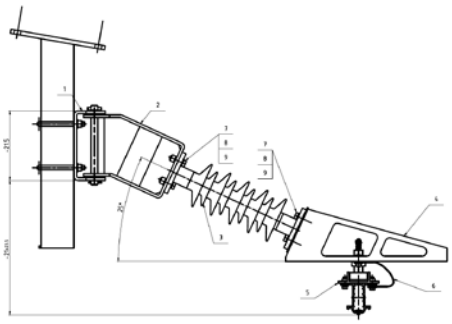
Planning is assisted by our ELFF® planning tool which allows us to prove in the shortest possible time whether the rigid overhead conductor rail system will fit into an existing tunnel, what contact wire height can be achieved and by how much the tunnel could be reduced in size if the overhead conductor rail system is used.



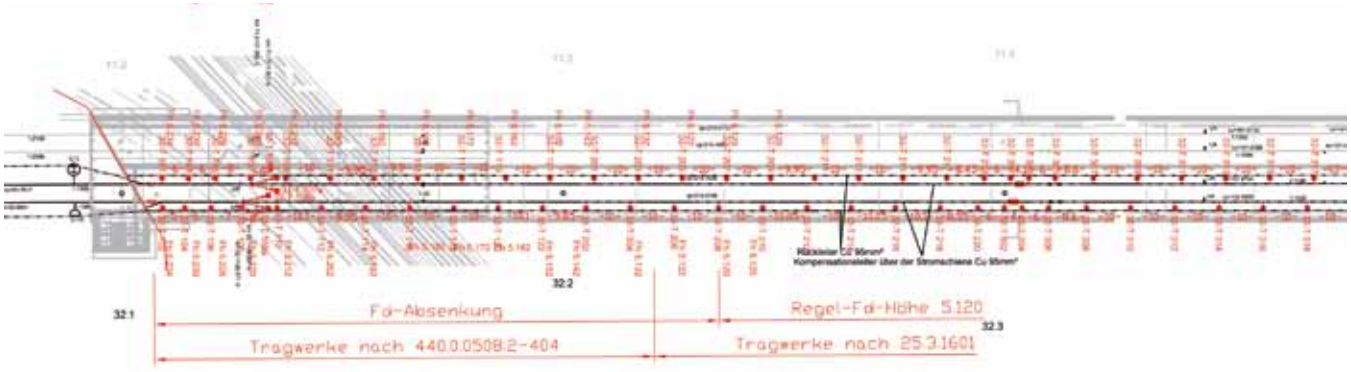
Tunnel tube with overhead conductor
produced by ELFF®

Severn Tunnel cross-section profile with rigid overhead conductor-rail system
produced by ELFF®





Example of 25 kV support



Site location plan extract for a rigid overhead conductor-rail system

References

Electrical and mechanical testing, fire resistance tests and, finally, actual operational experience of the Furrer+Frey rigid overhead conductor-rail system have demonstrated that the rigid overhead conductor-rail can perform reliably at speeds of up to 250 km/h.

On November 17, 2014, a measuring train reached the speed of 302 km/h on the conductor rail in Sittenberg-Tunnel in Austria! [1]

Some of the approvals held by Furrer+Frey conductor-rail systems:

Germany
Zulassung Eisenbahn-Bundesamt für Stromschiene Bauart Furrer+Frey

Switzerland
Bundesamt für Verkehr, Typenzulassung für das Stromschienen-Fahrleitungs-system S-FL 250

UK
Network Rail – Certificate of Acceptance for Conductor Beam Assembly [2]

Europe
EBC Eisenbahn Cert_EC Design Examination TSI Certificate

EC Declaration of Conformity for Interoperability Components
Overhead line DSS, overhead conductor rail

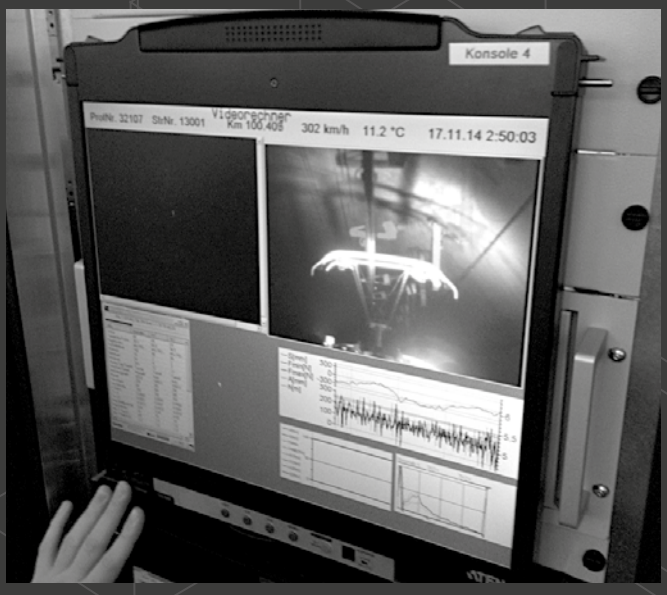
India
Delhi Metro Rail Corporation Limited for Conductor Rail System

Austria
bmvit Oberste Eisenbahnbaubehörde erteilt der ÖBB Zulassung der DSS für 250 km/h uneingeschränkt

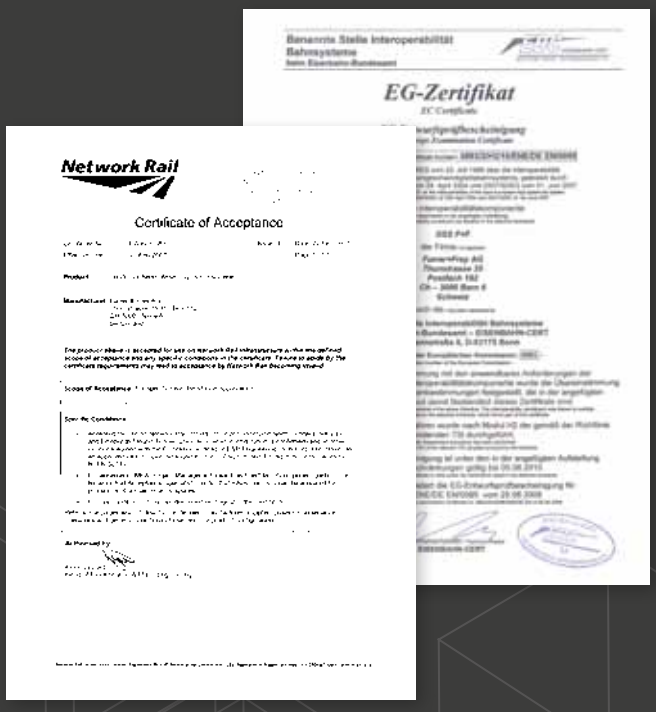
France
RFF_SNCF_Rapport d'evaluation du dossier téchnique Catenaire Rigide Furrer+Frey

South Korea
Korean National Railroad
Product acceptance for
Overhead conductor bar

Hong Kong
Kowloon-Canton Railway Corp.



[1]



[2]
Cover sheet of Network Rail approval and TSI Compliance certificate.

Your partner for the design, delivery and construction of rigid overhead conductor-rail systems.

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Furrer+Frey®
Overhead contact lines

ROCS I General Technical Data		
Rated voltage	V DC	600 - 3000
	kV AC	11 - 25
Short circuit current	kA	40 during 60 ms
Continuous current across all components*	A	3500
Ambient temperature	°C	> - 30
Max. conductor temperature	°C	90
Max. distance between support structures	m	12
Max. train speed	km/h	250
Conductor-rail cross-section	mm^2	2100
Conductor-rail material	Aluminium alloy	
Contact wire used	EN 50149	100 - 161 mm^2
Max. length between expansion elements	m	800
Weight of the conductor rail without contact wire	kg/m	approx. 6.1