# Overhead Conductor Rail Systems Furrer+Frey®

Furrer+Frey®
Overhead contact lines

# Furrer+Frey® Overhead Conductor Rail Systems OCRS

For many decades Furrer+Frey® has maintained very close relations with train operating companies. The diminution of infrastructure costs and the reliability and safety of rail operations have always been, and still are, important discussion topics. 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® overhead conductor rail system.

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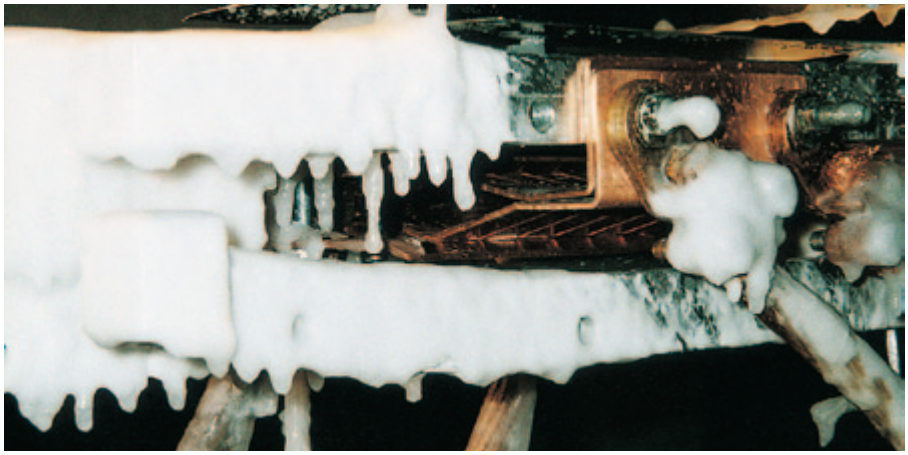

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The Furrer+Frey® overhead conductor rail system makes it possible to choose smaller tunnel cross-sections for new builds and allows the electrification of tunnels originally built for steam or diesel traction. The system's major advantage is its low overall height, plus the fact that there is no contact wire uplift even if operated with multiple pantographs. Our overhead conductor rail demonstrably offers high electrical cross-sections, so that additional feeders can be avoided. Moreover, this system's fire resistance is significantly greater than that of a catenary system. And, lastly, our experience of the system which is now installed on over 1 700 km of track has proven that the Furrer+Frey® overhead conductor rail system is extremely operationally reliable and requires little maintenance. This is true regardless of the operating voltage, from the 750 V urban rail systems to the 25 kV high-speed rail lines. — **[1]**

Electrical and mechanical testing, fire resistance tests and, finally, actual operational experience of the Furrer+Frey® overhead conductor rail system have demonstrated that the overhead conductor rail can perform reliably at speeds of up to 250 km/h. — **[2,3,4]**

The overhead conductor rail mainly bears only its own weight; there are no additional mechanical tensile forces. The overhead conductor rail can be directly combined with the contact wire, meaning that it can be integrated into existing overhead contact line systems.

# References


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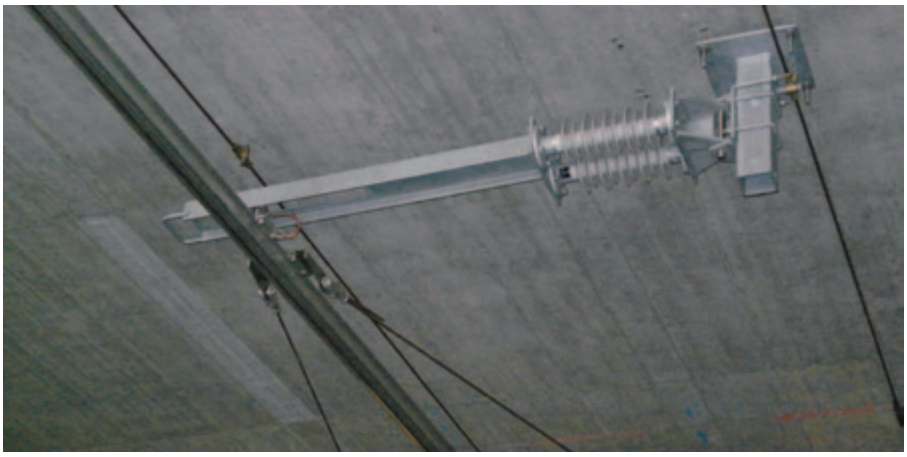
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**The number of countries covered by our reference list is quite impressive. The systems we have already built and the experience we have gained as a result, provide both the foundation and the spur for us to constantly develop and improve the Furrer+Frey® overhead conductor rail system.**

To date, more than 1700 km of Furrer+Frey® overhead conductor rail systems are in daily use in more than 20 countries throughout the world*: Australia, Taiwan, Thailand, South Korea, Hongkong, China, India, Turkey, Italy, Spain, France, Belgium, Germany, Austria, Croatia, Netherlands, Great Britain, Denmark, Sweden, Norway, Russia, USA, Ukraine, Algeria and, of course, in Switzerland.

* These are all systems which have been completed, not future projects

Examples of overhead conductor rail systems planned and executed by Furrer+Frey®:

## Installation in Tunnels

- Olso Tunnel, Norway — **[1]**
- North-South Berlin, Germany — **[2]**
- Berlin International Airport, Germany — **[3]**
- Buschtunnel, Germany — **[4]**
- Tunnel Engelberg, Switzerland — **[5]**

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## Conductor rail on open track

### Bourg-en-Bresse – Bellegarde

The conductor rail over open track connects two tunnels on short distance. The continuous conductor rail reduces the number of changeovers between catenary and conductor rail. — **[1]**

### Copenhagen Mainstation

The team of architects that revitalized the building of the mainstation wanted to have an overhead contact line that adapts to the curved platforms.
The conductor rail follows the curved track. — **[2]**

### Salzburg Mainstation

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 overhead conductor rail. — **[3]**

### Südtirolerplatz

Before the cut-in double track could be covered by a concrete roof the overhead conductor rail was installed at provisional supports. — **[4]**
After the roof was in place the supports for the conductor rail could be fixed at drop tubes. — **[5]**

### Westbahn

In view of the remodelling of Wien Mainstation the connecting Lainzer-tunnel was equipped with overhead conductor rail. — **[6]**

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## Installation in depots and maintenance shops

- RHB liftable conductor rail, Switzerland — **[1]**
- Metallostroj St.Petersburg, Russia — **[2]**
- Rotated section insulator in Würzburg, Germany — **[3]**

### Fixed conductor rail system

- Dresden Reick, Germany — **[4]**
- Helgoland depot, Denmark — **[5]**
- Bernmobil depot, Switzerland — **[6]**

### Movable conductor rail systems

- Geneva, on track and retracted, Switzerland — **[7, 8]**
- Short moveable section, Krefeld, Germany — **[9]**
- Frankfurt Griesheim, Germany — **[10, 11]**

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## Equipping lift, bascule and swing bridges

- Lifting bridge in Sweden — **[1,2,3]**
- Swing bridge in France — **[4,5]**
- Swing bridge in the USA — **[6]**

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## Equipping lift, bascule and swing bridges

- Bascule bridge in Turkey — **[1]**
- Bascule bridge Boston-New Haven, USA — **[2,3]**
- Bascule bridge in Germany — **[4]**
- Bascule bridge in Sweden — **[5]**
- Bascule bridge in Portland, USA — **[6,7]**

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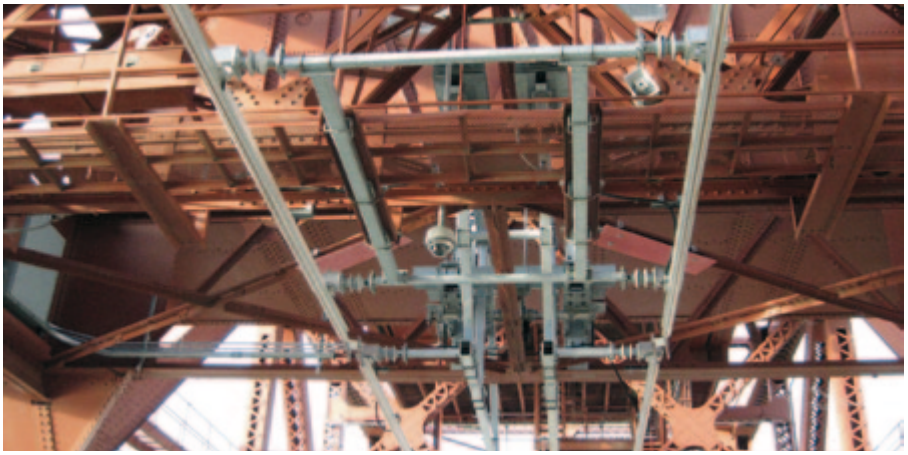

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## Systems in loading terminals

- Loading terminal in Kiruna, Northern Sweden — **[1]**
- Loading terminal in Schynige Platte, Switzerland — **[2]**

## Special applications for

### Overbridge

- Sargans, Switzerland — **[3]**

### Temporary structures

- Brüggmoos, Biel, Switzerland — **[4]**

### Tunnel refurbishment

- Berghau Tunnel, Germany — **[5]**

### Three-phase railways

- Jungfraubahn, Switzerland — **[6]**

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# Components which make up a Furrer+Frey® OCRS

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## The conductor rail profile

The box-shape profile has become more sophisticated as a result of experience gained over 25 years. We currently use the CR3-HS profile. An untensioned contact wire is clamped to the lower side of the profile by means of a special insertion device. 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. Thanks to the profile's large cross section, there is no need for auxiliary lines such as feeders and cables. The profiles are generally delivered in 11.90 metre lengths. — **[1,2]**

## 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 and, 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. — **[3]**

## Support structures

The overhead conductor rail replaces the catenary system in particular circumstances and/or because it is more reliable. There are at present many types of support structures available, all of which have proven their worth in practice and which have been granted appropriate approvals. Three examples are shown below:

- Hinged support structure, *Sittenberg* — **[4]**
- Sliding support structure, *Metro* — **[5, 6]**
- Minimum encumbrance support, *Axen tunnel* — **[7]**

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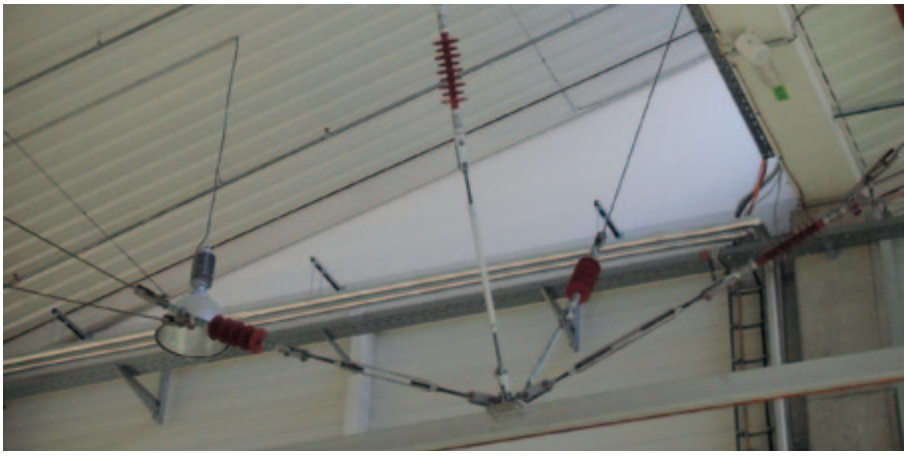

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## Pendulum support structure

We achieve the fine adjustment of the height at which the overhead conductor rail system is positioned using patented swivel heads on the support structure. These swivel heads also contain spring stacks. Depending on train speeds and where the support structures are situated, these spring stacks are allocated to installed components such as expansion joints or section insulators. In this way, we can achieve the optimum dynamic behaviour between overhead conductor rail and pantograph. — **[1]**

## Flying support structure — **[2]**

## Transition bar

The overhead conductor rail system must provide a possibility to be integrated in an existing catenary systems. We have developed the transition bar in order to do this. The transition bar takes up and absorbs the vibrations from the contact wire of the catenary system and reinforces it with an increasing cross section onto the full profile of the overhead conductor rail. — **[3]**

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## Expansion element

Like in a catenary system, temperature changes also produce changes in the length of the 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. — **[4]**

## Fixed point anchor

The position of long conductor rail systems is determined by fixed point anchors between the expansion elements. These compensate for varying longitudinal forces in the overhead conductor rail caused by any inertia in the hinges of the support structure or the gliding elements. Long conductor rail sections fixed to pendulum support structures do not necessarily need fixed point anchors. The profile sections' own weight can provide sufficient stabilisation.

## 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 overhead conductor rail. Once inside the ends of the conductor rail, the contact wire is installed without being subjected to tensile forces. — **[5, 6]**


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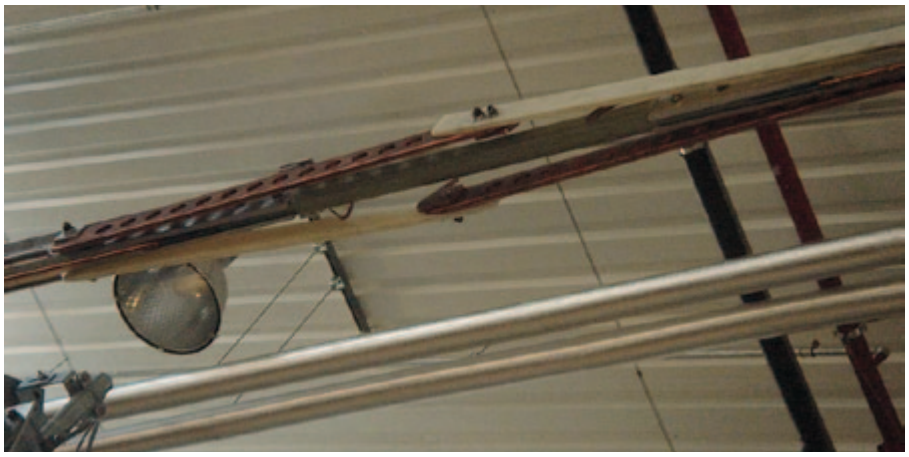


## Anchoring the catenary system in the maintenance workshop

In maintenance shops, the catenary system is normally anchored to the front of the building with a termination arrangement. In this arrangement, the contact wire is passed and anchored via a transition bar and the messenger wire is firmly terminated. Inside the maintenance shop, a fixed or moveable conductor rail is installed according to the local requirements. — **[1, 2]**

## 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 overhead conductor rails which branch off are bent up with a large radius. — **[3, 4, 5]**

## Section insulators

Section insulators are designed either with parallel overlapping conductor rails or with „inline" section insulators for the conductor rail. For speed > 140 km/h we use section insulators with special skids. — **[6, 7, 8]**

## Phase separation

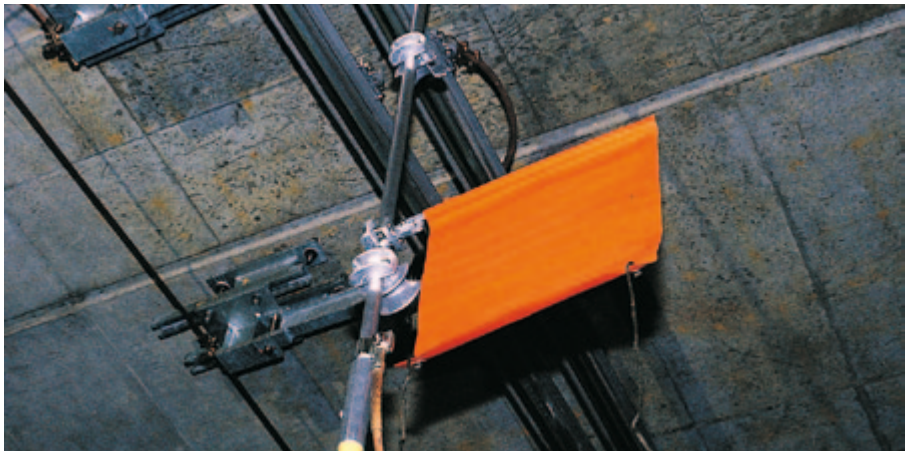
Phase separation is achieved in the same way using section insulators and/or parallel overlaps.

## System separation points

We have special solutions and components for system separation points.

## 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. — **[9]**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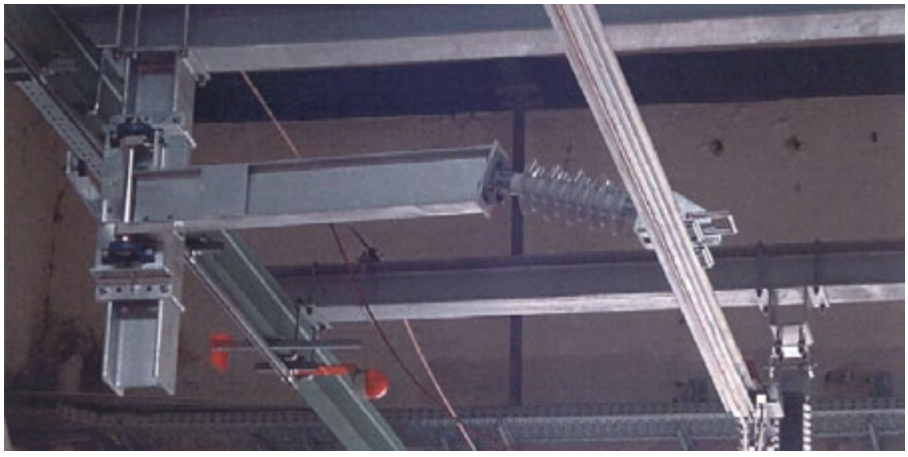

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## Earthing

Just like the contact line, the overhead conductor rail also needs to be earthed. Depending on the project and the design of the support structures, this can be done either on each support structure or by using special current carrying earthing clamps. These earthing clamps have also been tested for short circuit currents of 40 kA for 60 ms. — **[1]**

## Protecting plastic cover

At particularly exposed, damp places the 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. — **[2,3]**

## Retractable overhead conductor rail

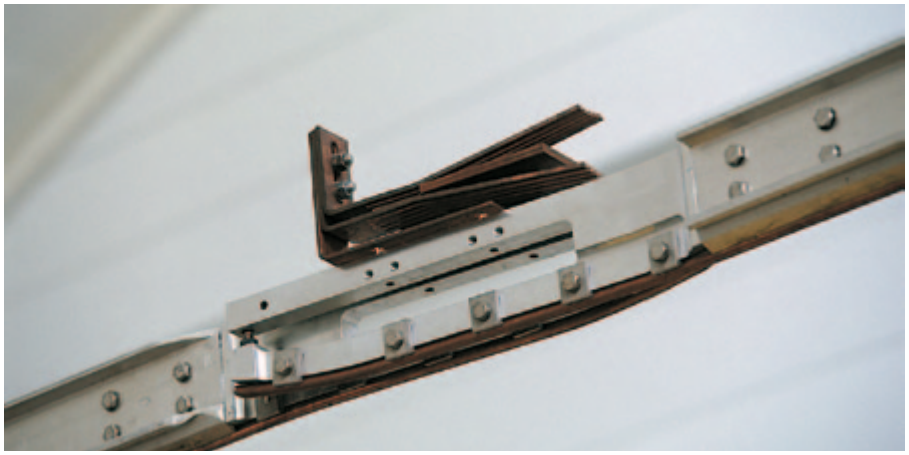
The many new multiple units have an increasing number of equipment items attached to the roof area. The contact line or the overhead conductor rail should not obstruct access to these equipment items for carrying out maintenance work. Maintenance shop cranes are installed in many places for lifting these items off the roof area. So as to allow work to be carried out without hindrance, we have developed the retractable conductor rail and, of course, the associated safety controls. We shall restrict ourselves here to the retractable conductor rail. Information about the controls can be found in our brochure: Railway safety control systems for depots. — **[4]**

### Moveable bracket, slave

Whether it's short retractable sections or conductor rails of up to 250 metres long in maintenance shops, the overhead conductor rail system is always suspended from horizontally or vertically moveable cantilevers. In the case of slave cantilevers, only a pivot bearing is installed. — **[5]**

### Moveable bracket, motorized

Depending on the length of the section of conductor rail to be moved, a number of moveable brackets are motorized and set in motion by a central operating unit or local operating panels. At the same time, we do not just monitor the movement of the conductor rail but we also ensure that the system is switched off and properly earthed before it is possible to access the roof working platforms or to start using tools. — **[6]**



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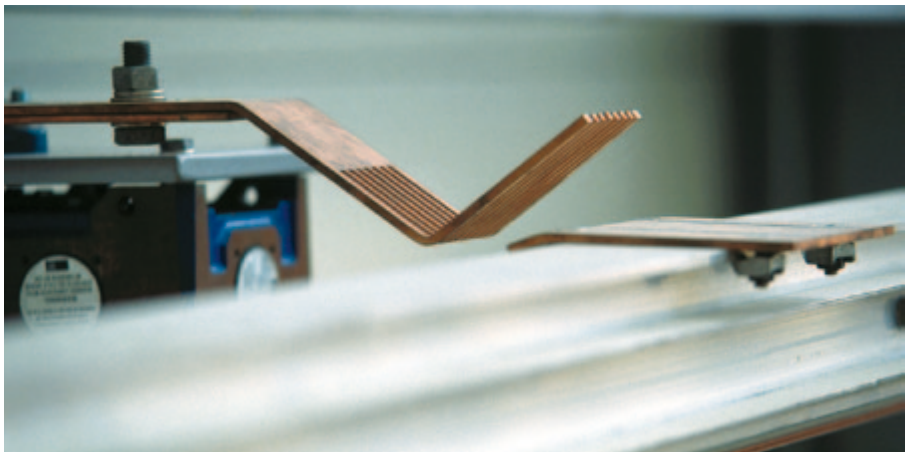

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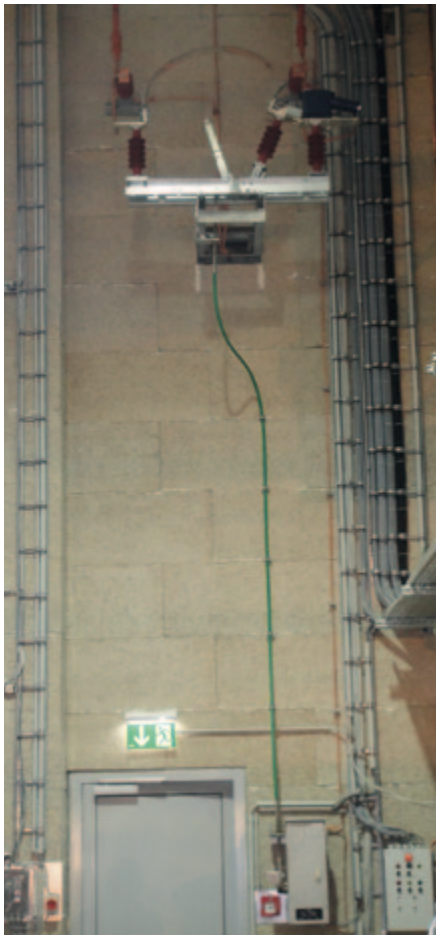

## Electrical contact

The product range includes electrical contacts depending on how the overhead conductor rail system and the conductor rails which then connect up are moved. — **[1]**

## Forced earthing

As with the electrical contacts, several forced earthing methods are realized. — **[2]**

## Power supply feed for pivotable overhead conductor rails

The power can be fed in via the cantilevers. The design varies depending on the project. — **[3]**

## Control systems in depots and maintenance shops

Information about the controls can be found in our brochure: Railway safety control systems for depots. — **[4, 5]**

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# Planning a Furrer+Frey® OCRS

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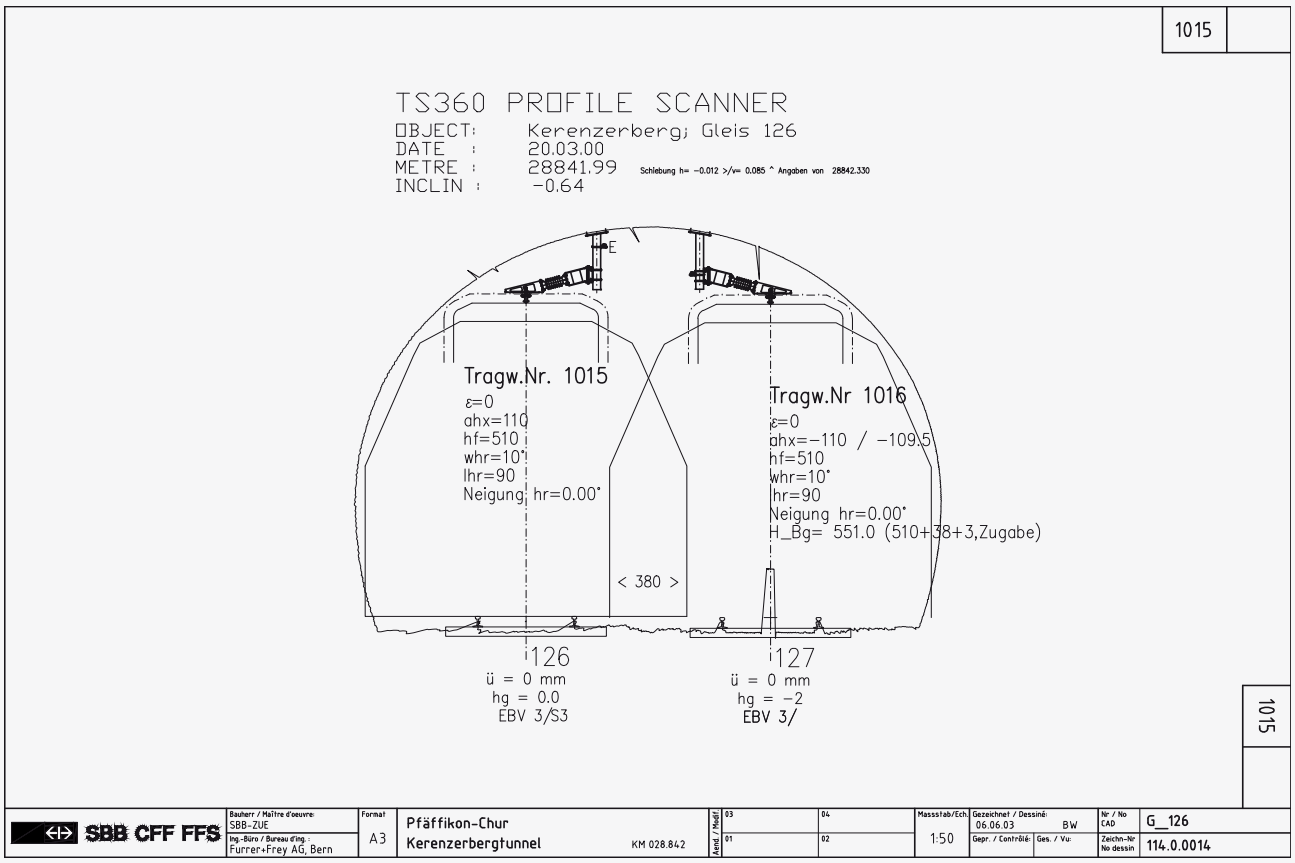


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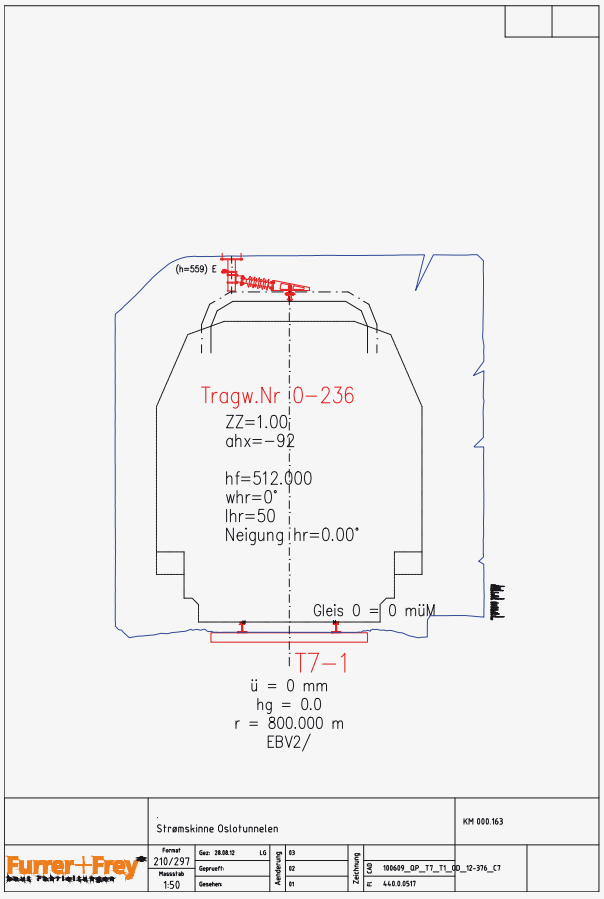


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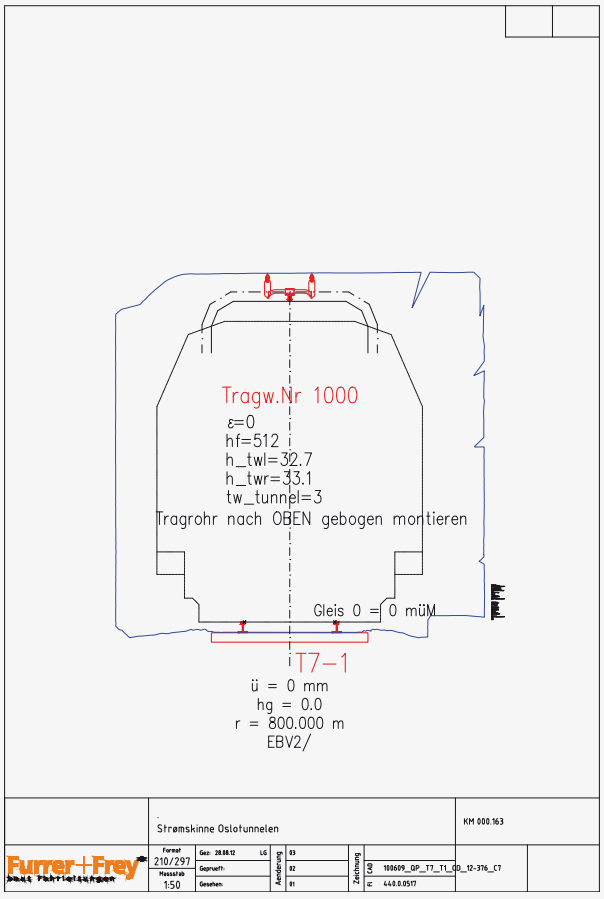

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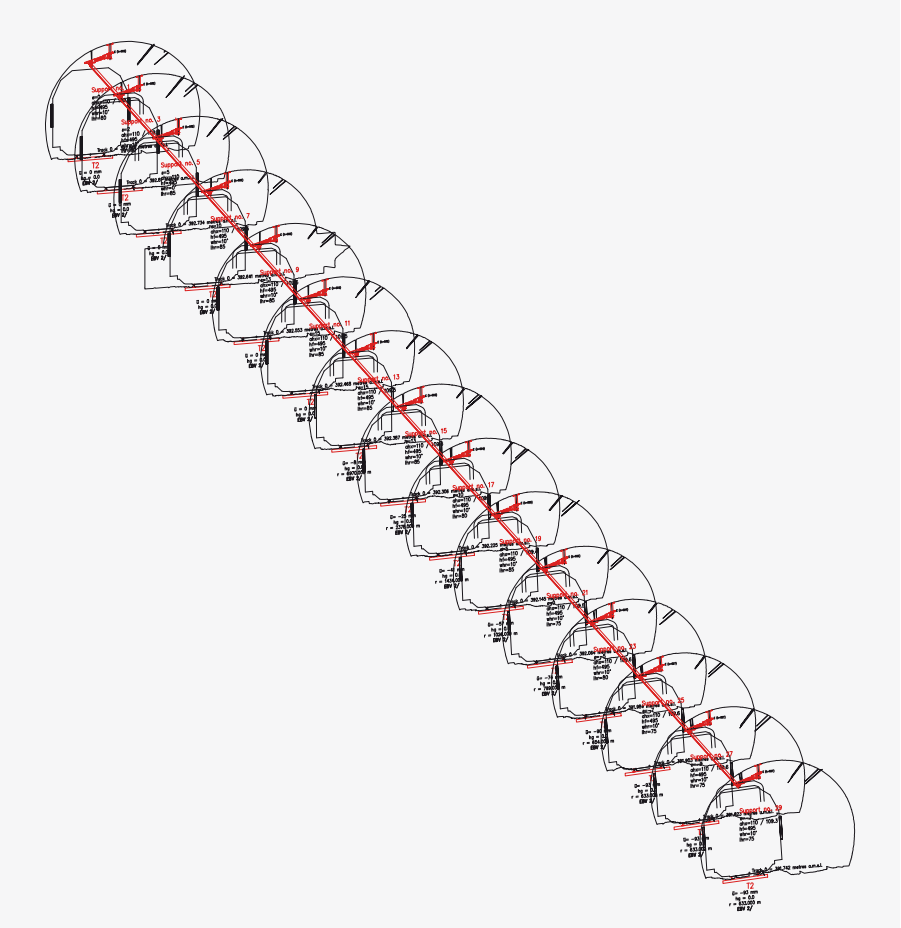

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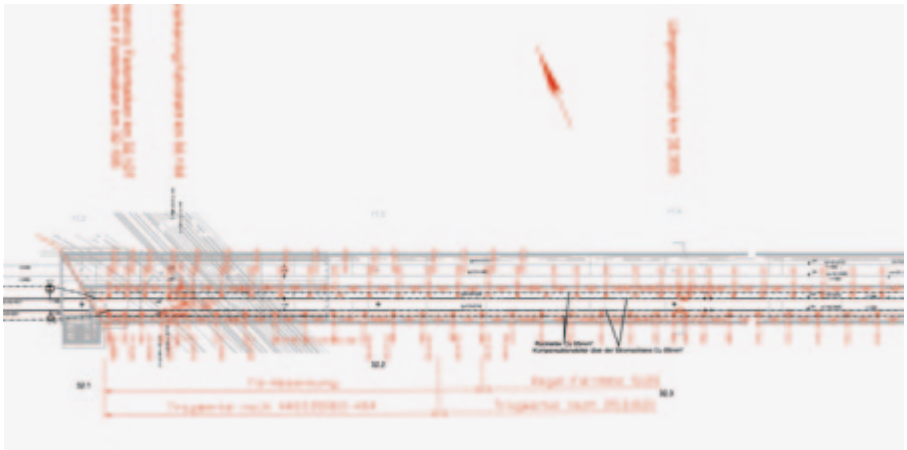

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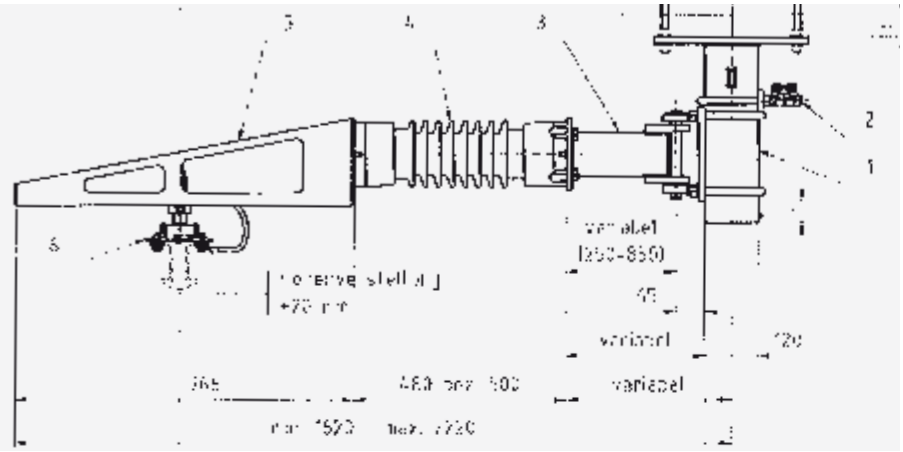

**The overhead conductor rail system, as designed by us, permits a very large degree of planning freedom. Depending on train speeds, the distance between supports is 7 to 15 meters. Radii of down to 120 m can be managed without difficulty using standard elements. Below this figure, the conductor rails 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 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 employed.

According to the EN Standard 50122 no overhead contact line zone has to be considered, since it is assumed that the conductor rail is practically indestructible and will not fail in the event of short circuits. This results in considerable savings with regard to earthing measures.

With the experience we have built up over many years, we are able to rapidly produce preliminary project documents and quotations.

- Tunnel cross-section profile with overhead conductor rail system produced by ELFF® — **[1,2,3]**
- Tunnel tube with overhead conductor rail system produced by ELFF® — **[4]**
- Site location plan extract for an overhead conductor rail system — **[5]**
- Example of 15 kV support — **[6]**

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# Assembly aids for the Furrer+Frey® OCRS


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## Drilling equipment

A range of drilling equipment is available for undertaking drilling tasks in the tunnel roof vault. — **[1,2]**

## Test device for set bolts

We do test the bolt setting but also the vault material around. — **[3]**

## Lifting equipment for conductor rails

The conductor rail profile sections can be delivered ex works in special transportation racks. We have the appropriate lifting equipment for raising the conductor rail profile section up to the desired contact wire height. — **[4]**

## Contact wire insertion vehicle

The contact wire insertion device is used to insert the contact wire into the profile of the 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. Of course, in the event of undesirable burnouts following a short circuit, the contact wire insertion device can be used to replace parts of the contact wire or to replace it completely at the end of its life cycle. There is no need for any adjustments to be carried out after replacing the contact wire since the position of the overhead conductor rail system will not have changed. — **[5]**

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## 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 venting 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. For systems several kilometres long we use the speed-related grease dispensing system. Our small greasing system for short sections in maintenance shops works on the same principle. — **[6]**

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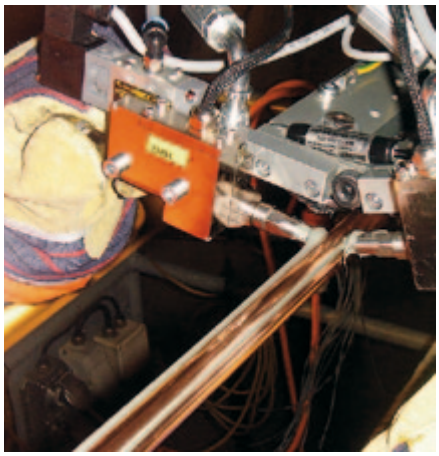

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Overhead contact lines

# Homologations and approvals

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**Eisenbahn-Bundesamt**

Eisenbahn-Bundesamt, Postfach 20 61, 53010 Bonn

Fa.
Furrer + Frey AG
Ingenieurbüro für Fahrleitungsbau
Postfach 182

CH-3000 Bern 6

Bearbeitungskennzeichen

1221/11101/22AZ2/0011/54

Bei Zahlungen und im Schriftverkehr bitte immer angeben

| Geschäftszeichen/Bearbeitung | Tel. (02 28) 98 26- | Fax. (02 28) 98 26- | Datum |
|---|---|---|---|
| 22.12 Shz 41/9- Herr Syre | 223 | 229 | 22.05.1996 |

Zulassung für Stromschiene Bauart Furrer + Frey

Ihr Schreiben vom 19.09.94 - Fuj/mac/531

Anlage:
Zulassungsurkunde

Sehr geehrte Damen und Herren,

mit o.a. Schreiben beantragten Sie die Zulassung für die Stromschiene Bauart Furrer + Frey. Zugelassen werden soll die Ausführung dieses Systems mit Horizontaltragewerk und Stromschiene Typ II.

Dem Antrag waren folgende Unterlagen zur Prüfung und Genehmigung beigefügt:

- Zulassungsantrag an die DB AG,
- Versuchsberichte
  - 25/15 kV Isolator, elektrische Prüfung,
  - 25/15 kV Isolator, mechanische Prüfung,
  - Dilatation/Stoßlasche, elektrische Prüfung.

Hausanschrift:
Vorgebirgsstraße 49, 53119 Bonn
Tel.-Nr. (02 28) 98 26-0
Fax-Nr. (02 28) 98 26-1 99

Überweisungen an Bundeskasse Bonn
Konto-Nr. 38 001 060 Landeszentralbank Bonn (BLZ 380 000 00)
Konto-Nr. 11 900-505 Postbank Köln (BLZ 370 100 50)

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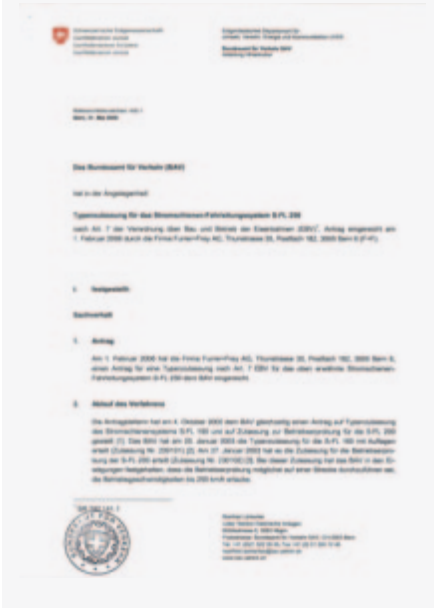

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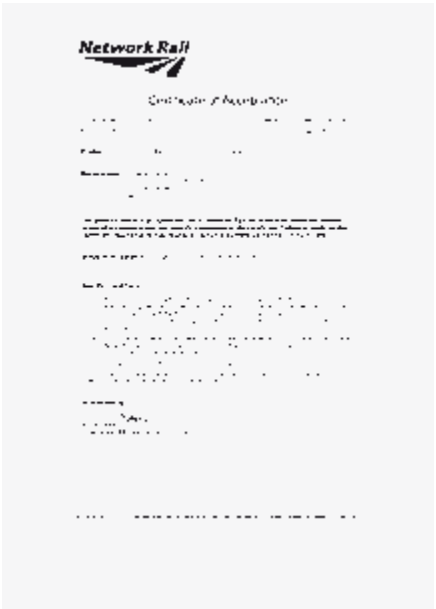

Network Rail

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**EG-Zertifikat**

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Furrer + Frey

**EC Declaration of Conformity for Interoperability Components**

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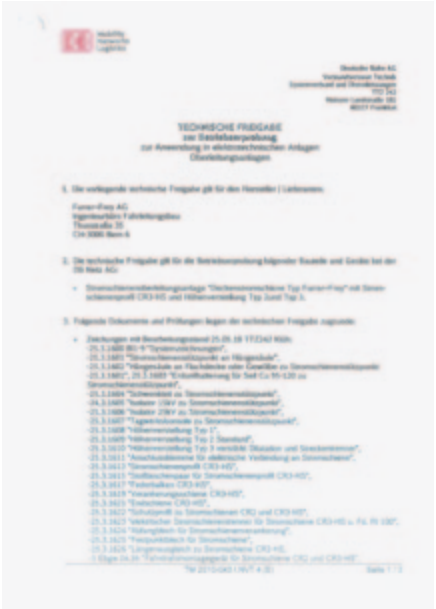

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Zusammenfassung

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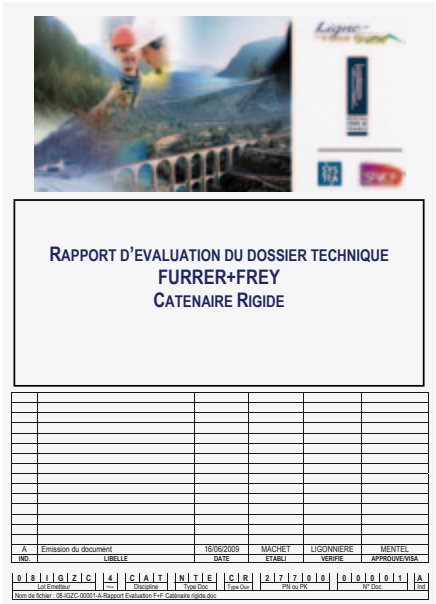

RAPPORT D'EVALUATION DU DOSSIER TECHNIQUE
FURRER+FREY
CATENAIRE RIGIDE

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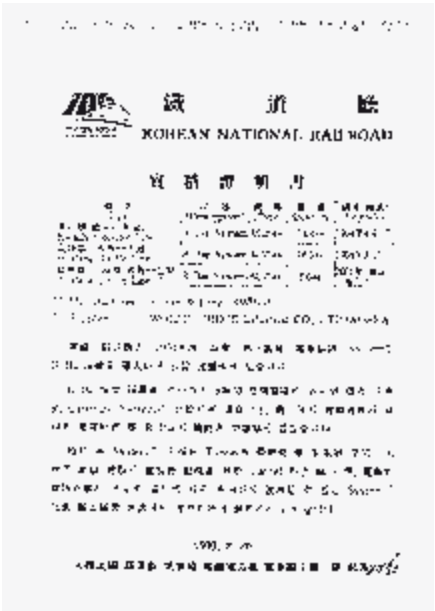

KOREAN NATIONAL RAILROAD

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To Whom It May Concern

Some cover sheets of all the current approvals held by Furrer+Frey® overhead conductor rail systems:

## Germany

Zulassung Eisenbahn-Bundesamt für Stromschiene Bauart Furrer+Frey — **[1]**

## Switzerland

Bundesamt für Verkehr, Typenzulassung für das Stromschienen-Fahrleitungs-system S-FL 250 — **[2]**

## UK

Network Rail – Certificate of Acceptance for Conductor Beam Assembly — **[3]**

## Europe

EBC Eisenbahn Cert_EC Design Examination TSI Certificate — **[4]**

## EC Declaration of Conformity for Interoperability Components

Overhead line DSS, overhead conductor rail — **[5]**

## DBAG

Technische Freigabe, Deckenstrom-schiene Typ Furrer+Frey — **[6]**

## Austria

bmvit Oberste Eisenbahnbaubehörde erteilt der ÖBB Zulassung der DSS für 250 km/h uneingeschränkt — **[7]**

## France

RFF_SNCF_Rapport d'evaluation du dossier téchnique Catenaire Rigide Furrer+Frey — **[8]**

## South Korea

Korean National Railroad Product acceptance for Overhead conductor bar — **[9]**

## Hongkong

Kowloon-Canton Railway Corp. — **[10]**

Furrer+Frey®
Overhead contact lines

# Furrer+Frey® Overhead Conductor Rail Systems OCRS

## 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 |
| 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 |

*incl. across expansion elements

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

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