Urban mass transit systems, such as metros and city trains, and even main-line railways often can only reach inner-city areas on railway lines that run through tunnels. Therefore, electric traction must also be made possible in constricted space conditions like those created by small tunnel cross sections.

Due to its low installation height, the aluminum overhead conductor rail Sicat® SR is able to meet this requirements perfectly and is also suitable for train passages with one or more pantographs. It is designed for use in tunnels, under bridges, on lifting bridges as well as in maintenance workshops or even in sections which can be pivoted out of the line gauge, such as in workshops, to ensure very easy inspection of rail vehicles. In addition, Sicat SR can be used for vehicles with electric charger.

Features

- Rigid aluminum section with four longitudinal guiding edges for the best possible connection of conductor rail joints
- High current-carrying capacity and high short-circuit strength
- Use of long-lasting extruded sections, even for the conductor rail fittings
Overview

Advantages compared with conventional overhead contact lines

- Lower installation height (e.g. 600 mm for 25 kV AC systems)
- Elimination of tensioning equipment for contact wire and catenary wire
- No need to observe the overhead contact line zone acc. to EN 50122 or to connect conductive system components to the return conductor
- High current-carrying capacity (e.g. 3,500 A with the clamped contact line AC-150)
- Reduced voltage drop compared to overhead contact lines with single contact wire and with catenary suspension
- High short-circuit strength of the overhead conductor rail
- Simple design based on the use of a low number of different components
- Up to 43 % contact wire wear possible, therefore longer contact wire service life

Dynamic properties

- The interaction between pantograph and overhead conductor rail meets all quality requirements of the applicable standards.
- Simulations and measurements demonstrate that the contact forces and standard deviations permitted by the applicable standards and regulations are observed.
- Even running of the pantograph pans is ensured by limitation of the conductor rail sagging, gradients and gradient transitions.

Improvements compared with existing overhead conductor rail systems

- Easy installation of the joints due to additional guiding edges along the conductor rail
- Vibration-proof design of the joints due to the combination of guiding edges and bolt locking elements
- High current-carrying capacity of the joints due to the large contact surface of the inner plate on the inside face of the conductor rail section
- Use of long-lasting extruded profiles, even for the conductor rail fittings
- Due to the possibility to adjust the angle of the support, the mean perpendicular of the overhead conductor rail can always be adjusted according to the pantograph contact strip, even in sections with track superelevation, thus ensuring an optimum quality of pantograph passage and transmission of current at all times
- High clamping force and excellent quality of the electrical contact due to the tapered design of the clamps on the conductor rail profile

Contact corrosion

The risk of contact corrosion between the aluminum conductor rail and the copper contact wire is combated by the following precautions:

- The provision of drain holes inside the conductor rail to enable condensation to drain off
- The application of contact grease between copper and aluminum when the contact wire is clamped into the conductor rail with special grease device

<table>
<thead>
<tr>
<th>Regular values</th>
<th>[V DC]</th>
<th>[kV AC]</th>
<th>750…3,000</th>
<th>15…25</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal voltage [V DC]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Permanent current load at 50 K excess temperature, without contact wire [A]</td>
<td>2,900</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short-circuit current [kA]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ambient temperature [°C]</td>
<td></td>
<td></td>
<td>≥ -40</td>
<td></td>
</tr>
<tr>
<td>Max. temperature of conductor [°C]</td>
<td>90</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distance between supports* [m]</td>
<td>up to 12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. running speed [km/h]</td>
<td>250</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conductor rail cross section without contact wire [mm²]</td>
<td>2,300</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conductor rail material</td>
<td>Aluminium</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clampable contact wire acc. to EN 50149* [AC-/BC-80 up to 150]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Max. permissible half section length [m]</td>
<td>up to 400</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specific mass of conductor rail without contact wire [kg/m]</td>
<td>ca. 6.2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* other values on request
Design

Conductor rail

The conductor rail consists of an extruded aluminum alloy profile. A contact wire is clamped into this extruded profile and, like a conventional overhead contact line, transmits the current to the rail vehicle.

Conductor rail joint

The conductor rail segments are joined together by means of conductor rail joints.

Four guiding edges along the side of the conductor rail ensure a mechanically stable joint. Two outer plates serve for accurate fixing of the rail height and fastening of the joint. Two inner plates, which have large contact surfaces, perform mainly the task of current transmission between the rail and the joint. Bolt locking elements ensure that the conductor rail joints are vibration-proof and cannot loosen.
Supports

There are two functionally equivalent types of suspension for the Sicat SR overhead conductor rail:

Supports with gliding suspension clamp
These supports are the preferred choice for constricted installation conditions in which only very short pivotable support arms can be used (e.g. in small round tunnels). The use of these supports still enables the installation of large section lengths despite such conditions.

For AC systems, the gliding supports have to be equipped with an additional contact spring to provide equipotential bonding between the supporting arm and the conductor rail. For higher running speeds, the use of the contact spring as a damping element to improve the quality of interaction with the pantographs is also recommended for DC systems.

Pivotable supports
Ever smaller track radii mean ever greater reduction in the section lengths. Pivotable supports are especially well suited for such applications.

Since ever smaller track radii call for ever shorter installed section lengths, it is more cost-effective below a certain track radius to install pivotable supports.

A Gliding suspension clamp 8WL7233-0
B Suspension clamp with contact spring 8WL7232-3
C Transition element 8WL7230-2A
D Earthing clamp 8WL7234-0A
E Feeder clamp 8WL7235-0A

6 Fittings made of extrusion profile material
7 Gliding elements
8 Guiding edges
Transition element

A 5-meter-long transition element is provided to reduce the differences in elasticity at the transition from the conventional overhead contact line to the conductor rail. Increasingly larger cutouts in the conductor rail section enable the moment of inertia to be reduced in the direction of the catenary and, consequently, the elasticity to be adjusted accordingly.

Earthing clamp

Earthing clamps are provided along the length of the conductor rail for the connection of earthing equipment during maintenance and service work at the overhead conductor rail system.

Electrical connectors

Electrical connectors bridge the individual rail sections. They consist of flexible copper wires which are connected to the conductor rail by feeder clamps. One feeder clamp is capable of transmitting the total permissible current of the conductor rail.
Conductor rail section transition

The conductor rail is divided into several section lengths to compensate thermal expansion. Special attention has been paid on a design that ensures optimal quality of interaction with the pantographs and a good electrical connection in the section transitions. Depending on the running speeds, the section transitions will be carried out as conductor rail ramps or as expansion joints.

Conductor rail ramp
A specially shaped conductor rail ramp is provided at the end of each section length to ensure a smooth guiding for the pantograph. The type of conductor rail ramp in the section transitions is designed for running speeds up to 140 km/h.

Expansion joint
At running speeds of over 140 km/h the quality requirements of interaction between pantograph and contact line cannot be ensured by conductor rail ramps. The thermal expansion of sections will be compensated by a specially developed expansion joint design for good dynamic running qualities, which therefore can be achieved even at speeds up to 250 km/h.

Technical data expansion joint

<table>
<thead>
<tr>
<th>Expansion joint</th>
<th>8WL7238-0A-...-0E</th>
<th>8WL7238-0F-...-0J</th>
<th>8WL7238-0K-...-0O</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal voltage</td>
<td>[kV DC] up to 3</td>
<td>[kV AC] up to 3</td>
<td>[kV AC] up to 3</td>
</tr>
<tr>
<td></td>
<td>25</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>Working range A</td>
<td>[mm] 2x 500</td>
<td>2x 500</td>
<td>2x 500</td>
</tr>
<tr>
<td>Length</td>
<td>[mm] 3,775</td>
<td>3,775</td>
<td>3,775</td>
</tr>
<tr>
<td></td>
<td>[mm] 2,775</td>
<td>2,775</td>
<td>2,775</td>
</tr>
<tr>
<td>Weight</td>
<td>[kg] 54</td>
<td>61</td>
<td>77</td>
</tr>
<tr>
<td>Permanent current load</td>
<td>[A] 1,224</td>
<td>2,075</td>
<td>3,150</td>
</tr>
<tr>
<td>Rated short-time withstand current</td>
<td>[kA] 45</td>
<td>45</td>
<td>45</td>
</tr>
<tr>
<td>Rated short-time duration</td>
<td>[ms] 100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>
**Insulated sections**

Insulated sections are created either by parallel alignment of two conductor rail profiles or by use of section insulators. At use of section insulators, the electrical connection of the overhead conductor rail is interrupted by an insulator which simultaneously ensures the mechanical connection between the conductor rail elements.

The pantograph of the passing vehicle is guided in the area of the insulator by means of two copper rails. Any arcs that occur during the pantograph passage are guided by the arcing horns and extinguish then.

For section insulation by default section insulators up to 25 kV AC and up to 3 kV DC are offered.

---

**Technical data section insulator**

<table>
<thead>
<tr>
<th>Section insulator</th>
<th>8WL7238-5A</th>
<th>8WL7238-7A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permissible operating load [kN]</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Minimum failing load [kN]</td>
<td>32</td>
<td>32</td>
</tr>
<tr>
<td>Weight [kg]</td>
<td>45.4</td>
<td>31.1</td>
</tr>
<tr>
<td>Nominal voltage [kV]</td>
<td>up to 25 AC</td>
<td>up to 3 DC</td>
</tr>
<tr>
<td>Creepage distance [mm]</td>
<td>1,255</td>
<td>305</td>
</tr>
<tr>
<td>Clearance in air [mm]</td>
<td>185</td>
<td>60</td>
</tr>
</tbody>
</table>
In addition Siemens offers a wide range of accessories and utilities for installation and maintenance of the overhead conductor rail and its components like contact wire installation car, greasing device, drilling and cutting templates and special grease for greasing the contact area between contact wire and conductor rail.

### Accessories / utilities

<table>
<thead>
<tr>
<th>Accessory</th>
<th>Order number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact wire installation car</td>
<td>8WL7236-4A</td>
</tr>
<tr>
<td>Greasing device</td>
<td></td>
</tr>
<tr>
<td>• Control casing</td>
<td>8WL7236-2A</td>
</tr>
<tr>
<td>• Adapter</td>
<td>8WL7236-2B</td>
</tr>
<tr>
<td>• Connecting rod for greasing adapter</td>
<td>8WL7236-2C</td>
</tr>
<tr>
<td>Drilling template</td>
<td>8WL7236-0</td>
</tr>
<tr>
<td>Cutting template</td>
<td>8WL7236-1</td>
</tr>
<tr>
<td>Grease</td>
<td>8WL7230-4</td>
</tr>
</tbody>
</table>

### Contact wire installation car

The contact wire installation car enables easy insertion of the contact wire into the profile of the overhead conductor rail. Via a connection rod, the contact wire installation car can be combined with a greasing device.

### Greasing device

The greasing is carried out at the contact area between contact wire and conductor rail. The amount of the grease to be applied is regulated depending on velocity (0…5 km/h). To avoid undesirable arcs at the first passings of pantographs, the bottom side of the contact wire is not greased.

**Further features:**
- Very low consumption of grease
- Easy use of greasing device
- Greasing device can be used at any point of the conductor rail
Electrical tests

The overhead conductor rail elements, clamps and fitting elements are tested for:
• Short-circuit strength
• Proof of continuous current-carrying capacity in a temperature-rise test

acc. to the following standards:
• IEC 61952
• IEC 62271-1
• DIN EN 50119 (VDE 0115-601)

Mechanical tests

• Test of tensile load for conductor rail joint and anchoring clamp
• Supporting load test for suspension clamps
• Cantilever load for suspension clamps
• Sliding load for suspension clamps
• Tensile and compression test at section insulator

acc. to the following standards:
• DIN EN 50119 (VDE 0115-601)
• DIN VDE 02163
• IEC 61952-2002
• IEC 61109
• Endurance test of expansion joint and gliding suspension clamp

Certificates

The overhead conductor rail system Sicat SR has been certified as interoperability constituent in accordance with the interoperability directive of the rail system and the related directive TSI Energy.

In addition, the Bundesamt für Verkehr (BAV) of Switzerland has granted type approval for running speeds up to 250 km/h.

Benanntes Zertifikat

EG-Zertifikat

EC Certificate

EG-Entwurfsgenehmigung

EC Design Examination Certificate


Siemens AG

Mozartstraße 12b
91052 Erlangen

This Certificate confirms that the design documents of the system are determined in accordance with the relevant European Directives and standards.


Benanntes Zertifikat

EG-Erneuerungsgenehmigung

EC Renewal Examination Certificate


Siemens AG

Mozartstraße 12b
91052 Erlangen

This Certificate confirms that the design documents of the system are determined in accordance with the relevant European Directives and standards.


Benanntes Zertifikat

EG-Zertifikat

EC Certificate

EG-Entwurfsgenehmigung

EC Design Examination Certificate


Siemens AG

Mozartstraße 12b
91052 Erlangen

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Mozartstraße 12b
91052 Erlangen

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Canada:
Calgary – Light rail DC

USA:
Los Angeles – Light rail DC

Dominican Republic:
Santo Domingo – Metro DC

Brazil:
Fortaleza – Metro DC

Saudi Arabia:
Mekka – Metro DC, Movable overhead conductor rail

India:
Delhi – Metro AC
Delhi – Airport link AC
Chennai – Metro AC

Katar:
Doha – Metro DC

Australia:
Brisbane – Movable overhead conductor rail

Germany:
Test center Wegberg-Wildenrath – Movable overhead conductor rail, DC
Project RRX, Dortmund – Movable overhead conductor rail, 15 kV AC

Norway:
Bergen – Light rail DC

Sweden:
Stockholm

Poland:
Łódź – Light rail DC
Olsztyn – Light rail DC

Switzerland:
Zimmerberg tunnel – 25 kV AC
Tunel de Gibet – 25 kV AC

Spain:
Lantano tunnel – 25 kV AC

Turkey:
Istanbul – Metro DC

Russia:
Jekaterinburg – Movable overhead conductor rail

References
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www.siemens.com/rail-electrification

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