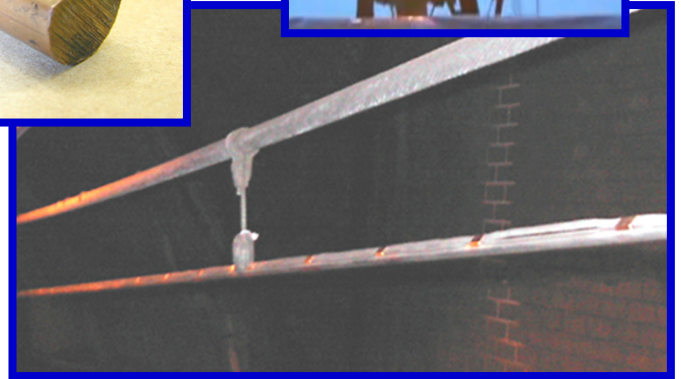


# SAN<sup>®</sup>

Railway Systems



 SYSTEM  
BLUE WIRE

## CAT HEATING OVERHEAD CONTACT SYSTEM DE-ICING – SYSTEM BLUE WIRE

### Prevent ice & frost accumulation on contact wire

Efficient electrical heating of the contact wire to bring the temperature above freezing point.

### Reduce mechanical stresses on the contact wire

No need for mechanical removal of ice.

### Quick and easy installation

Flexible silicone rubber sheath, light weight and triangle shape makes installation easy.

### High heating efficiency

The triangle shape always insure maximum surface contact with the contact wire.

### Superior performance

Assured by use of UV stable, silicone rubber, heat transfer jacket.

### State-of-the-art control systems

Energy saving control of the heat based on air temperature, wire temperature, humidity, dew-point and/or weather forecast.

### Monitoring and control

Wireless monitoring of the entire installation.

### **Eliminate Costly Interruptions of Revenue Service due to the effect of cold and ice/frost accumulation on the tramline/trolley/contact wire.**

Ice on the contact wire causes tramlines and light rails to lose power and in extreme cases leads to the contact wire / catenary system being brought down. Arcing caused by the presence of ice leads to excessive wear to the pantograph conductors, all leading to traffic delays and service disruption.

Mechanical removal of ice is manpower and time consuming and mechanically stresses the contact wire.

SAN Railway Systems offers the System BLUE WIRE solution that prevents accumulation of ice and frost on the contact wire.

The system contains everything from weather detection, weather forecast, heating wire, mounting clips, controllers and supervision software.

### APPLICATION

Along the line there are typical places more exposed than others regarding ice problems on the contact wire. Here is a list of typical places.



#### In and out of tunnels

The air inside the tunnel maintains a constant temperature and humidity. Traffic in and out and the natural ventilation forces the high humidity air to meet the cold environment outside the tunnel. Ice will be created as rime on the contact wire.

Water from the ceiling dripping down on the contact wire will create glaze.



Pittsburg – Mt. Washington Tunnel Portal



#### On bridges crossing rivers

The air above the river is normally warmer and the moisture content higher. On the bridge the warmer humid air meets the cold contact wire. Both hoarfrost and rime will accumulate on the wire.



Austria:  
Pöstlingbergbahn



#### Lines along big lakes and rivers

Same problems as for bridges crossing rivers.



Boston:  
Reservoir yard

#### Passing under bridges

Water dripping down from the bridge ceiling hits the cold contact wire, resulting in glaze ice.



#### Up hill elevated lines

The temperature normally decreases at higher altitude. This means that along the elevated line we will see a big temperature difference. The risk of having rime conditions somewhere along the line is much bigger. Ice on the contact wire reduces the power when the vehicle needs it the most.



#### Yards

Ice on the contact wire very often accumulates during the night. The vehicles cannot move due to ice accumulation causing revenue service interruptions.

### DE-ICING HEATING SOLUTION

SAN Railway Systems and RTR Technologies offer a complete solution, based on heating the contact wire to prevent new ice from building up and existing ice to melt.

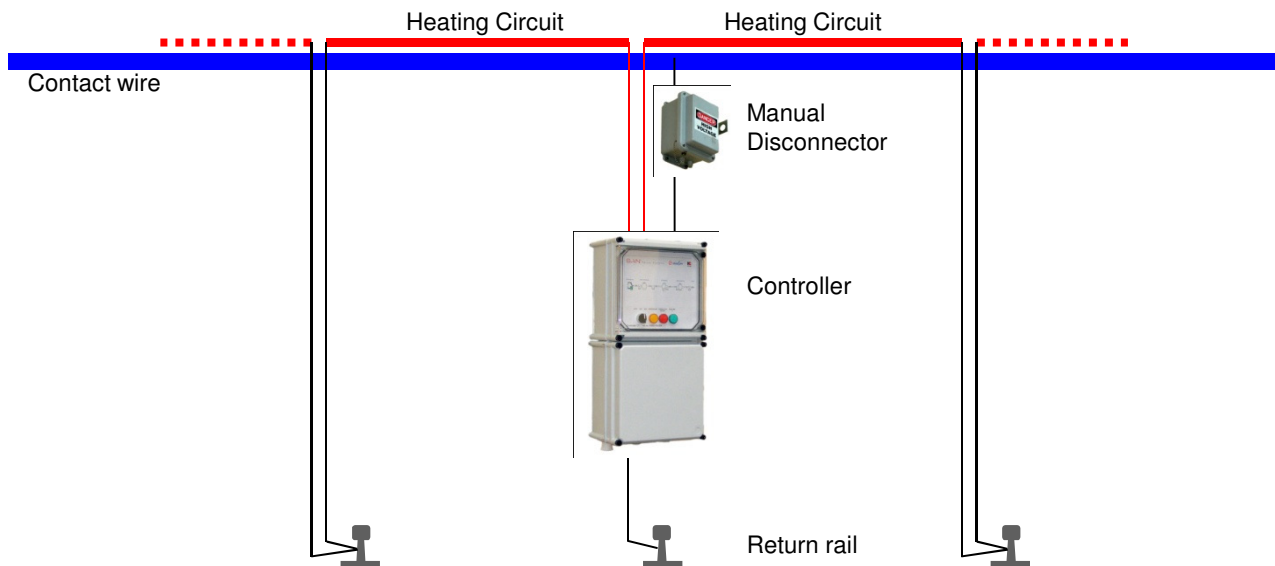


The heating element is a triangular cable mounted with springs on top of the contact wire. The system provides sufficient heat to raise the temperature app. 10°C over ambient temperature @ 9 m/sec. wind speed.

The heating cable is powered from the contact wire. To control the power and run the system using the minimum energy, a number of controllers are needed.

Every controller is capable of controlling multiple heating circuits. Standard heating circuit are either 150 or 300 meter long.

Every controller installation also includes a manual disconnect to disconnect the controller and the heating circuits from power. This disconnect is normally mounted above the controller.



### CONTROLLER

Every controller can operate as a stand alone controller. The power for the heating cable is managed based on multiple historical metrological measurements and instant measurements.

- Air temperature (Standard)
- Cold contact wire temperature (Optional)
- Air humidity (Optional)

The controller can, at any time, be switched to “Manual ON/OFF” either remotely or by operating a switch. A lamp for every circuit indicates heating status.

The system measure that every circuit is actually heating. If a failure is detected, this is reported and visibly indicated on the controller.

Advanced self diagnostic tools and multiple fail safe modes are integrated part of the controller.

### REMOTE CONTROL

To maintain and manage a complete heating system covering a large geographical area, remote control is highly recommended.

Every controller has multiple communication options. From wired RS485 or Ethernet to wire less GSM with GPRS communication technology.

SAN Railway Systems offers an easy to use hosted SCADA solution that provides the users with all information and remote control facilities. The solution is based on GPRS and the user only need access to the internet.

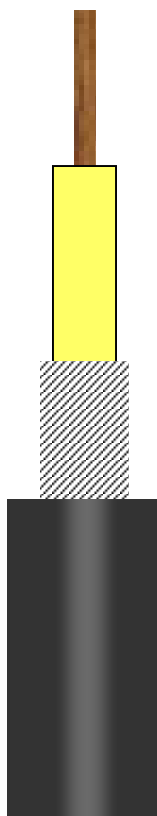
All controllers can be made, to interface with an existing SCADA system.

### HEATING CABLE CONSTRUCTION

The heating system, which is patent pending, consists of an insulated constant wattage heater surrounded by a heat transfer material. The power output is controlled by a microprocessor based system.



The heating cable is secured to the contact wire with phosphor-bronze attachment clips to avoid galvanic corrosion. The heating cable is in a triangular shape. This makes it very easy to mount on top of the contact wire. Also the shape provides excellent thermal contact with the contact wire. Finally it also makes the fastening springs easy to handle and very efficient to mount.



**Lead wires:** The heating elements consist of multiple twisted metal alloy wires.

**Heater strip Insulation:** Consist of an electrical insulating cross-linked extruded fluoro-polymer outer jacket.

**Heater Jacket:**

**Heat transfer aid:** The outer material is a silicon rubber loaded with heat transfer materials yielding a highly heat conductive electrically non conductive compound

### HEATING CABLE EFFICIENCY

Infra Red picture of a heating cable on top of the contact wire. The series of pictures shows how fast the wire is heated.

The 3 clips mounting the heating cable are visible on all pictures.

This series of pictures was taken at -5°C, wind speed 2-3 m/sec, 78% RH, Power 28 W/m.

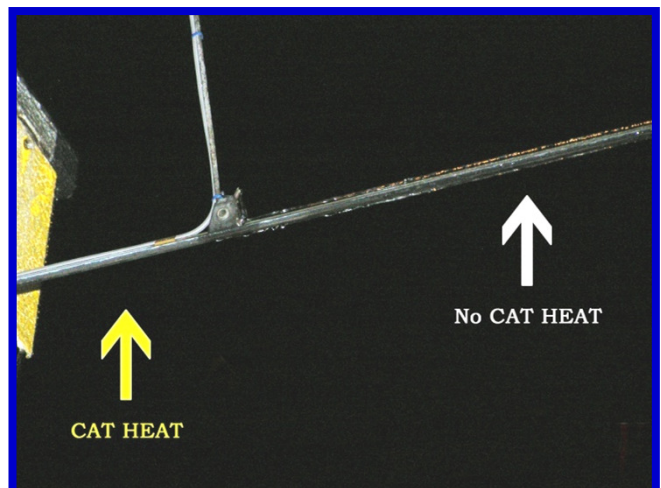
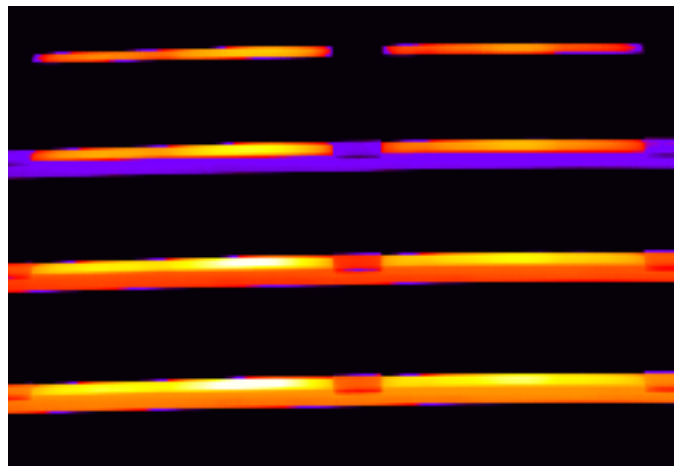
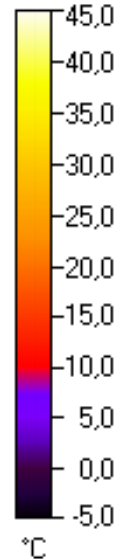
After just 5 minutes the contact wire is above freezing temperature and ready to melt ice.

1: 1 minutes

2: 5 minutes.

3: 10 minutes

4: 15 minutes





### CABLE SPECIFICATIONS

Heating Cable specification is shown for a typical 750 VDC installation. Supply voltage from 500 to 1500 VDC can be supplied (3000 VDC under construction).

#### Heating Cable

Dimension: Triangle 6.5 x 6.5 x 6.5 mm  
Type: Serial constant wattage cable

Cable type: RTR#201051  
length: 152 meter +- 10%  
Ohm per m: 0,82 ohm / meter

Cable type: RTR#201079  
length: 304 meter +- 10%  
Ohm per m: 0,20 ohm / meter

Power output: Min. 26,2 W/m  
Nom. 30,0 W/m  
Max. 33,8 W/m

Typical Heating capabilities: Raise the temperature  
10°C @ 9 m/sec. wind speed

Supply voltage: Nom. 750 VDC  
Max. 900 VDC

Insulation mat.: Silicon rubber base loaded with heat transfer materials.

Insulation test: Acc. to ASTM D3032  
5000 VDC in 2 minutes

Insulation resis.: min. 3000 Mohm/m

Weathering test: Acc. to ANSI/ASTM D2565-76

Lead pull: 18 kg vertical in 10 min.  
without deformation.

Max sheath temp.: 120°C

### CONTROLLER SPECIFICATIONS

Controller can be customized to meet any demand, software, control and enclosure wise.



#### Standard Controller:

Dimension: 300 x 600 x 220 mm  
Weight: 8,5 kg

Power output: Up to 4 heating circuits  
4 x 10 KVA

Fuse output: Individual fuse for every circuit

Supply voltage: Nom. 750 VDC  
Max. 900 VDC

or  
Supply voltage: Mains 230 VAC

Supply fuse: Fuse for mains supply

Input:  
Air temperature: -50 to +50 gr. C  
Type: Pt1000  
Humidity: RH 5 – 98%

Contact wire temperature: Pt1000  
Current measurement: Yes, one per heating circuit

Measurement type: Hall element  
5-15 ADC

Communication: Ethernet TCP/IP  
Wireless GSM GPRS  
Wireless GSM-R GPRS

### RTU – INTELLIGENT CONTROLLER



The Intelligent RTU unit stands up to the harshest environments. The specially developed, proprietary alloy enclosure provides noise immunity, wide temperature range, impact/vibration resistance, and DIN-rail mounting without special tools. The RTU is pre-programmed to control all communication and input/output for the CAT heating system

Alarm handling:	Smart alarm management with embedded calendar
Battery back-up:	Intelligent battery charger
Ambient temperature storage:	-40°C to +80°C
Ambient temperature operation:	-10°C to +50°C
Humidity:	5-95% non condensing
Approvals:	CE, UL/CSA
EMC:	EN61326-1
EMI emissions:	EN61000-4-2,3,4,6
MTBF:	EN55022
	EN61326-1
	>400.000 hours

### BLUE WIRE – SCADA SUPERVISION SOFTWARE

BLUE WIRE SCADA is the scalable software package that extend the reliability and efficiency of the contact wire heating. On-line management and control software to bond all controllers on a tram line or in a territory together. Valuable information at the fingertip of:

- **Traffic Control Department.**
- **Maintenance Department.**
- **Technical Department.**

Errors and operational status is reported immediately to the right person, both at the user interface, in a SMS and/or in an e-mail. Call for repair could be done with no delays. No jeopardizing the regularity of the tramline traffic.

The SCADA software can be customized in multiple way e.g. Language, graphical presentation and error handling.

#### Operational status:

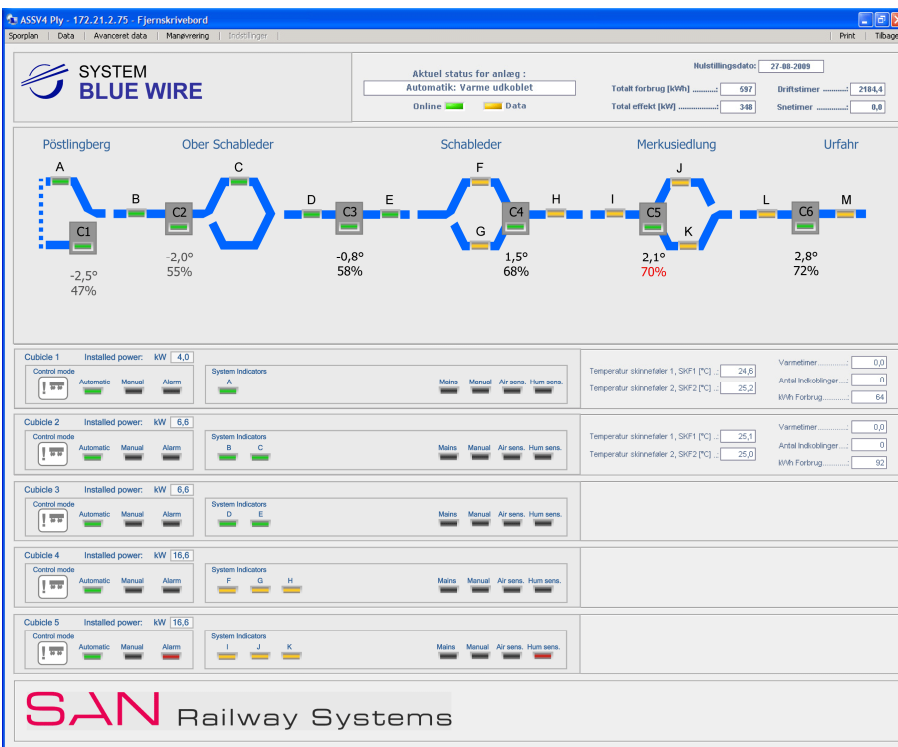
- Manual or Auto operation
- Control mode
- Locale weather conditions
- Heating circuits ON or OFF
- Energy counters
- Total heating hours
- Heating circuit power
- Current measurement for each heating circuit

#### Instant message on errors:

- Communication error
- Mains supply failure
- Low or no current in heating circuit
- Too high current in heating circuit
- Temperature sensor failure
- Humidity sensor failure

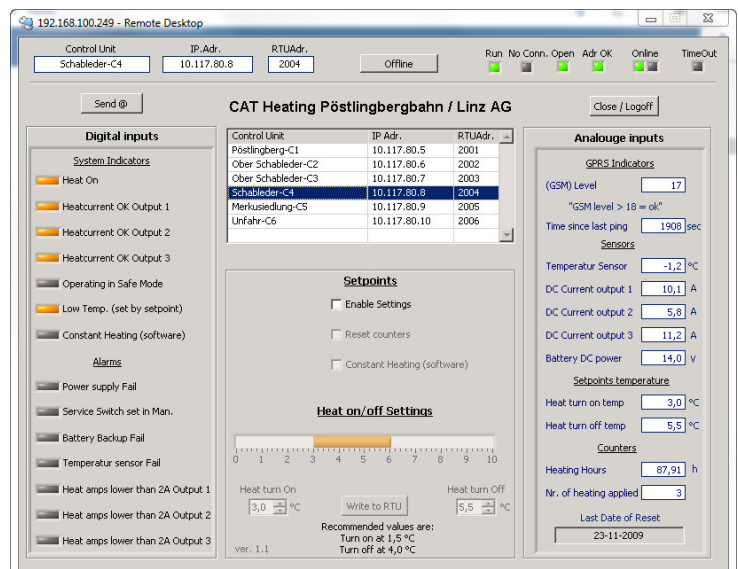
#### Remote settings:

- Turn individual circuits ON/OFF
- Temperature & Humidity levels for every control mode
- Diagnostic tool



Screen shot of the BLUE WIRE SCADA software package. Shown is a graphical presentation of a full tramline that includes 6 controllers and 13 heating circuits. If everything is green or yellow, no failure or errors to report.

Screen shot of the diagnostic tool “BLUE WIRE Service Access” for technicians and engineers. Features also remote download of new firmware for each controller when upgrades or changes has to be implemented



### SCADA AS A HOSTED SOLUTION

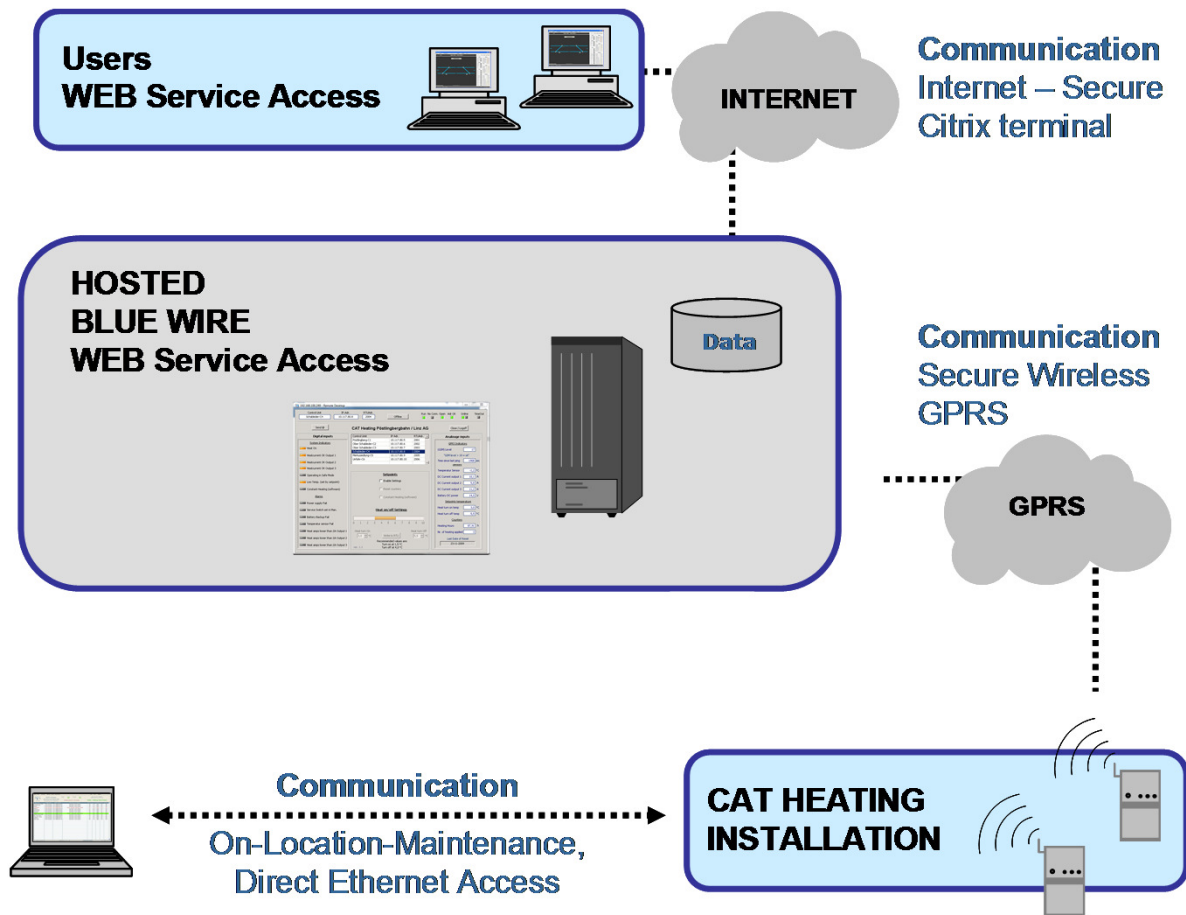
Complete SCADA solution on the Internet

SAN Railway Systems offers an easy to use hosted SCADA solution that provides the users with on-line information and remote control facilities. The solution is based on wireless GSM (GSM-R) using GPRS communication technology. The user only need access to the internet.

Safety solution: The solution is provided in a secure GPRS environment and the user is connected via a secure Citrix terminal solution. Minimal risk of hackers or virus.

Hosted BLUE WIRE SCADA benefits:

- No need for any IT hardware investments
- No need for maintaining a server application and the communication gateways
- SAN Railway Systems maintain the IT solution
- SAN Railway Systems can update, modify and implement changes very quickly.
- SAN Railways Systems has the experience from other similar hosted installations



### BLUE WIRE SCADA – SERVER SOLUTION

SAN Railway Systems offers the same easy to use SCADA solution to be installed on your own server in your own secure data network.

If a secure GPRS network is already in place and/or the communication is based on a wired network (ethernet or fibre optic cables) or GSM-R, it make sence to host the solution in In-house.

### ICING CONDITIONS



Ice accretion can be categorized in 4 different main types of ice:

- **Hoarfrost**
- **Rime**
- **Glaze / Ice rain**
- **Snow**



**Hoarfrost** Air humidity freeze on surfaces directly from the vapour phase if the contact wire is colder than the air temperature and below 0°C.

**Rime** Air humidity condensate on the contact wire when the air temperature is below the dew point temperature. The condensate will freeze if the contact wire is below freezing point.

**Glaze / Ice rain** Water droplets hits a contact wire colder than 0°C and freezes. Water droplets could be super cooled rain.

**Snow** Normally snow will not create ice on the contact wire, but wet snow (snow just around the freezing temperature) will react just like water droplets and will freeze to ice on a contact wire colder than 0°C.

### ACCESORIES



#### Power resistors

If the heating circuit is shorter than the specified standard length, a power resistor will be mounted at the end of the cable to substitute the missing cable (resistance value). The load resistor is weather resistant and could normally be mounted high on the pole.



#### Supervision

Team to educate the local staff to install the CAT Heating system.



#### Protection shield

Shield and a special rail bracket to protect the connection of the return (reference) current.

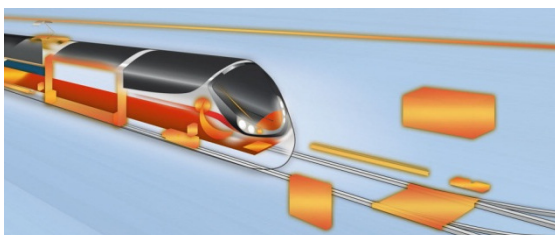


#### Power Termination Kits

Special assigned for reliable termination to cold wire or hot/hot wire termination.

### SAN Electro Heat A/S (Member of the NIBE group)

Danish located, international company offering more than 50 years of experience in developing and manufacturing of advanced, technical electric heating solutions and components. Products highly cost and energy optimized developed together with the customer. Our focus and know-how is divided into four business areas: Railway Systems, Wind Power, Industrial Process and Comfort Heating.



### SAN - Railway Systems (Part of NIBE Railway Components)

Complete systems to secure optimal operation under any winter weather situations: Switch Point Heating, Overhead Wire de-icing and Third rail de-icing. Our focus is to deliver highly efficient systems that reduces energy consumption and reduces the total cost of ownership. From heating elements through intelligent controllers to advanced server based computer monitor program. Including all necessary fittings, power transformers, weather stations etc. Rolling stock comfort heating, door step de-icing, heating of hydraulic systems, toilet/waste water systems and Test load resistors.

Our design has proven its reliability trough thousands of installations all over Europe.

### SAN Elektro Heat A/S - SAN Railway Systems

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