



A Guide to
Rail Network
Heat Tracing Applications



The **Heat Tracing Authority™**



Keeping You On Track

Introduction

From the start of the company in 1974, Heat Trace Limited has been at the forefront of the electric heat tracing industry. Significant annual investment into Research & Development has resulted in a unique and innovative range of surface heating products and systems - a number of which have been specifically developed to meet the needs of rail networks around the world.

Heat Trace's product portfolio for the Transportation Industry includes a range of safe, reliable and energy efficient solutions for a variety of "winter protection" applications for rail network infrastructure, rolling stock and properties.

Severe winter weather can cause extensive disruption to rail networks and transport systems, resulting in delayed or cancelled journeys that affect businesses and individuals alike.

In England alone, it is estimated that the overall cost of this disruption is around £280M per day! The direct economic cost alone amounts to £130M per day! *

(*Figures supplied by DfT)

Standards

All Heat Trace Limited cables and associated components are designed and manufactured in accordance with the latest international standard IEC 62395 - (Parts 1 & 2) Electrical resistance trace heating systems for industrial and commercial applications.

In addition, heating systems used on rail networks carry Network Rail UK Acceptance Certification.



Innovation-led technology has resulted in Heat Trace Limited becoming the industry's technical leader...

The Heat Tracing Authority™



1974 - 2019





Keeping You On Track

Applications

Heat Trace Limited provide a range of safe, reliable and energy efficient solutions, offering “winter protection” in a number of different transportation sectors, including:

- **Main Rail Networks**
- **Light Rapid Transit Systems**
- **Tramways**
- **Monorails**

Within these sectors heating applications can found for:

- **Infrastructure**
 - Switches and turnouts
 - 3rd rails
 - Monorail tracks
 - Catenary Wire de-icing
 - Pantograph shoe de-icing
 - Tunnel ice prevention
- **Rolling Stock**
 - Water supplies freeze protection
 - Sanitary system freeze protection
 - Diesel fuel lines temp maintenance
 - Door and threshold ice prevention
- **Property**
 - Snow & ice prevention systems for:
 - Paths and stairways
 - Car Park access/exit ramps
 - Disabled access ramps
 - Platforms
 - Roof and gutter systems

(See separate Commercial Application Guide for details of these specific applications)





Points Heating

General Information

Winter weather conditions vary considerably from country to country and applications and system requirements will depend on the regional weather patterns and the design operating parameters of the the local rail network.

Electric point heaters are important in maintaining the operational integrity of the rail network. In addition to the actual turnout, a high speed point system may include a swing nose crossing that will also require heating. Consideration may also be given to providing heating under the point operating mechanism, as well as under the stretcher bars, to prevent the build-up of snow and/or ice that could restrict the movement of the point mechanism. Clamp lock heaters are sometimes fitted inside the clamp lock by the manufacturer.

The main criteria for any application is to ensure satisfactory operation of the point system in normal winter conditions. It is not commercially viable to provide a point heating system that will cope with severe winter conditions, as the heat requirement and subsequent operating costs are likely to be prohibitive. Under severe weather conditions the track would probably be impassable in any event and would require the use of mechanical snow and ice clearing equipment.

To be effective, a point heating system should ideally be able to perform satisfactorily in light winds, maintaining the rail temperature at +3 Deg C against a minimum ambient temperature of around -25 Deg C, with a precipitation rate of about 150mm/hour. (These performance criteria are based on the requirements for the UK rail network and may vary from country to country.)

A point heating system needs to perform three distinct functions:

1. Prevent the moving switch rail from freezing to the fixed stock rail.
2. Prevent the switch rail from freezing to the supporting slide plates.
3. Prevent any build of snow, sleet or hail between the switch rail and the stock rail that could compact and prevent the point system from operating correctly.

Where there is a danger of drifting snow that could affect the point system, it is recommended that suitable snow fences or wind shields are employed where practical.

The use of electric points heating systems, eliminates the need for continual application of de-icing chemicals, which are generally only effective down to about -7 Deg C and can also accelerate corrosion.

The fully automatic capability of an electric points heating system also eliminates the need for mechanical snow and ice removal methods that require additional manpower.



Typical Points Heating System in Operation



Contact Rail Heating

General Information

In regions where an electrified third rail network is utilised winter weather can also have a disruptive effect on rail traffic when ice and snow form on the conductor rail to the extent that traction is compromised. This is particularly relevant at the exits of stations and on sections of track where low speeds can be encountered.

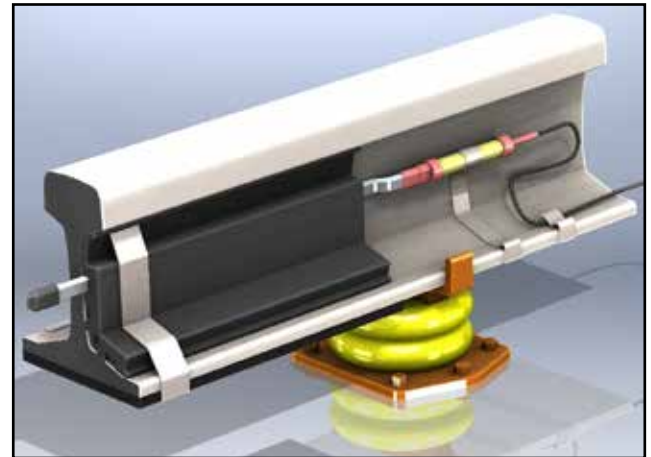
The principle behind the heating of the conductor rail is to allow the train to accelerate under its own traction up to about 30mph, in order to allow it to get away from the station, or perhaps from a signal location where the train may have been required to stop. To achieve this a section of around 200 metres of conductor rail is heated on the exit track of the station, or where the train needs to pull away from the signal. Once the speed is up to 30mph the collector shoe is able to act as its own “scraper” and take traction.

Heat Trace has successfully installed a number of these system on the UK rail network. Unlike the constant power heaters usually employed on points systems, the Heat Trace system utilises high power self-regulating heater technology to provide an economical and energy efficient solution.

Energy efficiency can be further enhanced by incorporating a thermally insulating barrier strip over the heater that directs more generated heat into the rail, rather than it being dissipated into the air. Coupled with Heat Trace’s own PowerMatch+ controller, this results in a significant reduction in operating costs, whilst extending the life of the heating system.

The heater and the thermally insulating strip are held in position on the rail using specially designed spring clips that can be easily removed and replaced for track maintenance purposes.

To allow the system to be fitted to various types and sizes of contact rail the thermally insulating strip can be easily modified to fit different rail profiles and positioning of the heater strip.



120CRH7 Self-regulating Contact Rail Heater - Heater output 120W/m @ 0DegC (750 volt dc supply) As Used on Network Rail’s Main Line 3rd Rail System in the UK



120CRH7 Self-regulating Contact Rail Heater Installed on 3rd Rail for London Underground



The “EL” in Chicago the Elevated LRT System uses Heat Trace’s 90CRH6 Self-Regulating Contact Rail Heater Operating on the 3rd Rail for Winterisation Duties





Urban Transit Systems Track Heating

General Information

Track surface heating encompasses such applications as main rail (permanent way), tramways, urban transit systems, monorails and APMs (Automated People Movers).

The heating prevents ice and snow accumulation on the entire system, or on specific areas such as high speed curves, gradients, acceleration and deceleration areas, monorail guide rails, etc. Monorail tracks are particularly vulnerable to problems caused by ice and snow accumulation, particularly if they are automatic / driverless systems and they are located in regions that are affected by winter conditions.

Accumulation of snow and/or ice on the track causes loss of traction and can seriously affect the train's ability to brake safely, accelerate away from stations and to negotiate inclines. When the running wheels lose traction they can spin on the track, causing the on-board control computer to believe that the train is travelling too quickly and shut down power.

Heating of the running surfaces of the monorail track eliminates this problem and the train can continue to operate safely and correctly in all weather conditions.

Heat Trace can offer several types of heater for monorails, including series resistance constant power, or parallel resistance constant power, or self-regulating heaters - depending on the applications and operating requirements of the system. These systems can operate from the traction power supply, or from an independent power supply, ensuring optimum versatility.

The type of heater used, the method of attaching to the track, together with the use of thermal insulation are all discussed in detail with the monorail design and supply company, together with the chosen track fabrication and installation company.



Heated Monorail Track Using Heat Trace's Longline Series Resistance, Constant Power Output Heater





Miscellaneous Rail Network Heating Systems

Points Drainage Tray Heater

On some LRT points systems a drainage tray is located beneath the switch push-rod mechanism. During winter conditions the run-off water is prone to freezing and the drainage outlet holes get blocked. As the drainage tray continues to fill up, the water can freeze and impede the movement of the switch push-rod mechanism.

Heat Trace can provide a pre-terminated, self-regulating heating cable system that can be fitted to the tray to prevent this from happening. As it is a self-regulating heater and only a short length, no direct controls are required, although it may be fed from the same supply as the points heating system.



Points System Drainage Tray Heater

Pantograph Carbon Shoe Heater

The build-up of ice on the pantograph collector shoe can result in poor contact with the overhead catenary traction power cables, causing arcing and deterioration of the carbon shoe.

Heat Trace can provide high power self-regulating heaters that are used to ensure the contact surface of the pantograph collector shoe remains free of ice. The heaters can be powered directly from the traction power supply using voltages up to 1500 volts dc. Depending on the design of the system we have a variety of methods to secure the heater and any capping that is used.



Pantograph Carbon Shoe Heater

NOTE

..... FUTURE DEVELOPMENTS

Heated Overhead Catenary Power Lines

Heat Trace are currently in the process of developing a high power output, high voltage, self-regulating heating cable system for keeping the overhead catenary power lines free from the build up of ice.



Heated Overhead Power Lines - UNDER DEVELOPMENT





Rail and Track Heating - Product Selection

Rail Heating Product Range

Heat Trace have a range of products suitable for rail heating systems. The type and style of heater will vary from region to region and with the specific requirements of the client. Whatever the requirements may be, Heat Trace will be able to provide a suitable system, either parallel constant power output heaters, self-regulating heaters, or series resistance heaters.

All parallel resistance heating cables, both constant power and self-regulating, are cut-to-length and can be provided in pre-terminated set lengths, or in bulk on reels, together with termination components and cold lead power cables, for pre-terminating by the end user. Heaters can be supplied to suit a variety of voltages up to 1500 volts, together with heater outputs up to 200W/m.

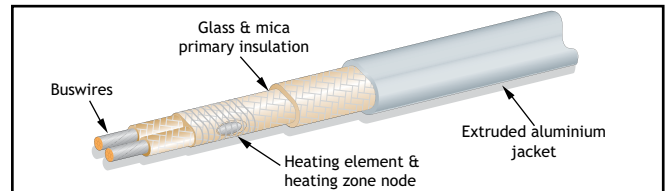
In addition to the heaters, we also supply a range of ancillary equipment, such as rail clips for securing the heater to the rail, power connectors and control and distribution systems. Control systems can range from simple ON/OFF mechanical, or digital controllers, through high energy efficient system controls, to fully automatic, complete weather monitoring systems with alarms and remote access facilities.

Heater and Ancillary Selection

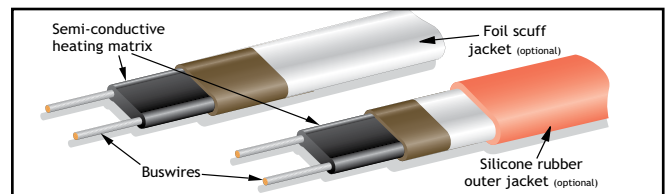
Rail profiles vary considerably from country to country and sometimes, region to region. This is particularly relevant for rail systems that have been in operation for many years, where the track and rail design may not be suitable for fitting all types of heating system. It is therefore important when choosing a heater and its associated ancillaries, that the products are suitable for the rail profile and track layout.

Rail clips for securing the heaters to the rail need to be designed to suit the heater as well as the rail profile. It is important that the heater must be allowed to move laterally on the rail under expansion and contraction, yet still remain secure enough to stay in contact with the rail under any vibration and flexing of the rail during normal operation.

Heater Selection



RHT - Parallel Resistance MI Heater, Extruded Metallic Outer Jacket, Constant Power Output for Points Heating, Outputs up to 200W/m, Cut-to-Length Capability



CRH - Parallel Resistance, Self-Regulating Heater. Outputs up to 120W/m, Used for Points Heating, or 3rd Rail Heating, Cut-to-Length Capability, Voltages up to 1000v AC/DC as standard.

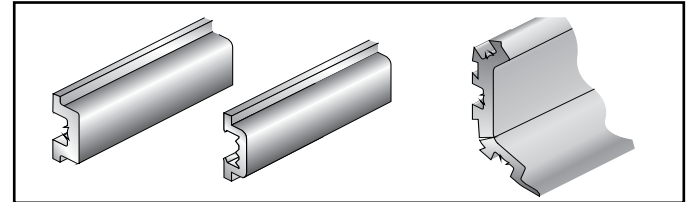


Rail and Track Heating - Product Selection

Thermal Insulation Capping

Heat Trace has developed a range of thermal insulation capping for use with our range of heaters. This capping can save significantly on system operating costs, whilst at the same time providing mechanical protection for the heater and ensuring the heater retains good contact with the rail along its entire length.

The capping can be supplied for single or multiple heaters enabling it to be used on several different style of modern rail profiles. The capping can be supplied with suitable securing clips to suit most modern rail profiles.



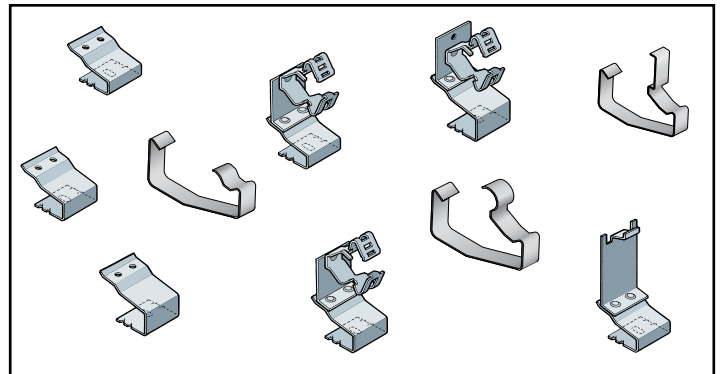
Heavy duty insulating capping. Suitable for most modern rail profiles and a variety of heater positions. Securing clips can also be provided

NOTE:

The above illustrations show just a selection of the most commonly used heaters and capping for rail applications. HeatTrace, however, can offer a comprehensive range of heaters to suit all types of applications.

Rail Fixing Clips

Heater clips are required to hold the heater in position on the rail. These clips can vary in design and style depending on the type of heater employed and the application. Clips should ensure that the heater remains in close contact with the rail in order to aid heat transfer, whilst at the same time allowing the heater to move laterally under expansion and contraction. The rail clip should also be capable of withstanding the excessive vibration of heavy rail traffic and be resistant to oil, diesel fuel, de-icer, weed killer and other chemicals found in this type of environment.





Control Systems

The Importance of Energy Efficiency

The power required to allow any rail or track heating system to perform satisfactorily under the required conditions can be extremely high. This is because most track heating systems need to install sufficient power to cater for worst case conditions that do not occur at all times, furthermore, the high powers are necessary because most rail/track heating systems cannot, or are not, effectively insulated and the track acts as a large heat sink with most of the generated heat escaping into the atmosphere rather than heating the track.

As a result of this, serious consideration should be given to thermally insulated capping, or insulating shields over the heater where possible, together with temperature controllers, that monitor the ambient temperature ensuring that only sufficient power is used to match the heating requirements of the system as weather conditions change.

Here we use a typical UK points heating system to demonstrate the potential energy savings and reduced operating costs that can be achieved using a temperature control system.

Although the high powers installed may be capable of protecting a points system under the worst case conditions of -25 Deg C, the average temperature in the UK, when it is below zero degrees C, is only about -4 Deg C. So, under normal average freezing conditions, only a fraction of the installed power is required.

A conventional ON/OFF controller (manual or automatic operation) is likely to apply full power whenever the ambient temperature is below 5 Deg C and, according to the UK Winter Facts figures shown opposite could be energised for around 2500hrs per year.

By using energy efficient temperature controllers, together with thermally insulated capping over the heaters, operating costs can be reduced by as much as 80-90% when compared with conventional ON/OFF controls.

A typical RT60 E turnout, with a 10 metre heated length, will have an installed heating power of around 8kW. Average annual operating costs for this one heated points system would be in the region of £2000 per year. Assuming temperature controllers save only 60%, this could result in reduced operating costs of £1200 per year for just one average point heating system!

EXAMPLE OF UK WINTER TEMPERATURES

Average number of hours below 0°C is approx 1000 hrs/yr

Average number of hours below 3°C is approx 2000 hrs/yr

Average number of hours below 5°C is approx 2500 hrs/yr

Average temp when it is below freezing -4.1°C

(Data taken from UK Met Office reports over 25 year period)

With the number of heated points system in the UK currently at around 18,000 - this could mean temperature controllers would offer significant annual savings in the region of £21.6M. It also means a reduction in CO2 emissions of around 9.28 million tonnes.*

(*Above figures based on cost of electricity at £0.10/kWh and 1kWh of grid electricity being equivalent to 43kg CO2)

Temperature controllers can be programmed to maintain the rail temperature at +3 Deg C against a minimum ambient temperature of, for example, -25 Deg C. The control monitors both the rail surface temperature and the ambient temperature and can be programmed to only deliver sufficient power to maintain the desired rail temperature. The installed load would only deliver 100% of the available power when the ambient temperature was at its minimum of -25 Deg C, or when the track temperature falls below a preset minimum temperature, such as during a snowfall. With an average UK freezing temperatures of less than -5 DegC, together with an average of only 50 hrs of actual snowfall, significant energy savings can be achieved with temperature controller - in the region of 80-90%!





Design & Engineering Services

As you would expect from a high calibre company, Heat Trace is able to fulfil the expectations of clients who wish to entrust the widest possible range of services to a single contractor able to manage all aspects of a rail or track heating project.

A complete range of Design & Engineering Services is available - ensuring that all requirements of the client are satisfied.

Consultancy

Close liaison with the rail network operator, the main engineering contractor and the electrical installation contractor, is recommended in order to ensure client specifications are met with the most suitable and energy efficient type of heating system, with the lowest cost of ownership.

Design

Heat Trace Limited can offer help and assistance with system design and specification. All design work is carried out in accordance with ISO9001 certification. System design complies with all the latest national and international standards and approvals including: **IEC 62395 - (Parts 1 & 2) Electrical resistance trace heating systems for industrial and commercial applications.**

It is essential that rail heating tracing systems are compatible with the primary rail electrical systems in use on the particular rail network. The design of protective equipment, such as earthing and residual current devices should be undertaken in consultation with the rail network engineers, so as not to compromise the effectiveness of track train detection and other operational and safety systems.

Keeping You On Track



Commissioning

Our commissioning engineers will carry out final inspection and testing, ensuring system operation is in accordance with design specification, prior to handing over to the client.

Project Management

Dedicated Project Managers will ensure the smooth operation and completion of all major projects.

Personnel Training

Training in product knowledge, system design, installation and maintenance procedures can be provided at one of our Affiliate/Partner company premises.





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