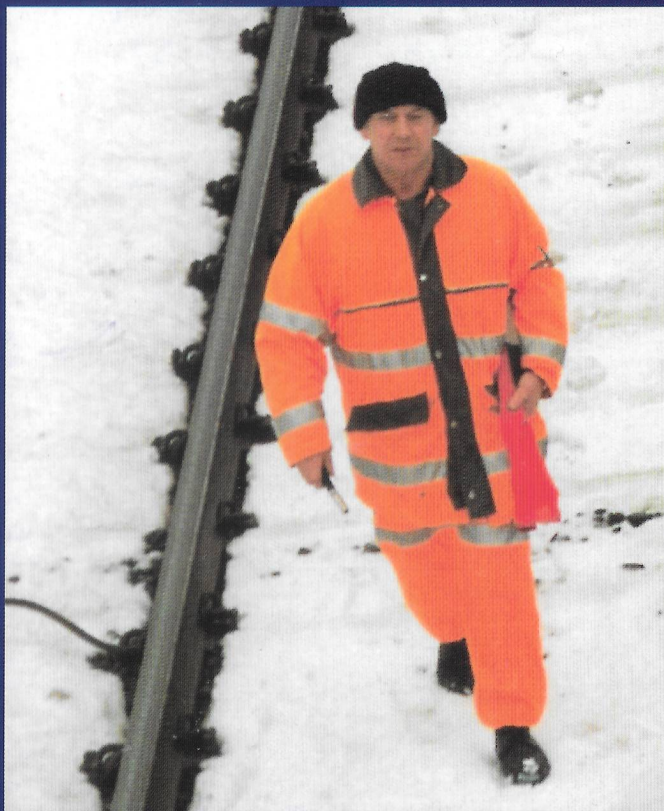


WORKING IN COLD WEATHER



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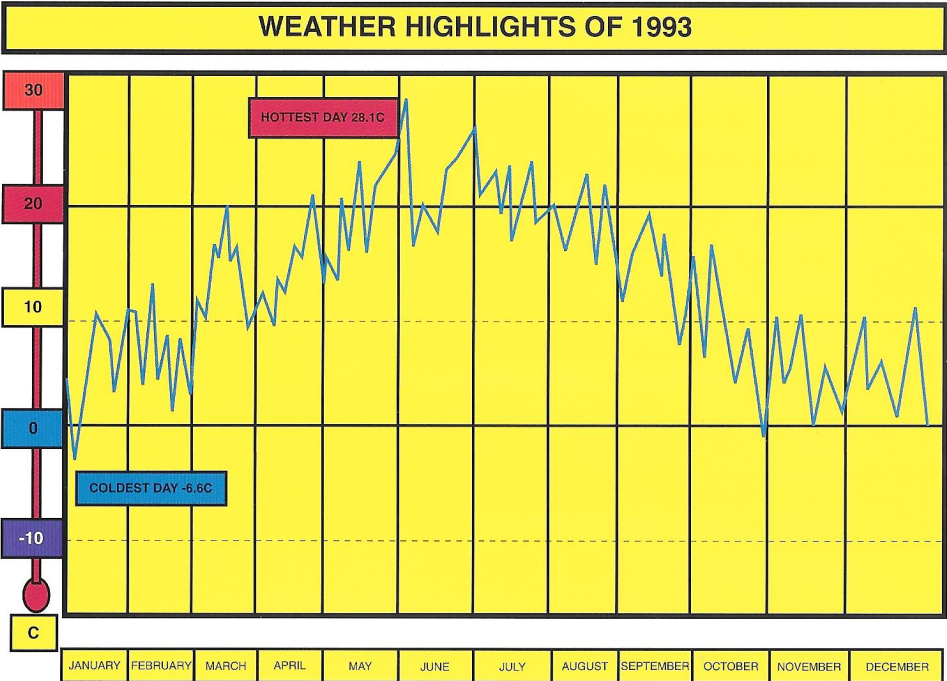
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COLD WEATHER

1.1 LOW TEMPERATURES AND WIND

How often do we consider the effect of cold? Probably only when we slip on some ice or on a dark winter's morning when the car windscreen freezes over as fast as it is cleaned.

While the number of occasions that it is freezing during daylight working hours is relatively low, we often work night shifts, respond to call outs, undertake handsignalling at night or watch cracked crossings, etc.



1.2 WIND CHILL

Wind is also a consideration; it is a nuisance when it blows a tree across the tracks or the garden fence blows over, but beyond that we take little notice unless it is almost a gale. However if you combine low temperatures with the wind the effect on the human body can be quite surprising.

Wind blowing on the body causes cooling, the greater the wind speed the greater the cooling effect, this is known as the wind chill factor.

The table below details the effects of wind chill for a given air temperature and wind speed and gives the equivalent temperature felt by the body.

EQUIVALENT TEMPERATURES ON THE HUMAN FLESH

WIND SPEED (MPH)	AIR TEMPERATURES DEGREES CELSIUS							
	+4	+2	0	-2	-4	-6	-8	-10
0	+4	+2	0	-2	-4	-6	-8	-10
5	+2	-1	-3	-4	-6	-8	-10	-12
10	-3	-5	-7	-10	-12	-15	-17	-20
15	-6	-8	-11	-14	-17	-19	-22	-25
20	-8	-11	-14	-17	-20	-23	-26	-29
25	-10	-13	-16	-19	-22	-25	-28	-31
30	-12	-15	-18	-21	-24	-27	-30	-33
35	-13	-16	-19	-22	-25	-28	-31	-35
OVER 35	VERY LITTLE FURTHER EFFECT							

RISK OF FROST BITE AT A TEMPERATURE OF -6 OR BELOW

A temperature of 4°C, with a wind speed of 25 mph is common in winter in many parts of the country. In such conditions the body feels that it is at -10°C, which we would regard as very cold if we saw it forecast on the TV weather map.

Having wet clothes will cause increased evaporation in a wind and the cooling effect will be accentuated.

HAIL, FROST, SLEET, ICE & SNOW

2.1 HAIL

When water vapour is carried up into the atmosphere and the temperature is below -10°C ice pellets will be formed. When they become too heavy to be supported by the air currents they will fall as hail. They may also collect more water which becomes ice and they will increase in size as they fall. Hail can sometimes cause physical damage when it reaches ground level but will quickly melt.

2.2 FROST

If the air temperature is 0°C or below, water vapour in the air freezes and frost will occur. Hard frost consists of minute crystals of ice which form on the ground on cold, clear nights when condensation takes place after freezing. Denser and harder ice forms when super-cooled-droplets suddenly freeze on contact with a surface at ground level.

2.3 SLEET

This is part melted snow or hail or snow and rain mixed together. The air temperature at ground level will be just above 0°C .

2.4 ICE

Ice forms when water freezes. This is 0°C for pure water; however if it is not pure then the freezing point will be lower, which is why ice melts when salt is present. When water changes to ice it expands by 11%. If trapped in a confined space it can exert very considerable pressure in the process. Water in a crack or fissure in a rock may fracture the rock as the ice forms. Ice, like glass, is very strong in compression, weak in tension and shatters easily if struck.

2.5 SNOW

Snow forms when the temperature of the lowest 300m of air above the ground is near 0°C. Water vapour condenses on ice crystals in the clouds and when it becomes too heavy it falls as snow flakes.

It is not easy to forecast exact temperatures because of geographical factors and the wind chill effect.

Snow rarely falls if the air temperature is above 4°C. Between 0°C and -4°C the biggest flakes occur and as the temperature drops below -4°C the crystals decrease in size. Between 0°C and -25°C there are six different crystal sizes all with different characteristics including the “wrong type of snow”!

One foot of snow is the equivalent of one inch of rain, this is important to remember when the snow thaws, since a thick layer of snow will produce a lot of water and subsequent risk of flooding(see item 20 for details).

It should not be forgotten that snow weighs about 240kg/m³, so a heavy fall can build up quite a load on a light roof, such as some of our “home made” stores.

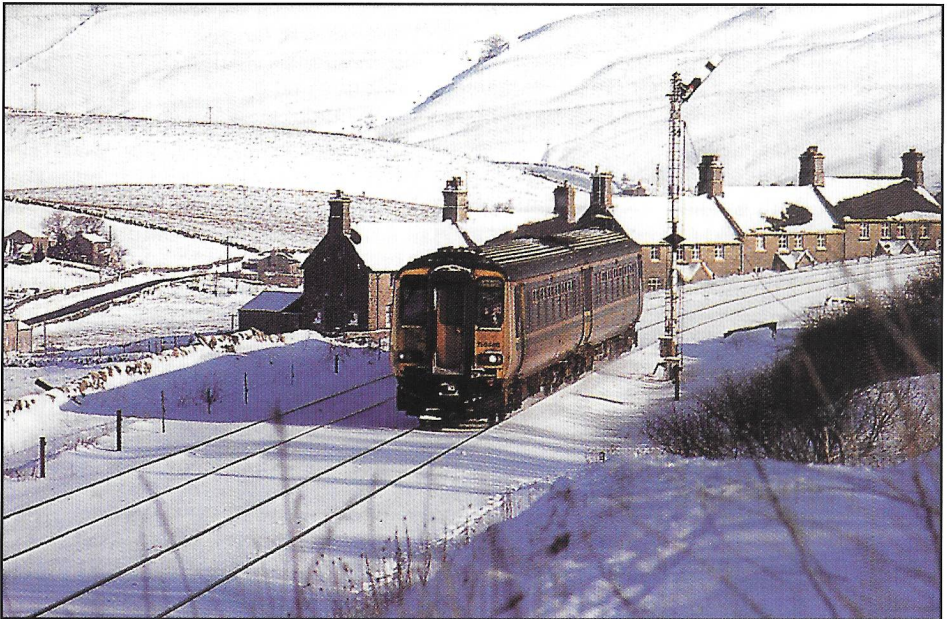


TEMPERATURE AND HEIGHT

3. TEMPERATURE AND HEIGHT

Air pressure reduces with height. Wind passing up over a mountain expands and cools. In the UK the prevailing wind is from the south west and the moist air coming from the Atlantic rises over the Welsh and Scottish mountains and the Pennines, this reduction in air pressure causes the vapour to condense and fall as rain, which is why the west side of mountains are wetter than the east.

In dry air there is a loss of about 1°C per 100m of height and in very moist conditions 1°C per 200m of height gained. If travelling from an office or home cabin at sea level up into the hills, the temperature change can be quite noticeable, especially if the wind is blowing and the chill factor applies.



COLD AND THE HUMAN BODY

4.1 COLD AND THE HUMAN BODY

Everybody gets cold on the track in winter. It may take the form of shivering or it may be loss of feeling in the fingers, toes or ears. Do we know why? Do we know it can severely slow down our reactions? Do we know it can become dangerous when it affects our mental and physical reactions?

In cold weather the body should be kept at a more or less constant temperature to remain comfortable and efficient. Any marked variation from 37°C causes problems. A lowering of the internal body temperature by only 2 degrees can lead to a condition called hypothermia (see 4.2). By using correct clothing and considering other factors this problem can be avoided.

In winter, track staff usually wear jeans, vest and pants, a shirt, a jersey, an issue anorak and leggings and a pair of gloves. Whilst these items may be adequate if the temperature is low and a person is working, what about the Lookout who stands still and generates little heat?

Lookouts probably wear the same clothing as those people who are working. As the Lookout gets colder and colder, he also becomes less efficient - yet he is the one looking after the gang's safety!! Rotating people to act as lookouts will help maintain their comfort, efficiency and hence everyone's safety. In cold weather an alternative is for the Lookout to have a thermos of hot tea or similar to help maintain his body temperature.

If the body is cold then there is greater risk of damage to the muscles if strenuous work is suddenly undertaken. Physiotherapists will recommend that before starting work in such conditions a few gentle exercises to move the muscles, they get the blood circulating and greatly reduce risk of injury. Train interruptions will not help if they are frequent or prolonged, since the body is repeatedly cooled and heated, producing temperature fluctuations.

Taking a rest at lunchtime in a warm vehicle or cabin, or having periodical food and hot sweet drinks will also help to maintain the body temperature, but it should not be overdone (See Item 4.2).

COLD AND THE HUMAN BODY

4.2 HYPOTHERMIA

We normally associate hypothermia with old people, but it can affect anyone in certain conditions. The body operates most efficiently when it is between 36°C and 37°C. Hypothermia occurs when the body starts to cool down below 35°C and to try and maintain the correct temperature it starts certain protective measures.

The symptoms of hypothermia are:

- ◆ the person complains of feeling miserably cold.
- ◆ the small capillaries of the hands and feet constrict, to minimise heat loss through the skin, which goes pale (or blue) and feels abnormally cold. This process allows them to cool whilst the essential organs are kept at the right temperature. However this does not protect the head and the back of the neck, which have the brain and the spinal cord near the skin's surface.
- ◆ when uncontrollable shivering starts it is the body's means of producing heat through exercising the muscles, albeit involuntarily. If that fails then the body's core temperature drops, reflexes slow, as does movement, and there will be an impairment of thought and judgement - definitely not the time to be on the track.

At this stage the person is in trouble and action must be taken, if not, the situation becomes dangerous and

- ◆ the shivering stops
- ◆ muscle co-ordination problems start
- ◆ speech becomes slurred
- ◆ the person may become irrational
- ◆ the person will have slow pulse and respiration rate.
- ◆ If the body temperature drops any further then the person will probably become unconscious.

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Whilst it may seem extreme to go into great detail about hypothermia, one should not forget the hand signalman in the middle of nowhere, a watchman on a cracked crossing, a lone patroller, a driver of a broken down vehicle and the like. They are all at risk if cold, wet or windy conditions occur. Staff knowing the symptoms may help prevent an incident.

If the person has wet clothing then the evaporation of the moisture causes even greater cooling, increasing the heat loss. Getting caught in a shower, without waterproofs, is a typical situation.

If a person gets really cold then taking a warm sweet drink, or eating something that will quickly produce energy, such as chocolate, dried fruit or nuts, may help to restore the situation to normal. Putting on additional clothing that protects against the elements may also assist in certain circumstances. Alternatively going into a warm place, such as a cabin or a vehicle will help, but it should not be excessively hot, since the body then rushes blood to the skin, which can deprive the vital internal organs of their blood.

CLOTHING FOR COLD WEATHER

5.1 GENERAL

Normally track staff will be working in the open so clothing must be flexible and permit a full range of movements to accomplish all the required tasks, as well as keeping them warm and dry.

For warmth a number of thin layers of clothing are better than two thick ones, since each garment will trap a layer of relatively still air and hence heat. As the body warms up a layer can always be removed and then when work stops it can be replaced so that the body keeps a more or less even temperature.

Wind chill is serious so the clothing needs to be windproof and waterproof. Waterproof clothing often has the problem of permitting perspiration to build up inside which is unpleasant and can be uncomfortable when exercise stops, since it then evaporates causing further cooling.

Staff are provided with various items of outer protective clothing in accordance with the Personal Protective Equipment Regulations, but other items must be bought by the person. With careful shopping around staff can gradually acquire a sensible range of clothes to fully protect against the worst of the weather to keep themselves comfortable, warm and efficient.

Waterproof clothing for track welders should be of flame retardant material.

5.2 THE FEET

Nylon and other artificial fibres usually have little insulation value and hold perspiration. Whilst pure wool is one of the best insulators it may need reinforcing with say nylon, to provide wear resistance in items such as socks. A selection of safety boots is available and staff should be able to choose the type that suits them best. Using a pair of boots a size larger than normal, combined with an insulated insole and a extra pair of stockings will greatly help in keeping the feet warm and minimise any rubbing. A pair of socks over woollen football type stockings is ideal, since the latter reach almost up to the knee caps and help keep the legs warm.

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Care must be taken that the boots fit properly and are comfortable, they must be kept clean and repeated applications of dubbin or similar will assist in waterproofing them.

Wellington boots, usually worn when there is snow on the ground, are very bad insulators against cold and additional socks or stockings should be worn. An alternative is to wear normal boots and issue leggings but to use the equivalent of army gaiters (from a war surplus or any out door shop) to stop snow getting over the top of the boots.

5.3 THE LEGS

In addition to the comments above, a pair of thermal long johns will restrict heat loss in very cold conditions, even a pair of tights (men's tights are available!!) in cold weather underneath jeans or trousers provide a limited amount of extra insulation when it is cold. Jeans are not the best form of leg covering to wear, whilst they are very strong and hard wearing, they do absorb a lot of water when wet, making them heavy and obviously increasing the cooling effect if it is windy. Similar remarks apply to jogging trousers.

5.4 THE TORSO OR BODY

The main idea of underwear is to keep the torso skin temperature as stable as possible. Thermal underwear is ideal and readily available but a string vest, a close fitting rugby shirt, which has long sleeves, a jersey with a round neck, plus a top coat, is as effective for short term exposures that we normally undertake. One problem area is the small of the back, because with normal clothing this is often exposed as a person bends over and the kidneys can be severely cooled. Long backed garments, such as rugby or lumberjack shirts, are available if one looks around in the shops. Padded waistcoats and one piece overalls help to retain the body heat and give total freedom of arm movement.

CLOTHING FOR COLD WEATHER

5.5 OUTERWEAR

The old type of anorak and trousers are polyurethane coated on the interior and whilst this provides waterproofing and windproofing if used for an extended period with hard work there can be a build up of perspiration inside the clothing. This then condenses and damps the clothing beneath and becomes uncomfortable, as well as causing cooling because of evaporation.

The latest type of high visibility clothing is windproof and waterproof, being made of a breathable fabric, so that whilst the rain runs off the surface the perspiration can travel out through the fabric. This hi-tech clothing should keep anyone comfortable in all but the very worst conditions.

5.6 THE HANDS

Fingers are often the first part to go numb in the cold and woollen or cloth gloves will help retain heat, especially if there is a thin pair under an outer glove. Two gloves may reduce the sensitivity of the fingers, but is no worse than if they go numb, cold fingers will reduce the grip on tools and there is then a risk of slipping and an accident. Whilst it may sound cumbersome there are many jobs which can be done whilst wearing gloves, e.g. patrolling, using a Pan Puller.

5.7 THE HEAD

The head can contribute up to one third of the body's total heat loss, so wearing some form of hat is a considerable help in staying warm, especially if one is bald or has a crew cut! A woolly bobble hat or balaclava type are best, in that they keep a permanent warm air layer around the head. If the ears can also be covered, without losing too much hearing, then so much the better. The ears are extremities with little thickness and could possibly become frostbitten if it is very cold and windy.

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Wearing a hood over the head causes a certain amount of loss of hearing and peripheral vision and appropriate precautions must be taken, such as touch Lookouts. What must be avoided is a fur lined parka or snorkel type anorak which seriously restricts both vision and hearing.

Where hard hats / safety helmets have to be worn then a woollen hat without bobble can be used under the helmet but straps **MUST** be adjusted for a correct fit.



TRACK PROBLEMS

6.1 TRACK MOVING DOWN THE HILL

Rails expand and contract with temperature changes. A 18.288m (60ft) rail can differ in length by 14mm over the normally accepted range of UK rail temperatures from -13°C to + 53°C. CWR is installed at a Stress Free Temperature (SFT) between 21°C and 27°C, chosen such that the rail is neither in excessive tension nor compression at very high or very low rail temperatures. If the temperature is very low the rails will be in tension, which is not normally a problem except in curves. The track may move inwards as it tries to reduce its own length, rather like a buckle in reverse. This may be accentuated by poor ballast conditions or lack of ballast shoulder on the low side of the cant.

A maintenance tamp in cold weather can literally move a whole curve down hill as the rails contract and move a very small amount each time the tamper lifts the track. A curve in CWR that has moved inwards will have an SFT probably less than 21°C and therefore if un-noticed is a potential buckle site when the warm weather occurs.

A problem may occur with reballasting in winter, since the ballast on the low side of the cant will have little resistance and movement can occur during the first few cold nights, unless the Dynamic Track Stabiliser is used. RT/CE/S/011 states that monitoring is required where there is known to be a possibility of lateral movement. Factors are:-

- ◆ temperatures below 0°C
- ◆ track radius less than 600m
- ◆ cant 100mm or more

Monitoring, by checking the dimensions to alignment pegs or other markers, will be carried out at a frequency which will be agreed locally, depending on site conditions.

If the temperature is below 0°C then work on CWR should not be started if it is:

- ◆ within 90m of an adjustment switch
- ◆ on a stressed curve with a cant greater than 90mm.
- ◆ on a stressed sharp curve with a radius of 600 to 300m.

Maintenance work in track can be carried out down to -7°C provided the ballast is not frozen.

Arrangements for welding in cold weather may be found in RT/CE/S/032

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Jointed track having moved downhill, will have expansion gaps less than that required for a given rail temperature, again a buckle risk when warm weather occurs.

Special care should be taken with clearances to structures and OLE contact wire lateral dimensions if the track starts to bodily move down the hill.

Wind has a cooling effect on rails in a similar way as on the human body, in strong winds the rail temperature can be 6°C lower than air temperature.

6.2 RAIL FAILURES

When the rail contracts under cold conditions any tensile stress will find the weak spots or defects in the metal. The first very cold nights in late autumn or early winter when there is a large variation between day and night temperatures are usually when there is a spate of failures. The very low temperatures of late January or February, typically cause more failures.

When rail steel is notched or otherwise damaged, by say a blow from a bar and a sharp edge mark is left, this point will be very susceptible to breaking in cold weather.

6.3 JOINTS

Joints, especially insulated ones, are prone to cracking or failure in very cold weather. As the rail attempts to pull apart, the fishbolts can be put under load and may bend or break, if they hold then the fishplate itself may crack or break at any minor weakness. In cold weather a close watch should be kept on all insulated joints for signs of wide gaps, glue line failure and/or bolts bending, since these are the first indications of excessive tension in the joint. Ordinary jointed track should have 10mm gaps at the rail ends when the rail temperature is 0°C.

6.4 ADJUSTMENT SWITCHES

In cold weather adjustment switches will normally open up. If the rail temperature is between -4°C and +2°C the gap should be 125mm and the overlap 635mm. Full details of the precautions for adjustment switches will be found in Railtrack Line Specification RT/CE/S/011, and in the CEC booklets "Hot Weather Guidelines for Permanent Way and Creep in Jointed Track".

6.5 FROZEN BALLAST IN TRACK

RT/CE/S/011 quotes that tamping and lining may not be carried out if the rail temperature is less than -7°C . However it must be remembered that in winter the ballast in track usually contains water and this can freeze. Normally it will not be a problem unless sub zero temperatures last for some days. Freezing will commence at ground level then gradually go deeper; initially any bang on the surface will break the ice holding the ballast together, but when the frost has really set in the ballast becomes solid and even a tamper will not get its tines into the stone.

Whilst working in frozen ballast may not be possible in very cold, but not snowy weather, there is other work that can be done, e.g. fencing, tree lopping and felling, scrub and scrap clearance.



6.6 FREEZING OF BALLAST IN WAGONS

In very cold weather ballast can freeze in the wagons and fail to drop when the doors are opened, or the doors themselves can freeze solid.

This occurrence is especially likely when there has been rain or the ballast is wet, followed quickly by low temperatures. In winter the ballast will normally have some moisture on it and partial freezing may occur.

This situation is aggravated when a wind is blowing since this adds to the cooling effect and lowering of the temperature.

Previous remedies, such as the use of flame guns or de-icers are generally no longer allowed, for safety and environmental reasons.

One possible preventative measure is to use paraffin or oil lamps underneath the wagon at the stabling point, which may provide enough heat to stop freezing in the first instance. Another possibility is to stable the wagons under cover in, say, a plant depot. Prevention is the best answer; if there is a long cold spell then ballast should not be loaded until the last minute to minimise the risk of it freezing.

When unloading ballast in freezing conditions care should be taken that lumps of frozen ballast are not dropped and placed under the sleepers. If this happens then when it thaws there is a risk of settlement occurring.

In winter, ballast will usually have moisture on it so any period of low temperatures is likely to cause it to freeze in the wagon. A rain shower provides even more water to freeze the stones together.

6.7 FROST HEAVE

When water freezes it expands. If the formation contains silt sized soil and water, any prolonged low temperature may cause an ice lens to form and this swelling can cause top and/or twist problems. Clay soils which are wet can also have similar problems, freely draining sandy soils should be no problem. Wet spots, wet ash or peat can all freeze and therefore heave. A careful watch must be kept when the thaw starts since the melting of the ice lens may be only partial, especially if it freezes again at night. The thawing water may also seep into other places causing further problems.

Ballasted track on top of underbridges and shallow culverts is particularly prone to frost heave, since cooling will take place from both above and below and any water in the relatively thin layer of ballast will easily freeze since there is no insulating formation or soil below.

6.8 FLANGEWAYS

It is most important that flangeways are not allowed to become obstructed by ice or snow, this applies to the gaps between stock and switch rail, crossing nose and wings, check rails in S & C and plain line and also at any level or foot crossing. Particular problems can arise at a farm crossing with animals and/or vehicles dropping mud or muck which then freezes solid.

In heavy snow it is necessary to pay particular attention on plain line to the area inside the running edge. Snow can become compressed by the passage of trains and form into hard ice. If snow continues to fall then with the repeated action of traffic the wheels can ride up and over the rail head. This can be a particular problem where lightweight vehicles, such as Sprinters, are the only traffic. Staff must be kept on watch for this and sometimes cleaning of the flangeways is required to keep the gap at the running edge on plain line.

6.9 ICE ON RAILS

Whilst we normally think of water dripping from tunnel roofs or the underside of overbridge decks and forming icicles, it must be remembered that the water can fall onto the rail, freeze and build up as a lump, if big enough it could possibly cause a wheel to climb and derail.

6.10 TAMPING IN SNOW OR VERY COLD CONDITIONS

In winter, ballast in the track usually has some moisture in it and is therefore prone to freezing quite easily. Great care must be taken not to tamp if it is frozen since lumps can be reorientated and whilst the top may look good, the slightest thaw will cause havoc with top as the stones realign themselves.

Tamping with snow on the track will force lumps of snow into the ballast and whilst it may produce a good top and line, again as soon as it thaws, voids will occur and the top will deteriorate.

If tamping is essential but, for example a snow storm occurs in the middle of a rebalasting job, the work may have to continue, but a precautionary TSR (perhaps more severe than the one for the work) and a watchman might be required, so that any settlement that occurs during the thaw is safely monitored and controlled.



OFF TRACK PROBLEMS

7.1 ICICLES IN TUNNELS

N.B. Whilst this part is written as referring to tunnels, it also applies to those overbridges that have water drips from the underside of the deck or arch, as well as rock cutting faces.

Icicles can form in tunnels and cold air blowing through can lower the temperature even more. Icicles can cause severe damage to the front of a vehicle if they break off as it passes through the tunnel as well as the possibility of smashing the windscreen and the risk of injuring the driver.

Icicles in tunnels with OLE are a real danger. If an icicle gets too close to a live wire then the electricity may jump the air gap and go to earth, which can cause severe structural damage. Any icicles hanging close to a live wire must be immediately reported to the Electrical Control Office so that action can be taken. Local arrangements are made by the Infrastructure Contractor for icicle removal and the P.Way have a responsibility for reporting them in the same way as any other dangerous occurrence.

If there is sheeting in a tunnel then a careful watch should be kept that the ice does not build up behind and force it foul of structure gauge or the OLE. Similarly an air shaft may have water running down it and when it freezes may produce large quantities of ice, which could be highly dangerous if it was to fall. These forms of ice should be reported as soon as possible, so that appropriate staff can be called to deal with them.

7.2 CLIFF FACES

Cliff faces and cuttings are susceptible to slipping. If there is water in a crack then when it freezes it will expand and whilst it may not fall at that time because it is all frozen together, when the thaw comes it may slip bodily. Such faces should always be regularly checked during thaws and after frosts. In the late autumn a walk along the tops of cuttings may reveal cracks, perhaps due to a dry summer. These should be filled in to prevent water getting in and causing slips in the wet weather.

7.3 STRUCTURAL CLEARANCES

Many older station platforms, bridge abutments and wing walls have an outer skin of brick or stone but rubble fill within. Prolonged sub zero temperatures will cause the fill to freeze if there is any moisture in it, platforms and retaining walls may move and the former should have clearances regularly checked in such weather, since only a small movement can make a platform foul of a loco, etc. This situation is also likely to arise if weep holes are blocked.

7.4 DRAINAGE SYSTEM

Track drainage systems do not normally freeze since they are “kept warm” by the surrounding ground. However if there is prolonged sub zero weather then it is possible. More likely is freezing of slow flowing water when it comes out of a pipe; here there is a risk of the ice building up and blocking the water outlet, if it backs up then there may be more problems. Great care should be taken that catch pit covers are in place, whilst reducing heat loss it also reduces the risk of someone falling in, especially if there is snow on the ground.

Weep holes in bridge abutments, piers and retaining walls must be kept free of ice, if the water behind backs up then pressure will build up and can crack or spall off concrete or brickwork. The staff may need to drill out such holes to keep them free.

7.5 LINESIDE VEGETATION

Lineside vegetation can cause problems in snow, since the additional weight may bend the branches so far that they make contact with the OLE return wires, go foul of the structure gauge, or they may break and fall across the track.

General management of lineside vegetation should cover the normal situations but it is worth remembering that some species of trees and shrubs can be a particular problem in snow. Evergreens, such as cedars, have flat branches which can accumulate considerable quantities of snow until they suddenly break with possible disastrous results.

POINT HEATERS

8.1 GENERAL

Both gas and electric point heaters are fitted with thermostats which control the current supply. Exact temperatures of switching on and off vary according to the type and make of heater. A typical unit will switch on at 2°C, it then takes a while for the rail to reach 6°C when the thermostat switches off. This cycle then repeats as often and for as long as necessary whilst the temperature is low. With such temperature limits it is possible for snow to fall but the heaters do not switch on, although some manufacturers have snow sensing devices. A switch may be available in the local signalling centre to over-ride the thermostat in exceptional circumstances. A close watch must be kept that heaters are not left switched on unnecessarily, since the electrical power consumption is heavy and the resulting electricity bill can be large, gas installation may quickly run out of cylinders and the unit becomes useless.

Care should always be taken since switch heaters can become very hot and if touched with the bare hand can cause burns.

If switch heaters are on for a considerable time then the switch lubricant has a tendency to dry out and more frequent lubrication may be required. P. Way staff and patrollers should look out for loose or disconnected cables or damage to electrical switch heaters and report such faults. Gas installations should be checked for loose, damaged or crushed hoses and the bottles checked for being empty or full. During snow or heavy frost the patroller should check not only that the heater is working but that each pad or plug heater is working.

8.2 ELECTRICAL

Three types of electric point heaters are in use. The first is a type of pad which fits between the slide chair and the timber. It is a glass reinforced plastic encased electrical heating element. The second is a small heating cartridge which is inserted into a hole drilled into the slide chair. The third type is a strip element which clips to the stock and switch rails. All three types are connected to a 110V electrical supply, which comes from a trackside transformer.

8.3 GAS

Certain places still have gas switch heaters, normally supplied from LPG bottles. Gas burners are attached to the outside of the stock rail and provide heat to the rail. Again the operation of the heaters is controlled by a thermostat and manual over-ride may be provided on site. Gas switch heaters are normally maintained by special staff. The number of gas switch heaters should be decreasing, because of the safety and gas bottle handling problems. Wherever possible they should be replaced with electric heating.

In winter there should be 2 gas bottles in use and 2 spares secured in each cage. No bottles are permitted to be stored outside the cages.

Care must be taken in prolonged low temperatures that the gas supply does not run out and regular changing of bottles will be necessary.

LIAISON WITH LOCAL AUTHORITIES

9. LIAISON WITH LOCAL AUTHORITIES

The Maintenance Contractor should liaise with the local authorities to ensure that there is a clear understanding of how the road snow clearing operations can effect the railway and vice versa. Rail snow clearance will cause a mess for road users at any road level crossing; similarly if the road snowsweeper goes over a crossing it will make a mess of the track. In either case some manual snow clearing will probably be necessary. Most important is to check that the rail wheel flange gap is not obstructed by a build up of compacted snow or ice, which could lead to a wheel climb situation and a derailment. Certain level crossings have severe gradients, humps, etc. which may cause problems to the road snowplough and require special attention.

Road authorities use salt and grit to clear most roadways. If salt or salt laden surface water accumulates under the surface of the crossing then there is a great risk of corrosion of the steel rails. (See Item 12)

Some local authorities have snow blowers; these must not be allowed to blow snow either onto the track or into the vicinity of the OLE.

SNOWMEN

10. SNOWMEN

The engineering staff should carefully consider the implications on proposed work and the likelihood of snow. Having men on standby and doing absolutely nothing is unnecessary and uneconomical and should be resisted. Standing down snowmen can be a further problem and Contract Managers should keep careful watch on the weather and also listen to local weather forecasts and when necessary contact Railtrack or the Depot Manager (eg EWS) to reduce to a minimum the time men are kept on snow duties.

Many areas have a two or three stage system for snowmen, dependent on the frequency of snowstorms, e.g.:

1. **Level 1** for a light snowfall, puts a team of men together with a driver and a vehicle located at a specific place, such as a cabin with a telephone. This enables the control office to contact the team should any switch become a problem, they can then take the necessary action within a largish area.
2. **Level 2** for medium snowfall, the stand-by will be small teams of staff with or without vehicles to cover specific locations, such as major junctions to keep pre-determined routes open. This should be agreed previously with Railtrack (or other Operator)
3. **Level 3** will only apply during heavy and prolonged snow. Shifts will be changed to permit 24 hour cover and endeavour to keep some trains running on main routes.

Thought must be given to the welfare of staff who will be actually out in the snow or somewhere on standby. Fog huts, bothies, cabins and road vehicles all provide some form of protection from the elements, but the following must also be considered:

1. heating
2. cooking facilities
3. means of communication with the signalling centre and control

Some Areas even provide emergency rations in the form of self heating instant meals and soups.

WINTER ACTION PLAN

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11. WINTER ACTION PLAN

Prior to each winter Railtrack’s Contract Manager should meet and agree with the local Maintenance Contractor a Winter Weather Action Plan. This should lay down and document exactly what procedures are to be operated, by whom and when, so that there is no confusion when a sudden cold snap or snowstorm occurs. Such information should include details of who is responsible for all switch heaters (and if they are working), weather forecasts, call out procedures for frost and/or snowmen, priority of routes to be kept open in heavy snow, snowplough arrangements etc.

So that problems in winter due to frost or snow are minimised the following reminder programme can be used as a very rough guide.

MONTH	ACTION
August	Check and order supplies
September	Check that those switch heaters for which the company is responsible are working. This should be complete by the 1st October each year. Seek the assurance of the Electrification Engineer that all electrical heaters are in order. Agree Winter Weather Action Plan.
October	Check that supplies have been received Team Brief staff on the Action Plan, winter weather precautions and arrangements. Ensure that all road vehicles have adequate anti-freeze in radiators and that de-icer is issued.
November	Distribute supplies. Ensure that all gas bottles are in place.
November March	Check on the quantities of supplies being used and replace as necessary, this is essential after snow or long periods of very cold weather.
March April	Collect surplus supplies, etc., clean and store as necessary. Collect any gas bottles and return to the hire company to avoid loss or theft Review the effectiveness of the Action Plan, any other problems and/or lessons from the previous winter

N.B. Supplies include de-icing materials, spray units, brooms, shovels, scrapers, paint brushes, gas bottles, de-icer, diesel anti-freeze, radiator anti-freeze.

LEVEL CROSSINGS

12. LEVEL CROSSINGS

Rail corrosion in level crossings can be a major problem and one that is difficult to detect unless the crossing surface is lifted. Normally only the edges of the bottom flanges of the rail foot will be eaten away - it is doubtful if the usual ultrasonic rail examination will detect it, unless very severe. Every time a level crossing surface is removed for any reason the P. Way should inspect the rails for possible corrosion.

Various alternatives have been used or proposed in an attempt to prevent rail corrosion in level crossings:

Coat the rail with a grease, such as Tracklube. This obviously rubs off when the rail is moved and the Pandrol clips are knocked in, so is not 100% effective.

Arrange with the Local Authority to install slot type drains across the road on the high side of the crossing to stop salt laden water seeping into the crossing itself.

Arrange for the Local Authority to position drain gulleys close to the level crossing to reduce the flow of salty water in the gutters.

Arrange that the Local Authority do NOT spread salt in the vicinity of the level crossing.

Reballast and provide drainage at the level crossing to ensure any water can drain freely away.

Arrange for an inspection of each level crossing to a frequency laid down in the contract and change rails as necessary. This can often be combined with tamping through the crossing.

Periodical flushing of the crossing with a water jet, especially after it is known that the road authority have spread a lot of grit and salt during a cold spell; this is only wise if the ballast and drainage are good!

Use a rail of less corrosive steel or sacrificial cathode protection. This may have to be used where other alternatives do not work.

Each crossing will have its own particular circumstances so a selection of the options above may be required to reduce the problem. Consultation with the Local Authority is recommended since they have had severe problems with salt corrosion of concrete bridges and may have devised alternative procedures for a particular area.

DE-ICING MATERIALS AND CHEMICALS

13. DE-ICING MATERIALS AND CHEMICALS

The chemicals and materials approved for use on or near railway lines in snow and ice have minimum corrosive properties and electrical conductivity in comparison with other materials. They also have low, or no, toxicity, but COSHH assessments and safety data sheets should be referred to for any particular hazards. Improvements have been made in recent years, not only with de-icing compounds, but also in lubricants used in switches etc. Many of these are effective at temperatures below 0°C, thus reducing the requirement for de-icing. However, modern de-icing compounds are capable of melting ice and snow at temperatures down to -20°C and should therefore be suitable for use throughout Britain.

13.1 AREA OF APPLICATION AND MATERIAL

AREA	MATERIAL
Car Parks and Areas Away from Platforms and Track	Rock Salt Catalogue No. 7/058859
Road and Barrow Crossings	Kilfroast CIM Catalogue No. 7/25019
Platforms, Walkways, Footpaths, Footbridges and Level Crossings	Kilfroast GDF Catalogue No. 7/30014 Kilfroast CIM Catalogue No. 7/25019 Kilfroast IMP (DP139) Catalogue No. 7/140764
Lineside Signs	Kilfroast Anti-Icing Paste (KAIP) Catalogue No. 7/46041
Switches and Crossings	DP705 Catalogue No. 7/140765 Kilfroast Points De-Icing Lubricant Catalogue No. 27/540
Conductor Rails	Kilfroast Electrce 101 Catalogue No. 7/56094

Note: Where available, Catalogue numbers refer to the 25kg bag size supply, which can be readily handled.
The above products are available and approved at the time of printing, but your Stores might provide alternatives.

13.2 MATERIAL PROPERTIES

Rock Salt is extensively used on public roads, but it will damage concrete and corrode steel. Its use is therefore prohibited on the track, railway footbridges and other areas close to the track.

Kilfrosts CIM is a chloride-free, granular material and contains an anti-slip additive which is particularly resistant to being blown about by wind and passing trains. It has a low conductivity so as not to activate track circuits. If applied prior to freezing it can protect against freezing.

Kilfrosts GDF is a rapid and effective spray-applied de-icing fluid.

Kilfrosts IMP (DP139) is a chloride-free granular solid, less resistant to wind and, because the granules are spherical, can be more slippery than Kilfrosts CIM.

Kilfrosts Anti-Icing Paste is an oil free, water soluble paste.

Kilfrosts Electric 101 is oil based and does not melt ice and snow but forms a non-stick barrier which prevents ice and snow from bonding on to the crown of the rail.

DP705 is a general purpose de-icer formed from a glycol and water mixture. Glycol is an effective anti-freeze, but because it is soluble in water it is easily washed away in heavy rain or snow.

Kilfrosts Points De-Icing Lubricant is a smooth flowing, viscous liquid, which prevents freezing and ice build-up.

13.3 APPLICATION

In all cases, reference must be made to the manufacturer's or supplier's instructions for application of the de-icing agent. The correct type of applicator must be used and the material applied at the recommended rate. The manufacturer, or supplier should be contacted via Procurement if there are problems with any material, or if further advice is required.

CLEARING PROBLEM AREAS

14.1 SWITCHES & CROSSINGS

Flame guns should no longer be used in switches because of the risk of damage to plastic components, signal cables etc. as well as the safety risk of using the guns.

Any loose snow or ice should be swept away and then DP705 sprayed between the switch and stock rails and the flangeways between the crossing vee and the wings and the check rail protecting the crossing nose. After about ten minutes the snow should have melted and a further application is required to re-wet the area. A daily application might be necessary in a long freezing spell to prevent re-freezing.

De-icers are not lubricants and grease should be applied where appropriate, to facilitate switch movement. The use of a grease or lubricant known to perform at low temperatures will ensure that switch movement is maintained as long as possible in ice and snow and reduce the requirement to apply de-icer.

A points de-icing lubricant (Kilfrost De-Icing Lubricant, Catalogue No. 27/450) is available. This is a smooth-flowing, viscous liquid which prevents freezing and ice build-up on switches and slide chairs.

14.2 POINT RODDING

The Maintenance Contractor is responsible for the clearance of snow and ice from point rodding. After sweeping away as much loose snow as possible DP705 should be applied.

14.3 LINESIDE SIGNS : SPEED BOARDS ETC.

The Maintenance Contractor has the responsibility of keeping all speed restriction boards clear of snow and ice. KAIP (a de-icing gel) should be painted on the surfaces, preferably before the onset of snow, to provide a protective film. If the surface is already snow covered it should be brushed off first and then the gel applied.

14.4 PLATFORMS, WALKWAYS, FOOTPATHS & FOOTBRIDGES

The Maintenance Contractor should use one of the Kilfroast products (or similar) listed previously. GDF is primarily intended for de-icing purposes only and will quickly melt frost, ice and snow to leave a non-slip surface. Anti-icing performance with GDF is limited.

CIM is initially slower acting than GDF but is effective for longer. If applied prior to freezing it can protect surfaces against moderate frost for many hours, making it particularly suitable for unstaffed locations.

IMP (DP139) is similar to CIM but is dustier and does not have its anti-slip properties.

In all cases, heavy accumulations of snow and ice should be removed prior to applying the de-icing compound which will then remove any ice bonded to the surface.

Care must be taken when applying these materials onto a frozen surface because they soon start to melt ice, forming water. The effect of this water lying on top of ice can be a very slippery surface. If the initial application of de-icer is insufficient to completely melt the ice, refreezing will produce a smooth and more dangerous surface than before. Thus re-application of the de-icer must be made as necessary.

14.5 ROADS, CAR PARKS AND PATHS AWAY FROM THE TRACK

Rock salt may be used here but not where it might be carried by tyres or feet onto the track, platform or any steel or concrete bridge over the railway. Salt should not be used if a thaw will bring the salt into these areas.

14.6 LEVEL CROSSINGS

Kilfroast GDF, CIM or IMP (DP139) should be used after removing excess snow (the chemical then works directly on the compacted snow or ice, rather than that which is loose). Rock salt must not be used on level crossings because it seeps under the crossing units and corrodes the rail foot.

SAFETY

15. SAFETY

Falling snow and sleet reduce visibility and hence sighting distances. Cold reduces a person's efficiency and therefore great care must be taken if it is necessary to work on the track under such conditions.

A safe system of work **MUST** be established.
IF IT IS NOT SAFE THEN DO NOT WORK.

Walking in frosty conditions adds to the hazards of being on the track. Great care should be taken to avoid treading on smooth surfaces such as sleepers, cable trough lids or catchpit covers. The latter two items can be particularly hazardous if slightly displaced and covered by a thin layer of snow. Walking in snow should be done at a slow steady pace to minimise injury if such a mishap should occur.

A warning has already been given in Item 5.7 about the restriction to hearing and seeing by wearing hoods.



SNOWPLOUGHS AND BLOWERS

16. SNOWPLOUGHS AND BLOWERS

When snow blocks the line, either because of a heavy fall or because of drifting, it is the responsibility of the Infrastructure Contractor to clear it. Until this has been done he has control of the line and must hand it back as would be done after a T II or T III possession. Small drifts may be cleared by hand but larger ones or a major snowstorm may require the use of snowploughs or blowers. Full details for the suspension of running of traffic and the use of snowploughs/blowers are given in Section W of the Rule Book. In summary, trains will be stopped if the snow is more than 150mm above top of rails (Sprinter services will have terminated sooner), although those fitted with miniature snow ploughs will run with up to 300mm of snow above rail level.

Independent snow ploughs have moveable side flaps, spade plates and skids which must be retracted when running to and from site and in certain other locations, e.g. platforms, level crossings, centre girder bridges, AWSs, AVIs. Railtrack (or the Infrastructure Controller) is responsible for defining such locations.

The speed of ploughing is not permitted to exceed 50mph, but slower speeds will be more normal. Where deep drifts exist the plough may need to take a number of runs to clear the site. When ploughing is in progress the adjacent line will usually be blocked to rail traffic unless it is known that all clearing will be done to the cess side.

After the passage of a snowplough/blower a check should be made at:

- 1) level crossings
- 2) continuous check rails
- 3) all switches and crossings

to ensure that compacted snow or ice has not filled any flangeway gap, or otherwise caused further problems.

When a snowplough or blower is taken through a tunnel it should be done initially at slow speed since any icicles that may be hanging from the roof will be broken off with some violence and can do damage to the loco windscreen, etc.

ROAD VEHICLES

17. ROAD VEHICLES

Every road vehicle should be checked for radiator anti-freeze prior to winter to ensure that the concentration is adequate; this will normally be undertaken by the servicing agent. Whenever a driver has to top up a radiator in winter anti-freeze must be added to the water in the correct proportion to ensure that protection is maintained. Great care must be taken not to spill anti-freeze on any paint or metal work - it is corrosive and a very effective paint stripper.

Windscreen de-icer is a commercial product and must be used in accordance with the instructions on the container. It is helpful if the de-icer is kept in a warm environment overnight, such as the driver's bag, then it is warm when first applied and will help the thawing process.

Only commercially available windscreen washer fluid should be used to reduce the freezing point, unauthorised additives must not be used. Pouring hot water over the screen is very risky since the sudden thermal shock may crack the glass.

Windsreen de-icer and washer fluid might be stock items in your company material stores.

Diesel will start to coagulate at about -11°C and causes blockages in the jets. Where very low temperatures are likely then there is an additive available to reduce this problem.

Whilst it is not always possible to keep a vehicle under cover at night, it does help to park a vehicle with its radiator close to a wall, which reduces the wind cooling effect and can prevent any snow blowing into the radiator. Covering the windscreen at night will also help prevent frosting.

SNOW FENCES

18. SNOW FENCES

In certain locations which regularly suffer from snow it is worth recommending to Railtrack the installation of snow fences to prevent snow drifting onto the tracks. Critical locations are where there are gaps or variations in height of hedges or walls or a valley which acts as a funnel for the snow when the wind blows and permits it to settle in deep drifts.

Snow fences at trackside have been tried with varying degrees of success: the fence needs to be the equivalent of five times its own height from the track to provide an area of still air in which the snow will settle. This dimension may not always be practical if the railway boundary is close to the track.

Chestnut paling or plastic netting fences will catch the snow but need to be firmly anchored to take the additional loading of snow and wind.

SALT

19. SALT

The use of salt on the railway is strictly limited, since it has a very damaging effect on both concrete and steel (and most other metals). To some extent concrete is porous and when salt dissolves in water it enters the concrete. It will then chemically attack the steel reinforcement and corrosion will take place. The resulting chemicals expand and the concrete will spall and crack with possible disastrous weakening of the structure. Many road and foot bridges of concrete have suffered this problem, both on the road and the railway; the cost of repairs or demolition and reconstruction has been very high.

Salt when in solution in water becomes an excellent conductor of electricity and can seriously effect track circuits. In a number of locations salt spillage from wagons has polluted the ballast and when wetted by rain has caused a serious problem; in some places ballast cleaning has been necessary.

Any form of concrete can be affected, even platform paving slabs. The only relatively safe place to use salt is on walkways that are tarmac or gravel, but even then thought must be given if the site is adjacent to a steel or concrete surface, such as a footbridge when boots and shoes or water run off may cause transfer of the salt.

FLOODING AFTER THE THAW

20. FLOODING AFTER THE THAW

When snow thaws it turns back into water; one foot of snow is the equivalent of one inch of rainfall. Minor amounts will probably soak away into the ground or go into track drains without problems. However major flooding can arise if the thaw is very rapid or it rains on the snow.

Run off from adjacent land can be a major problem, since many hedges have been removed in recent years and the drainage ditches filled in. The result is a large area of land which may drain into a single ditch or accumulate until it pours over the top of a cutting. It may then carry topsoil with it or even wash down the bank slope.

Bridges at risk from scour will be known and local instructions will be laid down for dealing with possible flood situations.



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