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**ROAD DIRECTORATE  
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**Public Company  
"REPUBLIC OF SRPSKA ROADS"  
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# GUIDELINES FOR ROAD DESIGN, CONSTRUCTION, MAINTENANCE AND SUPERVISION

## VOLUME III: ROAD MAINTENANCE

### SECTION 3: WINTER SERVICE

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### 3.3.1 GENERAL

Winter maintenance is the largest and most costly part of the routine maintenance of state roads. It involves a number of activities, works and tasks that are indispensable to maintain the roads in a passable condition and to ensure that the traffic proceeds appropriately safely given the winter circumstances.

The work consists of winter maintenance of public roads: ploughing of snow and slush, salting the carriageway due to snowfall and ice, pavement maintenance, installation and maintenance of snow posts, snow fences, and auxiliary traffic signs.

As a rule, the winter period lasts from November 15 of the current year to March 15 of the next year, but this also depends on weather conditions. To maintain public roads in winter is to ensure they are passable and sufficiently safe for traffic. To ensure successful winter maintenance, we must plan and prepare for the winter maintenance work in advance.

Concerning the winter service we suggest that the client, who orders these services, plays a greater role. This is, however, conditioned by adequate equipment, particularly by the weather stations in connection with the meteorological services. In this way, the costs of orderly duty would be significantly decreased, as the workers would be in the state of readiness at home (the costs would be lower by up to 85%) and would be ordered to the duty essentially later. By different rates of readiness (up to 3), the required number of labour and machinery for individual actions can be better and cheaper adjusted in view of the intensity and quantity of precipitations.

In case the contractor decides (and is responsible as well) by himself upon the commencement and frequency of performing the works within the winter service, the costs are significantly higher (up to 1/3, as the experiences show), not even mentioning the consumption of strewing materials and unnecessary charging the environment.

The contractor are requested to adjust themselves to the up-to-date trends relating to the equipment and human qualifications. Namely, a state-of-the-art equipment for the needs of the winter service essentially reduces the time and material consumption, and the control of the consumption of these materials is simpler, provided that these machines are equipped with the up-to-date technology (automatic recording of strewing followed by subsequent transfer into a computer of the accounting and supervising), provision of GPS to monitor the time and distance (in the meantime, it is therefore difficult or even impossible to perform services for other clients as well).

For the execution of the winter service works it is very important to educate the labour on correct strewing, on strewing materials, etc. Moreover, for the operative execution of the winter service, a meeting with all the contractors, police, and the client is necessary. After the termination of the winter service, a meeting shall be organized with the same participants to analyse the performance of the winter service, and, on the basis of fresh ideas, to write down measures required for the elimination of mistakes in the consecutive winter.

Prior to each winter season, the winter service mechanization shall be inspected and taken over. In particular, the condition of strewing machines shall be checked. These machines shall have certificates on the executed calibration of strewing. Such a calibration is required for at least ½ of all the registered strewing machines in each season, and for all the machines that have been damaged.

A few terms and definitions:

A **road maintenance unit** is a part of the routine road maintenance company in charge of a definite area of roads of a certain type (up to 220 km of roads).

A **road maintenance depot** consists of buildings and areas used for road maintenance.

**Density of spreading** (Streudichte) is the amount of spreading material per unit of spread area.

**Round-trip time** is the amount of time spent ploughing or spreading the road section defined in the operational plan. This includes the time to return to the starting position.

A **ploughing unit** is a system consisting of at least one truck with a driver and a ploughing attachment.

A **ploughing group** is a system of several trucks with drivers and ploughing attachments, capable of ploughing a carriageway in a single pass.

A **spreading unit** is a system of at least one truck with a driver and a spreading attachment.

A **spreading group** is a system of several trucks with drivers and spreading attachments, capable of salting or sanding a carriageway in a single pass.

**Deicing material** (auftauendes Streumittel, Auftaumittel) is the material used to prevent or reduce ice on the carriageways and make them less slippery in wintertime.

**Priority class** is the winter maintenance priority level on a scale of I to IV. Lower numbers have higher priority.

A **snow fence (palisade)** is a barrier used to reduce windspeed and thus causes the snow to be deposited on a desired location.

The **snow fence covering level** is the ratio of the covered areas to the entire area of the snow fence.

**Winter mechanization** consists of vehicles, machines, attachments and other used in winter maintenance of roads.

**Winter maintenance (service)** (Winterdienst) is a term covering all measures and work activities needed to maintain roads during winter and ensure the safety of traffic thereon; this includes:

- work before the winter service begins, and after it ends,
- monitoring and reporting the road conditions,
- salting and sanding of carriageways in
- snow clearing.

**Winter traffic signs** and road furniture consists of signs and furniture needed for the winter maintenance service.

**Winter conditions** are worsened driving conditions on roads caused by winter phenomena (snowing, ice on the road or on tree branches, cold, wind, etc.).

**Ice** is the smooth, slippery cover of the carriageway, caused by winter weather phenomena. The following forms of ice may be distinguished based on the formation process:

**Compacted snow** is ice formed by snow compacting on the pavement, by the freezing of vehicle-trodden snow, or the freezing of slush and the remains of snow.

**Hoar frost** is ice formed when moisture from the air freezes upon contact with the pavement.

**Black ice** is formed by the freezing of water and moisture on the pavement.

**Ice layer** is a homogeneous layer of ice that forms on the carriageway due to freezing rain or due to rain falling on the freezing-temperature pavement, due to the

freezing of water from melting snow, or other water reaching the carriageway surface (from access roads, berms, slopes and trench ploughs).

A **snow drift** is formed by wind carrying dry snow which then accumulates in locations where wind speed decreases (hedges, fences, cuts and slopes, embankment edges, buildings, noise fencing, etc.).

An **avalanche** appears if a large amount of snow suddenly slides onto the road from a nearby steep slope. The snow may be partly mixed with gravel and vegetation from the hillside.

### 3.3.2 WINTER SERVICE ORGANIZATION

According to the Regulation, the winter maintenance service lasts from November 15 of the current year to March 15 of the following year, or in compliance with actual weather conditions. The winter maintenance of the roads ensures their passability and adequate traffic safety. To avoid any failure, the winter service shall be planned in advance in due course.

Preparations for the winter service are carried out in accordance with the prepared Winter Maintenance Operational Plan (WMOP).

In spring, when the winter season and associated activities are over, a thorough analysis of the winter service for the past winter shall be made. Such an analysis represents a basis for the preparation of programmes of winter service activities for the subsequent season.

Already in the summer, one shall commence to elaborate the WMOP on the basis of the existing information from the past winters, as well as of the data on available capacities and materials.

The road manager shall make appropriate winter service contracts with authorized and qualified contractors.

The winter service shall be organized through the winter locations of maintenance. At these locations, labour, vehicles, mechanization, materials, and other equipment are situated.

The Road Directorate prepares the WMOP, by which the following is regulated:

- order the preparation of a Winter Maintenance Operational Plan,
- defines the special conditions regarding the operation of the winter maintenance (special statements on equipment, materials, depots, preventive actions, education),
- defines the standby schedule of all agents involved in winter maintenance,
- special requirements regarding the performance of various activities,
- ways of informing the public about road condition and passability,
- orders the preparation of an analysis of the winter maintenance service,
- orders the inspection of roads at the end of winter service, with a view to identifying damage and proposing plans to repair the damage.

These instructions are a part of the Winter Maintenance Operational Plan.

Winter service contractors are bound by the Operational Plan once it has been accepted.

Snow clearing and road spreading on a particular road network maintenance area (e.g. the area of a single road maintenance depot) are above all the responsibility of the head of the depot (i.e. of a road maintenance unit). He or she must ensure a maximally efficient performance of winter service tasks given the available staff, machines, and other equipment. The head must above all ensure that the team is ready to begin winter maintenance at the beginning of winter, and that the work proceeds efficiently throughout the winter. The service head must coordinate the winter service's activities with his/her superiors to avoid mismatches in road maintenance timing or technical

issues, especially along the borders with other road maintenance depots. The machines and the technical staff must be used in a rational and economical manner.

### 3.3.1.1 Preliminary activities

In the summer, work begins on the preparation of the Winter Maintenance Operational Plan (WMOP), based on the available information from previous winters and the information about available and required facilities, materials, and equipment. The contractors prepare their winter service operation plans and submit them to the road maintainer's winter maintenance experts for examination and confirmation at least 30 days before the beginning of the winter season.

Preliminary activities generally run from October 1 to November 15 of the current year and consist of the following:

- preparation of the winter maintenance operational plan;
- installation of winter traffic signs;
- installation of winter road furniture;
- preparation of stores of salting and spreading material;
- getting the road maintenance depots ready for the needs of winter maintenance;
- preparation of winter mechanized equipment;
- issuing preliminary information to the public.

Before the road administrator confirms the proposed WMOP, the winter service contractor must hold a meeting with the concerned state and communal bodies.

Such meetings may also include winter service contractors of adjacent areas, as well as representatives of companies affected by the winter service (bus companies, skiing resorts, etc.).

During these meetings, the participants may provide their opinions and comments on improving the execution and coordination of winter maintenance.

After informing all the concerned bodies and companies, forwards the WMOP, along with their comments and opinions, to the road administrator.

### 3.3.1.2 Winter Maintenance Operational Plan

The **Winter Maintenance Operational Plan** is the basic document for the operation of winter maintenance.

It is prepared by the winter service contractor for each maintenance area; the road administrator's experts must then examine and coordinate these plans. The Winter Maintenance Operational Plan must be very detailed, and contain at least the following information:

- organization chart of the winter service management, as well as the competencies and responsibilities of the winter service contractors,
- preliminary activities, as well as activities to be performed after the winter is over,
- a plan of the road network with labels indicating winter service priority classes and the winter maintenance starting points,
- a standby schedule, presence requirements, levels of readiness, and the assignment of work to individual teams,
- plans of salting, spreading, and snow clearing,
- the schema of the data to be exchanged on the subject of road condition and passability,
- the assignment of machines and other equipment, spreading material, and staff to the individual planned tasks,



- preventive servicing of all necessary winter maintenance machinery and equipment,
- professional training and education of the maintainers and professional staff,
- marking the roads with suitable traffic signs and furniture (warning signs), installation of snow posts, snow fences and auxiliary traffic signs,
- ensure the stores contain sufficient amounts of spreading material,
- locations and means of removing certain kinds of vehicles from the traffic in case of unfavourable road conditions,
- important telephone numbers,
- organizational conditions in case of extreme weather situations,
- informing the public.

The operational plan must contain graphic representations of the road network showing the planned measures. These drawings must also indicate the coordination and prioritization of the activities.

Based on previous experience, the operational plan must also define the approximate amount of spreading materials needed to prevent ice on the roads.

The supplement shows an example of the contents of the Winter Maintenance Operational Plan.

### 3.3.1.3 Preparatory activities

The preparatory activities, usually carried out in October, consist above all of:

- preparing the stores of spreading material on critical sections of roads, as well as in road maintenance depots,
- installation of snow fences,
- installation of snow posts,
- installation of auxiliary traffic signs ("winter" traffic signs), and
- work on the preparation of the plan and on training the staff.

The autumn preparation for the winter service should conclude by ensuring that:

- the available mechanized equipment is ready for winter service; this includes documentation pertaining to the calibration of the spreading units, provided by the authorized service shop,
- the staff are ready and have the additional knowledge necessary for winter service,
- sufficient space for the storage of spreading material is available,
- sufficient amounts of spreading material (sodium and magnesium chloride, crushed stone) are available,
- the roads and their surroundings are ready for winter conditions and winter maintenance (installation of snow posts, auxiliary traffic signs, snow fences, etc.).

### 3.3.1.4 READINESS CHARGES, COMPENSATION, AND DEPRECIATION

**The readiness charge** is the compensation for a vehicle needed for winter maintenance and equipped with an automated salt/sand spreader (attached throughout the winter service season), which means that the vehicle cannot be used for any other tasks (e.g. on a construction site). This is only charged for vehicles assigned to level-1 readiness, i.e. usually one vehicle per road maintenance depot (for trunk roads) or winter maintenance point (for regional roads). The charge is based on an hourly rate (fixed for each particular vehicle), multiplied by 140 hours per month. All the effective hours actually worked during a particular month are of course deducted from that amount. An effective hour rate consists of a fixed cost and a variable cost for each vehicle. The readiness charge is

usually also allowed for machines needed for the smooth operation of winter maintenance, particularly excavators and loaders used to prepare and load the salt or spreading mixture. The number of hours included in the readiness charge depends on the agreement, with recommended values being around 20 hours per month. The charge is computed in the same way as for vehicles (with deduction of effective hours). One excavator or loader is allowed per road winter point or depot.

**Compensation** is a sum covering all the vehicles needed during winter maintenance according to the winter maintenance plan (level-3 readiness). This is essentially a charge allowed to the winter maintenance contractor in exchange for providing, at the required time, the number of vehicles called for by the winter maintenance plan, and for fitting out these vehicles with the requisite equipment. This requires the contractor to reassign vehicles from other activities (e.g. construction sites) to winter service, attach ploughs and spreaders, and later send the vehicles back after the winter maintenance work is done. At the same time, the compensation acts as a guarantee that the contractor will provide vehicles to our road administration and not to some other customer.

The compensation is calculated as follows: take the total number of effective hours of all the vehicles of this contractor during the last winter season; subtract all vehicles assigned to level-1 readiness. The remaining hours are divided by 4x140 hours (because the winter service lasts 4 months). The result is the allowed monthly number of compensations. This is not the same as the number of vehicles in level-3 readiness.

**Depreciation:** In the context of winter service, depreciation usually applies to the attachments, machines and equipment used exclusively for winter maintenance. In particular, this includes snow cutters (which may be self-propelled or not), snow blowers, salt silos, MgCl<sub>2</sub> and CaCl<sub>2</sub> tanks, etc. The problem here is that we cannot tell in advance how many hours we will need this specialized equipment for during any particular winter season; thus it is impossible to include the depreciation in the definition of the hourly rate. Usually these machines are also very expensive (e.g. self-propelled snow cutters). Thus the usual agreement is to define the length of the depreciation period of such machines and then pay fixed annual depreciation costs. After the depreciation period is over, the customer (i.e. the road administration) may require the contractor to provide a new machine, or (more usually) if the machine is still in good condition it may be kept in use (the principle of economy), and only direct costs of repairs are paid from that point on. Depreciation periods for ploughs, spreaders, and millers may be to 3, 7, 10, or 14 years, depending on the agreement between the road administration and the contractor.

The levels of readiness (readiness phases) of staff and the mechanized equipment (quantities are based on a single road maintenance depot or winter maintenance point):

Level 1: equipment – 1 vehicle in readiness at the depot (a plough and a spreader are constantly attached to the vehicle; if unexpected needs arise, the vehicle can be immediately dispatched to intervene and begin taking action), excavator or loader ready at the depot.

staff – 1 driver on standby at the depot; this work can also be done a machine operator and a road worker, who can immediately join an activity during their working hours, while outside working hours they are waiting at home and are ready at short notice (15 % of the regular hourly rate).

Level 2: equipment– a second vehicle in readiness is added (fitted out the same as the vehicle mentioned in the first degree description),

staff – the machine operator and the road worker who would otherwise wait at home outside regular working hours now remain on standby at the depot, while a second machine operator and a second road worker wait in readiness at home.

Level 3: in this phase, all available mechanized equipment and staff required by the Winter Maintenance Operational Plan are ready and waiting at their posts. Usually this point is also the beginning of the action.

#### Experience-based standards:

The number of maintenance depots is usually already fixed, as the system of depots is already in existence and it would be too expensive to move them around solely for the sake of rationalizing the operational paths. However, the general principle is that each depot should handle 100-200 km of roads. Regarding the number of vehicles needed for level-3 readiness, experience shows that one ploughing or spreading unit is needed per 25 km of two-lane road. Of course the actual numbers must also take the terrain into account.

Winter compensation is paid for vehicles and machines that are included in the winter maintenance operational plan but are not in use all the time. This compensation is a kind of "booking fee" for vehicles and machines that are used for other tasks but must when needed be available for the winter service.

Winter compensation is also paid for an excavator stationed at a winter maintenance point and used for preparing the spreading mixture and loading the spreading material in cases when other arrangements have not been made (e.g. silos and conveyor belts).

The winter compensation is paid as a fixed monthly amount for each vehicle.

### **3.3.1.5 STANDBY SCHEDULE AND READINESS**

Three levels of readiness are defined; the level depends on the expected weather conditions. Level-1 readiness is permanent, independent of weather conditions, and lasts 24 hours per day. It begins and ends on dates defined by the road administrator or by the road maintenance regulations, i.e. from November 15 of the current year to March 15 of the next year. Level-2 and level-3 readiness depend on weather conditions and must be ordered in writing.

The readiness levels are as follows:

#### Readiness Level 1

On all road maintenance units, a standby worker must be present at all times, 24 hours a day (minus 8 for regular working hours). This worker inspects roads and controls their passability, as well as addressing any minor problems and doing any necessary salting work in places where ice might form on the pavement. One standby worker can handle from 80 to 120 km of roads.

Usually this worker is a driver and is assigned to a truck with a spreading attachment and a front plough.

The standby worker constantly monitors the pavement conditions, particularly in critical sections that are known from previous experience (but must also be listed in the WMOP). This includes sharp bends, steep slopes, bridges, shaded areas, road-railway crossings, road intersections, etc.

Level-1 readiness billing: driver 720 hrs – 176 (regular working hours) = 544 hrs/month (this calculation uses the average number of days in a month – actual billing should be based on the actual number of days)

Generally, a machine operator familiar with the spreading material loader should also be in readiness at home during the afternoons, weekends and holidays, and at night.

If extraordinary conditions develop (snow shower, unexpected road ice, etc.), the team that had been waiting in readiness at home also joins the work (as spreading or ploughing units).

In the mornings, the winter maintenance contractor's staff are at their regular working places and are working on routine annual maintenance tasks when they are not involved in winter maintenance activities.

**Note:**

During the times when no intensive snow clearing, salt spreading, and other winter maintenance activities are in progress, the winter service is supplemented by any urgent routine road maintenance tasks that can be performed (or which it is perhaps even recommended to perform) during winter (lopping roadside vegetation, cleaning traffic signs, etc.).

Routine maintenance activities that must be performed during winter are important for the preservation of roads and of the environment, and to maintain the orderly appearance of roads. Some of these tasks, such as pruning of vegetation, excavation of alluvia from ditches (unless the ground is frozen), etc., are in fact best performed in wintertime when the vegetation is dormant and the ground lightly frozen. These tasks are carried out during regular working hours in periods of level-1 readiness.

**Readiness Level 2**

The winter maintenance service enters level-2 readiness when the weather forecasts indicate that weather conditions may deteriorate, or when ordered by the road administrator's standby service. At that point, additional teams waiting in readiness at home are activated besides the regular standby worker. Depending on the weather forecast, teams working their regular working hours may also be involved, especially on critical points.

Level-2 readiness costs are calculated based on the number of hours actually worked.

**Readiness Level 3**

When it begins to snow and more snowfall is forecast, an appropriate number of teams and mechanized equipment is activated; in case of heavy snowfall, this means all the teams and equipment allocated for such work in the operational plan. According to the operational plan, additional teams and equipment (which are otherwise employed on routine maintenance work) are also in readiness and become involved as soon as necessary.

**3.3.1.6 WINTER INSPECTIONS**

The main purpose of winter inspections is to observe the pavement and detect presence of ice. These inspections are carried out from 3 to 5 AM during the winter service season, or as needed during the pre-winter and post-winter transitional period (depending on the weather conditions).

The winter inspections are performed daily. In dry weather, a pickup truck is used, its loading platform laden with spreading materials in addition to the equipment needed for ordinary inspection work.

During periods of changeable weather, a truck with a spreading attachment is used.

During such inspections, any problems that could endanger the traffic safety should also be addressed (protection of dangerous locations, removal of rocks, etc.).

Winter inspections may also be carried out at the explicit request of the police if they report that ice has formed on a particular section of a road.

**3.3.3 INSTALLATION OF WINTER MAINTENANCE FURNITURE AND SIGNS**

Snow posts, winter traffic signs, and snow fences are installed in the period before the start of the winter service.

**Traffic signs**

Winter conditions on the roads require the drivers to have more information about traffic conditions than during summertime. Thus, additional traffic signs are needed, as provided for by the winter maintenance operational plan. The winter maintenance contractor must install such additional signs before the commencement of the winter conditions. Winter

traffic signs that inform road users about road conditions must agree with the actual conditions on the road.

### Snow posts

Snow posts must be set up during winter to mark the width of the carriageway and the direction of the road. They should be painted with yellow and red stripes 33 cm wide. The distance between the snow posts depends on the conditions but should not exceed 50 m. In bends and in areas where fog is common the distance between the snow posts should be no more than 25 m. The snow posts must be placed so as to allow the snow plough to clear snow as far as the base of the post without exceeding the ploughing surface or hitting any barrier. They are placed next to delineator posts but slightly closer to the road. If a snow post is located outside the curb, a red horizontal shingle should be attached to the top of the post. Snow posts must also be used to clearly mark locations where there is a danger of vehicles skidding off the road, as well as locations such as avoidance points, curbs, fences etc. In areas where snow drifts or high amounts of snowfall are expected, the snow posts should be taller than the expected depth of the snow cover.

The snow posts may be made of wood or of some other suitable material. If wooden, the lower end must be pointed and protected by a protective coating.

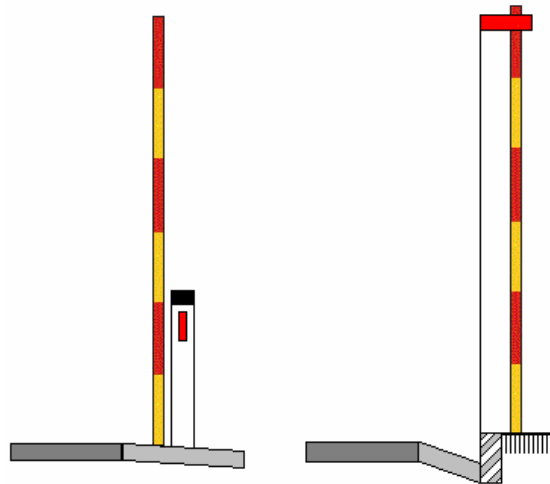


Figure: Placement of snow posts.

### Snow fences

In some locations, wind may cause snow drifts during snowfall. To prevent snow drifts from forming on the carriageway, snow fences should be installed to reduce the wind speed. A snow fence must be located far enough from the road to prevent the snow that accumulates before or after the barrier from reaching the road. Snow fences can be temporary or permanent.

- Permanent snow fences

Permanent snow fences may be set up in areas where snow drifts are common and where suitable real estate can be obtained. Such snow fences are effectively plantations of appropriate shrubs or trees. Tests must be conducted beforehand to ascertain a good location of the plantation.

- Temporary snow fences

Temporary snow fences must be installed in suitable locations before the winter and removed after the winter. These snow fences are barriers that reduce the wind speed and cause snow to accumulate before and after the barrier but without reaching the road.

If snow fences allow some passage of air, the snow drift on both sides of the barrier is longer, extending approx. 5 times the fence height before the barrier and 8-10 times the fence height after the barrier.

If the snow fence blocks air flow completely, the drift extends 10 times the fence height before the barrier and 15 times the fence height after the barrier.

In the case of a snow fence where half of the area is covered, the required distance is 12-15 times the fence height.

Such snow fences can be made of various materials (wood, wire, ropes, cloth, etc.).

#### Snow fence coefficients

|                    |      |      |      |      |      |
|--------------------|------|------|------|------|------|
| Degree of covering | 0,3  | 0,4  | 0,5  | 0,6  | 0,7  |
| Coefficient (c)    | 0,74 | 0,86 | 1,00 | 1,14 | 1,29 |

- Snow fence placement

For each road section where snow drifts occur, the plan must define the direction of snow fence placement depending on the prevailing wind direction (or several directions if winds from several directions are common). The snow fence works best if placed at 90 degrees to the wind direction; it works well if the angle between the snow fence and the wind direction is at least 60 degrees. In case of winds blowing from several directions, a stair-shaped snow fence is recommended.

It is important to place snow fences far enough from the road, thereby preventing the snow accumulating along the snow fence from reaching the carriageway.

The distance of the snow fence from the carriageway depends on the wind speed and the amount of snow, as well as on the terrain configuration and the efficiency of the snow fence. The distance of the snow fence from the carriageway protected by this snow fence should be 5 m greater than the length of the snow drift behind the snow fence. The snow fences used should permit partial passage of air.

In adverse snow conditions a single row of snow fences may be insufficient to deposit all the snow carried by the wind. In this case higher snow fences should be used, and two or more rows of snow fences should be installed. The distance between the rows should be at least ten times the snow fence height, and the distance from the last row to the road should be fifteen times the fence height. Individual rows should not be longer than 80-100 m. If there are several rows, they should stagger by at least 10 m.

The following methods should be used to evaluate the effectiveness of the snow fences:

- at the end of the wind season, photos of the snow along the snow fences should be taken,
- observing and measuring the snow drifts (geodetic measurements).

Figure: Snow fence placement if wind blows at an oblique angle to the road.

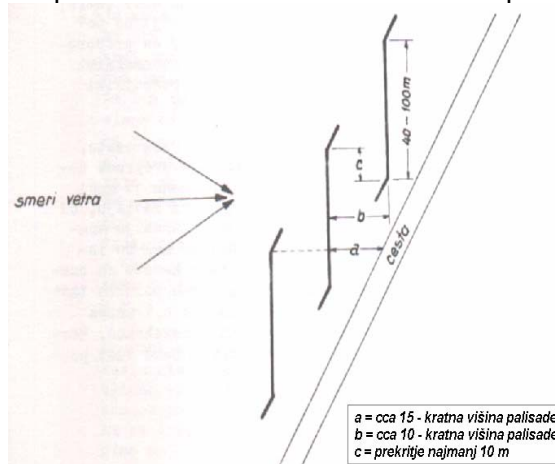


Figure: A double row of snow fences with a lot of space before the road; wind direction is orthogonal to the road.

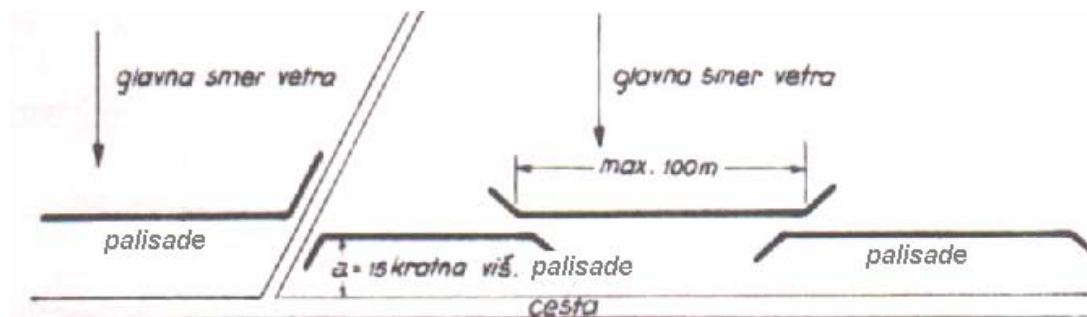
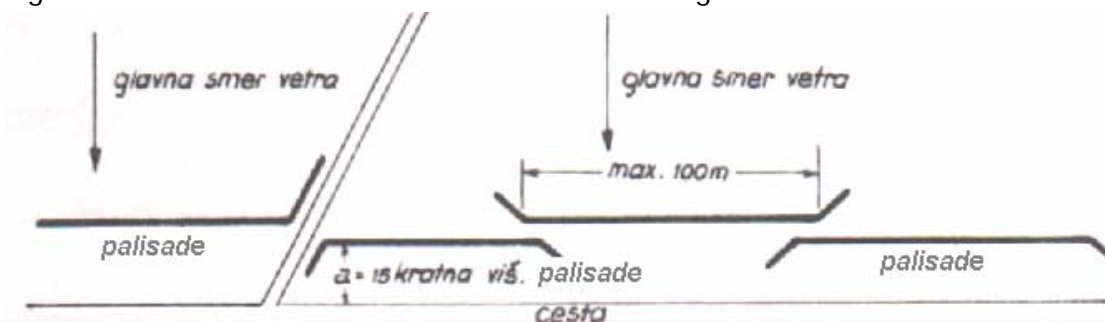


Figure: Placement of snow fences if the wind is orthogonal to the road.



A most effective way of protecting the road from snow drifts should be determined on the basis of annual observations on variously located snow fences.

Other types of snow fences can also be used to prevent the snow that is being plowed from the roadway from falling into areas where it could obstruct or endanger the traffic or cause damage to adjacent landowners.

#### After the winter

After the winter is over, the winter traffic signs must be removed. During this process, the traffic signs and posts should suffer as little damage as possible. The traffic signs should be transported to a road maintenance unit, cleaned, and stored in a suitable location. Replacements of any missing or damaged signs should be ordered early enough so as to arrive at the winter maintenance unit before the next winter begins.

The snow posts and snow fences must be removed in the spring, once the snow begins to thaw. Snow fences placed on agricultural land should be left there too long, otherwise they may obstruct agricultural work. After removal, any damage to the snow fences should be repaired, and the snow fences stored and protected in a suitable location.

### **3.3.4 INFORMATION ON WEATHER DEVELOPMENT AND PAVEMENT CONDITION**

Condition information may be divided into two groups, weather information (e.g. temperature, wind speed), and road information (e.g. pavement temperature, amount of melter remaining on the pavement). Both types of information are important for road maintenance.

Routine maintenance contractors must possess equipment and devices necessary to measure at least the following information: snow depth, air temperature, and the amount of ice melter remaining on the pavement.

The best and most reliable data about the wintertime pavement condition are obtained through road weather stations (RWS).

### **3.3.1.7 Weather service cooperation**

Efficient and economical winter maintenance absolutely requires early information about the expected weather conditions. Only then can the road maintenance service perform, on time and at economically justifiable costs, its tasks related to preventing and minimizing the impact of winter on traffic.

A cooperation contract must be set up with the weather service. This contract should specify which information will be provided, at what times, and which locations are particularly important for the road maintenance service.

The weather service is also very important when making decisions concerning avalanches (whether a road section should be closed, or some other measure undertaken).

### **3.3.1.8 Road weather stations**

As mentioned above, the road weather stations (RWS) provide the best decision-making information for the winter maintenance service. In this case, the weather service's forecasts are mostly of a precautionary character and are of more interest in the longer term than as short-term forecasts. Of course the information must flow in both directions and each model must be supplemented by the other one.

The RWS provide the following information:

- air temperature
- road surface temperature
- pavement internal temperature
  - relative air humidity,
  - precipitation (type and quantity),
  - amount of ice melter remaining on the pavement.

This data must be documented. Measuring stations must be placed on characteristic locations. The data for locations between stations are estimated from characteristic data obtained after multiple earlier measurements under various conditions (so-called "thermal mapping").

The main downsides of this system are the relatively high initial investment costs and the complex maintenance requirements.

If the weather developments are hard to estimate and no measurement data are available, the vehicles of the winter inspection service should perform control drives.

### **3.3.1.9 Other decision-making aids**

In case of quickly changing weather conditions or of precipitation moving through an area, it is recommended to contact the road and weather services of adjacent regions that came into contact with these conditions earlier than one's own region.

Nor should the experience and knowledge of the individual winter service workers be underestimated, especially concerning local peculiarities.

## **3.3.5 PRECAUTIONARY SPREADING**

Precautionary spreading is necessary to prevent the formation of ice, particularly on critical sections of roads and when snowfall is forecast.

Road sections where precautionary spreading is to be carried out must be defined in the winter maintenance operational plan.

Precautionary spreading should be performed when the development of climatic conditions indicates that ice is very likely to develop on the road.

The routine winter maintenance contractor must use the automated road weather reporting stations (road weather stations) to monitor the climatic conditions. Where such stations are not available, the forecasts of the weather service should be used; if possible,



special forecasts focusing specifically on road conditions should be obtained. If such forecasts are not available or do not match the actual conditions on a particular location, the routine maintenance contractor must work from its own observations of climatic parameters and from past experience.

Before beginning the precautionary spreading, the routine winter maintenance contractor must also measure the amount of ice melter remaining on the pavement. Special measurement devices are used for this purpose.

The time when precautionary spreading is to begin should be defined based on these parameters and on the amount of time needed to spread the entire road section. The precautionary spreading time must be chosen carefully; if spreading is done too early, winds and traffic will remove the spreading mixture from the pavement and the effect will be the same as if no spreading had been done at all. If spreading is done too late, ice may form on the road and traffic safety could be endangered.

The precautionary spreading mixture should be based on wet salt consisting of dry NaCl moistened by a suitable proportion of a  $\text{CaCl}_2$  or  $\text{MgCl}_2$  solution.

Spreading equipment can be attached to the loading platform of a truck or other transport vehicle, or can be mounted in place of the loading platform. The salting mixture is stored in a tank or on the loading platform, and is brought to the spreader (which is located at the back of the vehicle) by a conveyor belt or a spiral conveyor.

The wet salting equipment is installed on the truck's loading platform. In addition to the equipment mentioned above, this installation consists of a salting liquid tank, a pump, and suitable sprinkler nozzle used to moisturize the dry salt. This moisturizing takes place while the salt is being transported from the tank and before it falls to the ground.

#### Anti-icing spreader requirements

The spreading density must be in the range of 5 to 40  $\text{g/m}^2$ , and must be easy to control. Likewise it should be possible to control the breadth of the spreading in the range of 2 to 6 m (in the case of single-disk devices), and to choose if the spreading takes place to the left of the vehicle, to the right of it, or centered behind the vehicle. For normal conditions, spreading 15  $\text{g/m}^2$  is usually sufficient.

The anti-icing mixture must be spread behind the vehicle as evenly as possible. No part of the spreading vehicle or equipment should obstruct the flow of the mixture. The even distribution of the spreading mixture is ensured by a special guide. When the vehicle is fully loaded, the spreading disk should be no more than 0.5 m above the pavement.

The salting liquid spreader can be attached to the loading platform of a truck or mounted in place of the loading platform. The spreader includes a salting liquid tank, a pump, and sprinkler nozzles for the distribution of the anti-icing liquid.

If dry salt is humidified before being spread onto the pavement, the correct proportion of salting liquid relative to the amount of salt must be determined. Generally this proportion should not exceed 30 %. If the spreading dosage changes, this proportion should remain fixed.

Any leftover spreading materials will eventually need to be removed from the spreading equipment; it should be possible to also do this while the vehicle is stationary.

Precautionary spreading is carried out in cases when temperatures are expected to drop below the freezing point and will thus cause ice to form on damp spots of the road (bridges, shaded areas). The amount of salt to be spread should not exceed 10  $\text{g/m}^2$ .

### 3.3.6 ICE AND SNOW REMOVAL

#### 3.3.1.10 SNOW CLEARING

The required type, amount, and time of snow clearing and spreading depend on the importance of the road, its function, layout, and structural characteristics. The traffic and weather conditions determine the technical means and staff used for winter service. According to these proposed guidelines, snow clearing and spreading is intended to meet several goals:

- the public road network should be passable even after large amounts of snowfall and large snow drifts, as required by the regulations;
- in the interest of traffic safety, any obstacles that affect road use in winter should be as small as possible;
- despite winter conditions, suitable traffic safety must be ensured through the use of snow clearing and spreading (in accordance with the priority classes);
- while taking the above considerations into account, efforts towards economy should also be made, using optimized ploughing routes and optimal speed of winter service vehicles, thereby decreasing the fuel consumption and environmental impact.

Where one or more roads connect or cross, snow must not be pushed or thrown on the traffic surfaces of the road(s) connecting to the road being ploughed.

If the connecting or crossing roads are managed by different routine maintenance contractors, they must, before the ploughing begins, come to an agreement about where to push or throw the snow.

In the case of multi-level junctions or road-railroad crossings, snow must not be pushed or thrown onto the lower road or railroad.

Any exceptions should be agreed on beforehand, in writing, by the routine maintenance contractors involved.

During snowfall, and even more so during snow clearing, some snow sticks to the traffic signs and road furniture, making the signs hard to recognize and thus non-functional. Signs must be immediately cleared at least to the point of being functional.

#### 3.3.1.11 AVALANCHES

For roads where a danger of avalanches exists due to heavy snowfall and steep slopes above the road, the winter maintenance operational plan should include the possibility of closing the endangered road section.

After heavy snowfall, the slopes above the road should be inspected by an avalanche expert (usually sent by the weather service). The European five-level avalanche risk scale should be used to evaluate the danger of an avalanche. After inspecting the location, the expert writes up a report and sends it to the road administrator. If there is no risk of avalanche, the road section in question can be ploughed.

#### 3.3.1.12 ICE REMOVAL

Operative spreading must be carried out depending on the pavement condition. When level-1 readiness is in effect, the amount of time elapsed from the moment when the winter maintenance point is notified about ice on the road to the moment when spreading begins, i.e. when the first spreader vehicle leaves the winter maintenance point, should not exceed 10 minutes.

In level-2 readiness, this time should not exceed 10 minutes for the first two vehicles.

#### Equipment

Other equipment is used besides the equipment used for precautionary spreading.

A two-chamber spreader can be mounted on the vehicle. This spreader can carry and spread two different kinds of spreading material, e.g. two types of salt, or salt and sand or grit. This combination is very useful in areas where the pavement often changes from macadamized to asphalt and back.

Trailer spreaders are attached to the truck or transport vehicle. Such spreaders have their own loading platform and a spreading mixture distributor. If the collector reaches below the truck's loading platform, spreading material can be easily resupplied into the collector by lifting the loading platform.

It must be possible to control the spreading density (of the sand or sand/salt mixture) in the range of 50 to 300 g/m<sup>2</sup>. It must also be possible to control the breadth of the spreading (in the range of 2 to 6 m) and its location relative to the vehicle.

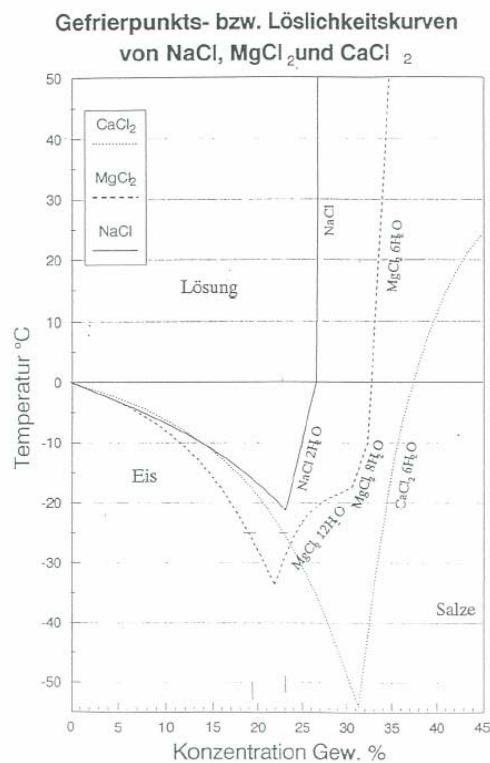
The spreading material used to increase the roughness of the road surface usually consists of natural stone material in the form of sand or crushed stone. To achieve sufficient roughness, at least 100 g of spreading material per m<sup>2</sup> is required; usually, 150 g/m<sup>2</sup> is recommended; the ratio of sand volume to salt volume is between 3/1 to 2/1.

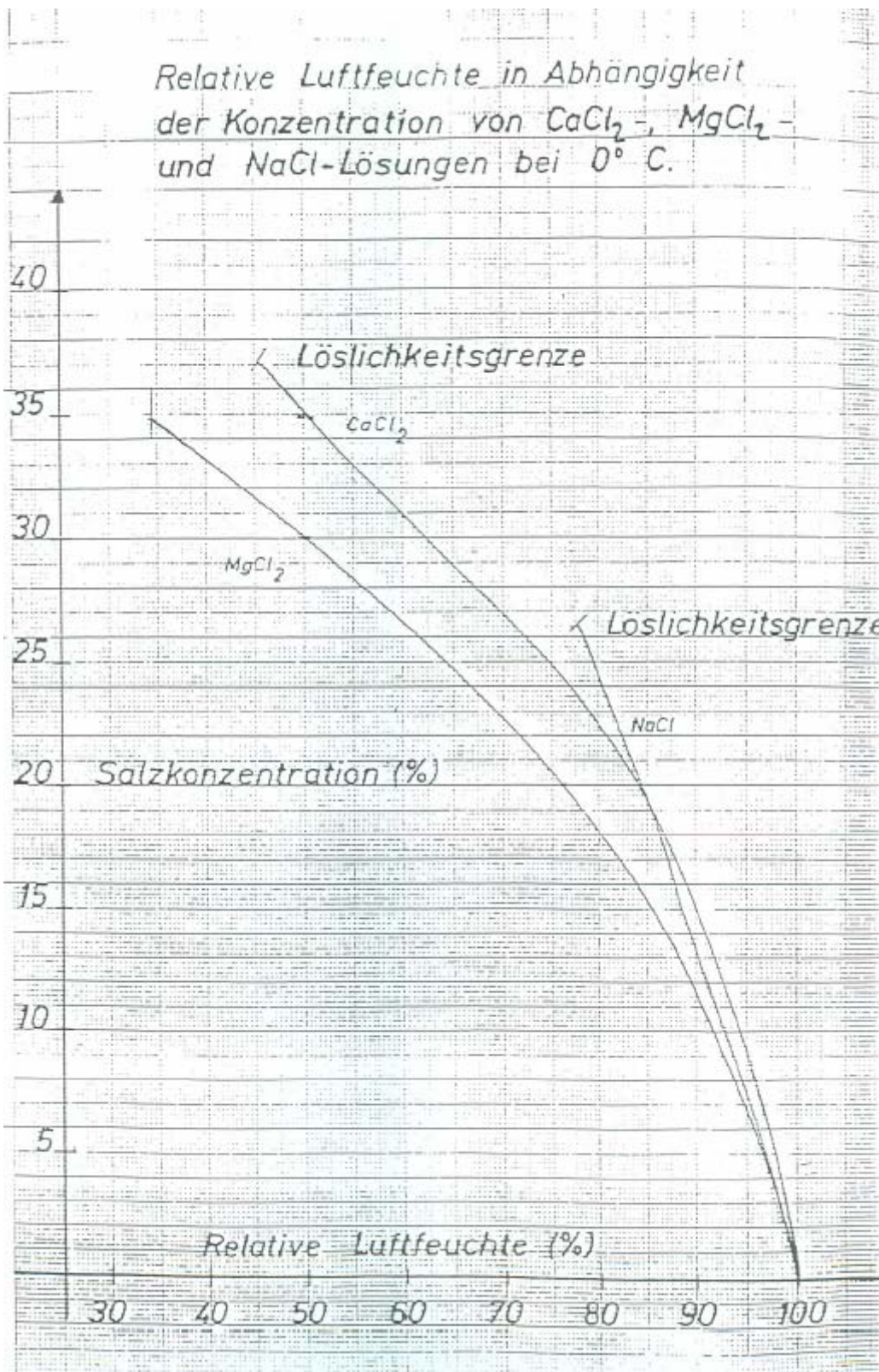
Such roughening spreading material can be spread behind the vehicle or in front of its drive wheels. The spreading material may be spread from a height of up to 0.5 m. The spreading material should be spread as evenly as possible over the entire pavement.

It must be possible to choose if the spreading takes place to the left of the vehicle, to the right of it, or centered behind the vehicle. The spreading material must be distributed evenly behind the vehicle. The spreading height must not exceed 0.5 m.

To ensure efficient removal of ice, the anti-icing materials should be mixed in the correct proportions. Of course the humidity already present in the air and on the pavement must also be taken into account. This is because all ice melters release heat on contact with moisture. Therefore, phase diagrams of melting materials are an important aid in decision-making.

Phase diagram of sodium, magnesium, and calcium chloride (moisture/water mixing efficiency):





After the winter is over, the sand or grit that have been spread on the pavement must be cleared away.

### 3.3.7 SPREADING MATERIALS

Ice prevention and removal activities are an integral part of winter service. They depend on ice type and thickness, on climatic conditions, the available machinery, and the road maintenance priority class. Levels of readiness and the activities used in ice prevention and removal are defined in the winter maintenance operational plan.

The following methods are used to prevent and remove ice:

- mechanically (spreading sand, grit, etc.),
- chemically (spreading an ice melting liquid),
- combined (spreading a mixture of sand and melter),

#### 3.3.7.1 TYPES OF SPREADING MATERIALS, THEIR CHARACTERISTICS AND STORAGE

The salt supplier must take into account the requirements that must be met by the salt (sodium chloride (NaCl), calcium chloride (CaCl), and magnesium chloride (MgCl)) used for salting the roads.

#### 3.3.7.2 TECHNICAL CONDITIONS

##### 3.3.7.2.1 Spreading salt – sodium chloride NaCl

###### 3.3.7.2.1.1 Granulometric composition and permitted humidity at 110 °C

Granulometric composition defined by the procedures from the standards EN 933-1 and EN 933-2 on the sieves mentioned below

Permitted humidity defined by the procedure from the standard ASTM E534-91 at 110°C

##### Sea and rock salt– dispersed state 0-4 mm, humidity up to 4%

- The required granulometric composition of the 0-4 mm sea or rock salt to be supplied:

| granules / mm |           |
|---------------|-----------|
| > 4.00        | max 10%   |
| 2.00/ 4.00    | 15 - 40 % |
| 0.40/ 2.00    | 40 - 70 % |
| < 0.40        | max 15 %  |

Recommended control method: EN 933-1 and EN 933-2

- Allowed humidity given this granulometric composition of 0-4 mm sea or rock salt is maximum 4%

Recommended control method: ISO 2483

##### Sea and rock salt – dispersed state – granularity 0-2 mm

- The required granulometric composition of the 0-2 mm sea or rock salt to be supplied:

| granules / mm |           |
|---------------|-----------|
| > 2.00        | max 20 %  |
| 1.00/ 2.00    | 30 - 80 % |
| 0.20/ 1.00    | 30 - 60 % |
| < 0.20        | max 15 %  |

Recommended control method: EN 933-1

- Allowed humidity given this granulometric composition of 0-2 mm sea or rock salt is maximum 4%

Recommended control method: ISO 2483

#### Sea and rock salt for silos – 0-4 mm

- The required granulometric composition of the 0-4 mm sea or rock salt to be supplied:

| zrna / mm  |           |
|------------|-----------|
| > 4.00     | max 10%   |
| 2.00/ 4.00 | 15 - 45 % |
| 0.40/ 2.00 | 40 - 70 % |
| < 0.40     | max 15 %  |

Recommended control method: EN 933-1

- Allowed humidity given this granulometric composition of 0-4 mm sea or rock salt is maximum 1%

Recommended control method: ISO 2483

#### Sea and rock salt for silos – 0-2 mm

- The required granulometric composition of the 0-2 mm sea or rock salt to be supplied:

| zrna / mm  |           |
|------------|-----------|
| > 2.00     | max 20 %  |
| 1.00/ 2.00 | 30 - 80 % |
| 0.20/ 1.00 | 30 - 60 % |
| < 0.20     | max 15 %  |

Recommended control method: EN 933-1

- Allowed humidity given this granulometric composition of 0-2 mm sea or rock salt is maximum 1%

Recommended control method: ISO 2483

#### 3.3.7.2.1.2 Chemical analysis of the dried sample of sea and rock salt (NaCl)

- NaCl content min 96 %
- Insoluble matter content max 2 %

Recommended control method: ISO 2479

#### 3.3.7.2.1.3 Ice melting efficiency of the salt at the temperature of -5 °C

The salt must be able to melt at least 5 ml of ice per 60 minutes when spread at the rate of 100 g/m<sup>2</sup>.

Recommended control method: SHRP H-205.1

#### 3.3.7.2.1.4 Anti-agglomerating additive for 0-2 and 0-4 mm sea or rock salt

##### *dispersed-state and silos*

The supplier must provide information about the type and quantity of anti-agglomerative additive used, and provide analysis outputs.

This must include the analysis of all cyanides if cyanide complexes have been used.

The amount of potassium hexacyanoferrate (II) trihydrate ( $K_4Fe(CN)_6 \cdot 3 H_2O$ ) allowed is the minimum amount sufficient to permanently prevent agglomeration, but no more than 150 mg per one kilogram of originally supplied salt.

Recommended control method: Doc. CEES/CN Nr.136

### 3.3.7.2.2 Heavy metals

The following are recommended maximal allowed levels of various dangerous elements in the salt:

|              | Maximum allowed levels of dangerous elements |
|--------------|--|
| Arsenic (As) | max. 0.5 mg/kg                               |
| Copper (Cu)  | max. 2.0 mg/kg                               |
| Cadmium (Cd) | max. 0.5 mg/kg                               |
| Lead (Pb)    | max. 2.0 mg/kg                               |
| Mercury (Hg) | max. 0.1 mg/kg                               |

The supplier must provide a report on ecotoxicological data on anti-coagulation additives, as well as a measurement of heavy metal content. The reports must be from a competent organization.

### 3.3.7.2.3 Spreading material – calcium ( $CaCl_2$ ) or magnesium chloride ( $MgCl_2$ )

#### 3.3.7.2.3.1 Sample chemical analysis

Calcium chloride solution:

- concentration to be supplied 24 % solution
- or 20 % solution
- insoluble matter content max 1 %

Magnesium chloride solution:

- concentration to be supplied 30 % solution
- insoluble matter content max 1 %

Dry calcium or magnesium chloride:

- Required level of calcium chloride 75 %
- or of magnesium chloride 47 %
- insoluble matter content max 3 %

The concentration of solutions can be established easily by measuring their density. The procedure is described in the ISO 649-1 and ISO 649-2 standards.

#### 3.3.7.2.3.2 Heavy metals

The supplier must provide a report, prepared by a competent organization, on the analysis and measurements of heavy metal content and ecotoxicological data for the anti-coagulation additives.

### 3.3.7.2.3.3 Sampling and control testing

Control tests must be performed on all supplied quantities of the various spreading materials.

Samples must be taken randomly from the truck while the spreading materials are being unloaded in the spreading contractor's warehouse. Sampling is done by a representative of the organization authorized by the customer to conduct the testing.

A sample of the NaCl spreading material must weigh 2 kg, be sealed in an airtight container and properly labeled with the supplier's name, granularity, source, and the location where the sample was taken. A sample of the sampling material based on a 24% or 20% CaCl<sub>2</sub> solution or a 30% MgCl<sub>2</sub> solution must contain 1 litre of the solution, and must be sealed in an airtight container and properly labelled with the supplier's name, concentration, source, and the location where the sample was taken.

The purchaser of the spreading materials must bear the costs of sampling and analysis for the purposes of control testing.

Suppliers must provide an original report on the control test. The report must be no more than 3 months old; all pages must carry the original signature and stamp.

### 3.3.7.2.3.4 Internal and external control of the supplied quantities

Internal control of the supplied spreading materials is carried out at the supplier's location. Analyses described in section 4.15.2.1 are carried out once per every 500 t of supplied spreading material. Once per every 5000 t, the supplier must hire a competent organization to conduct the tests from all the sections, and send the report on this internal control to the purchaser of the spreading materials.

The internal control of CaCl<sub>2</sub> and MgCl<sub>2</sub> solutions must be carried out by the supplier for every batch produced and consists of analyses described in section 4.15.2.2.

The purchaser of the brine must take and test random samples of the supplied brine and compare them to the analysis of dry samples. Control testing is carried out by a competent organization once per 50,000 l supplied.

The internal control costs must be borne by the supplier.

The costs of control testing are covered by the purchaser of the spreading materials.

### 3.3.7.2.4 Deviations from the required granulometric composition and humidity of the NaCl salt and the reduction of the price due to still acceptable deviations

#### 3.3.7.2.4.1 Sea and rock spreading salt, granularity 0-4 mm

- The required granulometric composition for the supplied sea and rock salt of 0-4 mm granularity:

| granules / mm | required gran. composition (in %) | max. deviation from required (in %) | original price reduced by (%) |
|---------------|-----------------------------------|-------------------------------------|-------------------------------|
| > 4.00        | max 10%                           | 5                                   | 2                             |
| 2.00/ 4.00    | 15 - 40 %                         | -                                   | -                             |
| 0.40/ 2.00    | 40 -70 %                          | -                                   | -                             |
| < 0.40        | max 15 %                          | 5                                   | 5                             |

For each further 1 % of deviation from the required granulometric composition, the price is reduced by a further 1 %.

Spreading materials containing more than 15 % of grains larger than 4 mm or smaller than 0.4 mm are unacceptable.

If spreading material appeared acceptable and was accepted and spread, but later chemical analyses showed that the material was of an unacceptable quality, the price of all the supplied quantities of unacceptable spreading material are reduced by 10 %.



- Maximum allowed humidity in the sea and rock NaCl of 0-4 mm granularity, given the required granulometric composition:

| allowed humidity | humidity in test sample (up to, in %) | original reduced | by | price (%) |
|------------------|---------------------------------------|------------------|----|-----------|
| max 4 %          | 4.5                                   | 5                |    |           |
|                  | 5.0                                   | 10               |    |           |
|                  | 5.5                                   |                  | 20 |           |

Spreading materials containing more than 5.5 % of humidity are unacceptable.

If spreading material appeared acceptable and was accepted and spread, but later chemical analyses showed that the material was of an unacceptable quality (in terms of technical requirements), the price of all the supplied quantities of unacceptable spreading material are reduced by 15 %.

#### 3.3.7.2.4.2 Sea and rock spreading salt, granularity 0-2 mm, humidity up to 1 %

- The required granulometric composition for the supplied sea and rock salt (NaCl) of 0-2 mm granularity:

| granules / mm | required gran. composition (in %) | max. deviation from required (in %) | original reduced by (%) | price (%) |
|---------------|-----------------------------------|-------------------------------------|-------------------------|-----------|
| > 2.00        | max 20%                           | 5                                   | 2                       |           |
| 1.00/ 2.00    | 30 - 80 %                         | -                                   | -                       |           |
| 0.20/ 1.00    | 30 - 60 %                         | -                                   | -                       |           |
| < 0.20        | max 15 %                          | 5                                   | 5                       |           |

For each further 1 % of deviation from the required granulometric composition, the price is reduced by a further 1 %.

Spreading material containing more than 5 % of grains larger than 2 mm and more than 10 % of grains smaller than 0.2 mm is unacceptable. If spreading material appeared acceptable and was accepted and spread, but later chemical analyses showed that the material was of an unacceptable quality (in terms of technical requirements), the price of all the supplied quantities of unacceptable spreading material are reduced by 10 %.

- Maximum allowed humidity in the sea and rock NaCl of 0-2 mm granularity, given the required granulometric composition:

| allowed humidity | humidity in test sample (up to, in %) | original reduced | by | price (%) |
|------------------|---------------------------------------|------------------|----|-----------|
| max 1 %          | 1.2                                   | 5                |    |           |
|                  | 1.4                                   | 10               |    |           |
|                  | 1.6                                   |                  | 20 |           |

Salt containing more than 1.6 % of humidity is unacceptable.

If spreading material appeared acceptable and was accepted and spread, but later chemical analyses showed that the material was of an unacceptable quality (in terms of technical requirements), the price of all the supplied quantities of unacceptable spreading material are reduced by 20 %.

#### 3.3.7.2.4.3 Sea or rock salt for silos, granularity 0-4 mm

- The required granulometric composition for the supplied sea and rock salt of 0-4 mm granularity:

| granules / mm | required gran. composition (in %) | max. deviation from required (in %) | original reduced by (%) | price (%) |
|---------------|-----------------------------------|-------------------------------------|-------------------------|-----------|
| > 4.00        | max 10%                           | 5                                   | 2                       |           |
| 2.00/ 4.00    | 15 - 45 %                         | -                                   | -                       |           |

|            |           |   |   |
|------------|-----------|---|---|
| 0.40/ 2.00 | 40 - 70 % | - | - |
| < 0.40     | max 15 %  | 5 | 5 |

For each further 1 % of deviation from the required granulometric composition, the price is reduced by a further 1 %.

- Maximum allowed humidity in the sea and rock NaCl of 0-4 mm granularity, given the required granulometric composition:

| allowed humidity | humidity in test sample (up to, in %) | original reduced | by | price (%) |
|------------------|---------------------------------------|------------------|----|-----------|
| max 1 %          | 1.2                                   | 5                |    |           |
|                  | 1.4                                   | 10               |    |           |
|                  |                                       | 1.6              |    | 20        |

Salt containing more than 1.6 % of humidity is unacceptable.

#### 3.3.7.2.4.4 Sea or rock salt for silos, granularity 0-2 mm

- The required granulometric composition for the supplied sea and rock salt of 0-2 mm granularity:

| granules / mm | required gran. composition (in %) | max. deviation from required (in %) | original reduced by (%) |
|---------------|-----------------------------------|-------------------------------------|-------------------------|
| > 2.00        | max 20%                           | 5                                   | 2                       |
| 1.00/ 2.00    | 30 - 80 %                         | -                                   | -                       |
| 0.20/ 1.00    | 30 - 60 %                         | -                                   | -                       |
| < 0.20        | max 15 %                          | 5                                   | 5                       |

For each further 1 % of deviation from the required granulometric composition, the price is reduced by a further 1 %.

- Maximum allowed humidity in the sea and rock NaCl of 0-2 mm granularity, given the required granulometric composition:

| allowed humidity | humidity in test sample (up to, in %) | original reduced | by | price (%) |
|------------------|---------------------------------------|------------------|----|-----------|
| max 1 %          | 1,2                                   | 5                |    |           |
|                  | 1,4                                   | 10               |    |           |
|                  |                                       | 1,6              |    | 20        |

Salt containing more than 1.6 % of humidity is unacceptable.

#### 3.3.7.2.4.5 Calcium (CaCl<sub>2</sub>) or magnesium (MgCl<sub>2</sub>) chloride solution

The required concentration to be supplied:

| required concentration | if actual concentration is below the required one by | the original price is reduced by |
|------------------------|--|----------------------------------|
| 20 % solution          | 1 %  | 5 %                              |
| 20 % solution          | 2 %  | 10 %                             |
| 24 % solution          | 1 %  | 4 %                              |
| 24 % solution          | 2 %  | 9 %                              |
| 30 % solution          | 1 %  | 4 %                              |
| 30 % solution          | 2 %  | 9 %                              |

The actual concentration must be no more than 2 % below the required concentration. Solutions that fall more than 2 % below the required concentration are unacceptable.

The price reductions due to failure to meet the technical requirements are additive. The total price reduction must not exceed 22 % of the original price. Salt that would require greater reduction than that is unacceptable.

#### 3.3.7.2.5 Recommendations

It is advisable to use a public tender process to select suppliers of spreading materials. The suppliers submitting their offers must provide samples and reports as described in the previous sections.

At least two suppliers should be selected for each type of spreading materials. This is chiefly to ensure that spreading material stocks can be maintained even if there is a problem with one of the suppliers.

#### 3.3.7.2.6 Storage of spreading materials

Spreading materials are stored dry.

The total capacity of all warehouses must not be smaller than the average monthly consumption of salt on an average year.

Ice melting salts should not be stored for more than three years.

#### 3.3.7.2.7 Storage of solid materials

The area of the warehouse halls should adapt to local conditions and should be about 10-12 m wide. Lorries and trailer-trucks need 20 m of length and 9 m of height clearance to unload the spreading material in the warehouse hall. These measurements provide enough room for about 600 t of spreading material.

Sufficient corrosion protection must be provided when storing melting materials (salts).

Vertical silos generally have a capacity between 30 and 250 t. They are made of steel, wood, or artificial materials, and must be kept in a useful state.

The arrangement of the salt storage rooms must ensure that the salt can not contaminate the surrounding area.

After the winter season is over, the silos must be emptied and the salt transferred to ordinary warehouses. The silos are refilled with fresh salt before the next winter.

Crushed stone can be stored in the open, but must be protected from precipitation. Small containers for 0.5–1 m<sup>3</sup> of spreading materials should be installed for the local use of traffic participants along roads, squares, sidewalks, bridges, and slopes.

#### 3.3.7.2.8 Storage and preparation of brine

Wet salting requires the use of a device for the preparation of the salting solution.

The device used to make brine out of dry salt consists of a salt dissolving tank, a brine storage tank, a pump, and a loading device. If concentrated solution has been purchased, the brine equipment consists of a tank (minimal volume 30,000 l) and a mixing assembly to control the desired concentration.

The amount of brine stored must be sufficient for several full-scale winter service measures.

#### 3.3.7.2.9 Environmental effect

##### 3.3.7.2.9.1 Spreading materials for melting of ice

Melters damage the road, buildings, vehicles, as well as the surrounding area:

- corrosion of vehicles and reinforcement bars of structures and buildings if their corrosion protection is poor or damaged,
- contact damage on vegetation next to the road,

- damage caused to plants and parts of plants due to absorption of large quantities of sodium and chloride materials from the ground,
- injuries to fish due to a short-term high quantity of chlorine in the water after rainfall.

The environmental impact can be reduced by spreading less material, particularly through wet salting, improved spreading technology, and stronger safety precautions.

#### 3.3.7.2.9.2 Spreading materials for roughening

Generally, the roughening spreading material has no chemical effects on the road and its surroundings. However, passing vehicles tend to throw it across the curbs into the area next to the road, leading to the following effects:

- choking up drainage installations;
- pollution of agricultural land;
- pollution of green areas and raising of shoulders;
- damage to parked and moving vehicles;
- damage due to dust.

When collecting old spreading material, the dust endangers the health of the people involved in the work.

Once the spreading material has been collected, it must be treated using special procedures. It can be reused only under certain conditions.

### 3.3.8 EXTRAORDINARY EVENTS

This is a description of procedures and measures in cases of environmental emergencies.

#### 3.3.8.1 Types of environmental emergencies

Environmental emergencies are large-scale unforeseen events with an unexpected influence on the road (landslides, avalanches, floods, storms, heavy snowfall, black ice, freezing rain...).

#### 3.3.8.2 Environmental emergency procedures

When an environmental emergency develops, the police or individuals bring it to the attention of the road maintainer.

The road maintainer installs traffic signs to protect the location of the emergency, and notifies the road administrator and the supervisors both in writing and by phone. The notification must specify the road, section, station, type of damage, and estimated repair costs. If the emergency event covers a wider area that falls under the jurisdiction of several maintainers, the maintainers of adjacent regions should also be notified.

The routine maintenance contractor prepares a cost estimate for restoring the road to a passable condition and forwards it to the road administrator. Upon receiving confirmation from the latter, the contractor begins work on restoring road passability.

If addressing the environmental emergency event requires long-term work, the road maintainer should prepare a closure plan, send it to the road administrator for approval, and close the road.

The road can be closed partially (e.g. only half the road) or fully. In the latter case, a detour must also be defined and marked by signs.

Activities related to removing the consequences of environmental emergencies can be carried out as urgent work, or they may be the subject of public tenders on the national level.

In case of large-scale damage which can not be repaired using the existing budgetary funds, the government should propose an appropriate law which will allow money from the reserve budget to be used.

### **3.3.9 AFTER-WINTER ACTIVITIES**

After completion of the winter service, the maintenance contractor is obliged to perform adequate removals and cleaning, and to carry out the required repairs. He shall also wash the machinery and vehicles to remove the salt residues. The winter traffic signs, edge posts, snow barriers, and other furniture needed in winter conditions shall be appropriately stored.

#### Traffic signs

This work must be done in such a way as to cause minimal damage to the traffic signs and posts. Traffic signs must be transported to a road maintenance unit where they will be cleaned and stored in a suitable place. Missing and damaged signs must be replaced early enough; they should be present at the road maintenance units before the next winter.

#### Snow posts and snow fences

After the winter season, snow posts are removed from the roadside. Broken ones are discarded; however, if only the tip is damaged, the post should be sharpened again and painted with a protective coating.

The posts should be stored in covered depots on winter maintenance points.

Snow fences located on agricultural land should not be left standing there too long, as they may stand in the way of agricultural work. After they are removed, the snow fences should be repaired, stored in a suitable location, and protected.

#### Cleaning of warehouses and depots used for the storage of spreading materials

After the winter is over, all spreading material warehouses and depots should be inspected and made ready for the next winter.

The road maintenance unit and its buildings must be kept in an orderly state at all times, particularly during the winter season. Material and equipment must be in its prescribed place, clean and properly stored. Material and tools used for road maintenance must be in accessible locations.

Special attention should be paid to the protection of the environment.

### **3.3.10 WINTER MAINTENANCE ANALYSES**

With a view to improving the winter maintenance and making it cheaper, an analysis of the winter maintenance should be done after the winter season is over.

This analysis includes:

- obstacles caused by snow and ice to traffic participants;
- response times of the winter service contractors, and their consequences;
- financial analysis of the winter maintenance activities.

#### **3.3.10.1 Activity log and control**

All measures undertaken in the context of winter service should be thoroughly documented; this provides a proof that the clearing and spreading requirements have been carried out properly.

The driver must capture and record the following information when carrying out an activity:

- date of the activity,

- the area of the activity and the path there; did the drive there proceed according to plan, or if not, what were the deviation from the plan,
- state of the mileage counter; distance driven,
- type of spreading material, total consumption of the spreading material, refills, spreading density settings,
- snow clearing data (yes/no, mechanized?),
- the times and locations of the more important actions,
- record the time of snowfall, the thickness of snow both near and on the carriageway.

In addition to this, the road maintenance depot as a whole must also record general information about the weather, temperature, pavement conditions, and measures undertaken (beginning, end, plan of action, management of the work).

All data are archived because they may be needed for later analysis or as proofs.

### **3.3.10.2 Statistics and evaluation of the winter maintenance**

The data captured during the winter are used for:

- documenting the activities of the winter service (including for purposes of guarantees),
- billing (separately for hired vehicles),
- winter service statistics both for the contractor's own use and as a justification should there be any complaints from the higher levels,
- detailed analyses of the activities as the basis for further planning of work and equipment.

### **3.3.11 WINTER MAINTENANCE TRAINING**

Due to the specific conditions involved, the winter maintenance of roads is a very difficult task. Any non-professional activity can lead to harm. Thus, prior training is absolutely necessary, as is regular refreshment training and training when work procedures changes or new things are introduced.

The training is carried out at the organizations performing the winter maintenance on roads, mostly in the form of lectures about new developments in the area of equipment, materials, and legislation. In addition to that, presentations of new equipment should be organized, usually by manufacturers or their sales representatives. The person who will head the winter maintenance service must also participate in further special brief training before the winter maintenance season begins.

The training should be both theoretical and practical.

Particular attention should be paid to the following topics:

- weather forecasts, weather observation, connections between weather phenomena and winter maintenance;
- basics of winter maintenance and the use of spreading materials;
- measures undertaken to ensure economic use of spreading materials;
- planning, execution, and keeping track of various activities and measures;
- vehicles and machines, handling them, including practical exercise;
- last winter's experiences (statistics, summaries, anything unusual);
- new developments in the coming winter (new machines, programmes, regulation, findings, etc.).

### 3.3.12 “WHITE ROADS”

Outside populated areas, salting and spreading should be performed on all roads with only a few exceptions. These exceptions, the “white roads”, may include sections with the following characteristics:

- unimportant for traffic, low levels of traffic;
- few bends, no steep slopes;
- where a detour along other roads is possible;
- no locations with a high density of traffic accidents;
- no special kinds of traffic (e.g. coaches, school buses);
- macadamized roads;
- roads in specially protected areas with a fragile ecosystem.

Such sections must be specially marked as such and must be under intensive observation by the road service.

Spreading of material for roughening is particularly suitable to mountainous roads in areas of large quantities of snow. The sections of such roads shall be regularly inspected, and spreading shall be repeated if required.

### 3.3.13 WINTER SERVICE IN POPULATED AREAS

Municipal road maintenance decrees define additional requirements for road maintainers. This usually involves the methods of snow removal (transporting it away) as well as plowing priorities. The latter take into account the importance of various public roads, giving particular priority to roads used for public transport. Municipal authorities hire a contractor to perform winter maintenance.

The contractor must prepare a Winter Maintenance Operational Plan, which includes a distribution of roads and other areas by clearing priority (roads are divided into priority classes and are separate from clearing of non-traffic areas). The contents of the Operational Plan are the same as those shown in the supplement. The WMOP must be approved by the road administration.

The WMOP must provide for the coordination of different winter maintenance contractors, which includes considerations such as not pushing snow into the area handled by somebody else (e.g. in road crossings, sidewalks, parking lots, etc.).

Snow drifts on the side of the road, between the carriageway and the sidewalk, must be removed early enough to prevent the carriageway or the sidewalk from effectively becoming narrower.

On parking lots, snow should first be piled on the side and later driven away by trucks.

In populated areas, spreading and salting is usually performed on carriageways and bicycle lanes, but may also be done on sidewalks if ice forms thereon. Friction-increasing spreading material is not normally used in populated areas.

Municipal authorities may require owners of land adjacent to the road to clear and spread areas such as sidewalks or pedestrian lanes on the side of the carriageways.





GUIDELINES FOR ROAD DESIGN,  
CONSTRUCTION, MAINTENANCE AND  
SUPERVISION

VOLUME III: ROAD MAINTENANCE

SECTION 3: WINTER SERVICE

SUPPLEMENT 1: WINTER SERVICE OPERATIONAL PLAN

Sarajevo/Banja Luka  
2005



### 3.3.14 SUPPLEMENT 1: WINTER SERVICE OPERATIONAL PLAN

**TITLE PAGE:**

Number: \_\_\_\_\_

Date: \_\_\_\_\_

Client: \_\_\_\_\_

Supervisory body:  
\_\_\_\_\_

Prepared by: \_\_\_\_\_

Responsible head of winter maintenance: \_\_\_\_\_

Director

**Examined by (supervisor):** \_\_\_\_\_

**Date:** \_\_\_\_\_

**Approved by (custodian):** \_\_\_\_\_

**Date:** \_\_\_\_\_

**"COMPANY"**

**CLIENT**

Date: \_\_\_\_\_

Number: \_\_\_\_\_

**RE: Statements**

**THE COMPANY \_\_\_\_\_, being the winter service contractor, states that:**

- vehicles, machines, and other equipment assigned by the plan to winter maintenance work will not be used for winter maintenance of other roads;
- spreading material warehouses are separate;
- sufficient quantities of crushed stone have been provided and should suffice for the entire winter season. Accounts of the quantities actually used will be made on a monthly basis;
- based on the experience from previous years, there are no locations where new snow guards need to be constructed (this statement is only necessary for contractors in areas without snow guards);
- precautionary spreading will be limited only to the areas where it is the most urgently needed;
- all chiefs of maintenance depots are familiar with the winter maintenance operational plan.

Director

**“COMPANY”**

**CLIENT**

Date: \_\_\_\_\_

Number: \_\_\_\_\_

**RE: Statement on the current condition of the technical equipment**

**THE COMPANY \_\_\_\_\_, being the winter maintenance contractor, states that the technical equipment needed for winter maintenance work is:**

- trucks – have been inspected and are in perfect working condition;
  
- machines – ready for the winter season, with all necessary permits;
  
- equipment – has undergone both routine and investment maintenance, and has been inspected.

Director:

**"COMPANY"**

**CLIENT**

Date: \_\_\_\_\_

Number: \_\_\_\_\_

**RE: Statement on spreading unit calibration**

**THE COMPANY \_\_\_\_\_, being the winter service contractor, states that 50% of our spreading units have been calibrated by an authorized service shop.**

Director:

ATTACHMENT:

- Proofs of calibration (following this page)

**CLIENT**

Date: \_\_\_\_\_

Number: \_\_\_\_\_

**RE: Statement**

The company .....,  
being an engineering and consulting company for the maintenance and protection of state  
roads, states that all supervisors are familiar with the winter maintenance operational  
plan.

Supervisor:

\_\_\_\_\_

Director

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## 1 GENERAL

Winter maintenance consists of a number of tasks and activities necessary to ensure the passability of roads and the traffic safety in winter conditions. It is performed whenever winter phenomena (snow, ice on the road or on vegetation, etc.) can endanger the normal course of traffic.

Incorrect or untimely actions on the part of the responsible organizations in wintertime can cause great economic damage. Therefore, the law requires a good winter road maintenance service to be organized.

The following preparations are required to ensure the uninterrupted operation of winter maintenance and to avoid large traffic disruptions:

- prepare the winter maintenance operational plan, which is the basic document on the organization of winter maintenance. The plan contains all necessary information and all necessary instructions to workers involved in winter maintenance;
- provide a sufficient quantity of spreading materials;
- prepare all the necessary machinery, equipment, and specialized winter machines that will be needed for winter maintenance work;
- prepare and equip roads, installing appropriate winter traffic signs and road furniture;
- ensure that road users will receive timely information about winter maintenance in the media.

The contract for the routine maintenance of roads, signed by the client and **the Company** \_\_\_\_\_, provides for the maintenance of roads in the area covered by **the Company** \_\_\_\_\_

In this area, the Company \_\_\_\_\_ maintains:

\_\_\_\_\_ km of motorways,

\_\_\_\_\_ km of expressways,

\_\_\_\_\_ km of trunk roads and

\_\_\_\_\_ km of regional roads,

the total length being \_\_\_\_\_ km.

**2 ROAD LIST**

**MOTORWAYS, EXPRESSWAYS, TRUNK ROADS, REGIONAL ROADS**

| section | road | route         | section length (m) | AADT vehicles per day | priority class |
|---------|------|---------------|--------------------|-----------------------|----------------|
|         |      |               |                    |                       |                |
|         |      |               |                    |                       |                |
|         |      |               |                    |                       |                |
|         |      |               |                    |                       |                |
|         |      | <b>TOTAL:</b> |                    |                       |                |

**3 LIST OF ROADS FOR EACH ROAD MAINTENANCE UNIT**

ROAD MAINTENANCE DEPOT \_\_\_\_\_

**MOTORWAYS, EXPRESSWAYS, TRUNK ROADS, REGIONAL ROADS**

| section | road | route         | section length (m) | AADT vehicles per day | priority class |
|---------|------|---------------|--------------------|-----------------------|----------------|
|         |      |               |                    |                       |                |
|         |      |               |                    |                       |                |
|         |      |               |                    |                       |                |
|         |      |               |                    |                       |                |
|         |      | <b>TOTAL:</b> |                    |                       |                |

**Attachment: ROAD NETWORK MAP**

## 4 EXPLANATION OF THE WINTER MAINTENANCE OPERATIONAL PLAN

### 4.1 CONCEPT

The winter maintenance operational plan is designed in accordance with the provisions of the Public Road Act and the Regulation on the maintenance of public roads.

Winter service or winter road maintenance is only one segment within the larger context of routine road maintenance. Due to extreme conditions that often occur on roads during winter, such as ice, snow, sleet, rime, etc., this is also the most difficult part of road maintenance. Therefore winter maintenance requires particularly thorough and careful preparation.

All measures related to winter maintenance must be carried out in due time.

Precautionary salting and sanding is equally necessary as it is to spread the roads after the snow has fallen, and to clear the snow off the roads. After the winter season, roads must be restored to their pre-winter condition by removing auxiliary traffic signs and winter-related road furniture, and by cleaning the area around the road.

The level of winter maintenance must be sufficient to reduce the economic and material damage (which is to some extent inevitable) to an optimally low level.

#### **SNOW REMOVAL**

Removal of snow from driving areas and areas intended for the use of vehicles being excluded from traffic should begin before the snow depth reaches **10 cm** for roads of the **first** and **second priority class**, or **15 cm** for other roads, and before driving becomes impossible even with the use of winter vehicle equipment. Roads in the **third** and **fourth priority class** should be kept passable as long as this is rational; afterwards they should be closed. **Third-class** roads should be reopened when the weather conditions improve, while **sixth-class** roads remain closed; their reopening depends on local circumstances.

Roads are considered passable even if traffic is hindered by the remains of snow on the carriageway, or even by a layer of packed snow that partially covers the carriageway (definitions can be found in the volume WINTER SERVICE), and also in cases where the carriageway is partly narrowed thus affecting the traffic or even requiring one-way traffic.

#### **ROAD ICE**

Ice forms when the pavement cools below freezing temperature ( $\pm 0^{\circ}\text{C}$ ), or in case of humidity, water, or residues of snow on the pavement.

This is because the amount of ice-related work is not proportional to the number of days with snowfall. Ice is the most frequent in periods when days are warm (causing the snow to melt) while nights are freezing. Therefore the standby teams must constantly inspect the pavement conditions, particularly in critical areas (which are recognized as such from previous experience). Such areas include in particular sharp bends, steep slopes, bridges, shady areas (especially in forests and near streams or rivers), road-railway crossings, road crossings and junctions, etc.

Precautionary spreading should be performed in such locations, or immediately when ice has been detected on the pavement. Warning traffic signs should be installed in locations where ice forms frequently and is especially dangerous to traffic due to the general characteristics of the road in that area.

On roads or longer sections of roads where the winter maintenance plan requires precautionary spreading, such spreading should be performed as soon as the likelihood that ice will form becomes sufficiently high. This applies to all priority classes.

#### **MACHINERY AND EQUIPMENT**

When the winter maintenance plan is prepared, the winter maintenance machinery and equipment must also be prepared and moved to their base positions.

Any damage to or failure of vehicles, machines, and other equipment, should be repaired in the field whenever possible, or in the workshops of the \_\_\_\_\_ **Company**. Repairs for external subcontractors may also be carried out. The head of the mechanical workshop cooperates with the head of the vehicle fleet to repair any breakdowns as quickly as possible, even outside regular working hours. All such repairs are treated as a matter of priority. Whenever a vehicle or machine is out of operation, or a worker is absent from work, the head of the winter maintenance standby teams and the head of the road maintenance depot concerned must be notified and a suitable replacement arranged. It is suggested that 10 % of spare shall be ensured, i.e. one spare machine per 10 machines.

### **SPREADING MATERIALS**

Partial stocks of spreading materials must be available by the time the winter maintenance plan has been prepared, while the remainder will be supplied gradually and in due time. The quantities supplied must match the amounts actually used for spreading.

## **4.2 STANDBY SERVICE**

The main standby service is unified and located in the \_\_\_\_\_ **Company** headquarters. On each road maintenance depot, it is organized as shown in a separate part of this plan.

### **STAFF**

The company in charge of winter maintenance should adopt an internal ordinance regarding the winter maintenance, which should also specify the obligations of the workers assigned to winter maintenance. These requirements should be explained to the workers by their respective regional heads in a meeting that takes place before the winter season. The heads of operative departments will brief the workers on the requirements arising from the regulations regarding the maintenance of public roads.

## **4.3 WINTER MAINTENANCE DURATION**

### **Preliminary activities**

The preliminary activities fall into the period **from 1.10.2003 to 15.11.2003**. They involve the following preparatory tasks:

- preparation of the winter maintenance operational plan;
- installation of winter traffic signs;
- installation of snow posts;
- preparation of depots for storing the spreading materials;
- preparation of road maintenance depots where the staff will be stationed;
- preparation of winter machinery;
- installation of avalanche barriers;
- training the workers.

### **WINTER MAINTENANCE**

Winter maintenance lasts **from 15.11.2003 to 15.3.2004**. This is the period when winter maintenance work is performed, by the trained teams of workers as defined in the plan, using the winter maintenance equipment and following the priority order as specified in the plan. If necessary, winter maintenance may also take place before 15.11.2003 or after 15.03.2004. Such extensions must be decreed by the appropriate organization as defined in the regulations.

### **Later activities**

Later activities will take place after the winter maintenance season is over, i.e. **from 15.3.2004 to 15.4.2004**. These activities include:



| <b>institution, name, surname</b>                    | <b>title</b> | <b>☎ at work</b> | <b>☎ at home</b> |
|--|--------------|------------------|------------------|
| ROAD DIRECTORATE                                     |              |                  |                  |
| MINISTRY OF THE INTERIOR                             |              |                  |                  |
| ROAD INSPECTORATE                                    |              |                  |                  |
| PUBLIC BROADCASTING COMPANY                          |              |                  |                  |
| TELETEXT   |              |                  |                  |
| RADIO  |              |                  |                  |
| INFORMATION SERVICE OF THE AUTOMOBILE ASSOCIATION    |              |                  |                  |
| WEATHER SERVICE                                      |              |                  |                  |
| POLICE ADMINISTRATION                                |              |                  |                  |
| TRAFFIC POLICE DEPARTMENT                            |              |                  |                  |
| Responsible employees of the maintenance contractor: |              |                  |                  |
|  |              |                  |                  |
|  |              |                  |                  |
|  |              |                  |                  |
|  |              |                  |                  |

**7 PHONE NUMBERS OF THE RESPONSIBLE EMPLOYEES OF THE CONTRACTOR RESPONSIBLE EMPLOYEES**

| <b>SURNAME AND NAME</b>            | <b>TITLE</b> | <b>GSM</b> | <b>PHONE / FAX</b> | <b>e-mail address</b> |
|------------------------------------|--------------|------------|--------------------|-----------------------|
| <b>HEAD OF THE STANDBY SERVICE</b> |              |            |                    |                       |
|                                    |              |            |                    |                       |
|                                    |              |            |                    |                       |
|                                    |              |            |                    |                       |
|                                    |              |            |                    |                       |
|                                    |              |            |                    |                       |
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|                                    |              |            |                    |                       |
|                                    |              |            |                    |                       |
|                                    |              |            |                    |                       |
|                                    |              |            |                    |                       |



## 8 DIVISION OF ROADS INTO PRIORITY CLASSES

Each road is assigned to a priority class depending on its category, traffic density and structure, geographic and climatic conditions, and local needs. The assignment of priority classes has been provided by the client (i.e. the road administration), which ensures the passability of the entire state road network.

### DIVISION OF ROADS INTO PRIORITY CLASSES

| prior. class | type of road  | when passable   | in case of snowfall  | in case of heavy snowfall   |
|--------------|---|---|--|---|
| I            | motorways, expressways  | 24 hours/day  | ensure passability of carriageways, major junctions, accesses to major parking lots, and emergency lanes | ensure passability of at least one lane and accesses to major parking lots  |
| II           | roads with AADT > 4000, trunk roads, main urban roads, major regional roads   | 05-22 o'clock   | ensure passability; traffic may be blocked up to 2 hours between 22-05 o'clock                           | ensure passability (of at least one lane, if there are several), traffic may be blocked, esp. between 22-05 o'clock |
| III          | other regional roads, major local roads, collecting urban and community roads | 05-20 o'clock   | ensure passability; traffic may be blocked up to 2 hours, esp. between 22-05 o'clock                     | ensure passability (of at least one lane, if there are several), traffic may be blocked, esp. between 20-05 o'clock |
| IV           | other local, urban, and community roads                                       | 07-20 o'clock, taking local requirements into account | ensure passability; traffic may be blocked briefly   | ensure passability; traffic may be blocked up to one day  |
| V            | public paths, parking lots, bicycle lanes                                     | depends on local requirements                         | ensure passability; traffic may be blocked up to one day   | ensure passability; traffic may be blocked for several days   |
| VI           | roads closed during winter conditions   |   |  |   |

**Note:**

- Roads are considered passable if the snow is not deeper than 10 cm for first- and second-class roads, or 15 cm for other roads, and if traffic is possible assuming that vehicles are using winter equipment.
- Regardless of the provisions of the third column, passability need not be absolutely guaranteed in times of extremely heavy snowfall, heavy snow drifts, or avalanches. The same applies to road ice if rain has made the entire road slippery and the available technical means are insufficient to remove the ice.

**9 LIST OF ROADS AND THEIR PRIORITY CLASSES**

| <b>section</b> | <b>road</b> | <b>route</b> | <b>WM priority class</b> | <b>AADT</b> | <b>notes</b> |
|----------------|-------------|--------------|--------------------------|-------------|--------------|
|                |             |              |                          |             |              |
|                |             |              |                          |             |              |
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|                |             |              |                          |             |              |
|                |             |              |                          |             |              |
|                |             |              |                          |             |              |

**TOTAL LENGTH OF ROADS IN EACH PRIORITY CLASS**

|                    |  |
|--------------------|--|
| Priority class I   |  |
| Priority class II  |  |
| Priority class III |  |
| Priority class VI  |  |
| <b>TOTAL:</b>      |  |

**Attachment: A MAP OF PRIORITY CLASSES**

**10 CAPACITIES OF SPREADING MATERIAL WAREHOUSES**

| <b>ROAD<br/>MAIN-<br/>TENANCE<br/>DEPOT</b> | <b>NaCl</b><br>0-2, 0-4<br>silo<br>(t) | <b>NaCl</b><br>0-2, 0-4<br>warehouse<br>(t) | <b>Crushed<br/>stone</b><br>4-8 mm<br>(tons or m3) | <b>Crushed<br/>stone</b><br>8-16 mm<br>(tons or m3) | <b>MgCl<sub>2</sub></b><br>(CaCl <sub>2</sub> )<br>silo<br>(t) | <b>MgCl<sub>2</sub></b><br>(CaCl <sub>2</sub> )<br>warehouse<br>(t) |
|---|--|---|--|---|--|---|
|   |  |   |  |   |  |   |
|   |  |   |  |   |  |   |
|   |  |   |  |   |  |   |
|   |  |   |  |   |  |   |
|   |  |   |  |   |  |   |

**Key:**

- ❖ silo (**S**)
- ❖ warehouse (**W**)
- ❖ open-air storage depot (**D**)
- ❖ sacks (**V**)

**MINIMAL STOCKS OF SPREADING MATERIALS**

Minimal stocks of spreading materials must be defined to ensure the timely availability of spreading materials.

| <b>ROAD<br/>MAIN-<br/>TENANCE<br/>DEPOT</b> | <b>NaCl</b><br>0-2, 0-4<br>silo<br>(t) | <b>NaCl</b><br>0-2, 0-4<br>warehouse<br>(t) | <b>Crushed<br/>stone</b><br>4-8 mm<br>(tons or<br>m3) | <b>Crushed<br/>stone</b><br>8-16 mm<br>(tons or<br>m3) | <b>MgCl<sub>2</sub></b><br>(CaCl <sub>2</sub> )<br>silo<br>(t)* | <b>MgCl<sub>2</sub></b><br>(CaCl <sub>2</sub> )<br>warehouse<br>(t)* |
|---|--|---|---|--|---|--|
|   |  |   |   |  |   |  |
|   |  |   |   |  |   |  |
|   |  |   |   |  |   |  |
|   |  |   |   |  |   |  |
|   |  |   |   |  |   |  |

**Key:**

- ❖ silo (**S**)
- ❖ warehouse (**W**)
- ❖ open-air storage depot (**D**)
- ❖ sacks (**V**)

Note: MgCl<sub>2</sub> (CaCl<sub>2</sub>) can be dry (t) or in a solution (l)

**11 CALCULATION OF THE REQUIRED QUANTITIES OF SPREADING MATERIALS**

**SALT**

| ROAD MAINTENANCE DEPOT | ROAD SURFACE (m <sup>2</sup> ) | NORM. REQ. kg/m <sup>2</sup> | AMOUNT tons   |
|------------------------|--------------------------------|------------------------------|---------------|
|                        |                                |                              |               |
|                        |                                |                              |               |
|                        |                                |                              |               |
|                        |                                |                              |               |
|                        |                                |                              |               |
|                        |                                |                              |               |
|                        |                                |                              |               |
|                        |                                |                              | <b>TOTAL:</b> |

NOTE: The normative requirements are non-realistic compared to the average over the last five years!

**CRUSHED STONE:** grain size 4-8 mm (for spreading on asphalt pavement)  
 (normative requirements for trunk roads = 10 m<sup>3</sup>/km,  
 for regional roads = 8 m<sup>3</sup>/km)

| ROAD MAINTENANCE DEPOT | ROAD LENGTH (km) | NORMATIVE REQUIREMENTS tons/km | AMOUNT tons   |
|------------------------|------------------|--------------------------------|---------------|
|                        |                  |                                |               |
|                        |                  |                                |               |
|                        |                  |                                |               |
|                        |                  |                                |               |
|                        |                  |                                |               |
|                        |                  |                                |               |
|                        |                  |                                | <b>TOTAL:</b> |

**CRUSHED STONE:** grain size 8-16 mm (for spreading on macadamized roads)  
 (normative requirements for regional roads = 8 m<sup>3</sup>/km)

| ROAD DEPOT | ROAD LENGTH km | NORMATIVE REQUIREMENTS tons/km | AMOUNT tons |
|------------|----------------|--------------------------------|-------------|
|            |                |                                |             |

|  |               |  |               |
|--|---------------|--|---------------|
|  |               |  |               |
|  |               |  |               |
|  |               |  |               |
|  |               |  |               |
|  |               |  |               |
|  | <b>TOTAL:</b> |  | <b>TOTAL:</b> |

**CALCULATION OF NaCl REQUIREMENTS**

Expected NaCl requirements:

Spreading length for motorways and expressways (4 lanes), using automated spreaders, 32 t/km, or 6.4 t/km for attachments. Spreading length for trunk and regional roads from the first and second priority class, using automated spreaders; {**length of trunk roads in km x 6 t/km** (normative requirements)+ **length of regional roads in km x 4 t/km** (normative requirements)} x **30%** = **\_\_\_ tons**

**CALCULATION OF MgCl<sub>2</sub> OR CaCl<sub>2</sub> REQUIREMENTS** (wet salting)

Normative requirements for wet salting: 30% MgCl<sub>2</sub> (CaCl<sub>2</sub>) mixed with NaCl.

For motorways and expressways, the number of spreaders for each motorway maintenance depot is determined on the basis of normative requirements (motorway length, number of lanes, difficulty of the sections involved):

---

This contractor covers the area of each road maintenance depot by one automated spreader to be used on trunk and regional roads from the first and second priority class.

**12 INVENTORY OF SPREADING MATERIAL STOCKS**

Company \_\_\_\_\_

Period from \_\_\_\_\_ to \_\_\_\_\_

| ROAD DEPOTS   |            | Depot 1 | Depot 2 | Depot 3 | Depot 4 | Depot 5 | Depot 6 | Depot 7 | Depot 8 | Depot 9 | TOTAL |
|---|------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-------|
| <b>NaCl<sub>2</sub> 0-4 mm<br/>4 % humidity</b>                 | Old amount |         |         |         |         |         |         |         |         |         |       |
|   | Supplied   |         |         |         |         |         |         |         |         |         |       |
|   | Used       |         |         |         |         |         |         |         |         |         |       |
|   | New amount |         |         |         |         |         |         |         |         |         |       |
| <b>NaCl<sub>2</sub> 0-4 mm<br/>1 % humidity</b>                 | Old amount |         |         |         |         |         |         |         |         |         |       |
|   | Supplied   |         |         |         |         |         |         |         |         |         |       |
|   | Used       |         |         |         |         |         |         |         |         |         |       |
|   | New amount |         |         |         |         |         |         |         |         |         |       |
| <b>NaCl<sub>2</sub> 0-2 mm<br/>4 % humidity</b>                 | Old amount |         |         |         |         |         |         |         |         |         |       |
|   | Supplied   |         |         |         |         |         |         |         |         |         |       |
|   | Used       |         |         |         |         |         |         |         |         |         |       |
|   | New amount |         |         |         |         |         |         |         |         |         |       |
| <b>NaCl<sub>2</sub> 0-2 mm<br/>1 % humidity</b>                 | Old amount |         |         |         |         |         |         |         |         |         |       |
|   | Supplied   |         |         |         |         |         |         |         |         |         |       |
|   | Used       |         |         |         |         |         |         |         |         |         |       |
|   | New amount |         |         |         |         |         |         |         |         |         |       |
| <b>CaCl<sub>2</sub> (20-24%) or<br/>MgCl<sub>2</sub> (30 %)</b> | Old amount |         |         |         |         |         |         |         |         |         |       |
|   | Supplied   |         |         |         |         |         |         |         |         |         |       |
|   | Used       |         |         |         |         |         |         |         |         |         |       |
|   | New amount |         |         |         |         |         |         |         |         |         |       |
| <b>CaCl<sub>2</sub> (dry) or<br/>MgCl<sub>2</sub> (ry)</b>      | Old amount |         |         |         |         |         |         |         |         |         |       |
|   | Supplied   |         |         |         |         |         |         |         |         |         |       |
|   | Used       |         |         |         |         |         |         |         |         |         |       |
|   | New amount |         |         |         |         |         |         |         |         |         |       |

NOTE: The above quantities reflect the stocks of spreading materials after the closing accounts of the 2002/2003 winter maintenance season, and form the basis for keeping track of the stocks during the 2003/2004 winter season.

Prepared by the contractor's representative: \_\_\_\_\_

Date: \_\_\_\_\_

Approved by the supervisor: \_\_\_\_\_

Date: \_\_\_\_\_

### 13 ACCOUNTING FOR WINTER MAINTENANCE WORK (STANDBY WORK AND READINESS) FOR EACH PHASE OF THE WORK

To ensure the passability of roads, the safety of road traffic, and timely response to winter conditions and emergencies, the winter maintenance service is located in one of several readiness levels at any given moment from 15.11.2003 to 15.03.2004, as well as outside this period if necessary.

#### 13.1 ACCOUNTING INSTRUCTIONS FOR STANDBY WORK AND READINESS

##### Monthly winter maintenance accounting plan

Winter service work is divided into several phases and accounting is done separately for each phase, as follows:

##### ***Readiness level 1***

This level involves:

- one person on standby at each winter maintenance point (usually a driver, being able to take action immediately if weather conditions deteriorate during a road inspection) 24 hours/day, all days of the month.

The calculation is: 24 hours x 30 days – effective regular working hours = 720 – 176 = 544 hours

- one machine operator and one road worker waiting in readiness at home per road maintenance depot or road maintenance point.

The calculation is: 16 hours x 20 days = 320 hours (workdays, regular hours deducted)

24 hours x 2 days x 4 = 192 hours (Saturdays, Sundays)

Total 512 hours, of which \_\_\_\_\_ hours are expected to be spent waiting in readiness and \_\_\_\_\_ hours of effective standby work outside regular working hours.

- chief of the standby service, who is however already included in the factors

The team also includes a truck (which incurs a readiness charge and is assigned to a suitable group) with an automated spreader and a front plough. Based on experience, \_\_\_\_\_ hours are expected to be spent inspecting the roads, which includes \_\_\_\_\_ hours of spreading and \_\_\_\_\_ hours of plowing; additionally, \_\_\_\_\_ hours are expected to be spent by the excavator loading the spreading materials. All these times are per spreading unit.

The total account of the level-1 readiness is the sum of the standby work and the readiness charges.

**In case of stable good weather, an agreement may be made with the supervisors to temporarily discontinue regular standby work on the depot (except for the head of the standby service). Accounting is based on the work actually performed rather than just for waiting on standby!**

**Standby work is accounted based on the standby work actually performed!**

##### ***Readiness level 2***

This level of readiness is introduced in when bad weather is forecast and a written order (fax) is sent by the head of the client's (i.e. road administrator's) standby service. At this level, each standby team is augmented by an additional vehicle (or two vehicles for winter maintenance points covering a larger amount of roads – approx. 200 km or more) with a driver and a road worker. The standby teams are called to their work stations if

necessary. Additionally other teams are placed in a state of readiness at home, as defined in the winter maintenance operational plan (blank readiness).

If necessary, the contractor may introduce level 2 readiness based on its own judgment of local weather conditions and by agreement with the supervisors. The head of the client's standby service must be informed. As soon as possible, the supervisor should send the contractor a written confirmation agreeing with the introduction of level 2 readiness.

Regardless of the total length of the roads, introduction of level 2 readiness requires an additional driver to be placed on standby.

After instructions are obtained from the client, the machine operator and the road worker that had been waiting in readiness at home are assigned to their place of work (the road worker is only needed if there is no automated spreading attachment).

Based on averages achieved during level 2 readiness, the expected number of working hours is \_\_\_\_\_ hours for each vehicle with a spreader and a plough. The appropriate number of workers, trucks, and excavators must be entered into the table.

Thus \_\_\_\_\_ hours of spreading and \_\_\_\_\_ hours of plowing are expected and have been agreed upon, and a further \_\_\_\_\_ hours of the excavator will be used for each road maintenance depot or winter road maintenance point to load the spreading materials.

Readiness charges will apply to the remaining road workers (per 15 km) and drivers (per 25 km), after the staff already engaged in level-2 work has been deduced. These remaining workers must be available in case the winter maintenance contractor moves into level 3 readiness.

The expected number of days spent in level 2 readiness is the average over the last two winter seasons.

A readiness charge or a monthly fee is collected for all remaining ploughing units (one per 50 km, deducting those already included in level-1 requirements).

Depreciation applies only to machines not older than 10 years. Thus, the total number of ploughing units must be entered, based on the extended price list for winter machinery. Machines subject to accelerated depreciation in the first 3 or 7 years must be listed separately. The remainder constitutes the monthly machinery depreciation given the approved price list.

The monthly costs also include snow posts, which are accounted based on the number of posts actually used, following the instructions in chapter **21** (based on calculation or on experience – approx. 1/3 of all snow posts are replaced in any given year), and the cold material, where the expected consumption is the average over the last three winter seasons.

The sum of level 1 and level 2 readiness is the total amount of standby work and readiness for each road company. The expenses obtained assuming a given number of operational hours per month are an estimate of the average costs per unit.

### ***Readiness level 3***

Finally, winter service may enter the third level of readiness, at which point all machinery and staff included in the plan are called into action and directly begin winter maintenance work. This estimate depends on the amount of snowfall and the number of winter maintenance operations. Based on experience from the previous years, the client assumes that each vehicle will be engaged up to 15 hours per month on work of this type.

### ***Salt storage***

Accounting for the storage of salt must take into account the average consumption over the last two winter seasons. The same method is also used for spreading materials.



**Inspection service**

During the winter maintenance period, inspectors' work is accounted separately as winter inspections. Only the inspection vehicles must be defined and assigned to groups for 100 work hours and 50 waiting hours.

**Other work**

In case of favourable weather conditions (a mild winter), any road workers in excess of one per 15 km and not engaged in standby work must spend their working hours (150 hours/month) on various non-winter maintenance tasks. The expected costs of this work are listed under "Excess road workers – variable". The contractors must prepare a work plan and a Gantt chart for each road section. The plan must also include expected machine requirements (e.g. excavators, motor saws, delineator post cleaner) and expected consumption of materials (e.g. gravel). This calculation assumes that the amount of non-winter work during the winter season will match that for an average winter. If the winter is mild, up to 30 % more of such work is expected; if it is particularly harsh, 30 % less of such work will be performed.

The xx % VAT must only be defined for the difference in work and machinery used in case of a mild winter, based on a formula!

**Vehicles equipped with an automated spreader attachment require only the driver, but no companion worker.**

**14 STATE OF MACHINES AND EQUIPMENT, ASSIGNMENT OF MACHINES TO MAINTENANCE UNITS**

In the summer, winter machinery is inspected and any major or minor maintenance work performed. Worn-out machinery is repaired or replaced. On average, machines available for the maintenance of the state road network are ..... years old.

**ROAD MAINTENANCE DEPOT \_\_\_\_\_**

| no. | name and surname | role | brand, type | license number | year purchased | readiness level |            | readiness level |             | readiness level |             |
|-----|------------------|------|-------------|----------------|----------------|-----------------|------------|-----------------|-------------|-----------------|-------------|
|     |                  |      |             |                |                | I.              |            | II.             |             | III.            |             |
|     |                  |      |             |                |                | vehicle         | machi-nist | vehicle         | road worker | vehicl e        | road worker |
| 1.  |                  |      |             |                |                |                 |            |                 |             |                 |             |
| 2.  |                  |      |             |                |                |                 |            |                 |             |                 |             |
| 3.  |                  |      |             |                |                |                 |            |                 |             |                 |             |
| 4.  |                  |      |             |                |                |                 |            |                 |             |                 |             |
| 5.  |                  |      |             |                |                |                 |            |                 |             |                 |             |
| 6.  |                  |      |             |                |                |                 |            |                 |             |                 |             |
| 7.  |                  |      |             |                |                |                 |            |                 |             |                 |             |
| 8.  |                  |      |             |                |                |                 |            |                 |             |                 |             |
| 9.  |                  |      |             |                |                |                 |            |                 |             |                 |             |
| 10. |                  |      |             |                |                |                 |            |                 |             |                 |             |
| 11. |                  |      |             |                |                |                 |            |                 |             |                 |             |

Appropriate boxes in the "readiness level" columns should be ticked "X".

ROAD MAINTENANCE DEPOT \_\_\_\_\_

| no. | name and surname | role | brand, type | license number | year purchased | readiness level |                 | readiness level |                | readiness level |                |
|-----|------------------|------|-------------|----------------|----------------|-----------------|-----------------|-----------------|----------------|-----------------|----------------|
|     |                  |      |             |                |                | I.              |                 | II.             |                | III.            |                |
|     |                  |      |             |                |                | vehicle         | machi<br>nister | vehicle         | road<br>worker | vehicle         | road<br>worker |
| 1.  |                  |      |             |                |                |                 |                 |                 |                |                 |                |
| 2.  |                  |      |             |                |                |                 |                 |                 |                |                 |                |
| 3.  |                  |      |             |                |                |                 |                 |                 |                |                 |                |
| 4.  |                  |      |             |                |                |                 |                 |                 |                |                 |                |
| 5.  |                  |      |             |                |                |                 |                 |                 |                |                 |                |
| 6.  |                  |      |             |                |                |                 |                 |                 |                |                 |                |
| 7.  |                  |      |             |                |                |                 |                 |                 |                |                 |                |
| 8.  |                  |      |             |                |                |                 |                 |                 |                |                 |                |
| 9.  |                  |      |             |                |                |                 |                 |                 |                |                 |                |
| 10. |                  |      |             |                |                |                 |                 |                 |                |                 |                |
| 11. |                  |      |             |                |                |                 |                 |                 |                |                 |                |

ROAD MAINTENANCE DEPOT \_\_\_\_\_

| no. | name and surname | role | brand, type | license number | year purchased | readiness level |                 | readiness level |                | readiness level |                |
|-----|------------------|------|-------------|----------------|----------------|-----------------|-----------------|-----------------|----------------|-----------------|----------------|
|     |                  |      |             |                |                | I.              |                 | II.             |                | III.            |                |
|     |                  |      |             |                |                | vehicle         | machi<br>nister | vehicle         | road<br>worker | vehicle         | road<br>worker |
| 1.  |                  |      |             |                |                |                 |                 |                 |                |                 |                |
| 2.  |                  |      |             |                |                |                 |                 |                 |                |                 |                |
| 3.  |                  |      |             |                |                |                 |                 |                 |                |                 |                |
| 4.  |                  |      |             |                |                |                 |                 |                 |                |                 |                |
| 5.  |                  |      |             |                |                |                 |                 |                 |                |                 |                |
| 6.  |                  |      |             |                |                |                 |                 |                 |                |                 |                |
| 7.  |                  |      |             |                |                |                 |                 |                 |                |                 |                |
| 8.  |                  |      |             |                |                |                 |                 |                 |                |                 |                |
| 9.  |                  |      |             |                |                |                 |                 |                 |                |                 |                |
| 10. |                  |      |             |                |                |                 |                 |                 |                |                 |                |
| 11. |                  |      |             |                |                |                 |                 |                 |                |                 |                |

**ROAD MAINTENANCE DEPOT \_\_\_\_\_**

| no. | name<br>surname | and | role | brand,<br>type | license<br>number | year<br>purchased | readiness level |               | readiness level |                | readiness level |                |
|-----|-----------------|-----|------|----------------|-------------------|-------------------|-----------------|---------------|-----------------|----------------|-----------------|----------------|
|     |                 |     |      |                |                   |                   | I.              |               | II.             |                | III.            |                |
|     |                 |     |      |                |                   |                   | vehicle         | machi<br>nist | vehicle         | road<br>worker | vehicle         | road<br>worker |
| 1.  |                 |     |      |                |                   |                   |                 |               |                 |                |                 |                |
| 2.  |                 |     |      |                |                   |                   |                 |               |                 |                |                 |                |
| 3.  |                 |     |      |                |                   |                   |                 |               |                 |                |                 |                |
| 4.  |                 |     |      |                |                   |                   |                 |               |                 |                |                 |                |
| 5.  |                 |     |      |                |                   |                   |                 |               |                 |                |                 |                |
| 6.  |                 |     |      |                |                   |                   |                 |               |                 |                |                 |                |
| 7.  |                 |     |      |                |                   |                   |                 |               |                 |                |                 |                |
| 8.  |                 |     |      |                |                   |                   |                 |               |                 |                |                 |                |
| 9.  |                 |     |      |                |                   |                   |                 |               |                 |                |                 |                |
| 10. |                 |     |      |                |                   |                   |                 |               |                 |                |                 |                |
| 11  |                 |     |      |                |                   |                   |                 |               |                 |                |                 |                |

**15 SPREADING MATERIAL DEPOTS IN CRITICAL LOCATIONS ALONG THE ROAD**

These small depots along the road are intended for the local manual spreading of roads in critical locations.

| ROAD No | LOCATION      | GRAVELm <sup>3</sup> | DEPOT – SILO |
|---------|---------------|----------------------|--------------|
|         |               |                      |              |
|         |               |                      |              |
|         |               |                      |              |
|         |               |                      |              |
|         |               |                      |              |
|         |               |                      |              |
|         |               |                      |              |
|         | <b>TOTAL:</b> |                      |              |

Critical road locations are areas where extreme winter conditions occur in the time of heavy snowfall and ice. This includes slopes, mountain passes, narrow gorges, viaducts exposed to the wind, etc.

The following critical sections are located in the area maintained by the \_\_\_\_\_ company:

| SEQ. NO. | ROAD | SECTION | ROUTE |
|----------|------|---------|-------|
|          |      |         |       |
|          |      |         |       |
|          |      |         |       |
|          |      |         |       |
|          |      |         |       |
|          |      |         |       |
|          |      |         |       |
|          |      |         |       |

Appropriate winter traffic signs must be installed in these locations. These signs are described in detail in the chapter on **reasons and locations of winter road traffic signs during the winter maintenance season.**

**16 LIST OF DANGEROUS ROAD SECTIONS WITH FREQUENT FORMATION OF ICE**

| ROAD NO. | SECTION | ROUTE | FROM km | TO km | LENGTH km | DESCRIPTION OF CONDITIONS |
|----------|---------|-------|---------|-------|-----------|---------------------------|
|          |         |       |         |       |           |                           |
|          |         |       |         |       |           |                           |
|          |         |       |         |       |           |                           |
|          |         |       |         |       |           |                           |
|          |         |       |         |       |           |                           |
|          |         |       |         |       |           |                           |
|          |         |       |         |       |           |                           |
|          |         |       |         |       |           |                           |
|          |         |       |         |       |           |                           |
|          |         |       |         |       |           |                           |
|          |         |       |         |       |           |                           |
|          |         |       |         |       |           |                           |
|          |         |       |         |       |           |                           |
|          |         |       |         |       |           |                           |
|          |         |       |         |       |           |                           |
|          |         |       |         |       |           |                           |

**17 MATERIALS SPREAD ON THE ROADS**

**SALT**

Either sea or rock salt can be used for salting the roads. It must meet all the conditions set in the Road Directorate’s tender regarding its granulometric composition, presence of humidity and any admixtures (impurities). Salt with granularity 0-4 mm is used when spreading with trailer spreaders, either by itself or mixed with crushed stone in a suitable proportion. Salt with granularity 0-2 mm is used for spreading with automated spreaders, either by itself or as a mixture of salt (NaCl) with a CaCl<sub>2</sub> or MgCl<sub>2</sub> solution. Salt has a tendency to agglomerate during storage, and anti-agglomerating additives must therefore be used. Salt is stored in tower silos or in covered warehouses, either loose or in bags.

**CRUSHED STONE**

This is crushed limestone material, obtained from the \_\_\_\_\_ quarry, consisting of 4-8 mm and 8-16 mm fractions. The crushed stone must meet the control requirements. The 4-8 mm fraction is used for spreading over asphalt pavements, either by itself or mixed with salt in a suitable proportion. The 8-16 mm fraction is used on macadamized roads. The stone is stored in warehouses or in open-air depots.

**CaCl<sub>2</sub>**

This is a 20% calcium chloride solution used together with dry salt (the exact proportion depends on the weather conditions) for salting asphalt pavements. The solution is stored in tanks; dry calcium chloride is packed in bags and stored in dry covered warehouses.

**MgCl<sub>2</sub>**

Is a solution with the same properties as CaCl<sub>2</sub>. It is stored in tanks, while dry magnesium chloride is stored in bags on pallets in warehouses of individual road maintenance depots.

**Estimated quantities of spreading materials**

To reduce harm to the environment, the amount of spreading materials used should be as low as possible, as long as it still enables efficient removal of road ice. The exact quantities depend on the type of dry or wet spreader used, as shown below. The spreader should include a dosage control device.

|                   |                           |                           |
|-------------------|---------------------------|---------------------------|
| <b>ASSALONI</b>   | salt consumption          | 5 - 50 g/m <sup>2</sup>   |
|                   | crushed stone consumption | 30 - 200 g/m <sup>2</sup> |
| <b>KAHLBACHER</b> | salt consumption          | 5 - 40 g/m <sup>2</sup>   |
|                   | crushed stone consumption | 25 - 200 g/m <sup>2</sup> |

For wet salting, the usual ratio of dry material and brine is 70:30.

**18 LOCATIONS OF WINTER ROAD TRAFFIC SIGNS**

**MOTORWAYS, EXPRESSWAYS, TRUNK ROADS, REGIONAL ROADS**

| road | section | station | location | code of the traffic sign or combination of signs |
|------|---------|---------|----------|--|
|      |         |         |          |  |
|      |         |         |          |  |
|      |         |         |          |  |
|      |         |         |          |  |
|      |         |         |          |  |
|      |         |         |          |  |
|      |         |         |          |  |
|      |         |         |          |  |
|      |         |         |          |  |



## 21 BASES FOR DETERMINING THE NUMBER OF SPREADING AND PLOUGHING UNITS

The number of spreading and ploughing units should be determined and calculated on the basis of the condition and length of the road section.

### THE FOLLOWING CONDITIONS SHOULD BE TAKEN INTO CONSIDERATION FOR SPREADING UNITS:

1. In areas where the longitudinal slope of the road is 4 % or more, the smoothness of the pavement has a particularly large impact on the passability and traffic safety. Such areas require more frequent spreading, and should be multiplied by a factor of 1.5.
2. In areas where the carriageway is at least 7 m wide, several passes must be made to ensure uniform distribution of the spreading material. A factor of 2.0 is used in this case.
3. Urban roads require more frequent and more thorough spreading because of public transport, junctions, and other circumstances. A factor of 1.5 is used.
4. If several of the above conditions occur together, they should all be taken into account.

### The following conditions should be taken into consideration for ploughing units:

1. In areas where the longitudinal slope of the road is 4 % or more, traffic is slower, heavier trucks are used, or delays in the use of chains occur, a factor of 1.5 should be applied.
2. If the width of a bidirectional carriageway is at least 6 m, a single plough unit cannot plough the entire width; in this case, a ploughing unit consists of two ploughs. If there are several lanes in each direction, a ploughing unit should consist of three ploughs.
3. Ploughing of urban roads takes more time due to urban traffic, curbs, and junctions. A factor of 2.0 should be used.
4. If several of the above conditions occur together, they should all be taken into account.

### DETERMINING THE NUMBER OF SPREADING OR PLOUGHING UNITS

Total road length in each priority class

| Priority class     | Length in km |
|--------------------|--------------|
| priority class I   |              |
| priority class II  |              |
| priority class III |              |
| priority class VI  |              |
| <b>TOTAL:</b>      |              |

### Calculation of the number of vehicles for priority class I

|                               | SPREADERS                      | PLOUGHS                        |
|-------------------------------|--------------------------------|--------------------------------|
| length of roads in this class |                                |                                |
| length with slope > 4 %       |                                |                                |
| length where width > 6 m      |                                |                                |
| length in populated areas     |                                |                                |
| calculation                   | Total km / 50 = ..... vehicles | Total km / 30 = ..... vehicles |

**Calculation of the number of vehicles for priority class II**

|                               | SPREADERS                      | PLOUGHS                        |
|-------------------------------|--------------------------------|--------------------------------|
| length of roads in this class |                                |                                |
| length with slope > 4 %       |                                |                                |
| length where width > 6 m      |                                |                                |
| length in populated areas     |                                |                                |
| calculation                   | Total km / 50 = ..... vehicles | Total km / 30 = ..... vehicles |

**Calculation of the number of vehicles for priority class III**

|                               | SPREADERS                      | PLOUGHS                        |
|-------------------------------|--------------------------------|--------------------------------|
| length of roads in this class |                                |                                |
| length with slope > 4 %       |                                |                                |
| length where width > 6 m      |                                |                                |
| length in populated areas     |                                |                                |
| calculation                   | Total km / 50 = ..... vehicles | Total km / 30 = ..... vehicles |

**22 PLOUGHING PLAN**

For vehicle and equipment (plough and spreader) combination no. 1:

| Vehicle type | License number | Driver's name and surname |
|--------------|----------------|---------------------------|
|              |                |                           |
|              |                |                           |

| combi-<br>nation | road | section | ploughing route | length<br>in km |
|------------------|------|---------|-----------------|-----------------|
| 1.               |      |         |                 |                 |
|                  |      |         |                 |                 |
|                  |      |         |                 |                 |
| TOTAL:           |      |         |                 |                 |

**MAP: PLOUGHING PLAN**



**23 SPREADING PLAN**

For vehicle and equipment combination (plough and spreader) no. 1:

| Vehicle type | License number | Driver's name and surname |
|--------------|----------------|---------------------------|
|              |                |                           |
|              |                |                           |

| combi-<br>nation | road | section | spreading route | length<br>in km |
|------------------|------|---------|-----------------|-----------------|
| 1.               |      |         |                 |                 |
|                  |      |         |                 |                 |
|                  |      |         |                 |                 |
| TOTAL:           |      |         |                 |                 |

**MAP: SPREADING PLAN**

**24 STANDBY SCHEDULES, REQUIRED PRESENCE, READINESS LEVEL, AND ASSIGNMENT OF TASKS AND WORK TEAMS IN THE WINTER SERVICE**

The area maintained by the \_\_\_\_\_ **Company** is divided into (number) ..... road maintenance depots. These depots are located at:

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

During the winter season, after the first snowfall or appearance of ice, a team is ready 24 hours a day, consisting of a standby worker at the workplace and a driver and machine operator waiting in readiness at home, as specified by the client.

Three levels of readiness are defined and the level in force depends on the expected winter weather conditions and the weather forecast received from the weather service.

Level 1 standby work covers all 24 hours a day and all days in the month, starting from the date required by the client and continuing throughout the winter maintenance season, as defined in the Regulations, regardless of the weather conditions.

During level 2 and 3 readiness, standby schedules depend on the winter conditions (and operations related to them) when ploughing and spreading are needed; it lasts for a few days or until all operations are done.

During level 2 and 3 readiness, standby work begins and ends when decreed in writing by the client or the \_\_\_\_\_ **Company**.

A team for the repair of minor and major faults on vehicles, machines, and equipment should also be organized (this team remains in readiness at home outside regular working

hours). This team repairs faults in the field or in the company garage and handles all equipment used for winter service.

In case of stable fair weather, regular standby presence in the workplace may be temporarily stopped (if the supervisors agree), excluding the head of the standby service.

The standby teams of the road maintenance depots send reports about weather conditions, road passability and the conditions on roads, depth of the snow cover, and various faults, breakdowns and other problems. The reports are sent to the company headquarters, where the head of the standby service takes appropriate action and forwards the reports in electronic form to the client's head of standby service.

These reports on the road condition and passability should be sent by the standby teams in the field to the head of the contractor's standby service at the company headquarters, and by the latter to the client's head of the standby service, at least once a day, no later than 04:45 AM. At times when major winter-related operations are in progress (e.g. ploughing or spreading), reports should be sent more frequently (one every three hours) or whenever major changes occur in the condition and passability of roads.

## 24.1 TASKS OF THE WINTER MAINTENANCE DUTY SUPERVISOR

The tasks of a winter maintenance duty supervisors can be performed by employees of the \_\_\_\_\_ **Company**, having secondary professional education and sufficient knowledge and training for these tasks. The standby service is active 24 hours a day without interruptions, follows the standby schedule, and lasts from the time it is instituted to the end of the winter season (usually from November 15 to March 15 of the following year). The standby service may be started earlier or later if warranted by the weather conditions.

### **The duty supervisor performs the following tasks:**

- organizes and monitors the ploughing and salting in the individual road maintenance depots;
- coordinates the work of the standby staff of the individual road depots;
- monitors the conditions and passability of individual road sections and forwards this information to the client in electronic form;
- maintains contact with the representatives of the client, the local police call centre, the automobile users' association, the local emergency notification centre, and the media, constantly keeping these entities informed about the road conditions, both in written and spoken form, using the fax, radio, and e-mail;
- monitors the weather conditions and the weather forecast (amount of precipitation, temperature, air pressure, etc.);
- maintains records on road closures, traffic accidents, obstacles and barriers on the roads, and forwards this information to relevant entities;
- organizes road closures and detours, as well as the installation of the required road traffic signs;
- helps repair breakdowns and failures of winter service machinery and other equipment;
- organizes an emergency winter service headquarters in case of heavy snowfall;
- inspects critical sections of the road when necessary, and controls the situation in the field;
- when relieved by the next duty supervisor, he informs him of any important events and of the road conditions during his duty period;

- maintains a standby service logbook, recording his actions during the duty period, as well as weather conditions, road conditions and passability, using the prescribed forms;
- monitors the consumption of spreading material and arranges re-supplies (salt or crushed stone).

## **24.2 TASKS OF THE WINTER MAINTENANCE STANDBY STAFF OF A ROAD MAINTENANCE DEPOT**

On each maintenance depot, the standby team includes foremen, inspectors, drivers, machine operators, and road workers. The standby service is active 24 hours a day (unless a different arrangement has been approved by the supervisors), with shifts following the standby schedule. During major ploughing and de-icing operations, the standby tasks are left to the foremen of the individual road maintenance depots. They report directly to their superior sector chief and to the current winter service duty supervisor.

### **The standby worker's tasks are:**

- organizes and leads the ploughing and spreading of road sections following the winter maintenance operational plan;
- cooperates with the winter maintenance duty supervisor and keeps him informed of any traffic jams, avalanches, snow drifts, closures, depth of snowfall, weather conditions, and the road conditions and passability;
- regularly monitors weather conditions and forwards them to the duty supervisor, keeping the data current whenever major changes occur;
- controls the road condition and passability;
- performs the road inspection tasks;
- redirects and replaces vehicles, machines, and other equipment in case of breakdown, and organizes immediate repair and replacements;
- when necessary, works together with the police in the field, helping in case of traffic accidents, exclusion of vehicles from traffic, removal of obstacles from the road, redirection of traffic, installation of traffic signs, etc.;
- calls for additional ploughing and spreading and determines the spreading material and method;
- monitors the road condition and passability and regularly updates the information;
- informs the duty supervisor of any emergencies;
- monitors the consumption of spreading material and informs the duty supervisor in case re-supplies are needed (salt or crushed stone).
- performs any other unforeseen tasks.

## **25 COMMUNICATION METHODS**

Within each sector, information is transmitted using UHF wireless stations located on each road maintenance depot and mobile UHF stations installed in winter maintenance vehicles. Information can also be transmitted via mobile or fixed telephony. In normal conditions, most of the communications are between the road inspectors of the individual road maintenance depots or the standby teams on the one hand and the non-stop standby service in the \_\_\_\_\_ company headquarters on the other hand.

During periods of higher readiness and when winter operations are in progress, communication involves all persons responsible for winter maintenance work, using UHF

stations and land and mobile phone connections. All responsible persons are listed in the operational work plan.

The Public Roads Act and the Regulation on the maintenance of public roads require the road maintainer to report on the road conditions and passability, particularly during the winter season. Besides regular reports, additional reports should also be sent in case of emergency events.

Reporting begins on the same day as the winter maintenance season, and continues until the client officially requests its discontinuation.

The standby staff forward their road condition and passability information to the client based on a standard set of codes (see the attachment).

## 25.1 PASSABILITY CONTROL

The control over the road passability is organized within the road inspection service, which carries out regular daily road inspections according to the plan and informs the standby winter service staff. If necessary, the inspectors also perform minor tasks needed to enable safe and smooth traffic (drainage maintenance, manual clearing of snow and ice, repair and replacement of broken traffic signs, issuing requests for the exclusion of vehicles in extreme conditions).

## 25.2 ROAD CONDITION AND PASSABILITY REPORTING CODES

| ROAD CONDITION |  | ROAD PASSABILITY |   |
|----------------|--|------------------|---|
| 0              | no snow or ice   | 0                | normal – pavement is dry  |
| 1              | fog (visibility: a few meters)                                       | 0+               | wet pavement  |
| 3              | road ice   | 1                | traffic slightly obstructed (visibility above 50 m)                                     |
| 3+             | ice in some places   | 2                | traffic heavily obstructed (visibility up to 50 m)                                      |
| 4              | snow-covered pavement, new snow keeps falling everywhere             | 3                | winter equipment required   |
| 4+             | pavement partly covered by snow                                      | 4++              | chains required   |
| 5              | packed snow on the pavement  | 5                | road temporarily closed, no detour  |
| 5+             | packed snow partly covering the pavement                             | 6                | road temporarily closed with detour   |
| 6              | snowy slush  | 7                | road closed during the winter   |
| 6+             | slush in some places   | 9                | care needed in exposed locations (near structures, forests, etc.)                       |
| 7              | snow drift (several meters thick)                                    | 9+               | motorways: care needed on the passing lane;<br>other roads: care needed when overtaking |
| 7+             | snow drift in some places (several meters thick)                     | -                | no information available  |
| 9              | avalanches triggering  |                  |   |
| 9+             | danger of avalanches   |                  |   |
| -              | no information available   |                  |   |
|                | No code assigned:  |                  | No code assigned:   |
|                | floods, landslides, pavement damaged by cold, thaw, snowy wind, etc. |                  | exclusion of vehicles, traffic jams, closures, police measures, road work, etc.         |

**25.3 FORM: "EMERGENCY EVENT NOTIFICATION"**

**EMERGENCY EVENT**

**NOTIFICATION**

**Event type:** .....

**Date:** ..... **Time:**.....

**Road section:**.....

**Location:**.....

**Measure undertaken:**.....

**NOTE:**

**Authorized person:**

.....

This notice sent to:

- the client's standby service (phone no. ....)
- police call centre.....

**25.4 WINTER SERVICE STANDBY STAFF**

Form used for the reports of the winter service standby staff:

**"COMPANY"**

**WINTER SERVICE STANDBY REPORT:**

**ROAD CONDITION AND PASSABILITY**

| No. | Road Number | Observation point | Road company | Time | Road condition code | Road passability code | Temp. | New snow depth | Note |
|-----|-------------|-------------------|--------------|------|---------------------|-----------------------|-------|----------------|------|
| 1.  |             |                   |              |      |                     |                       |       |                |      |
| 2.  |             |                   |              |      |                     |                       |       |                |      |
| 3.  |             |                   |              |      |                     |                       |       |                |      |
| 4.  |             |                   |              |      |                     |                       |       |                |      |
| 5.  |             |                   |              |      |                     |                       |       |                |      |
| 6.  |             |                   |              |      |                     |                       |       |                |      |
| 7.  |             |                   |              |      |                     |                       |       |                |      |

Notes:

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

DATE: \_\_\_\_\_

TIME: \_\_\_\_\_

NAME OF THE STANDBY WORKER: \_\_\_\_\_

**Attachment: A MAP OF THE OBSERVATORY STATIONS AND MEASUREMENT POINTS, AND OF THE CONTROL OVER THE ROAD CONDITION AND PASSABILITY**

## 26 ACTIVITIES IN EXTREME WEATHER CONDITIONS

### 26.1 WINTER SERVICE HEADQUARTERS

When extreme conditions occur (extremely deep snow, strong wind, snow drifts, avalanches, freezing rain, breakdown of a large number of ploughing machines), the winter service headquarters become active.

**The staff of the winter service headquarters decide what measures should be undertaken to ensure passability despite the extreme conditions, seeks help from related agencies, and maintains contact with the local civil defense staff.**

The staff consists of:

- the director of the \_\_\_\_\_ **Company;**
- the person responsible for winter maintenance;
- department heads;
- head of the vehicle fleet;
- duty supervisor.

If necessary, representatives of the client, supervisors, regional police call centre, and the traffic police can also be involved.

The meetings of the staff meetings are minuted, and any resolutions are also recorded in the duty supervisor's logbook.

In case of extreme winter conditions, at least minimal passability must be ensured, while taking the road maintenance priority classes into account.

Therefore a meeting of the winter service staff decides which road sections are less important and will be closed to all traffic during the extreme conditions, while all ploughing machines used in those sections are redirected to the most important road sections belonging to higher priority classes.

All relevant agencies and traffic participants must **immediately** be notified that certain road sections will be closed.

In case of extreme conditions, the winter service staff also decides on the use of available facilities belonging to related organizations. Before the winter season begins, discussions should be held with such organizations to determine what equipment is available and could be used during extreme conditions and major snow-clearing operations.

### 26.2 GENERAL FORMATION OF ROAD ICE

In extremely unfavourable weather conditions that cause the general formation of road ice, additional spreading units from level-2 readiness are brought into operation. The focus should be on wet salting because the wet salting mixture works more quickly and efficiently. If necessary, additional vehicles with trailer spreaders should also be used. The division of roads into priority classes should be strictly observed.

### 26.3 ROAD COOLING

When the road temperature drops suddenly, the same effects as in the case of road ice can be observed, except that immediate spreading only exacerbates the problem – it can actually cause more ice to form. In this case, additional warning traffic signs should first be installed, and drivers should be (in cooperation with the traffic police, if possible) particularly alerted to drive carefully. In extreme cases, such roads may need to be closed to all traffic for some time; road users should be notified of this through the media.

### 26.4 FREEZING RAIN

Freezing rain often causes branches of trees and bushes to break. If this happens on or near the body of the road, special traffic signs should be installed, or the road may even need to be partly or fully closed. The obstacle should be removed as quickly as possible. As a precautionary measure, vegetation that could endanger the traffic safety should be

lopped and pruned in due time. If the freezing rain also leads to ice or glaze frost, activities from the previous paragraphs should also be undertaken.

**26.5 SNOW SHOWERS**

In cases when heavy snowfall begins while the road conditions were normal (the pavement was clear and dry), the response should be the same as during the first snowfall of the winter season; if the conditions were not normal, the situation should be treated like any other beginning of snowfall. If a longer period of snowfall is forecast, precautionary spreading should be performed to prevent the formation of a packed snow “board”. When the snowing stops or the snow cover becomes thick enough, the snow should be cleared.

**27 SCHEDULE OF SPECIAL WINTER MACHINERY**

Special winter equipment and machines are available for use in extreme weather conditions (extremely deep snow) and to ensure the passability of road sections located at higher altitudes. This equipment is distributed among several road maintenance depots. It is used when normal ploughing equipment is insufficient to ensure the passability of roads.

| NO. | TYPE OF MACHINE or SPECIAL EQUIPMENT | PROPERTY OF | DRIVER, OPERATOR | DEPOT WHERE STATIONED |
|-----|--------------------------------------|-------------|------------------|-----------------------|
| 1.  |                                      |             |                  |                       |
| 2.  |                                      |             |                  |                       |
| 3.  |                                      |             |                  |                       |
| 4.  |                                      |             |                  |                       |
| 5.  |                                      |             |                  |                       |
| 6.  |                                      |             |                  |                       |
| 7.  |                                      |             |                  |                       |
| 8.  |                                      |             |                  |                       |
| 9.  |                                      |             |                  |                       |
| 10. |                                      |             |                  |                       |
| 11. |                                      |             |                  |                       |
| 12. |                                      |             |                  |                       |
| 13. |                                      |             |                  |                       |
| 14. |                                      |             |                  |                       |
| 15. |                                      |             |                  |                       |
| 16. |                                      |             |                  |                       |
| 17. |                                      |             |                  |                       |
| 18. |                                      |             |                  |                       |
| 19. |                                      |             |                  |                       |
| 20. |                                      |             |                  |                       |
| 21. |                                      |             |                  |                       |
| 22. |                                      |             |                  |                       |
| 23. |                                      |             |                  |                       |



**28 LOCATIONS AND METHODS FOR THE EXCLUSION OF INDIVIDUAL TYPES OF VEHICLES IN CASE OF ADVERSE ROAD CONDITIONS**

The location and procedure for the exclusion of vehicles from traffic are usually regulated by appropriate road traffic signs.

Exclusion points can be hired or specially constructed.

Exclusion should focus on heavy trucks such as semi-trailers and trailer trucks. Appropriate locations (such as parking lots or other suitable level areas) able to accommodate a certain number of such vehicles should be defined on the state road network. When no such places are available, excluded vehicles may be temporarily parked along the outer (i.e. right-hand, looking in the driving direction) edge of the road, if the terrain is suitable (sufficient carriageway width, sufficiently long straight sections of the road, roads on level terrain or detour roads).

**LOCATIONS WHERE TRUCKS MAY BE EXCLUDED FROM TRAFFIC**

| ROAD NO. | SECTION NUMBER | LOCATION OR ROAD SECTION | CAPACITY (number of trucks) |
|----------|----------------|--------------------------|-----------------------------|
|          |                |                          |                             |
|          |                |                          |                             |
|          |                |                          |                             |
|          |                |                          |                             |
|          |                |                          |                             |
|          |                |                          |                             |
|          |                |                          |                             |
|          |                |                          |                             |
|          |                |                          |                             |
|          |                |                          |                             |
|          |                |                          |                             |
|          |                |                          |                             |
|          |                |                          |                             |
|          |                |                          |                             |

**Attachment: MAP OF THE TRUCK EXCLUSION LOCATIONS**

**29 LIST OF MOBILE CRANES AND THEIR WHEREABOUTS**

| SEQ. NO. | PROPERTY OF | PHONE NUMBER | CRANE TYPE | CARRYING CAPACITY |
|----------|-------------|--------------|------------|-------------------|
| 1.       |             |              |            |                   |
| 2.       |             |              |            |                   |
| 3.       |             |              |            |                   |
| 4.       |             |              |            |                   |
| 5.       |             |              |            |                   |
| 6.       |             |              |            |                   |
| 7.       |             |              |            |                   |

**30 PRECAUTIONARY SPREADING**

Precautionary spreading is performed before or after major winter service operations, chiefly on so-called critical road sections, or on other sections where we wish to avoid the need for daily local spreading of shady areas, slopes, bridges, gorges, and roads from the first and second maintenance priority class with a high AADT. This can lead to savings because daily spreading is no longer needed. About 10-15 g/m<sup>2</sup> of wet salting mixture (70 % MgCl<sub>2</sub> or CaCl<sub>2</sub> and 30 % NaCl) is sufficient for precautionary spreading. Of course this type of spreading is sufficiently effective only in dry weather (there may be a minimum amount of snowfall, drizzle, fog, etc.). Pure NaCl or a gravel/salt mixture is not suitable for precautionary spreading because the traffic will push most (up to 90 %) of the salting material off the road. In the case of wet salting, this percentage is only around 10 %; the rest of the salting mixture adheres to the road and remains in effect for a longer period of time.

Precautionary spreading should be limited to areas where it is indispensable.

See the critical road sections on the map attachment!

**Attachment: A MAP OF THE CRITICAL ROAD SECTIONS**





## 32 WINTER MAINTENANCE ACCOUNTING PLAN

| MESEČNI PLAN OVREDNOTENJA ZIMSKE SLUŽBE                      |  |                       |                           |                          |                            | AREA            |                     |
|--|--|-----------------------|---------------------------|--------------------------|----------------------------|-----------------|---------------------|
|  |  |                       |                           |                          |                            | km:             |                     |
| <b>I. STOPNJA PRIPRAVNOSTI</b>                               |  |                       |                           |                          |                            |                 |                     |
| <b>Delovna sila</b>  |  | <b>število</b>        | <b>ur</b>                 |                          |                            | <b>KM/uro</b>   | <b>skupaj/mesec</b> |
|  | vsi: cestar                              |                       |                           |                          |                            |                 |                     |
| 1. ekipa:  | vsi: strojnik                            |                       |                           |                          |                            |                 |                     |
|  | pripravnost na domu: cestar              |                       |                           |                          |                            |                 |                     |
| 24 ur dnevno   | pripravnost na domu: strojnik            |                       |                           |                          |                            |                 |                     |
|  | dežurni v bazi (praviloma voznik)        |                       |                           |                          |                            |                 |                     |
|  | glavni dežurni (zajet v faktorju)        | 1                     | 0                         |                          |                            |                 |                     |
| <b>SKUPAJ</b>  |  |                       |                           |                          |                            |                 | - SIT               |
| <b>Vozila</b>  |  | <b>število</b>        | <b>ur</b>                 |                          |                            | <b>KM/uro</b>   | <b>skupaj/mesec</b> |
|  | vsi: vozilo 12-15 t                      |                       |                           |                          |                            |                 |                     |
| Efektiva in stojnine:  | vsi: vozilo 10-12 t                      |                       |                           |                          |                            |                 |                     |
|  | vsi: rovokopač                           |                       |                           |                          |                            |                 |                     |
|  | pripravnost: vozilo 12-15t               |                       |                           |                          |                            |                 |                     |
| 140 ur/mesec   | pripravnost: vozilo 10-12t               |                       |                           |                          |                            |                 |                     |
|  | vsi: posipalnik                          |                       |                           |                          |                            |                 |                     |
|  | vsi: plug                                |                       |                           |                          |                            |                 |                     |
| <b>SKUPAJ</b>  |  |                       |                           |                          |                            |                 |                     |
| <b>II. STOPNJA PRIPRAVNOSTI (100 % povečanje I. stopnje)</b> |  |                       |                           |                          |                            |                 |                     |
| <b>Delovna sila + vozila + stroji</b>                        |  | <b>število</b>        | <b>ur</b>                 |                          |                            | <b>KM/uro</b>   | <b>skupaj/mesec</b> |
|  | voznik                                   |                       |                           |                          |                            |                 |                     |
|  | cestar (če ni avtom.posipalnika)         |                       |                           |                          |                            |                 |                     |
|  | dod. vozilo 10-12 t - grupa 1            |                       |                           |                          |                            |                 |                     |
|  | dod. vozilo 12 -15t                      |                       |                           |                          |                            |                 |                     |
|  | plug > 3,5 m                             |                       |                           |                          |                            |                 |                     |
|  | plug                                     |                       |                           |                          |                            |                 |                     |
|  | posipalnik                               |                       |                           |                          |                            |                 |                     |
|  | rovokopač                                |                       |                           |                          |                            |                 |                     |
| <b>SKUPAJ</b>  |  |                       |                           |                          |                            |                 |                     |
|  |  | <b>število</b>        | <b>dni</b>                |                          |                            | <b>KM/DAN</b>   | <b>skupaj/mesec</b> |
| <b>Pavšalna pripravnost:</b>                                 |  |                       |                           |                          |                            |                 |                     |
| <b>Vozila in stroji</b>                                      |  | <b>skupno število</b> | <b>Amortiz. do 3 leta</b> | <b>Amortiz. do 7 let</b> | <b>Razlika (do 14 let)</b> | <b>KM/mesec</b> | <b>skupaj/mesec</b> |
|  | vozila                                   |                       |                           |                          |                            |                 |                     |
|  | rovokopači-nakladači                     |                       |                           |                          |                            |                 |                     |
|  | snežni plug šir. do 3,5 m                |                       |                           |                          |                            |                 |                     |
|  | snežni plug šir. nad 3,5 m               |                       |                           |                          |                            |                 |                     |
| Pripravnost ali  | vlečni posipalnik                        |                       |                           |                          |                            |                 |                     |
|  | avtomatski posipalnik - 4 m <sup>3</sup> |                       |                           |                          |                            |                 |                     |
| mesečno plačilo  | avtomatski posipalnik - 6 m <sup>3</sup> |                       |                           |                          |                            |                 |                     |
|  | avtomatski posipalnik - 8 m <sup>3</sup> |                       |                           |                          |                            |                 |                     |
|  | avt.posip. KALBACHER, KIPERWEIS.         |                       |                           |                          |                            |                 |                     |
|  | avt.posip. GILLETA, BALHACHK.            |                       |                           |                          |                            |                 |                     |
|  | stranski odmetalec                       |                       |                           |                          |                            |                 |                     |
|  | stranski odmetalec - neserijski          |                       |                           |                          |                            |                 |                     |
|  | čelna freza-priključek                   |                       |                           |                          |                            |                 |                     |
|  | čelna freza-lastni pogon                 |                       |                           |                          |                            |                 |                     |
|  | cisterna za CaCl <sub>2</sub>            |                       |                           |                          |                            |                 |                     |
|  | mešalna garnitura za CaCl <sub>2</sub>   |                       |                           |                          |                            |                 |                     |
|  | silos za sol 150 t                       |                       |                           |                          |                            |                 |                     |
|  | silos za sol 50 t                        |                       |                           |                          |                            |                 |                     |
|  | radio veze - kos / mesec                 |                       |                           |                          |                            |                 |                     |
| <b>SKUPAJ</b>  |  |                       |                           |                          |                            |                 |                     |
| <b>SKUPAJ I. in II. STOPNJA PRIPRAVNOSTI:</b>                |  |                       |                           |                          |                            |                 |                     |

|   |  |                |                           | AREA                          |                     |
|---|--|----------------|---------------------------|-------------------------------|---------------------|
| <b>SKUPAJ I. in II. STOPNJA PRIPRAVNOSTI:</b>     |  |                |                           |                               |                     |
| <b>III. STOPNJA PRIPRAVNOSTI</b>                  |  |                |                           |                               |                     |
| <b>Delovna sila + vozila + stroji</b>             |  | <b>število</b> | <b>ur</b>                 | <b>KM/uro</b>                 | <b>skupaj/mesec</b> |
|   | cestar                                   |                |                           |                               |                     |
|   | voznik                                   |                |                           |                               |                     |
|   | strojnik                                 |                |                           |                               |                     |
|   | UNIMOG U 900                             |                |                           |                               |                     |
|   | UNIMOG U 1200                            |                |                           |                               |                     |
|   | vozilo do 6 t                            |                |                           |                               |                     |
|   | vozilo do 8 t                            |                |                           |                               |                     |
|   | vozilo 8-10 t                            |                |                           |                               |                     |
|   | vozilo 10-12 t                           |                |                           |                               |                     |
|   | vozilo 12-15 t                           |                |                           |                               |                     |
|   | greder do 110 kW                         |                |                           |                               |                     |
|   | greder nad 110 kW                        |                |                           |                               |                     |
|   | rovokopač                                |                |                           |                               |                     |
|   | nakladač                                 |                |                           |                               |                     |
|   | traktor 75 KS                            |                |                           |                               |                     |
|   | traktor 90 KS                            |                |                           |                               |                     |
|   | snežni plug šir. do 3,5 m                |                |                           |                               |                     |
|   | snežni plug šir. nad 3,5 m               |                |                           |                               |                     |
|   | vlečni posipalnik                        |                |                           |                               |                     |
|   | avtomatski posipalnik - 4 m <sup>3</sup> |                |                           |                               |                     |
|   | avtomatski posipalnik - 6 m <sup>3</sup> |                |                           |                               |                     |
|   | avtomatski posipalnik - 8 m <sup>3</sup> |                |                           |                               |                     |
|   | avt.posip. KALBACHER, KIPERWEIS.         |                |                           |                               |                     |
|   | avt.posip. GILLETA, BALHACHK.            |                |                           |                               |                     |
|   | stranski odmetalec                       |                |                           |                               |                     |
|   | stranski odmetalec - neserijski          |                |                           |                               |                     |
|   | čelna freza-priključek                   |                |                           |                               |                     |
|   | čelna freza-lastni pogon                 |                |                           |                               |                     |
| <b>SKUPAJ</b>                                     |  |                |                           |                               |                     |
| <b>Na mesec</b>                                   |  |                | <b>ton, m<sup>3</sup></b> | <b>KM/tono, m<sup>3</sup></b> | <b>skupaj/mesec</b> |
| POSIPNI   | skladiščenje soli za posipanje           | ton            |                           |                               |                     |
| MATERIALI   | drobljenec                               | m <sup>3</sup> |                           |                               |                     |
| <b>SKUPAJ</b>                                     |  |                |                           |                               |                     |
| <b>PREGLEDI V ZIMSKI SLUŽBI</b>                   |  | <b>število</b> | <b>ur</b>                 | <b>KM/uro</b>                 | <b>skupaj/mesec</b> |
|   | preglednik                               |                |                           |                               |                     |
|   | efekt. pregledniško vozilo - grupa 1*    |                |                           |                               |                     |
|   | efekt. pregledniško vozilo - grupa 2*    |                |                           |                               |                     |
|   | pripr. pregledniško vozilo - grupa 1     |                |                           |                               |                     |
|   | pripr. pregledniško vozilo - grupa 2     |                |                           |                               |                     |
| <b>SKUPAJ</b>                                     |  |                |                           |                               |                     |
| <b>SKUPAJ STROŠKI ZA OBMOČJE</b>                  |  |                |                           |                               |                     |
|   | <b>DDV xx %:</b>                         |                |                           |                               |                     |
|   | <b>DDV xx %:</b>                         |                |                           |                               |                     |
| <b>SKUPAJ STROŠKI ZA OBMOČJE</b>                  |  |                |                           |                               |                     |
| <b>SKUPAJ STROŠKI ZA OBMOČJE za zimsko sezono</b> |  |                |                           |                               |                     |
| Opomba: * grupa 1 = cenejše pregledniško vozilo   |  |                |                           |                               |                     |
| * grupa 2 = dražje pregledniško vozilo            |  |                |                           |                               |                     |

### **33 SPECIAL CONSIDERATIONS RELATED TO WINTER MAINTENANCE OF MOTORWAYS**

#### **33.1 PRIORITY CLASSES**

Based on the work methods and technologies used for winter maintenance work, the first priority class is subdivided into two priorities, namely:

PRIORITY 1.

All motorway sections, motorway attachments, and rest areas.

PRIORITY 2.

Other areas along the motorway (service plateaus and other minor rest areas).

#### **33.2 SNOW CLEARING**

Snow clearing from the driving surfaces must begin as soon as the conditions no longer support the normal course of traffic.

A motorway is considered passable even if the traffic is obstructed by remains of snow on the carriageway, or if a part of it is covered by packed snow.

After the main driving surfaces, attachments, and priority-1 rest areas are cleared, work can begin on clearing the snow deposited on structures and signs, and on the removal of icicles.

#### **33.3 ICE**

Road ice is formed because the road temperature drops below freezing, or in case of sudden humidity at low temperatures, as rime or hoar, or because of snow showers or freezing rain.

Spreading should begin as soon as ice is detected on the pavement. Suitable permanent traffic signs should be installed to warn the traffic participants in those motorway sections where ice appears frequently and represents a particular danger to traffic.

On motorways or longer sections of motorways marked for precautionary spreading in the winter maintenance operational plan, this spreading should take place as soon as circumstances indicate that ice formation may be expected.

#### **33.4 TURNING ON MOTORWAYS**

The traffic safety law forbids turning on the motorways. However, long periods of snowfall are considered to be extraordinary circumstances. In these conditions, emergency midlane crossings are used to facilitate faster and more efficient ploughing. All safety precautions must of course be observed, including the use of vertical signs and lights.

Taking into consideration the provisions of the "Road Traffic Safety Act", turning on motorways is prohibited. In extraordinary cases, to achieve more effective and faster ploughing, intervention passages located in the central reserve are used. Adequate safety precautions by introducing vertical signs and traffic lights shall be taken. In extremely unfavourable conditions, the speed shall be limited and the traffic directed.

In the 200../200.. winter season, the motorway maintenance depot at ..... expects ..... midlane crossings to be used, the depot at ..... expects ..... midlane crossings to be used, etc. An I-25 sign with an IV-19 auxiliary panel should be installed 250 m away on each side of the crossing; another I-25 sign with an IV-2 auxiliary panel should be installed 500 m on each side of the crossing. An advertising campaign should be used to educate the motorway users how to act during winter maintenance operations and what the new signs mean.

#### **33.5 STRONG WIND**

On certain road sections in the coastal areas, strong northerly winds with gusts exceeding 120 km/h sometimes occur, particularly in winter. Thus the ..... expressway is expected to be closed to vehicles of certain types (trucks up to 8 tons, canopy trucks,

freezer trucks, semi-trailer and trailer trucks) for brief periods of time during strong winds. Existing parking lots should be used in this case. In addition to this, the location ..... is expected to be used for exclusion of trucks from traffic in the year 200...; this location is equipped with vertical signs that can be opened during road closures.

On certain road sections in Herzegovina, as well as in southwest and west Bosnia, a strong northeast wind with gusts of more than 120 km/h occurs particularly in the wintertime. Therefore it can be anticipated that, in case of a strong wind, the expressway ..... shall be closed for a shorter period for certain vehicle types (lorries of up to 8 tons, vehicles with canvas, freezers, trucks with trailers, etc.). Existing parking places are suitable to this purpose. In the year 200..., for the elimination of lorries from the traffic, an additional location ..... is foreseen, which is equipped with vertical traffic signs and opened at the road closure.

### 33.6 SPREADING MATERIAL

When the winter maintenance operational plan is prepared, stocks of spreading materials should also be ready, with further supplies to be obtained as needed throughout the year ....., from distributors selected through a public tender. We expect to use wet salting with  $\text{CaCl}_2$  and  $\text{MgCl}_2$ . Stationary  $\text{CaCl}_2$  collecting tanks are located at the motorway maintenance depots at \_\_\_\_\_, and the  $\text{MgCl}_2$  tanks are at \_\_\_\_\_ . Salt silos are at \_\_\_\_\_.

### 33.7 STANDBY SERVICE

A unified standby service will operate in the headquarters of the motorway maintenance depots at \_\_\_\_\_ and in their branches at \_\_\_\_\_. The standby service will be organized like in the previous years, as shown in an attachment to this plan.

Because the weather conditions may differ from one motorway depot to another, the state of waiting on standby at home will be instituted by each depot head (or his deputy) based on the short-term weather forecast.

Workers involved in winter maintenance are generally informed in advance when at-home standby state is to be introduced. This communication takes place through the head of maintenance, depot foremen, control centre, heads of toll gates (because the toll gate janitors must also be on standby at home), and bulletin boards at the depot headquarters and branch units.

If weather forecasts change (particularly during weekends and holidays), the workers may need to be summoned by phone (if they don't inquire by themselves). Coming to work during the state of standby at home is treated as regular work attendance, while outside that state it is treated as emergency work (as an unforeseen extraordinary event or circumstance).

In addition to the workers of the regular shift, the standby will usually involve:

- - head of maintenance
- - head of mechanized equipment
- - head of the routine maintenance unit
- - road inspector
- - a mechanic, electrician, or fitter
- - driver / salt loader operator
- - toll gate janitors

Notifications on road weather conditions are sent by toll gates, which are connected by the maintenance depots by internal phone lines.



Weather and road conditions are also monitored by workers doing work on the motorway; this information is collected by standby operators and forwarded to the head of the shift or the head of the standby service.

| The following toll gates perform observations | Internal phone no. | Reports to (int. phone no.) |
|---|--------------------|-----------------------------|
|   |                    |                             |
|   |                    |                             |
|   |                    |                             |

Inspection patrols along the motorway and its attachment is also performed by a shift group when needed or when considered necessary by the shift head (this is also recorded in the standby service log).

The vehicles used by the shift group for inspection patrols are in constant UHF connection with the depot, or they communicate with it using phones installed along the motorway.

The shift head records the entire progress of winter maintenance during his shift in the standby service log (from 07:00 o'clock to 07:00 o'clock).

During ploughing or spreading operations, or when removing the consequences of traffic accidents, or during traffic jams, the head of the standby service (who had been waiting on standby at home) reports for work to help the shift head; logging and forwarding of road condition information may then be done by either of them.

Following the instructions of the road administration and the Road Directorate, reports on the motorway conditions must also be sent at particular times to a specified e-mail address. An operator must send updates via the internet.

If the motorway needs to be closed or large obstructions appear (due to ice, snow, or accidents), the operator should inform the media, the police call centre, and the automobile users' association.

Notification in case of extraordinary events follows the procedure defined in the road administrator's instructions.

### 34 ORGANIZATION OF WINTER MOTORWAY MAINTENANCE

The following considerations must be taken into account in the organization of the winter maintenance:

- - proper management of the winter service,
- - permanent standby services,
- - operational organization,
- - timely and regular information for the motorway users.

#### WINTER SERVICE MANAGEMENT

The following workers lead the winter maintenance service and are responsible for its smooth operation:

- the director, being the person in charge of, and responsible for, the entire operations of the motorway maintenance company,
- the shift head, who coordinates the motorway depot heads over an entire area,
- the head of the motorway depot, who leads and coordinates the entire winter maintenance organization for the area covered by one motorway maintenance depot, organizes the mechanical, machine and traffic activities, and is responsible for ensuring that the equipment is ready for use in winter maintenance. He coordinates his activities with the maintenance head;

- the motorway depot maintenance head, being in charge of the organization of winter maintenance and its normal operation in all respects. He leads and coordinates operations on the entire area covered by the motorway maintenance depot, cooperates with other units, road companies, and other winter maintenance contractors. He is also responsible for information within the standby service;
- foremen and group leaders lead operations in the area of the motorway depot and are fully responsible for the correct performance of winter maintenance work in the field. Within the limits of this operational plan, they are responsible for the regular operation of winter maintenance.

All the above-mentioned workers lead the winter maintenance service in accordance with the winter maintenance operational plan and with their competencies.

In the motorway maintenance company, the winter service is organized following the winter service organizational scheme. All operative tasks belong to the motorway depots, while the winter service headquarters have the task of coordinating the operative units.

**35 NOTIFICATION METHODS AND DESCRIPTION**

Based on the instructions, all required agencies and organizations must be notified of any extraordinary events on the motorways, using a special notification and following the instructions.

Extraordinary motorway events include everything that impedes the normal course of traffic:

- traffic accidents leading to a partial or full road closure;
- road condition – snow or ice on the pavement, etc.;
- only in the \_\_\_\_\_ tunnel;
- environmental and ecological emergencies, etc.

The authorized person must notify the required institutions as quickly as possible.

**LIST OF OBSERVED LOCATIONS – ROAD CONDITION AND PASSABILITY**

| Road number | Section | Road Company | Time | Code | Temp. | New snow depth | Note | Notification |
|-------------|---------|--------------|------|------|-------|----------------|------|--------------|
|             |         |              |      |      |       |                |      |              |
|             |         |              |      |      |       |                |      |              |
|             |         |              |      |      |       |                |      |              |
|             |         |              |      |      |       |                |      |              |
|             |         |              |      |      |       |                |      |              |
|             |         |              |      |      |       |                |      |              |
|             |         |              |      |      |       |                |      |              |
|             |         |              |      |      |       |                |      |              |
|             |         |              |      |      |       |                |      |              |

Notes:

Date: ..... Time: ..... Standby worker: .....

The observations from these locations must be recorded daily (at 5:30, 13:00, and 22:30 o'clock) using a separate form (attachment) or into the standby log.

The following is an example of an extraordinary event notification:

### **36 INSTRUCTIONS ON MARKING AND PROTECTING OF VEHICLES STOPPED ON THE EMERGENCY LANE OF THE MOTORWAY**

In case of extraordinary events on the motorway, the requisite agencies and organizations must be notified by a special notification (see section 36).

These instructions specifies how to mark and protect vehicles that stopped on the emergency lane of the motorway because the special circumstances (heavy snowfall, very strong wind, traffic or other accidents, etc.) prevent them from continuing their journey along the motorway or other state road connecting to the motorway, and require them to be excluded from traffic and parked on the emergency lane of the motorway.

To ensure timely exclusion of such vehicles from traffic, signs indicating that such vehicles must temporarily exclude themselves from traffic may be set up at locations suitable for excluding vehicles from traffic even if they are not immediately next to the location of the temporary traffic problem.

The emergency lane of the motorway will host vehicles that have been temporarily excluded from traffic only at this point and did not exclude themselves from traffic by then (as they should have done following traffic safety regulations and earlier traffic signs to that effect).

Appropriate traffic signs, as described in these instructions, must be installed to clearly indicate that certain vehicles are required to temporarily exclude themselves from motorway traffic and place themselves in a protected position in the emergency lane of the motorway.

The marking of such temporarily excluded vehicles, as described in these instructions, does not include the marking of the emergency lane closure, as described in the instructions on the minimal marking and protection of certain motorway operations and barriers.

An appropriate speed limit must be introduced in those motorway areas where temporary exclusion of vehicles to the emergency lane is in effect.

The obligation of vehicles to remove themselves from motorway traffic should be marked by a changeable message sign indicating the type of vehicles to which this prohibition or limitation of motorway traffic applies, and by an auxiliary panel indicating the driving direction to which the limit applies, the distance to the start of the area where the prohibition or limitation actually begins to apply, and the word "Exclusion".

The word "Exclusion" on the sign mentioned in the previous paragraph may additionally be written in one of the following foreign languages: Italian, Hungarian, German, or English.

The changeable message sign must be installed at least 2 km and at most 3 km before the last motorway exit before the location where the traffic prohibition or limitation begins to apply.

At a distance of at least 3 km and at most 4 km from the location of the traffic prohibition or limitation, a traffic sign should be installed prohibiting the to-be-excluded vehicles from overtaking other vehicles, with an auxiliary panel indicating the length of the section to which the prohibition applies.

At a distance of at least 0.5 km and at most 3 km from the location of the traffic prohibition or limitation, the traffic sign from the previous paragraph may also be augmented by a speed limit sign and optionally an auxiliary sign specifying the types of vehicles to which the speed limit applies.

To ensure that the traffic signs mentioned in the previous paragraphs are always visible even in winter conditions, they should be placed on flyovers above the motorway in cases

when this would not cause the maximum distances specified in the previous paragraphs from being exceeded by more than 0.5 km.

The beginning of the area where excluded vehicles are parked on the emergency lane should be marked by a front road closure panel and a traffic sign indicating the type of vehicles prohibited from using the motorway.

The location where the vehicles must begin to exclude themselves from traffic must be marked by a mobile changeable message sign indicating the type of vehicles subject to the prohibition, by an auxiliary panel bearing the word "Exclusion", the distance to the last vehicle in the column of temporarily excluded vehicles, and the direction that should be taken by vehicles excluding themselves from traffic.

The word "Exclusion" on the sign mentioned in the previous paragraph may additionally be written in one of the following foreign languages: Italian, Hungarian, German, or English.

The panel from the second paragraph of this article must be placed at least 300 m and at most 500 m from the last vehicle in the column of temporarily excluded vehicles.

The driver of the vehicle removing itself from traffic should continue driving on the emergency lane of the motorway and park behind the last vehicle standing in the column of temporarily excluded vehicles.

The following scheme, which is also part of these instructions, shows an example exclusion of a particular type of vehicles to the emergency lane of the motorway in winter conditions.

SHEMATSKI PRIKAZ OZNAČITVE IZLOČANJA DOLOČENE VRSTE VOZIL NA ODSTAVNI PAS AVTOCESTE V ZIMSKIH RAZMERAH

