

# Efficiency of intervention technologies for snow removal equipment on public roads

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**Abstract:** The activity of snow removal on public roads is of particular importance for ensuring road transport in winter and implicitly for maintaining a stable, predictable and efficient economic and social climate. The organization of road snow removal is usually done by the local public authorities, through the public road administrator, varying depending on the geographical and climatic location of the road site. In Romania, the snow removal activity is regulated by the "Regulation on preventing and combating snow on public roads", indicative AND 525-2013, developed by the National Company of National Highways and National Roads in Romania. The snow removal activity is usually performed on the basis of a service contract and is temporary, depending on the evolution of meteorological phenomena and climatic zones. The actions to prevent and combat the consequences of dangerous meteorological phenomena are carried out according to their intensity on the following phases, as follows: prevention of icing formation and its neutralization, spreading of anti-skid material and snow removal. The preventive spreading of the anti-skid material is recommended to be done first on the entry / exit arteries in / from the localities. The activity of mechanical cleaning of public roads (streets, bridges, alleys, roundabouts) of snow with blade machines is performed when the snow layer exceeds the thickness of 5 cm. The activity is carried out by successive passages, starting from the axis of the road to the curb, until the complete removal of the snow layer.

**Keywords:** ROAD, SNOW, WINTER, TRANSPORT, BLADE, CLEANING

## 1. Introduction

The activity of snow removal on public roads is of particular importance for ensuring road transport in winter and implicitly for maintaining a stable, predictable and efficient economic and social climate. Snow removal means the clearing or clearing of snow partially or over the entire width of the roadway or road platform, when the snow layer exceeds 15 cm. Removing snow is an act of clearing snow from the entire road platform, including snow cords that may favor another snowfall.

## 2. Results and discussion

The organization of road snow removal is usually done by the local public authorities, through the public road administrator, varying depending on the geographical and climatic location of the road site. In turn, the administrator of the public road may carry out the snow removal operations with the equipment from his own endowment or through a commercial company with which he concludes a service contract. Given the high cost of snow removal operations, determined by the costs of materials, labor, equipment and transportation, the organization of road snow removal must be carried out with maximum efficiency and minimum resources, at a quality necessary to ensure smooth traffic on public roads on during the winter, without endangering the safety of road users.

In Romania, snow removal is regulated by the "Regulation on preventing and combating snow on public roads"[1], indicative AND 525-2013, developed by the Romanian National Company of Motorways and National Roads. According to the above-mentioned regulations, the public road management units must prepare the snow removal in the summer, by drawing up the operational plans for the operation by July 15. These plans stipulate that the period of action against icing and snow must be between 20 October this year and 31 March next year. on November 1. Also the existence of a permanent stock of fuel necessary to ensure the operation of the machinery for at least 14 days must be ensured. Snow guard panels are installed until December 1 of each year.

Depending on their importance, the roads are divided into several levels of intervention. Level I includes highways, public roads with four lanes, public roads with two lanes, which connect the capital with the county-residence municipalities and those that connect the municipalities with the county-residence municipalities, public roads (national, county or communal), which ensures the connection with railway stations, ports, airports, border crossing points or which conditions the supply of important economic centers with raw materials, food or labor and the national roads that connect the tourist resorts. Level II includes the rest of the national roads that are part of technical class III and the county roads that ensure the connection with the communal centers. Level III includes

the rest of the public roads that must be maintained in a state of viability. Level IV comprises the sectors of public roads with low vehicle traffic.

Snow removal equipment groups are grouped on bases, subbases and support points. The main types of machinery and equipment used in snow removal are the following:

1) All-wheel drive machine, (Fig. 1) [2] equipped with:

- Snow blade with left-right rotation system and / or universal plow with variable geometry, with two movable blades that allow their positioning at different angles (sharp, obtuse, 180 degrees).
- snowblower (only in snowy areas);
- Spreader with a minimum capacity of 3 m<sup>3</sup>, mounted on the base machine chassis;
- Pre-wetting installation (only where there is a calcium chloride installation);
- Front mechanical brush;
- Cable / Rigid towbar for vehicles.

The equipment must be operated from desks mounted in the cab.



**Fig. 1** All-wheel drive machine for snow removal.

2) High-capacity all-wheel drive tractor, equipped with:

- Snow blade, with left-right rotation system and / or universal plow with variable geometry, with two movable blades that allow their positioning at different angles (sharp, obtuse, 180 degrees).
- 3) Dumper truck with the formula of 4x4, 6x4 or 8x4 wheels and the payload of at least 10000 kg, equipped with:
  - Blade with left-right rotation system;
  - Spreader capacity min. 6 m<sup>3</sup> optional pre-wetting system;
  - Cable / Rigid towbar for vehicles.

The equipment must be operated from desks mounted in the cab.

4) Self-propelled snowblower all-wheel drive;

- 5) Backhoe loader with all-wheel drive, equipped with front bucket and / or plow;
- 6) Wheel loader;
- 7) Self-towing truck with a wheelbase of at least 8x4, equipped with special installations for towing and towing road trains:
  - Capstan;
  - Winch;
  - Special lifting arm.
- 8) Van with double cab, with special signaling panel for closing the traffic;
- 9) CaCl<sub>2</sub> preparation station;
- 10) Motor grader (Fig. 2) [3] with minimum engine power 160 hp;



Fig. 2 Motor grader.

- 11) Crane truck at least 40 tons.

The actions to prevent and combat the consequences of dangerous meteorological phenomena are carried out according to their intensity on the following phases, as follows: prevention of icing formation and its neutralization, spreading of anti-skid material and snow removal.

Road snow prevention is achieved by patrolling with equipment. This action takes place during quiet snowfalls or when the blizzards are light (wind strength below 30 km/h), and the scattered snow cannot immobilize the equipment on the road. If the wind force rises above that value and the snow is scattered in increasing numbers, the patrol action ceases and the machines withdraw, working to the base of residence or, if not possible, to the first locality on the route, in order to maintain traffic conditions for cars, buses or trucks that are covered in blizzard. The equipment used for patrolling is generally blade machines (graders, etc.) or vehicles with a metal blade mounted on the front (all-wheel drive multi-purpose machines, backhoe loaders, dump trucks, road tractors, etc.). Preferably, the blades will be fitted with rubber knives with metal insert. The most efficient patrol machine is the vehicle with adjustable blade, which is characterized by high blade mobility, high working speed and has the advantage that from a certain speed (usually over 30 km/h) throws snow from the side of the road platform. Their range is 30 - 50 km depending on the difficulties of the route, the frequency and abundance of snow.

The patrol formation is led by a technician and accompanied by a truck, which transports fuel and lubricants in sufficient quantities to ensure the supply of equipment on the road during the action. The equipment within the formation will work staggered in a transversal profile to include at least one traffic lane. Due to the fact that by patrolling the snow is collected in cords towards the edges of the platform, the equipment formations will be completed with turbo-milling equipment, which can also be used to remove the snow collected in front of the parapets. In areas with frequent blizzards, it is not allowed to keep the snow cords on the road platform, first releasing the part corresponding to the direction of the prevailing wind.

If two or more blade vehicles are assigned to a road sector, they can work independently, the start of the race will be delayed depending on the length of the road sector, the working speed and the abundance of snow. In this way a closed circuit can be achieved by ensuring the continuous presence of the machine on the road. Vehicles with blades will be equipped with a telephone or transceiver to ensure and inform operatively on road traffic conditions. The other means of patrol shown, which have low working speeds (10 - 20 km/h), but close, will be used in formations, on road sections less than 30 km long.

The choice of work teams is made taking into account the climatic character, the length of the road, the difficulties and the level of intervention of the respective road sector.

The control of icing and snow is done using both non-slip materials and chemical fluxes. The mixtures must be homogeneous and spread evenly over the road surface. The use of salt is effective only for temperatures on the road surface higher than - 7° C. Pure salt should be used only on well-sealed clothing only with the approval of the public road administrator. Calcium chloride or equivalent chemical fluxes will be used for lower temperatures.

The preventive spreading of the anti-skid material is recommended to be done first on the entry / exit arteries in / from the localities [4]. The activity of mechanical cleaning of public roads (streets, bridges, alleys, roundabouts) of snow with blade machines is performed when the snow layer exceeds the thickness of 5 cm. The activity is carried out by successive passages, starting from the axis of the road to the curb, until the complete removal of the snow layer.

### 3. Conclusion

The road administrator must organize efficiently and properly both the information and control system on the condition of the roads and the way of preparation and operation during the winter. The management and coordination of the prevention and intervention activity for the control of road ice and snow must be carried out through coordination units established at central and territorial level by the public road administrator.

Given that the coordination of snow removal equipment and its judicious distribution of different road sections is of great importance, it is advisable to equip the equipment with GPS-type tracking systems to provide real-time access to detailed information on the location of the equipment, snow removal, route, speed, fuel consumption, number and duration of parking.

### 4. References

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