



CONFERENCIA INTERNACIONAL  
SOBRE  
**VIALIDAD INVERNAL**

Del 27 al 30 de junio de 2017

Mendoza - Argentina

# Winter maintenance in mountain and northern areas

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# Norway



Physical Map of the World, April 2008

territorial  
dependency or area of special  
city / town  
capital  
Lake / reservoir  
mountain range  
mountain range (10 000 ft)



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# Winter period in Norway



Arctic circle

Normal Winter period:

- Northern part and mountains:  
September-May
- Southern part:  
November-March

January/February

Normal snow-depth: 0 - 2 meter

Normal temperature: 5 - -20 degree

Deepest snow: 6 meter on flat land

Lowest temp: -51 degree celsius

Highest mountain 2469 m

# Winter tires



Winter tires must be used in winter season when there is winter condition on the roads



Heavy vehicles over 3,5 tonn must bring snow chains 15th November –1th April



Studded tires may be used  
1st November - first Monday after easter  
16th October - 1th May in northern part

50 % are using studded tires in Norway

In some of the cities you must pay a fee for using studded tires because of dust problems

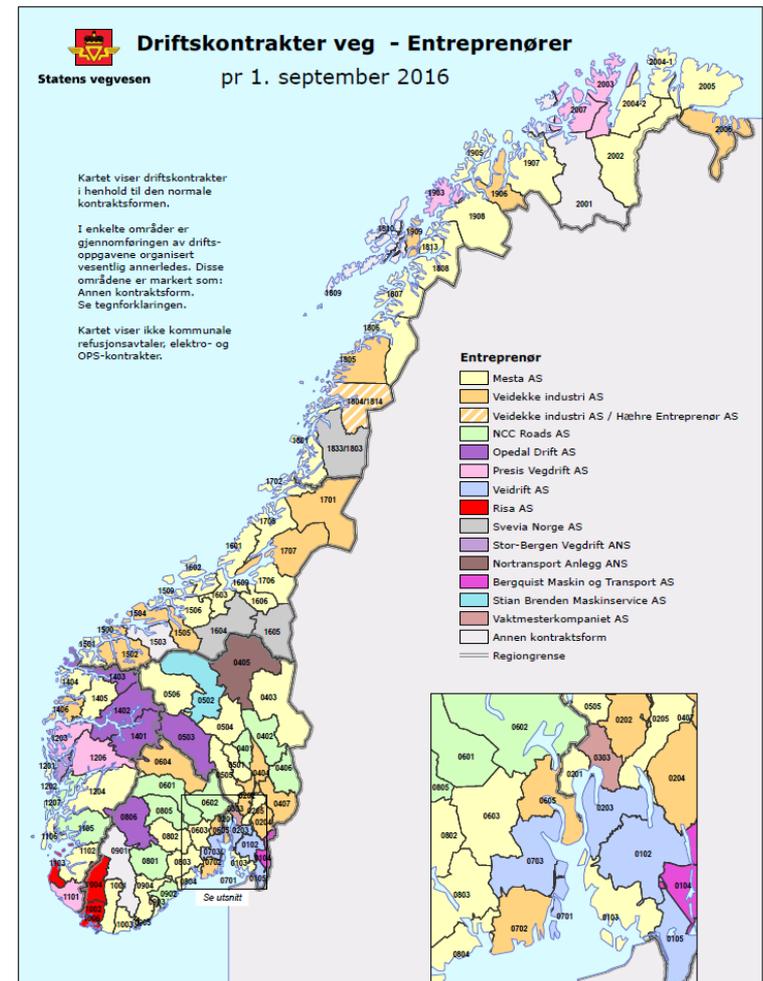
# All road work carried out by contractors after 2003

Winter maintenance is part of performance contracts for road maintenance.

Contractor decide what to do and when to do according to performance requirements.

108 road maintenance contracts:

- 5-years contracts
- Average road length 500-600 km



# Manual R610

## Standard requirements for operation and maintenance of national roads

This manual is basis for the requirements described in the performance contracts.

5 Winter Maintenance Classes, criterion:

Traffic volum, importance, traffic speed, accidents, geometric standard, climatic conditions, etc.



WMC

Average Day Traffic

Vinterdrifts-klasse	ÅDT								
	0	500	1500	3000	5000	10000	15000	20000	
DkA									
DkB									
DkC									
DkD									
DkE									



# Winter Maintenance Classes

- **DkA, DkB**
  - Bare roads (free from snow and ice) the whole winter
  - Salt to achieve bare road
- **DkC**
  - Bare roads when mild weather
  - Snow/ice when cold weather
  - Salt when mild / Sand when cold
- **DkD, DkE**
  - Accept snow and ice on the road
  - Sand to achieve required friction



Photo: Risa



Photo: NPRA

# Winter Maintenance Classes

## Pedestrian and cycle roads

- **GsA**  
Free from snow and ice  
Brushes and salt are used
- **GsB**  
Accept snow and ice  
Plowing and gritting with sand



Most cyclists in Norway  
use studded tires in winter

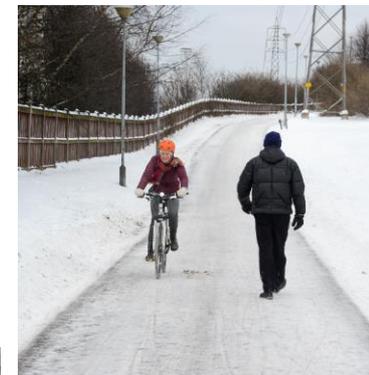


Photo: Knut Opeide, NPRA

# Standard requirements for different Winter Maintenance Classes:

Standard requirements	Winter Maintenance Class				
	DkA	DkB	DkC	DkD	DkE
Snow/ice surface maximum thickness	none	none	2 cm	3 cm	3 cm
Loose snow Maximum before plowing	none	None in wheel track	2 cm	2 cm	3 cm
Friction * Special road sections that need better friction	bare road	bare in wheel track	$\mu > 0,25$ *0,30	$\mu > 0,25$ *0,30	$\mu > 0,20$ *0,25
Maximal cycle time for snow removal during snow storm	1,5 hours	2 hours	2,5 hours	3 hours	3 hours

# Friction measuring device to check and document friction

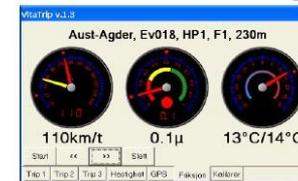
3 types advanced devices for winter friction:

Roar, Traction Watcher One, ViaFriction

- Measure fixed slip with an extra wheel
- Measure continuously with normal speed

Simple devices, decelerometers:

- Used in normal passenger cars
- Measure speed reduction during braking and calculate the friction index
- Weakness: Only for spot checks  
Not suitable at roads with heavy traffic  
Road inclination will influence the result  
Car and tire quality have some influence
- All device have to be calibrated before the winter

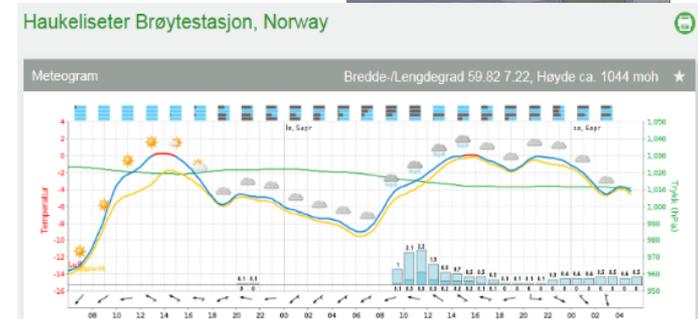
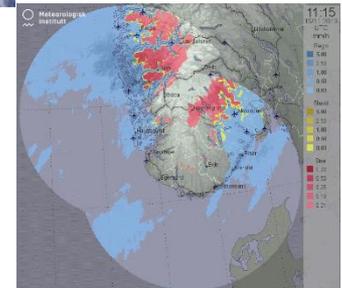


# Decision support systems for winter maintenance

- 300 Road weather stations
  - Camera, surface sensor
  - Temperature, humidity, wind, precipitation, radiation, road temperature, salt concentration
- Radar picture, showing last hours precipitation
  - Strength and type: snow/rain/sleet
- Weather forecast
  - Air pressure, temperature, clouds dew-point, precipitation, wind
- Local knowledge



Photo: NPRA



# Winter maintenance on motorways

- NaCl brine or slurry for anti-icing
- Pre-wetted NaCl grain for anti-compaction during snowfall and for de-icing
- Diagonal plows most common
- Tandem driving and side plows used when many lanes
- Extra rubber blades on plows used for salted roads to remove slush



Photo: NPRA

# Roads with snow/ice surface

- On snow covered roads an extra blade may be mounted under the truck and used during snow plowing to reduce the thickness of the snow-surface
- Effectiv to keep the snow-surface even and thin



Photo: NPRA

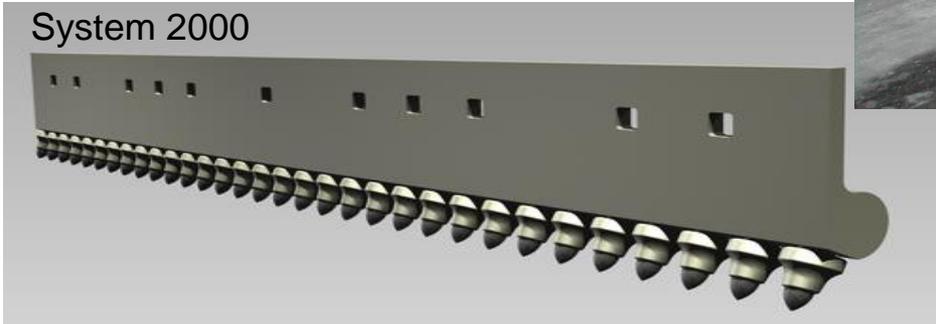
# Graders to remove hard snow and ice

- On snow- and ice-covered roads in cold and snowy areas graders are used to remove tracks in the ice and reduce the thickness of the ice
- Special blades with hard spikes are used on very hard ice



Photo: NPRA

System 2000



# V-plow on mountain passes

- V-plow suitable for mountain roads and narrow roads in snowy areas
- Throw the snow over the snow edge and far away
- Safer to use when plowing through hard snowdrift on the road



Photo: NPRA

# Mountain passes may be dangerous

Nice and peaceful when weather is  
calm



Next moment it can be complete  
chaos



Weather can change very fast

Photo: NPRA

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# Even in the mountains we have some neighbours to take into account

Reindeer on Hardangervidda mountain plateau

Snow edges must be removed to make it possible to cross the road



# The snow edges must be removed

To prevent drifting snow to collect on the road, snow in the trench must be cleared by a snow blower to prepare for the next storm



Photo: NPRA

## Reduced visibility ☹️

- Falling and drifting snow reduce the visibility specially in the dark
- Road lightning installed on the most difficult sections at Haukelifjell mountain pass, to keep the road open for traffic



*Photo: Harald Norem, NPRA*

## Strong wind and low friction ☹️

- Every winter high vehicles are blown off the road
- A double decker bus lost grip and went into the ditch at Dovrefjell
- There was strong wind combined with slippery ice
- 30 persons injured, 4 of them seriously



# Monitoring wind and road surface condition to prevent accidents

## Weather stations:

- Temperature, Wind, Precipitation
- Road surface state sensors

**Friction** is measured frequently by the contractor

Information is given to drivers about wind speed  
Road is closed when strong wind and slippery road



# Strong wind polish ice surface and make the sand blow away

- Drifting snow polish ice surface and make it very slippery
- The sand particles blow away when the wind is strong
- Warm wetted sand make the sand fasten to the ice
- Warm wetted sand:
  - Add 30 Vol% hot water to sand in spreader
  - Water temperatur (90-95 degree celsius)
  - Special sand (with fine graded material)
  - Special spreader with water tank and heater
  - 150-200 g/m<sup>2</sup>



# Warm wetted sand used on Dovrefjell

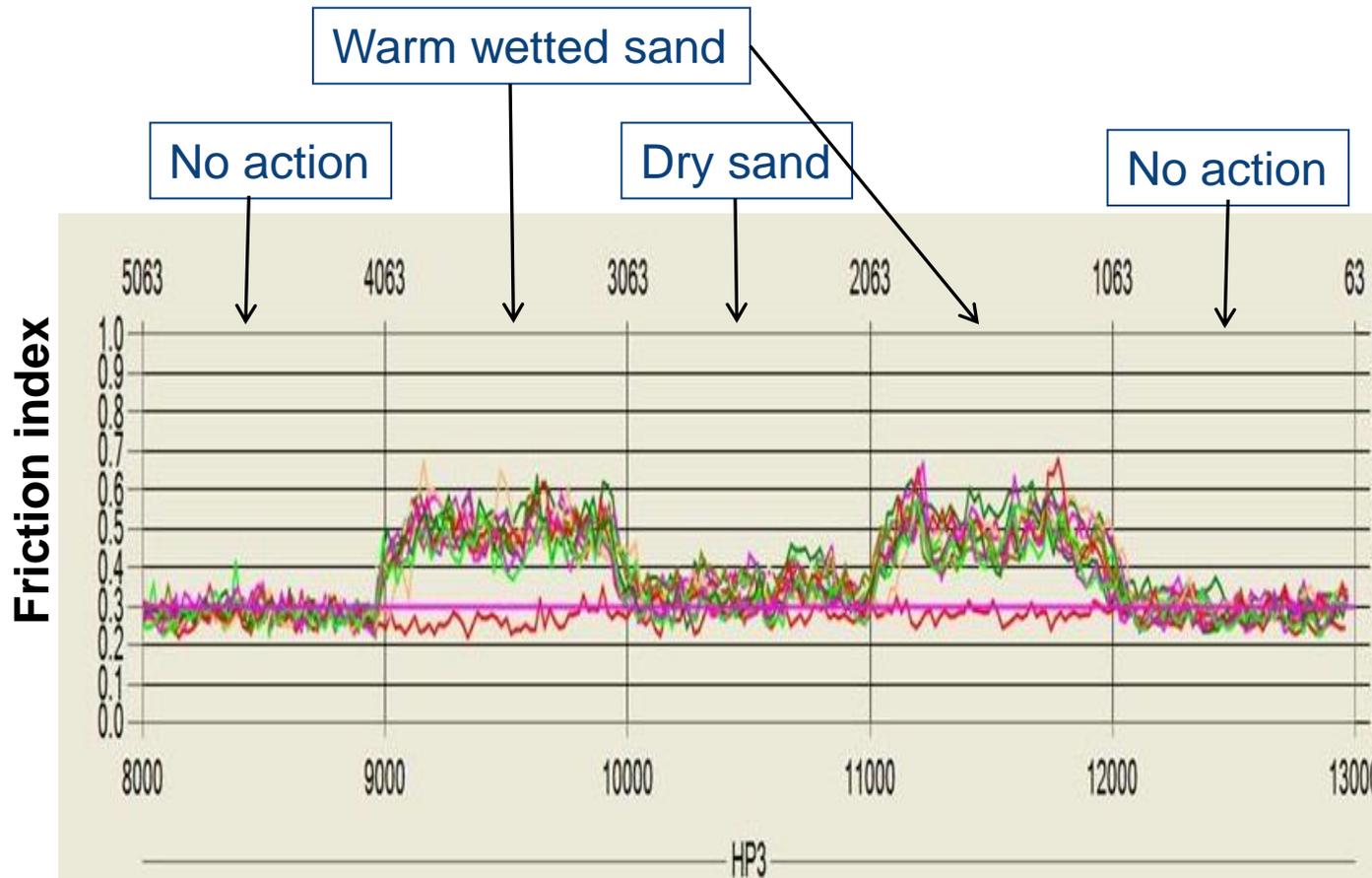
- Warm wetted sand melt down into the ice
- When freezing the sand will be fixed to the ice in lumps and act like a sand paper, creating very good friction that last for a long time
- Best result on cold, hard ice



Photo: NPRA

# Effect of warm wetted sand

Effect of Warm wetted sand compared to dry sand



## 25 stretches of road where convoy driving is used in winter

- When it's possible to drive, but driving conditions are so difficult that it's not proper to allow free traffic (e.x strong wind, snow drifting, low visibility)



Photo: Geir Brekke, NPRA

# Convoy traffic

- Requirements to join the convoy
  - food and warm clothes
  - enough fuel and good tires
- The snow clearing crew can exclude vehicles
- Maximum number of vehicles and people in case of rescue
- One snow plow in front, one escort car at the end.



Photo: Geir Brekke, NPRA

# 15 Winter closed roads in Norway

- Closing period usually October/November – April/May depending on winter condition



Photo: NPRA

# Opening of winter closed roads

- Snow blowers and excavators used to open
- GPS with ground stations are used to find the way, accuracy 10 cm
- When deep snow (more than 2 meters) we have to start at top and go down step by step with several rounds



Photo: NPRA

# Avalanche

- 1250 avalanche paths along Public Roads in Norway
- Some roads have to be closed in critical periods
- Dynamite is used to trigger avalanche
- Some places in avalanche-towers

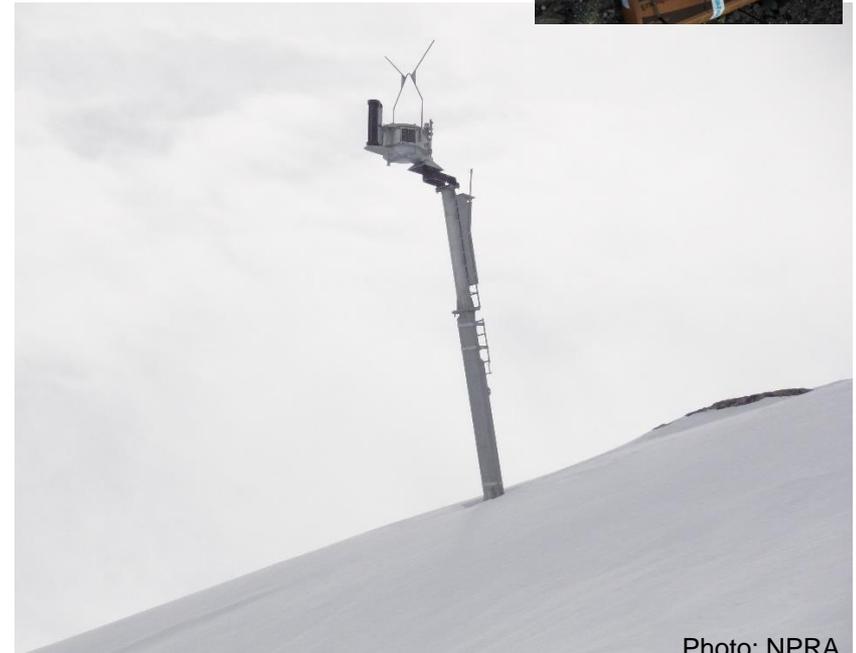


Photo: NPRA

# Daisy bell to trigger avalanche

- Daisy bell under helicopter is used in impassable places to trigger avalanche
- A mix of Hydrogen and Oxygen under Daisy bell explode and make a shock wave that start the avalanche



Photo: NPRA

# 5 Traffic Control Centers (TCC) in Norway

## Main tasks:

- Control and monitoring
- Decision support
- Traffic information



## Traffic information:

- Receive and disseminate information
- Give daily road and traffic information
- Produce information (radio, text TV, internet)
- Web-site: <http://175.no>
- Answer phone 24 hours (Phone number: **175**)

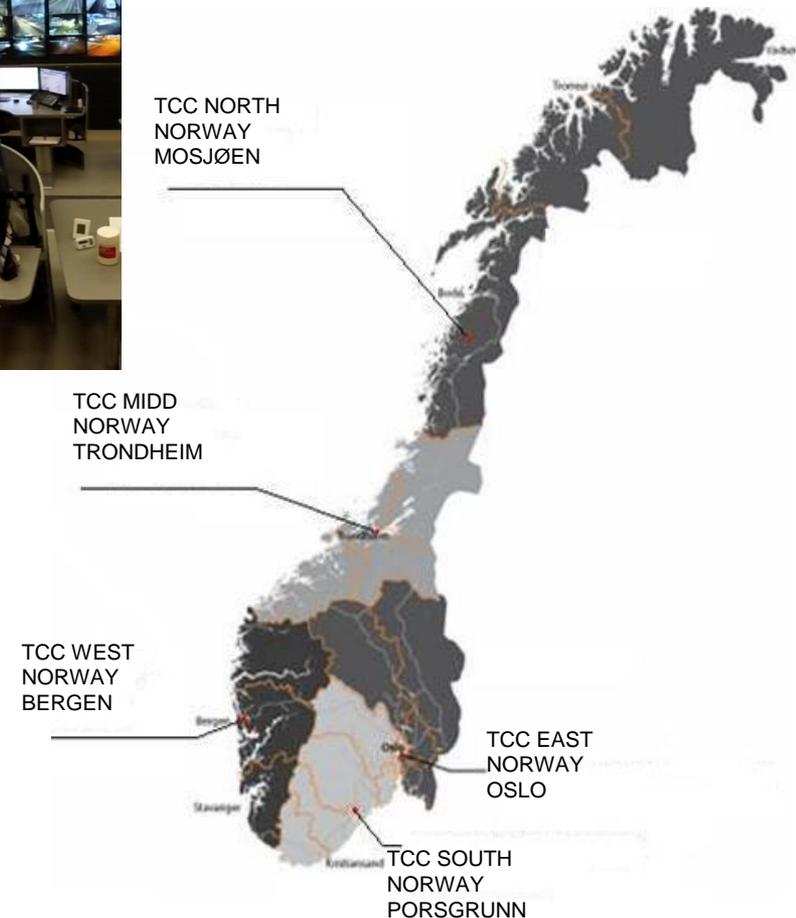


Photo: NPRA

# Norwegian winter roads are a challenge for foreign drivers

## Different road quality:

- Narrow roads
- Sharp bends
- Steep hills

## Fast changing weather, specially on the coast and in the mountains

- Heavy snow storms
- Drifting snow
- Low visibility
- Icy slippery roads
- Avalanche

**Some foreign drivers have little experience with winter conditions. Trailers with little load on drive axel. Tires not suitable for snow and ice.**



# Information Campaign Trucker's guide presented by Donna Diesel



## CONTENT:

- Facts about Norway
- How to drive in Norway
- Road and traffic conditions
- Choose the right route
  - Winter-closed roads
  - Routes with convoy driving
- Driving on icy roads
- Tire equipment requirements
- Use of snow chains
- Tunnel driving
- Laws, regulations and rules
- And other advices

# Trucker's guide give useful information to foreign heavy vehicle operators

Report is made by the Norwegian Public Roads Administration  
2015 version in 7 languages:

- Norwegian
- English
- German
- Finnish
- Russian
- Polish
- Lithuanian

Distributed on borders, traffic stations, gas stations etc.

Internet: [www.vegvesen.no/truckersguide](http://www.vegvesen.no/truckersguide)

A wide-angle photograph of a snowy mountain landscape. In the foreground, a person is snowmobiling down a slope, leaving a trail of snow behind them. The middle ground shows a vast, flat expanse of snow. In the background, there are rugged, snow-covered mountains under a clear sky. The overall scene is bright and crisp.

**Thank you for your attention**

**Gracias**

Photo: NRK