

Module

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trans^{ambulance}

Driving and road safety



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1. Basic principles of safety driving

Everyone must respect the traffic regulations, and this is the fundamental principle, respect. It is necessary to make the road a place of coexistence and cooperation among all users and to realize that we have to respect in order to be respected. To do so, it is essential to:

- Have a deep knowledge of the rules and traffic signs, especially those that have the greatest impact on safety (adequate speed, overtaking, preferences, etc.).
- Be aware of the characteristics of ambulance vehicle.
- Have a collaborative attitude that allows everyone to enjoy the road.

Principle of responsibility: the driver must follow the existing regulations, and avoid being a danger to others, accepting the consequences of their own actions.

Principle of trust: users of public roads are required to share it so that does not unduly impede the movement. They should also collaborate with emergency vehicles. But this can not mean a reduction in vigilance by the driver of the ambulance.

However, when we realize that another driver is not acting accordingly to the rules and regulations, we must give up our right, just to prevent further damage.

Principle of security or defense: sometimes you have to drive the ambulance not only properly, but defensively. That is taking into account the possible negligence of other people, especially children, elderly, etc.

Principle of personal safety: no one is forced to sacrifice his life or compromise his physical integrity when performing a lawful act, which employs regular diligence that its activity requires.

2. Specific regulation for priority vehicles

2.1. Mandatory Seat belts

As in any vehicle, the law requires to use seat belts properly fastened, both the driver and passengers of the ambulance service, patients and healthcare team, in urban and interurban roads. The ambulance driver shall ensure that all persons have their seat belts fastened in order to avoid further problems, both physical and legal.

If the patient travels on a stretcher, he/she will always be tied with belts of the stretcher (Figure 1).



Figure 1. Stretcher with 2 belts.

2.2. Identification of priority vehicles

Priority vehicles are identified by their own light signals, blue colored (pending the entry into effect of the new Traffic Law. Before, they were yellow in Spain,) and acoustic signals such as sirens.

These signals have a dual function:

- Identify the type of service provided.
- Warn his presence to have the right of way.

On May 9, 2014 came into force the reform of the Law of Traffic and Road Safety, which includes the change in color of the light of the priority vehicles such as ambulances, from orange to blue, to harmonize with the rest countries of the European Union.

However, this issue needs further policy development and therefore is not into effect nowadays. Until today, there was not a regulation developed and therefore can not reproduce its articles.

2.3. Priority of way

Both the priority as the right of way is ruled by the Traffic General Regulation in Spain. Specifically in its article 67.1, which states that priority vehicles “vehicles emergency services, public or private, will have right of way over other vehicles and other users of public roads, when they are in service. They may be able move above the speed limit and be exempt from other regulations or signs in the cases and under the conditions determined in this section.”

Ambulance drivers shall make responsible use of lights and sound signals only in an urgent service and take care not to violate the right of way at intersections of roads or traffic light signals, without taking extreme pre-

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cautions to ensure there is no risk of collision with pedestrians and drivers of other vehicles have stopped or providing the way.

In addition, drivers of priority vehicles must use the light signal separately when the omission of special acoustic signals does not put in danger other road users.

2.4. Emergency Corridor (Figure 1 and seq)

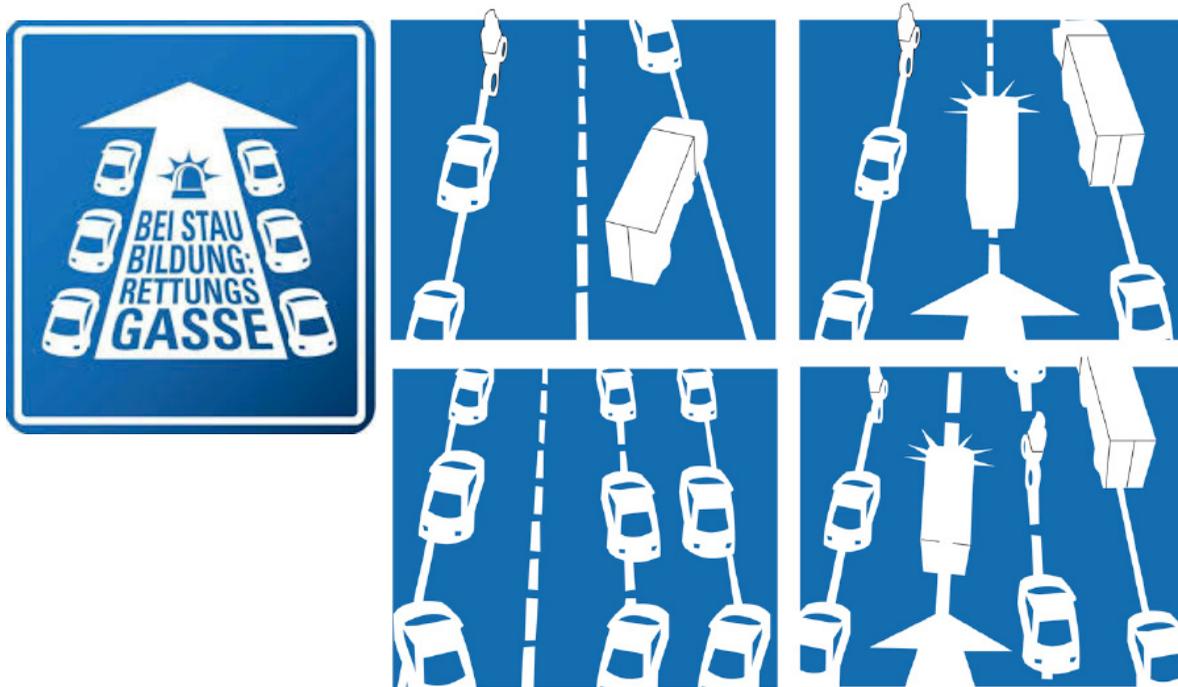
Precisely to make easier the passage of ambulances on highways, the creation of a virtual lane called emergency corridor has been developed. Corridors are virtual emergency lanes that are created for a limited time to be used only for ambulances and other emergency vehicles.



Figure 2. Winner of Cannes Lions 2014. Volvo trucks, trying a emergency corridor.

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In countries such as Austria, Germany, Slovenia, Czech Republic and Switzerland, this type of corridors are mandatory on highways, and now RACE calls for the creation of them in Spain too, or it becomes its use official when there is a traffic jam.



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In the first 60 minutes after a road accident the 75% of deaths occurred, is known as “the golden hour”. Decreasing in four minutes the time of arrival time of the ambulance could increase up to 40% chances of living chances of those victims.

The idea behind is that every driver knows where to move when an ambulance is coming with agility despite traffic jams. **The proposed emergency corridor is clear up the center of the road if it is two lanes, and move the two right lanes to the right, and the left lane to the left on three-lane roads.**





2.5. Use of the roadside

If the emergency corridor is not possible, the roadside is another alternative on interurban roads for ambulance in urgent service. It is not the best solution as it can be occupied by other vehicles, forced to run through it (tractors, mopeds, bicycles, vehicle breakdown, etc.). Nor should we forget that heavy vehicles drive on the right lane and could impede the escape route for emergency vehicles.

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The roadside can be eliminated by acceleration and deceleration lanes, as well as by bus stops with the risk involving the arrival of a vehicle that is joining the track.

2.6. Intersections

The General Traffic Regulation say that at intersections where there is no type of signaling that rules, priority should be given to vehicles approaching from the right, with the exception of emergency vehicles in urgent service.

As an ambulance driver, it is important to know that some parts of the vehicle or colleagues who are next, can hide information of traffic. Therefore, sometimes it is desirable that the driver's body forward slightly to enlarge the field of view and tell the colleagues what to do, so they will keep still and the driver will have better visibility.

Even if you have priority, try not to neglect the right of way of other road users and if you do, extreme precautions and make sure that pedestrians and drivers have stopped running.

2.7. Road signaling

The road signaling is the set of traffic signs and orders given by traffic agents. Remember that on all of them, giving the prevailing traffic officers.

Road signaling will be really useful to predict in advance any hazards that may affect the movement of the users of the public roads (passing cattle, landslides, etc.), Others affecting the layout of the track (succession of dangerous curves, elevation changes that reduces visibility, etc.) or affecting the pathophysiology of the patient during transport (speed bumps, firm irregular or unstable, roadworks, works with modified camber, etc.).

We also notice in time to adapt our driving emergency services, the destination that suits best (exits express roads, direction to take at junctions, roundabouts, etc.) and additional information (use of chains, mountain passes, slow traffic, near the crash which we address, etc.).

3. Driving techniques for ambulances

3.1. Lanes choice

- Use the right lane that best suits your destination. If the road has more than one lane for each direction, use the left lane, avoiding repeated change into other lanes, because the response of the other drivers can be unpredictable.
- Keep a good distance between the vehicles in front you, as well as the ones in your sides.

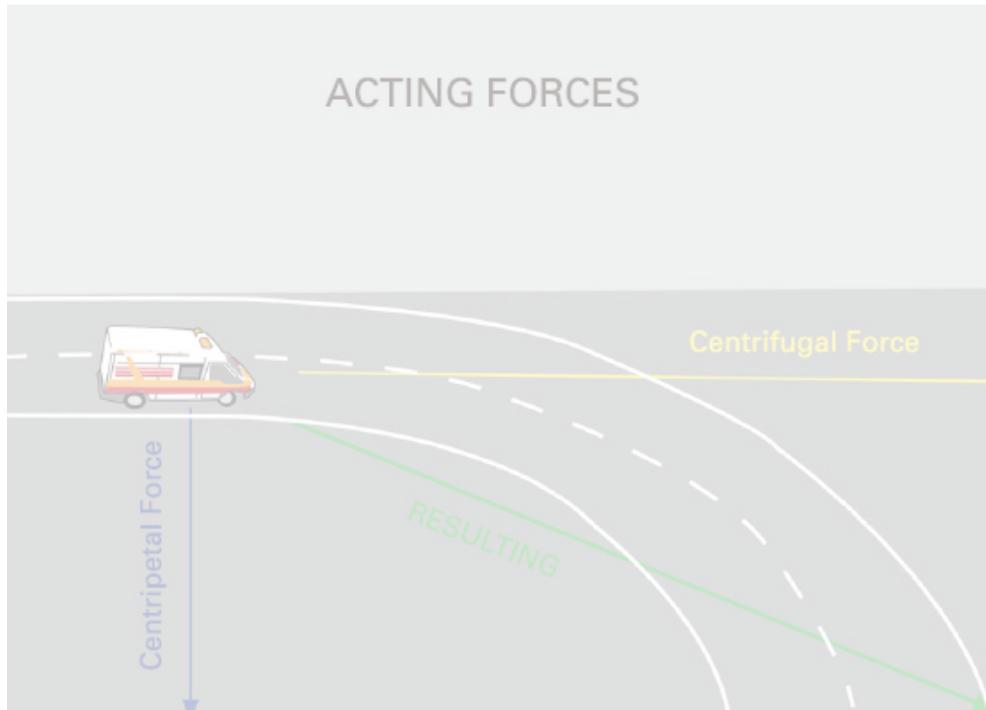
Never take for granted that with the lights and sirens people have to see the ambulance well in advance. Moderate your speed at intersections, curves, pedestrian crossings, flowing in the opposite direction and do not let your guard down, because when you circulate on urgent service you can always face surprises. As the saying goes, “prevention is better than treating”.

3.2. Curves

Curves are one of the most dangerous parts of the road, since the vehicle is subject to a number of forces in it which, if unbalanced tend to get of the way. The cant, in most highways inward curve, increases the grip of the wheels on the pavement, that is, greater adherence is achieved by tilting curve.

Recalling basic physics, according to the principle of inertia, a body in motion does not stop or vary its speed nor its rectilinear direction if not for the action of a force. This force gives the mass (positive or negative) acceleration that will make you change your speed or direction moves.

The force required to vary its speed is equal to the product of mass time acceleration. The force required to vary its rectilinear path equals the product of the mass of the vehicle by the centripetal acceleration (Figure 2).



Consequently to the drivers action, a centripetal acceleration is generated whose support point is the tires of the vehicle and is oriented towards the center of the radius of curvature is generated. A centripetal force is equal

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and opposite to another force, centrifugal force, having balance between the two forces. When the centrifugal force exceeds the limit of adhesion may result the drift.

The more closed the radius of the curve, the greater the forces acting during the course of the bend. The correct cant of the road, help you succeed in drawing the curve.

The best way to manage a curve is:

- To stop accelerating with enough time. The anticipation when assessing the danger is basic.
- To break lightly to reduce speeds in the gearbox and make acting engine braking. These two steps before entering the curve.
- To maintain a constant speed throughout the curve.
- To accelerate lightly out of it.

If mismanagement problems appears when facing a curve and suffer a skid car, this drift can occur in the front or in the back axis, usually depending on whether the vehicle has traction.

Understeer and oversteer

Understeer occurs when slides on the front axle. Understeer can happen to reach the curve speeding or an excessive acceleration in the turn.

How do we correct it?

We smoothly stop accelerating; we no more turn the steering wheel to the inside of the bend, since the wheels would intersect and continue sliding further because the lateral grip of the tire is less than the longitudinal adherence. When stop accelerating adhesion is gained in the front and can be re-rotating direction to manage the end of the curve.

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Oversteer occurs if the rear axle is slipping. The oversteer can occur because we brake abruptly or stop accelerating sharply in the turn, since a mass movement occurs forward and the rear axle loses grip and drift.

How do we correct it?

We turn the steering wheel towards the same side at the rear of the vehicle (countersteering) moves and then you have to undo that countersteering to prevent further sliding. Handling the steering wheel has to be fast and firmly. Meanwhile, in most cases must be very smoothly acceleration to recover the desired trajectory.

When colleagues are in the healthcare interior attending a patient, it is important to warn of the arrival of the curves for safety (yours and the patient) and if they have to perform some technique on the patient.

It is also important to perform continuous refresher courses aimed at an improvement in the management of ambulances.

3.3. Speed

The driver must adjust the speed to the circumstances: adapt speed means being able to stop the vehicle in any unexpected circumstance. Furthermore, he should consider speed limits for safety reasons, fluidity, comfort and economy. Maintaining a constant speed, security is increased in the circulation.

The time spent by the driver to identify the signals and other stimuli of the road, and react to them, are directly proportional to the speed at which you are driving.

3.4. Overtaking

Before overtaking with an ambulance, make sure the lane you intend to use there is enough free space for the maneuver and does not endanger or hinder to circulate around it, taking into account your speed and other ve-

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hicles. In case of doubt, do not get ahead. The responsibility to overtake always corresponds to whom performs maneuver.

Beware of bulky vehicles. Greatly impair vision and can not see what's ahead. The closer you get to them, the less visibility you have.

Around a motorcycle, bicycle or pedestrian is advisable to leave a lateral separation of security because they are easily destabilized. The lateral separation of safety two-wheeled vehicles and pedestrians will always be greater than 1.50 m.

Special caution if you go ahead several vehicles at once. Sometimes you cannot see the direction indicators for vehicles (flashing). Take care because some of them may move to the left lane to overtake or turn, and the big problem is that the driver, once started overtaking, has no space to return to the right. Do not forget the position, distance and speed of vehicles traveling in the opposite direction.

3.5. Tires, key to the grip

The tire is the only link between the vehicle and the road. The adhesion of the tire, according to the road conditions, is highly variable and has a limit. Once over that limit slip occurs.

The grip of a tire depends on:

- **The quality of the tire.** Therein the difference in price.
- **The system suspension / damping:** Executive absorb terrain irregularities and maintain tire contact with the pavement. They have to be in perfect conditions to do their job properly.
- **The conditions:** the drawings in your tires have a pattern with a mission to drain the water to the sides for an easier grip. Drawings should no have cuts or worns and must have a minimum depth of 1.6 mm to perform

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this task correctly. Lower efficacy with less depth. We verified this depth through the tread wear indicators is in the tread itself or with the finger.

- **The inflation pressure:** the right level is suggested by the manufacturer. With less pressure, the tire is further flattened, there is more surface contact with the ground and, therefore the tire evacuate more water, less effective.
- **The width of the tread:** is similar to the above, the wider the tire's surface is in contact with the road and more water must be drained.

4. Driving techniques in adverse weather conditions

When weather conditions are adverse (rain, snow, ice, wind, fog), driving becomes more difficult and dangerous because it affects visibility and adhesion.

4.1. Rain and poor visibility

The rain on the windows and mirrors in the vehicle produces a loss of visibility. The water deposited on the roadway prevents a correct reading of marks; night lighting with which vehicles are reflected in the wet pavement, behaving entire surface like a mirror. Likewise with hail.

Therefore, it is desirable to keep the items that the vehicle has in perfect conditions for good visibility.

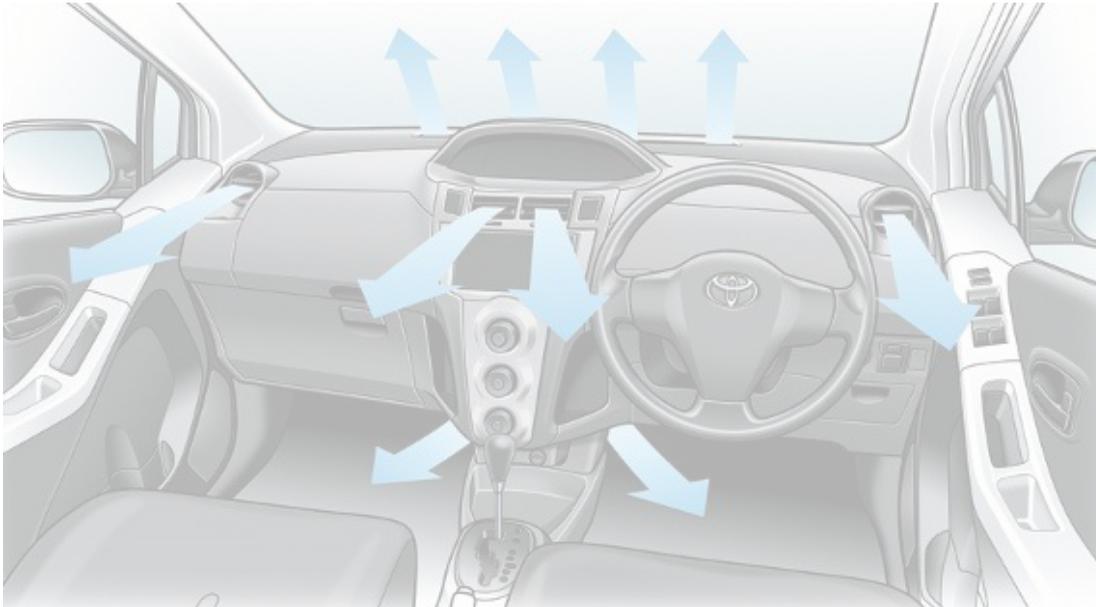
- **The wipers.** The wiper's rubber must be in perfect conditions so that when the sweep takes place on the front windshield or the rear window to be effective and remove as much water as possible.

The lack of visibility leads to take a particular care. This produces eyestrain. The continuous movement of the wiper to and fro, for extended periods of time increases the visual fatigue, so that the concentration and the visual

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acuity decreases. This phenomenon is called wiper's hypnosis. To avoid this, the best thing is to use the wipers at the slowest speed possible to have complete visibility, especially on long trips.

- **The washer fluid reservoir.** We have seen in the basic maintenance of the vehicle the importance to refill the washer fluid reservoir with water mixed with detergent and antifreeze product, especially in winter. If we



brush the wipers dry it will damage and shorten its duration, because dirt will scratch the windshield and these scratches can cause reflections and glare in the sun.

- **The HV/AC system.** A good air conditioning and proper orientation of the air vents to the windows of the vehicle ensures no fogging.
- **Lights.** It is important because it serves to see and be seen, both day and night.

4.2. Rain and lack of grip

With rain, grip is less. When it starts to rain, the water mixes with the dirt of the road and becomes to a very slippery mud that makes the adherence decreases. It may also occurs the opposite: there is plenty of water on the roadway. In this case, if we circulate with excessive speed, the tire will not be able to expel all the water and skidded. This phenomenon is called aquaplaning.

We currently have no control over the direction (seems it is floating), or nor in acceleration nor in the brakes. In case this happens on one side of the vehicle, we will notice how the vehicle is braked in the side that is in contact with water. What We Do?

- First, stay calm and feel sensations that the car transmits to us.
- lift the gas pedal and not touch the brake. This changes the radius of rotation of the wheels. it shows how adherence is recovered again by slowing down.
- Hold the steering wheel firmly but not violently.

4.3. Snow and ice. What to do before starting?

When the temperature is very low and the vehicle has been parked in an open space, it is likely that ice forms in the crystals. It is required to remove ice before completely; if it is not removed completely, visibility is not good and fogging will show up again.

If you know that temperatures will drop below zero overnight, and you can not park in a garage, it is important to take preventive measures to get the vehicle available for an emergency work. A solution can be to get a sheet or cardboard and cover the windshield. It is also important to leave the wiper raised to prevent sticking to the glass and the rubber breakage.

How do we remove the ice on the glass?

- Start the car engine. We leave it to idle for several minutes to acquire the ideal operating temperature (85-90 °C). Never accelerate vacuum for this purpose. This is extremely damaging to the engine by a lack of lubrication of the parts, as the oil is very thick and has not reached all areas experiencing friction.
- After several minutes, open the air vents and orient them toward the windshield and into the windows to end fogging. Connect the heated rear window to begin melting the ice. Not retreat misting by hand because it will leave residues affect hamper visibility when facing the sun or the headlights of the vehicles in the opposite direction.
- In the meantime, go outside and with a scraper, help remove the ice.
- Do not take hot water on the windshield to melt the ice.

4.4. Snow and poor visibility

When it snows, you should have the same precautions as when it rains or hails, and also some specific ones. If the snow is heavy, snow accumulates where the wipers do not reach and occasionally it will be necessary to stop and with a scraper, remove the snow. If the vehicle has rear heated window, turn it on.

Snow accumulates and even hides signals, road markings from the roadway and vertical signals. This represents a problem in reaching the scene of the emergency, which will get worse if we do not know the area or locality where we circulate. In very sunny and clear days is necessary to use sunglasses to avoid bright light caused by the rays on the snow. The lighting depends on the circumstances.

4.5. Snow and lack of grip

When it begins to snow the same situation of loss of grip occurs as when it starts to rain because the first flakes fall apart immediately, mixed with all the dirt, mud and grip shape is lost. Remember that in these circumstances, you have to use the brakes as little as possible.

It is important to follow the wheel tracks left by the cars that preceded to us. The treaded snow can freeze as a result of low temperatures and become ice. In that case circulate in the area of snow that has yet not be tread.

Snow ejects by our car accumulates in the wheel arches and can frost, reaching to rub the tire on it and preventing the rotation of the wheel. Look for a safe place to stop and withdraw the frozen snow.

- **When setting off:** you do not have to get the wheels to spin. The wheels spin because we transmit great force to the drive wheels (which receive power from the engine) and the rate of tyre grip is surpassed. The best recipe is to start the movement with a gear ratio in the gearbox as high as possible which may cause the vehicle to

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move (the 2nd or 3rd gear). Slowly lift the clutch and accelerate just anything, but steadily. To avoid sudden steering wheel movements.

- **Negotiating slopes:** circulate at a constant speed and in a too higher gear ratio possible. You have to face rising once. If we are forced to stop on the way up, we may not be able to return to starting off, since the vehicle can slide back and the wheels can slip. Best parking the vehicle on flat areas.
- **On downhill slopes:** it is the opposite. We will use the lower gears of the gearbox (1st and 2nd). The anticipation to stop accelerating is essential to get the en-



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gine braking of the vehicle (when you stop accelerating, the car engine loses rpm) and thus play very little or no brake. In very short and much inclination (eg entry to a garage) slopes is best to stop at first, leave the vehicle with no gear engaged (Neutral) and start to break from the begining very gently and with same pressure. If we brake stronger, lose grip and we slide uncontrollably.

- **To brake:** it is best to anticipate braking, leaving accelerating well in advance so that the car is losing speed and not need practically touching the brake.
- **Snow chains.** In many cases its use is mandatory and will be ordered by the appropriate authority, which prevent us from continuing our way if we do not have them. The chains are placed in at least one wheel on each side of the motor shaft. The most usual (several types) are some metal chains enveloping the tire tread, thereby producing greater adhesion. Placing chains requires some practice, so it is advisable to have practiced how to put them on dry land before; otherwise, we will not know put them in the snow. Gloves and some sort of waterproof material to avoid getting wet to our knees would be very useful in this situation. Once placed, you must drive the vehicle a few hundred feet and stop again to check their placement and tension them again if necessary. At the moment there is no need to remove snow, if you continue using them you can damage them, like the tread of the tire and the road.
- **Tires M + S (mud and snow)** are also known as winter tires. They are made of a compound that retains its properties at very low temperatures. Designed for use where maximum temperatures do not exceed 7 °C. Normal tire with these temperatures becomes very hard losing elasticity, influencing grip, braking distance, etc. Drawing its tread is deeper (4 mm) and on each cue a series of small incisions providing greater elasticity appreciated.

4.6. Ice and lack of grip

Driving on icy surfaces is without doubt the most dangerous for driving because adherence in many cases will be zero. The stopping distance can be up to ten times higher than in normal circumstances.

If the road is absolutely freezing, driving is impossible. In that case the competent authorities for traffic going to cut off circulation in the driveway. The problem is when we found unexpectedly with some isolated ice sheet when stepped and we lose control of our vehicle. What should we do?

- Raise the gas pedal very gently.
- Try to correct the vehicle path with very smooth movements of the steering wheel.
- Brake as little as possible, having to do it, very soft (bordering the pedal).

For such situations the best remedy is anticipation, a preventive driving. What does this mean?

We know that the gloomy and wet areas, areas with lots of vegetation and moisture, viaducts, bridges and elevated or below both steps and the entrance or exit of the tunnels in mountain areas are very prone to icing, so it is necessary to take extreme care and be very careful to anticipate the possible existence of ice on the road.

4.7. Fog and poor visibility

This is a weather phenomenon in which the clouds of small particles of water suspended in are virtually at ground level. This greatly affects the visibility and to a lesser extent, the adhesion.

Using lighting as required by regulations for such cases. It is important to see, but even more so is being seen. We do not recommend long-range lighting or road, its light beam goes higher and is more powerful, and when

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the fog is very low and very thick, light can not pass through that curtain of water particles in suspension, forming a screen where the light bounces and we can get to dazzle. You have to use the lighting that illuminate below, near the road.

The rear fog light is red but with greater intensity. If I took turned on being unnecessary, dazzled the vehicle behind to us.

Use reference road markings that define the directions of traffic or lanes in the same direction, also road markings or guiding devices that define the edges of the road.

Circulate so slowly and having to make such a major effort with the sight, will promote fatigue and eyestrain appear more early.

