KRC Michigan Tech

Winter Driving School

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2009

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Table of Contents

I. Overview. 2

II. Winter Driving 2

A. Preparing Your Vehicle For Winter Driving 3

B. Preparing To Drive In Winter Conditions 7

C. Basic Information on Road Surfaces and Vehicles 10

D. Braking Techniques 13

E. Vehicle Control Techniques 16

F. Special Situations 23

Winter Driving School

I. OVERVIEW

This booklet will help prepare your vehicle for winter weather and you for winter driving.

There is one caveat: you can read about safe winter-driving techniques all you want, but if you don't practice them, you won't become a better winter driver.

So practice—and build your ability and confidence.

II. WINTER DRIVING

We cover basic information taught in driver's education about seating position, steering, seat belts, mirror adjustment, and the like. We also discuss a much broader range of topics, including steering wheel/hand position; the coefficient of friction (slipperiness of the road); basic vehicle dynamics such as weight transfer and balance; vehicle drive systems; and newer control systems such as antilock brakes (ABS), traction control, and stability control. These topics are basic preparation for learning braking and control techniques, which are both taught and practiced and are critical to safe winter driving.

A. Preparing Your Vehicle for Winter Driving

Proper vehicle maintenance allows you to focus on driving, not mechanical problems, which becomes more important when road conditions worsen. Vehicle problems that seem negligible in the summer may become significant in the winter. Autumn is a perfect time to familiarize yourself with the basic functions of your vehicle and with the location of essential components. Your best reference is the vehicle's owner's manual, which details the features of your car, maintenance schedules, and fluid requirements. Once you've consulted the owner's manual, you or a certified mechanic should check the following systems in preparation for winter.

Engine Tune-up

It is recommended to have an engine tune-up in the fall. Check and service the ignition system, including spark plugs and wires, distributor, emission system components, and the fuel-injection system. If necessary, have an auto technician tune the engine. Check the voltage regulator and replace if necessary. Clean or replace the spark plugs. If you have a diesel engine, check to see that glow plugs are in working order. Make sure the distributor cap and all electrical contact points are clean. Check fuel filters for clogs or leaks. Make sure all cables operate freely and lubricate if possible. Inspect the air filter and replace as needed. All newer cars have solid-state electronic brain boxes, which often fail without notice. It is probably best to have your car dealer check these out in the fall while doing the other maintenance described here.

Coolant/Heating/Defrost System

Check the cooling system because improper levels of antifreeze can cause major engine damage. The cooling system should be flushed every other year. Flush and fill the system, as it is not only susceptible to freezing, it is also a source of heat and defrosting. Antifreeze should not only be strong enough to prevent freezing, but fresh enough to prevent rust. A mixture of 50 percent water and 50 percent antifreeze coolant is typically recommended by most auto manufacturers. Topping off your coolant with water will gradually dilute the mixture. Check the freezing point of the antifreeze using a tester sold in most automotive stores. If need be, drain some of the coolant from your system and add more antifreeze. Make sure the thermostat is working properly. It ensures that hot coolant is cooled through the radiator; if it is stuck, the engine may overheat. Check the heater/defroster for leaks. If there is insufficient heat, the system may be plugged and may need to be replaced. Examine all belts and hoses for cracks or leaks; the hoses shouldn't be excessively soft or brittle. The water pump should not make any strange noises; if it does, the pump may have to be replaced. Always refer to your vehicle's owner's manual or have a certified auto technician service your cooling/heater/defrost system.

Batteries and Charging System

While you need more power from your battery in the winter, it loses power as temperatures drop. Car batteries are put to a severe test in winter due to the extra demands of running heating fans and lights, and trying to turn over a cold engine, which draws more amperage from the battery. A marginal battery in warm temperatures may not start the car at zero. Have the battery inspected and load tested. Most are now maintenance-free, but the voltage should be checked occasionally, especially if the car is repeatedly used for short journeys. Consider charging the battery overnight or try to plan a longer run once in awhile. Make sure the battery connections are good. If the battery terminal posts seem to be building up a layer of corrosion, clean them, while the engine is off, with a wire brush dipped in baking soda and water. Let the fluid foam, and then rinse with water. Apply a thin film of petroleum jelly or light grease to the terminal posts to prevent corrosion, and reconnect. Be sure all cables are secure. The charging system should be checked and serviced. Check, and replace if needed, the alternator and alternator drive belt.

Brakes

Brakes that grab too quickly or unevenly can cause the car to spin on slippery roads. If the brakes do not apply equal force on each wheel, the imbalance could cause the car to pull to one side or possibly skid out of control. If your car's brakes squeal or pull the vehicle to one side when applied, or if the pedal feels soft when pumped, have the brakes inspected and adjusted. The brake fluid should be checked and added or replaced per the owner's manual. This may be a good time to have the brake pads and shoes replaced and the drums and/or rotors resurfaced or replaced. If the vehicle is equipped with antilock brakes (ABS), have them checked by a trained automotive technician.

Engine Oil

Many sources recommend an oil change in the fall. Oil in the engine can become thick and heavy when your car is left overnight in cold conditions. Do not run the engine too hard when it is cold. To protect the engine's moving parts, the oil quickly thins down during warm-up. Changing your engine lubrication to a lightweight oil will make your engine easier to turn over during cold weather. Some recommend switching to winter-weight oil if you aren't already using an all-season oil. The best practice is to follow the recommendations in your owner's manual. It is a good idea to change your engine's oil filter in the fall when you change your oil. At the same time, lubricate all grease fittings under your vehicle and on the steering system.

Transmission

Check the transmission fluid level and add fluid if necessary. If there is any doubt as to whether the transmission is operating properly, have a trained automotive technician check and service it. On rear-wheel-drive and four-wheel-drive cars, check the level of fluid in the differentials.

Windshield Wipers

To drive safely, you have to be able to see. Windshield washers and wipers are vital for maintaining good vision in winter. Make sure the windshield wipers are functioning properly. Replace wiper blades if they are cracked, split, streaking, or skipping. Some sources recommend replacing wiper blades every six months. Consider changing to winter wiper blades, which are made for driving in snow. They are covered with a rubber boot to keep moisture away from working parts of the blade. These are heavier and can push snow and ice more easily. Be sure to remove them in the spring because they are heavy and add to the wear and tear of the wiper motor. Keep the washer reservoir full and the pump/sprayers working properly and aimed properly. Use a winter-blend windshield washer fluid. Never add antifreeze; it may damage the vehicle's paint. For longer trips, it is a good idea to carry a spare gallon of washer fluid in your trunk. In the winter, you may use more windshield wiper fluid simply because the roads are wet and slushy and the chemical ice treatment applied to the highway is very sticky and difficult to see through.

Lights

It is important that all vehicle lights are working properly. You want to see and be seen, and, therefore, you want every advantage possible for low-visibility situations, which are common in winter. Check the aim and alignment of the headlights. If they are too high, they will reflect off falling snow and seriously limit visibility.

Exhaust System

Check your exhaust system for leaks. A properly sealed exhaust system reduces the risk of carbon monoxide poisoning and helps maintain optimum engine performance.

Shocks and Struts

Every bit of vehicle performance helps on ice and snow, so have a certified automotive technician test your shock absorbers and struts, which are critical to handling.

Tires

Probably the single most important consideration to confidently face winter driving is the vehicle's tires.

Tires are the only contact between your vehicle and the road. An all-season radial tire will not perform as well as a winter radial tire. When developing tires for vehicles, most car and tire manufacturers look at a wide variety of performance issues, such as dry handling, wet handling, noise, ride comfort, snow traction, etc. In general, the auto manufacturers typically choose a middle-of-the-road tire or one that is suited to how they feel the vehicle will be used. A sports car will have tires that provide better dry handling, while a luxury car will have tires with better ride comfort. The automotive manufacturers rarely put tires with great snow traction on their vehicles. Almost all factory vehicles have all-season radial tires. Some may have an M+S or M/S rating, which stands for Mud and Snow. These tires may be a little better in snow than the average all-season radial, but not nearly as effective as a purpose-built winter radial tire.

If you live in an area that has considerable snowfall or a longer-than-average winter season, where roads are often packed with snow or ice, it is recommended that you change your tires in the fall to a winter radial tire. Two identical vehicles, one with all-season tires and one with purpose-built winter tires, will have very different performance levels. Traction may vary by as much as 50 percent. (Be careful: If your car has all-season tires, remember that the car in front of you may have winter tires and be able to stop up to 50 percent faster.) Research the latest tire technology and find out about the latest advances in tire traction and performance. Tire technology is advancing so rapidly that last year's top performers may be in the middle of the pack this year.

A winter radial tire is made with a soft rubber compound and has numerous thin sipes, or cuts, in the tread blocks. These sipes allow the tire to flex and grip slippery surfaces better. Winter radial tires are designated by passing a certain type of test. If they have 10 percent more traction than the standard reference tire, they are considered a winter radial. Winter radial tires are identified by a symbol of three mountain peaks with a snowflake on the mountains, as shown in Figure 1.

RMA Severe Snow Conditions-Rated

Figure 1. Designation shown on the side of certified winter radial tires

There are many brands of winter radials on the market, and there are different places where one can see performance reviews. Keep in mind that the average driver will probably not be able to distinguish differences in performance for the top-rated winter radial tires, so price may be a good consideration when shopping. If you do purchase winter radial tires, put them on all four wheels, no matter what type of vehicle you have, because even though you may only have two-wheel drive, you still brake and corner with all four wheels.

If you put winter radial tires on your vehicle, it is recommended that you remove them in spring because they have a soft rubber compound and tend to wear out fast on pavement. In northern climates, many people use their winter radials during the winter and all-season radials the rest of the year.

It is important that tires be inflated to the recommended level so the tread will meet the road surface as it was engineered to do. Winter radial tires are a great improvement over all-season radials; however, you should not allow yourself to become too confident because you have snow tires. You still must use slower speeds and longer following distances when driving on ice and snow.

If you don't use winter radials, closely inspect your vehicle's all-season tires for wear. Tires should have at least an eighth of an inch of tread. Replace them if there is any question as to their safety. Reducing the air pressure may give them more grip in some conditions; however, it will change the handling characteristics of the vehicle and limit the maximum speed. It is best to follow manufacturer's recommendations for proper inflation pressures.

B. Preparing To Drive in Winter Conditions

Winter driving requires some preparations that are not normally required during the rest of the year. After making sure your vehicle is ready for cold temperatures, there are certain things you should do each time before driving:

- Keep your gas tank as full as possible. This protects against the presence of water in the tank, which can cause the fuel in the fuel line to freeze. Avoid using alcohol-blended gasoline during extremely cold temperatures. The alcohol in the fuel attracts and retains moisture, which also can freeze in your fuel line.
- Perform routine checks of the fluid levels in your car, making sure oil, windshield washer fluid, antifreeze, etc., are full. On really cold days, be careful about using the windshield washer and wipers when driving at high speeds. Even if the fluid contains antifreeze, high speed, combined with extreme cold, can freeze the solution on the windshield and block your view of the road ahead.

- Remove all snow and ice from your vehicle, including the roof.
- In winter, being seen is just as important as seeing. The range of your car's headlights, for example, can be reduced by one hundred feet if road grime is allowed to accumulate on the lens. Keep an old towel with your snow brush and use it to wipe the ice, snow, and mud off of the headlights, which will increase their brightness. Clear the taillights as well as your windshield, side glass, and mirrors. Front and rear lights and turn signal indicators/flashers require special attention when it's snowy and slushy. They may become caked in road grime, so clean them every time you fuel your vehicle. Pay attention to the use of your rear window defroster. On many cars, these electric devices shut off after only five or ten minutes of use. If snow is building up on the back window, reactivate the rear defroster. Rear vision should not be neglected. If your car has a rear wiper, use it to clear away light snow, but first check that it is not frozen to the glass.
- Do not wear restrictive clothing, such as bulky jackets or mittens. Dress warmly, in several layers, which allows you to remove some clothing for comfortable driving yet still having enough to keep you warm when you get out of your car. Keep in mind that, though it will be warm in the car while you are traveling, if you do end up stuck somewhere, it may get cold very quickly.
- Try to remove ice and snow from your shoes before getting in your vehicle. As they melt, they create moisture and cause windows to fog on the inside.
- Adjust your seat so that you can fully depress the brake pedal with your right foot (and the clutch pedal with your left foot in a manual transmission) and still have a slight bend in your knees. Make sure you don't have to reposition your body or hyperextend your legs to do this. Your left foot should be able to rest comfortably on the dead pedal—or fourth pedal—that area on the floor to the left of the pedal assembly. When your arms are held out directly in front of you, your wrists should be able to rest on the top of the steering wheel without your shoulders coming off the back of the seat. If you are tall, it may be difficult to do this without having to move your seat forward so that your legs are cramped. If this is the case, you'll have to use your best judgment to find a happy medium. At the very least, make sure you can comfortably grip the top of the steering wheel with both hands. You may use the tilt adjustment on your steering column to increase your comfort, but be cautious about tilting the wheel too low. It may cause your hands to hit your legs during a wide-radius turn.
- Keep a continuous flow of warm air circulating— not hot air, which will make you drowsy.

- Wear your seat belt and put young children in car seats. The lap belt should be low and snug over the hips to prevent injury to the abdomen and pelvis. The shoulder belt should be snug across the chest to prevent chest and head injuries. If a seat belt or car seat is not working properly, get it fixed as soon as possible.
- As the temperature drops, so does your battery's starting power. You can maximize starting power by turning off all accessories, including the heater, radio, and lights, before you attempt to start the car. If the car engine doesn't turn over, you may need a jump start. The owner's manual is the best source for guidance on how to start the car in cold weather. For carbureted cars, depress the accelerator once and release it. For fuel-injected vehicles, don't touch the pedal. Turn the key and hold it for only about twenty seconds. If the engine fails to start, wait a couple of minutes and try again.
- Once your engine is running, you may start driving, but don't accelerate too quickly during the first mile or two. Because of the danger of carbon monoxide poisoning, don't let your car warm up in the garage for a long period of time, especially if you have an attached garage. The fumes can seep into the house and overcome those inside, even with an open garage door. Also, idling a cold vehicle's engine for a long time to warm it up could harm the engine. The right way to warm up a vehicle is to drive it easily for a few miles.
- You can reduce fogging by turning the air recirculation switch to the OFF position. This brings in drier, fresh air. You can also run your air conditioner for a few minutes, which serves as a dehumidifier. It sounds contradictory, but engaging the AC compressor while defrosting your windows does a much better job, even if your car is not warmed up. The AC system dries the air that is blowing across the windows and removes the moisture inside the car. The heater will then warm the dry air, defrosting even more effectively.
- Plan long trips carefully by closely monitoring weather forecasts and road conditions. Be familiar with maps and directions to avoid confusion. If possible, plan to travel during the daylight and take at least one other person with you. Let others know when you are leaving and when you'll arrive. Give yourself plenty of time to get where you are going. Try to avoid hills, congested areas, and bridges. The best advice is to avoid driving when the conditions are bad. While this isn't always possible, it may be the most sensible course of action. Any unessential function should be postponed or canceled. Risking your life to have dinner with a friend or to go shopping may not be the wisest choice.
- Cold weather hastens the effects of alcohol, impairing your judgment. Keep the roadways safe by drinking responsibly and never driving drunk. If you are over twenty-one and choose to drink, always designate a driver before going out.

C. Basic Information On Road Surfaces And Vehicles

It is important that every driver understand some basic concepts for all types of driving, and this includes road surfaces and the effects of acceleration, braking, and steering. It is also important that drivers understand how their cars operate and function, especially with all of the different drive and control systems on the market these days.

Coefficient of Friction and the Concept of Grip

The coefficient of friction is a term used by engineers and scientists to tell how slippery a road surface is, among other things. A coefficient of friction of zero means that there is no friction—and therefore no grip. Without friction, you can't accelerate; and, if you were moving, you couldn't stop—no matter how much braking you apply. You also could not steer around a corner. A coefficient of friction of 1 or more means that there is good friction—and you will have good grip. Most dry highways have a coefficient of friction of 0.7 to 0.9. You already know how easy it is to drive, corner, and brake on a dry highway (unless you are traveling at very high speeds). Driving on slippery roads, or on roads with a low coefficient of friction, is much different. Packed snow roads may have a coefficient of friction of 0.2 to 0.4, and ice may be between 0.05 and 0.3, depending on conditions. Some measure the coefficient of friction using a certain type of tire and performing braking or acceleration tests. With good winter tires the coefficient of friction, or, in this case, the traction coefficient, will be better than having an all-season tire. You will have more grip on snow and ice. Drivers don't have to know the number; they just have to realize that when roads get slippery, the vehicle will be more difficult to accelerate, brake, and corner.

Use Grip (Adhesion) Efficiently

Your car sticks to the road with four small contact patches from your tires. Each is about the size of your fist. Tire inflation changes the contact patch, as does vehicle weight transfer from braking, accelerating, or turning. Also, your suspension determines how much grip (adhesion) you have. A tire has only so much adhesion to give. A tire past its limit of adhesion is either spinning, skidding, or sliding. Once a tire is to this point, it has no grip, and you're no longer in control.

When roads are slippery, use all of the grip (traction) available for one thing at a time. Brake only while travelling in a straight line prior to a curve or turn. Taking your foot off the brake before you steer into the curve allows you to use all of the grip available just for steering. Don't accelerate until you are able to straighten the steering wheel at the exit of the turn. This technique will allow you to be 100 percent effective at each maneuver—braking, steering, and acceleration. Most importantly, don't panic!

What Do Front-Wheel Drive, Rear-Wheel Drive, and Four-Wheel Drive Mean to My Driving?

Most people who live in northern climates own a front-wheel-drive (FWD) or four-wheel-drive (4WD) vehicle in order to get through the winters. They bought those vehicles because they believe they will get around in slippery conditions more easily, safely, and reliably. What some people don't always realize is that advantages in certain situations become disadvantages (or compromises) in other situations. FWD and 4WD vehicles mostly improve acceleration but not braking or turning. This means you can attain higher speeds but cannot turn faster or stop more quickly. Note that each drive train system presents a different method of propulsion, while being essentially identical in steering and braking functions. Differences in performance and handling characteristics are therefore most noticeable during acceleration.

Front-Wheel Drive—The FWD vehicle has the advantage of being pulled, and is therefore more stable as you accelerate. (Imagine trying to push a trailer attached to the front of your vehicle; it is much less maneuverable than when it is attached to the rear.) Additionally, in a FWD vehicle, the engine is located over the front wheels, which adds weight and provides more grip. This assists in steering maneuvers. However, overaccelerating this type of vehicle will cause the tires to spin (remember that a spinning tire has little grip) and the driver to lose steering control.

Rear-Wheel Drive—An RWD system pushes the vehicle rather than pulls it like an FWD. The disadvantage of this configuration is the relative ease of spinning the rear wheels. However, since only the rear wheels are spinning, steering control is maintained. Driven with care, an RWD vehicle has the advantage of splitting the tasks of acceleration and steering, allowing each pair of tires to function at or near maximum levels before losing control.

Four-Wheel Drive or All-Wheel Drive—4WD or AWD vehicles present a unique challenge. Most of them have open differentials. This means that if one wheel is on a slippery surface, the other wheel on that axle will not turn—all of the power goes to the wheel with the least resistance. So, 4WD and AWD are really misnomers. It really means the front and rear axles are driven. There are very few true 4WD or AWD vehicles where the axles (wheels from one side to the other) are locked together. Most drivers take their cue of changing road conditions from their vehicle slipping while accelerating. Driving a 4WD or AWD doesn't give you that information in a timely manner, since your vehicle won't slip as easily while accelerating as compared to an RWD or FWD vehicle. By the time you realize you're going too fast, it's often too late. Take your cue from the two-wheel-drive vehicles around you! A 4WD (or AWD) accelerates better because it spreads the work of propelling the vehicle over all four wheels (rather than just two drive wheels). Accelerate 3,000 pounds with

two tires and each has to move 1,500 pounds; use four tires and each has to move only 750 pounds. By cutting the workload of each tire in half, you gain significant advantage in acceleration. However, these vehicles don't change the condition of the road surface. Also, their ability to stop and turn is as limited as those of a two-wheel-drive vehicle. Remember, when your vehicle starts sliding, the last thing you need is more speed! Stay off the gas!

What Are Antilock Brakes?

Antilock braking systems (ABS) are designed to provide the best braking possible to the average driver while allowing steering control. On four-wheel ABS systems, there are speed sensors on each wheel and an electronic control module integrated with the vehicle's hydraulic brakes. There are several different configurations on the market, but the basic four-wheel ABS system monitors vehicle ground speed and each wheel speed and senses when a wheel is locked up during braking.

As most surfaces do not have all pavement or all snow/ice, the brake system will be cycled on and off as the wheel locks. Newer systems are more sophisticated and are able to control each wheel. This is much like pumping your brakes, except that the driver doesn't have to think about the pumping and can concentrate on steering. Although many people think having ABS will allow them to stop faster, this is not always the case. On some surfaces, a vehicle with ABS will require a longer distance to stop, but provides the driver with steering control since the wheels are not locked.

Some of the early ABS systems were only on the rear wheels of pickup trucks. These did not provide the driver with better steering control but did help in certain situations. Most newer ABS systems are four-wheel systems. The difference in the cost of four-wheel ABS systems is the level of tuning and the number of controllers. Some systems may only have one controller for both rear wheels and a controller for each front wheel, while more expensive systems may have a controller for each wheel.

What Is Traction Control?

Traction control systems were designed to help the driver get moving on a slippery surface. There are a variety of traction control systems on the market. Some sense when the wheels are spinning (as often happens when you accelerate on ice) and then brake the spinning wheel. Note that on most vehicles there is an open differential, and if one wheel is on ice and the other is on dry pavement, the wheel on ice will spin while the wheel on dry pavement will not move. Using the ABS braking system, the traction control system will lock and release the spinning wheel, or at least keep the wheel on ice from spinning. When this happens, some power will be transferred to the wheel on pavement, thus allowing the driver some traction. Other systems are more elaborate and may employ spark

retarding or fuel control in addition to utilizing the ABS speed sensing and braking capabilities. Traction control systems are helpful for starting on ice-covered hills or intersections. In a sense, they improve vehicle control because they help keep wheels from spinning, thus maintaining grip and steering control.

What Is Stability Control?

Stability control is one of the latest control systems and is called a variety of names, depending on the manufacturer. Stability systems provide handling and control when a vehicle oversteers or understeers. Again, the basic ABS system is used to monitor wheel speeds and to brake certain wheels. Stability control also uses steering wheel angle, lateral acceleration, and a yaw sensor to determine if the vehicle's heading is the same as the vehicles intended heading. Instead of braking all wheels, the stability control system will brake different combinations of wheels, depending on what the vehicle is doing and what the driver inputs are. When the wheels are braked with the ABS system, they don't lock up hard for a prolonged period of time and they don't slip, which means they provide some grip. Stability control is meant for drivers in emergency situations who may not know the best method of correction or cannot perform the corrections fast enough.

D. Breaking Techniques

Many accidents occur because people panic and lock their wheels. Once the wheels are locked, the driver has no steering control. Therefore, you need to learn how to brake without losing steering control.

Three different braking techniques are commonly used in winter-driving situations, other than full lockup.

Cadence (Pumping) Braking Technique

Cadence braking is pumping your brakes in a lock-release-lock mode and has been used successfully for many years by many people. Sometimes this method is easier for people to learn and use in a panic situation because the alternative—threshold braking—takes more practice to learn well. When using the cadence braking method, lock and release your brakes in a crisp and controlled manner. Make sure to release long enough to let your wheels roll in between lockups. Remember that if you lock your wheels, you lose steering control. If you need to steer, stop braking, make sure your wheels are rolling, and steer, but do not use severe steering maneuvers as you may unbalance the car.

Threshold Braking Technique

When on a slippery surface, threshold braking is the most effective braking technique. While not difficult, it requires some practice to perfect. Essentially, it is squeezing the brake pedal rather than stomping or pumping. Apply enough pressure to slow the vehicle quickly but not so much that the tires stop rolling. On any reduced traction surface (snow, ice, wet, gravel, sand), the amount of pressure that can be applied is substantially reduced, compared to dry pavement. If you lock up your tires, reduce the pressure on the brake until the wheels begin to roll again and maintain desired speed. This will allow you to steer the vehicle. Stopping distance is drastically increased on snow and ice, so plan ahead and give yourself lots of room. Focus your attention as far ahead as possible—at least twenty to thirty seconds. If you don't have anti-lock brakes, the best way to use threshold or controlled braking is the heel-and-toe method. Keep the heel of your foot on the floor and use your toes to apply firm, steady pressure on the brake pedal. Stop just short of locking the wheels. If your heel leaves the floor, the ball of your foot pushes the pedal, and the wheels lock because you're controlling the brake with your thigh muscles, which are incapable of finer control. Under the stress of trying to stop quickly, drivers almost inevitably overreact and lock the wheels. If this happens, use heel-and-toe action to release brake pressure one or two degrees, then immediately reapply it with slightly less pressure. Continue this squeezing action until the vehicle comes to a stop.

Using ABS Properly

ABS can't perform miracles. If you feel ABS engaging during everyday driving, slow down—you are exceeding the reasonable speed for the conditions. A report by the Insurance Institute for Highway Safety (IIHS) has raised questions about the effectiveness of ABS. The IIHS report, from 1996, notes that in single-vehicle accidents, cars with ABS are as much as 44 percent more likely to produce fatalities than are cars without ABS. It does not say that ABS brakes are ineffective or dangerous in and of themselves.

The problem may be that stopping with ABS in an emergency requires an entirely different braking technique than the one used with conventional brakes, and few drivers have had, or taken, the opportunity to learn this new technique. Different ABS systems work and react differently under extreme braking. While they all prevent the brakes from locking up, many of them generate pedal feedback—pulses or bumps—when they're working. They may seem to be pumping themselves; they may alternate between feeling firm and feeling soft; they may feel as though the pedal is going to the floor. This strange brake pedal action often causes drivers to instinctively reduce brake pressure, which deactivates the ABS, increases stopping distance, and can actually cause a loss of control by upsetting the car's balance. The primary function of ABS is to give

the driver maximum effectiveness in steering while braking. But steering in an emergency stop is itself a new technique. Abrupt or severe steering movements under these conditions will unbalance the car and may cause a loss of control. If you have a car with ABS you must learn to use it. ABS works and works well when you apply maximum braking pressure and hold it. Do not pump or ease off on ABS, brakes in an emergency braking situation, no matter what they seem to be doing. If you steer while in an ABS stop, do it smoothly, but don't, under any circumstances, release or lighten your pressure on the brake pedal until your car is stopped completely. (None of the above, by the way, applies to pickup trucks with rear ABS only, which should be driven as though they have no ABS at all.)

It behooves the driver of an ABS-equipped car to unlearn his or her old braking habits and to learn the new ones. To do that, take your car to a safe location, such as an empty and obstacle-free parking lot or a completely unoccupied street, preferably when the pavement is snow-covered or icy, and practice hard braking. Don't slam on your brakes, but press firmly, as hard as you can, with a force that would definitely lock up conventional brakes. Start at 15–20 mph and try to lock the brakes while driving in a straight line. Your tires may screech or even skid or slide momentarily, but they should not lock up. If you can lock up your brakes, your ABS is not functioning properly. Stop your practice immediately and get your brakes checked and repaired.

No matter what the car or the brake pedal does in this practice, don't let up on the braking pressure. Get used to what your ABS feels like when it's working; then do the same thing at 30–35 mph. At each speed, once you are comfortable with the feel of the car in a straight line, practice turning smoothly while under maximum braking. Repeat this exercise several times, particularly at the higher speed, until you are completely comfortable with the way your car will react to a maximum braking situation, and you are confident that it won't surprise you. (Some experts recommend using the heel-and-toe method with ABS.)

In any event, expect noise and vibration in the brake pedal when the ABS is in use. The mechanical noise or pulsations of anti-lock brakes while they are in use might catch drivers by surprise, but these sensations tell you the brakes are working. Remember that, while you have steering capability in a braking situation, your vehicle may not turn as quickly on a slippery road as it would on dry pavement.

Learn what ABS feels like in your car and how it's different from what you have learned in the past. It is an exercise that can save your life in an emergency. Don't be misled by ABS braking systems. Braking efficiency is limited by the grip available and the type of tires with which your car is equipped. If you carry too much speed into a corner and then try to brake, even ABS won't keep you on the road. Never count on technology to replace good judgment.

E. Vehicle Control Techniques

Vehicle control techniques are what you need to get out of a situation where control is lost—that is, what to do to regain control of a vehicle in a given situation. To be able to control the vehicle most efficiently, steering wheel grip is first addressed, followed by a discussion of some basic concepts of vehicle dynamics and the understanding of what understeer and oversteer are. Once these concepts are understood, the correction techniques are easy to learn.

Steering Wheel Grip

The proper grip of the steering wheel starts with the hands at the nine o'clock and three o'clock positions. See Figure 2. Using this hand position will make you a better, smoother, and safer driver. Contrary to the ten o'clock and two o'clock positions taught in driver's school, you have greater range of motion and control with your hands in the nine o'clock and three o'clock positions.

Figure 2. Correct steering wheel hand position

The palms should be cupping the outer diameter of the wheel. The heel of the palm should be positioned to apply a slight pressure on the front of the wheel for stabilizing your arm movements—don't make your thumbs do all the stabilizing. The grip itself should be relaxed—just tight enough to maintain control and good contact for sensory input. A tight grip on the wheel will tire your hands and arms quickly and, more importantly, will significantly reduce the sensitivity to the vibrations that is needed to gauge the control limits of the vehicle. While it is a natural tendency to grip the wheel tightly while cornering, no amount of squeezing on that wheel will increase the traction of your tires! However, the more relaxed the grip (without losing contact with the wheel), the more of that traction you will be aware of. It is a learned response to relax your hands (in fact, your entire body) during cornering, but it is something that you must master as quickly as possible. It will increase your sensitivity to the car's traction limits, and it will improve your awareness of the car's handling.

Before entering corners, take a deep breath and practice relaxing hands, arms, and shoulders. Breathe deeply, relax your muscles, and exhale. Another thing to do when you're in a long, straight stretch and clear of other cars: relax one hand at a time and wiggle the fingers (leaving the palm and thumb on the wheel). Doing this often will keep the muscles in your hand, wrist, and forearm from cramping.

When you keep your hands at nine and three o'clock, you always know exactly in which direction your tires are pointing. While this may sound basic, it is very important to increasing accurate car placement on the road. When your hands are at nine and three o'clock, steering inputs are more accurate. In other words, the information you feed the car through the steering wheel is more accurate than at any other position—what you think you are doing is closer to what the car will do. When your hands are away from this position, for example, at the top of the steering wheel, you have a tendency to lob the steering wheel sharply in one direction or the other as you turn a corner. This lack of smooth delivery has to do with the weight and momentum of your hands when you move them. At nine and three o'clock, you are able to move the steering wheel more smoothly or arc the steering through a corner, which helps keep the car balanced and makes you a smoother driver.

When you keep your hands at nine and three o'clock, emergency response, should it be needed, is faster. For example, if you are driving on the highway with one arm out the window and the other flopped over the bottom of the wheel and a deer runs out on the road in front of you, you must react quickly. But your hands have to move the entire distance from the window and the bottom of the steering wheel to the sides or top to enable you to actively steer the car. By the time you get your hands in position, it will be too late to steer away from the problem. With hands at nine and three o'clock, you maintain better control of the vehicle. Again, consider the deer scenario. You are able to swerve and miss it. But there are other challenges to deal with. First, if you're not at nine and three o'clock, you've probably lobbed the steering wheel, sharply unbalancing the car. This can lead the car into either a spin, crash, or an off-road excursion. With hands at nine and three o'clock, you are able to arc the wheel smoothly and direct the car away from the deer. This increases your chances of eliminating the spin completely or enabling a correction that will prevent the spin. On a long drive or on a straight stretch of road, it isn't necessary to keep both hands on the wheel all the time, but keep at least one hand on the nine or three o'clock position at all times.

Steering Wheel Control

When turning a corner, lead into the turn by pushing the wheel with the hand opposite the turn (left hand for a right turn, right hand for a left turn), and stabilizing the wheel with the other hand. Push the steering wheel through the twelve o'clock position rather than pulling it towards

the six o'clock position. For large steering inputs like a turn, the pushing arm has more control because the wrist stays in a firm position. The opposite wrist bends and will not provide smooth control. Pulling the wheel is effective for small steering inputs, such as moving across the track width where the action is really limited to a movement of the wrist and not the whole arm. If you're a puller right now, it will take a little retraining to make pushing comfortable, but, in the long run, it will make you a smoother driver. One of the critical keys to smooth car control comes from proper steering. If the car is to travel on a smooth, consistent arc, then the steering must be a smooth consistent turn. The purpose of this smoothness is to maximize the traction of the tires.

To understand this, take a sheet of paper, place it on a table, and place a book on the paper. Pull the paper slowly across the table, gradually increasing the speed. The book stays on the paper. Now, start to drag the paper again, but suddenly jerk the paper. The book loses traction and slides across the paper. Similarly, the traction of the tire is significantly influenced by your ability to provide smooth turning. Sudden jerks in the steering wheel will be like sudden jerks on the paper, and the tire will slide. The smoother driver will have more traction and will have higher cornering speeds. It is common to believe that you are turning smoothly, when in fact you are turning on a smaller, tighter, and jerkier radius than you need to. A typical tip-off to a driver that smoother turning is necessary is when a car tends to understeer during the first half of a turn. More often than not, this is caused by the driver's lack of steering smoothness.

Vehicle Dynamics and Weight Transfer

When you brake or let off the throttle, weight transfers to the front of the car. This increases the size of your tires' contact patches in front and lessens them in back. This means you have more traction in front than in back. When you accelerate, weight transfers to the rear. This decreases

the traction of the front tires and makes the car less responsive to steering inputs. See Figure 3.

Going around a corner transfers weight to the outside tires. Going around a corner while braking transfers most of the weight to the outside front tire. You only have a certain amount of adhesion from your tires. How much do you need for turning, and how much for braking or accelerating? Balance is a term used to describe vehicle stability, in a sense, but also how a vehicle is set up. A well-balanced car may have an equal or close to equal amount of weight on each wheel. Often, people describe situations where the car may become unbalanced. This indicates that there may be too little weight on one or more wheels, and the vehicle has a chance of losing control.

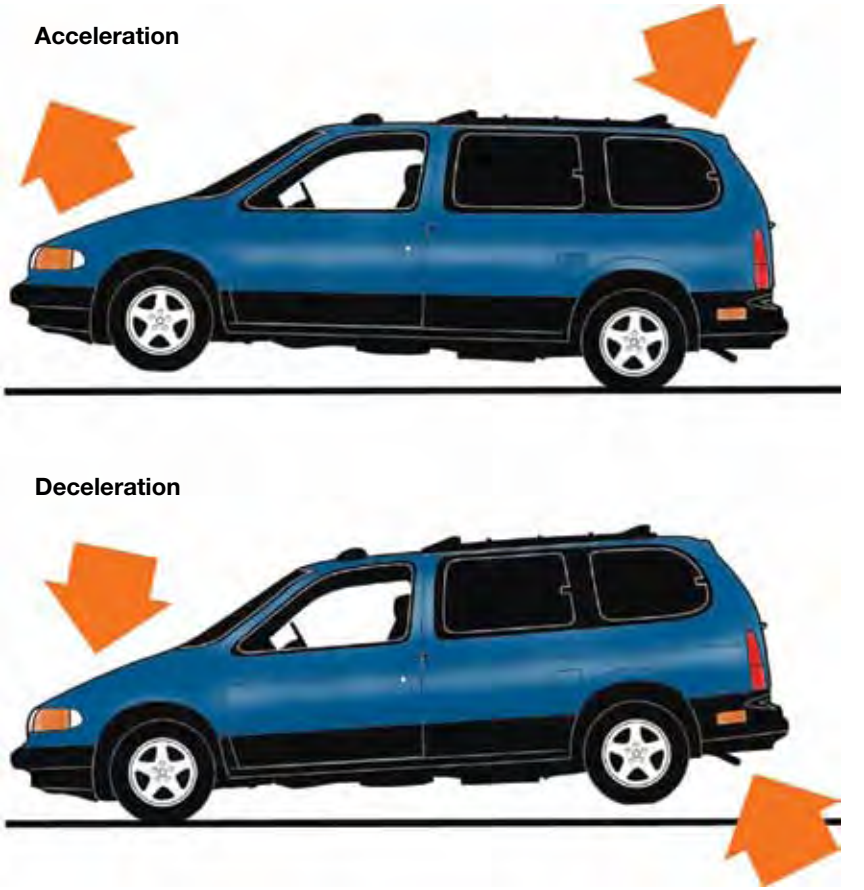

Figure 3. Illustration of weight transfer under acceleration and deceleration

Understeer and Oversteer

Understeer, sometimes called pushing, is when the car under performs to your steering inputs. The front tires are skidding or spinning, and they have passed their limit of adhesion. The front tires can't respond to your inputs. The car wants to continue to go straight. See Figure 4.

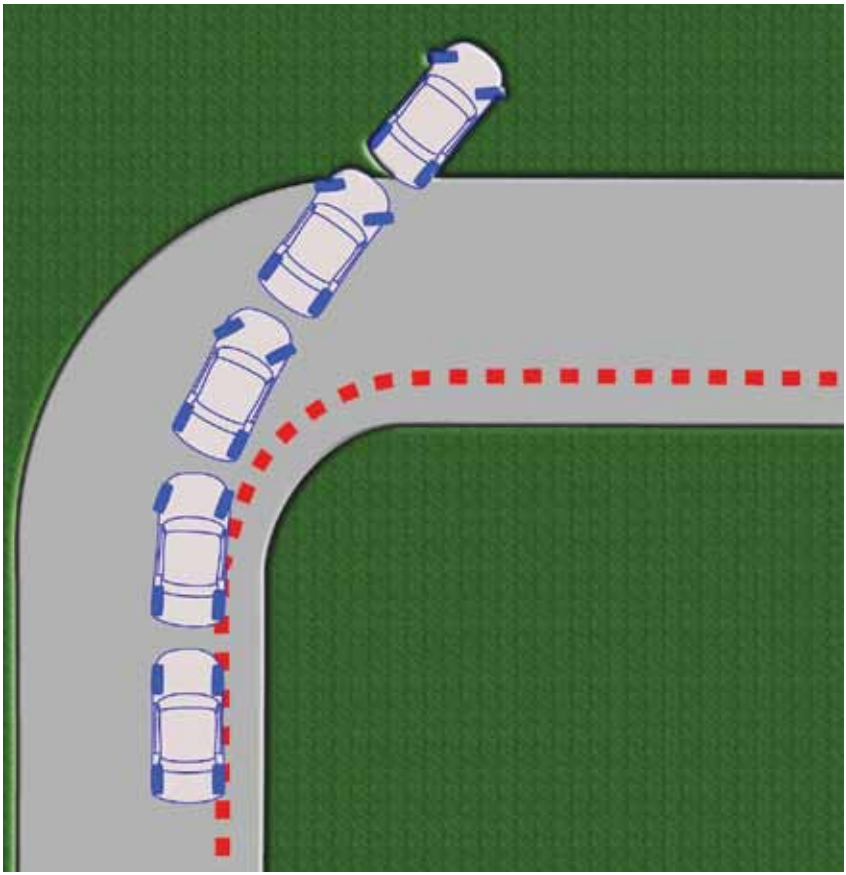

Figure 4. Illustration of understeer

Oversteer, sometimes said to be loose, is when the car over performs to your steering inputs. The rear tires are skidding or spinning, and they have passed their limit of adhesion. The back end of the vehicle wants to come around and start to spin. See Figure 5.

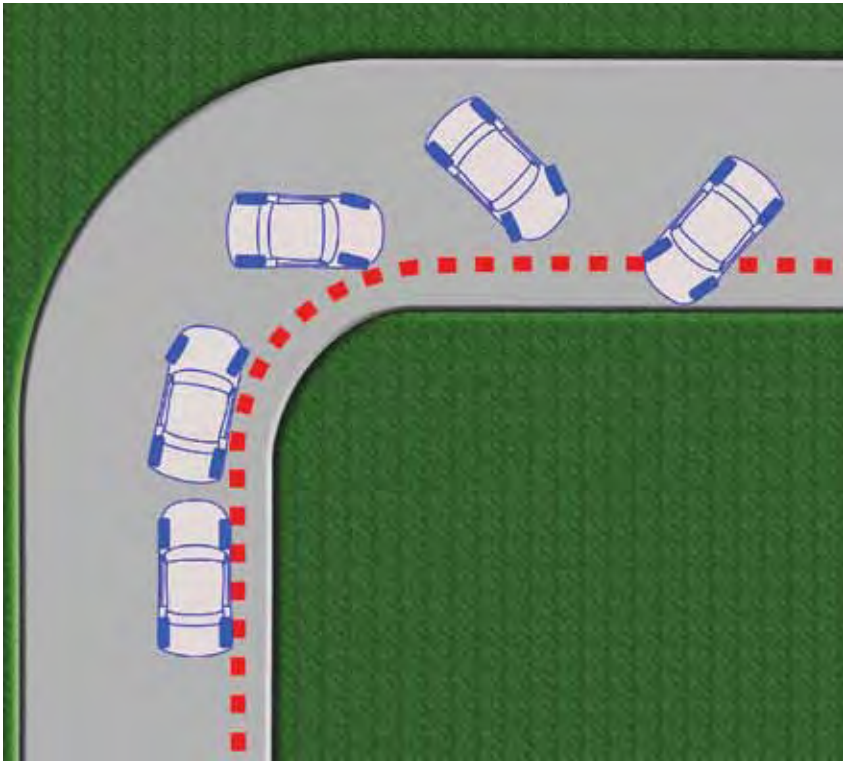

Figure 5. Illustration of oversteer

Preventing Understeer and Oversteer

Most cars are designed to understeer at their limit. Sliding in a straight line is preferable to spinning, and the natural reaction to a situation like this is to let off the gas, which transfers weight to the front, giving those tires more traction and reducing the understeer. Neutral handling or drifting is when all four tires lose traction at the same time so the car drifts instead of plowing straight ahead (understeer) or spinning (oversteer). The amount of traction you have at each tire is dependent on how hard the tire is being pressed against the pavement. Since any kind of weight transfer causes a change to this pressure, the traction you have at each tire is constantly changing with weight transfer. If weight transfer did not occur, traction would always be consistent, and the car would be easy to drive fast. Since weight transfer is unavoidable, the next best thing is to cause the weight to transfer as predictably as possible. This is done by driving smoothly. When you apply the brakes, don't slam them on; rather, progressively squeeze them. Squeeze into and out of the throttle. Turn the steering wheel gently, and try to make only one turn of the wheel to achieve the arc you want through the corner. As you accelerate out of the corner, unwind the wheel as you squeeze on the throttle.

Methods for Correcting Understeer and Oversteer

The methods used for correcting understeer and oversteer work with any type of drive system and result from the understanding of the vehicle dynamics described above. Many people lose control, and the first thing they do is lock the brakes. This is the worst reaction. It is natural, but locking the brakes only makes the situation worse.

To correct understeer, you must understand that the front tires have lost grip. In most cases the driver has turned the front wheels, and the wheels are either spinning or locked. To correct this situation, reduce steering input and reduce acceleration or remove your foot from the brake. You want the tire rolling again, and, especially on slippery surfaces, the tires have to be pointed in the direction of the vehicle to help the front tires regain grip. By reducing acceleration, weight is transferred from the rear to the front tires. This gives the front tires a little more grip. In some cases this is still not enough to regain grip to the front tires. So, to further enhance grip on the front tires, you need to remove the foot from the accelerator and apply the brakes but not lock the wheels. By doing this, weight is transferred to the front by both reducing acceleration and braking. It is important to note that one does not want to brake too hard and lock the front tires for any prolonged period of time. Once traction or grip is regained, you may steer the vehicle and slowly accelerate. These techniques work for FWD, RWD, 4WD, and AWD vehicles. Chances are, understeer will occur most likely in FWD, 4WD, and AWD vehicles.

To correct oversteer, the thought process is similar to understeer. In most oversteer cases, the rear wheels have lost traction, either through spinning or skidding, and the rear end of the vehicle has started to swing to the right or the left. In order to correct this situation, the driver must steer in the direction of the skid. If the rear end is sliding to the right, the driver should steer to the right; if the rear end is sliding to the left, the driver should steer to the left. At slow speeds, such as starting from a stop, if the vehicle starts to oversteer, the driver should remove his/her foot from the accelerator and steer in the direction of the skid. Again, do not hit the brakes. This only makes the situation worse. It transfers more weight to the front, making it more difficult to regain traction on the rear wheels. At higher speeds, the correction is similar. The driver steers in the direction that the rear end is moving. These techniques work for all types of drive systems, although the reaction of the vehicle to these inputs is slightly different. When coming out of oversteer, an FWD or 4WD vehicle may regain control faster. Correcting an RWD vehicle too quickly may cause the vehicle to oversteer in the opposite direction if the driver does not use smooth steering inputs. As the vehicle begins to recover, remember to countersteer so the vehicle does not oversteer in the opposite direction.

Climbing Hills

When driving up a steep hill, gain speed and momentum on the flat before starting uphill. When the car begins to slow part way up the hill, ease up on the accelerator, allow the car to slow down, and crest the hill slowly. If you try and accelerate too hard and spin the wheels, you may lose momentum and not make the top. It's better to make the top at a slower speed than to not make it at all. When approaching an icy hill, pick a path that will allow the most traction. Watch the cars ahead of you, and steer clear of spots where they spin their wheels or slide backward. Instead, head for unpacked snow or powder, where you'll get a better grip. Build speed gradually while you're still on level ground. If you have shift-on-the-fly four-wheel drive, shift into it before you reach the hill. If you get stopped on an uphill slope and have a manual transmission, try starting off in second gear. Try to get rolling as slowly as possible. With an automatic transmission, it's even easier. Never, ever, spin your wheels—just take off as slowly as possible. Spinning heats up the tires and just handicaps you further. If you can get rolling those first few inches, you can keep rolling. Another method that sometimes helps is to lightly apply the brakes with your left foot while lightly accelerating with your right foot. This helps to keep wheels from spinning.

Descending Hills

After you've reached the crest of a hill, begin your descent slowly, shifting into a lower gear to allow engine drag (rather than brakes) to reduce your speed. Note that you do not want to shift into a lower gear if you are traveling too fast, as this could cause the wheels to skid and cause a loss of control. The best thing to do is reduce your speed as soon as possible and then descend slowly. Try to pick spots that do not look slippery. Often, the shoulders of hills are not as slippery as the road. Roads get slippery from tire traffic, whereas the shoulders do not get as much traffic. If you live in an area where there is a lot of snow and there are sizeable snowbanks, a last-ditch method of slowing down is to scrape the snowbank just enough to slow you down.

Smoothness

If you must venture out or are caught away from home during a storm, the most critical driving skill is the ability to maneuver the vehicle smoothly. Think of walking on ice wearing dress shoes. To do that successfully, you keep your weight centered and you are fluid and smooth with your motions. The same thing applies in a vehicle—you don't want any sudden maneuvers or jerkiness that will upset the balance of the

vehicle and cause you to lose control. Slow down and keep your focus as far ahead as possible to allow more time to respond to any crisis that may arise. Steering, throttling, braking, and shifting should be smooth and controlled. Any abrupt movements will throw the chassis off balance and cause unpredictable results. You can practice this whether you are going fast or slow. If you have a passenger, notice if he or she moves. If you see your passenger moving side to side abruptly, you are not being as smooth with your steering as you should. If you see him/her move forward and back as you come to a stop, you are not using your brakes properly. This happens when you apply maximum braking force up until the car stops. Instead, you should first ease off the throttle, then slowly apply brakes (eventually to the point of braking hard if necessary); then, if you time it right, during the last ten feet or so you should be able to completely release braking pressure and coast to a stop.

Cool, Calm, and Collected

It is important to continually reinforce the idea of remaining calm and relaxed. If you feel anxious when it snows, you are not alone. Remaining calm is not something you can convince yourself to do; build this capacity through experience and practice, and your confidence will follow.

Look Where You Want To Go

A good technique to master is to look where you want to go. Often, students will be heading into a turn and see a large snowbank. They will think to themselves that they are going to hit that snowbank because it is so slippery. As with many other things that people do, thinking positively about what you want to do helps you do it properly. You know how to make the turn, but you are psyched out by the slippery conditions and snowbanks. If you look past the corner to where you really want to go, you will automatically do the things that need to be done to get there. That is why focusing on driving is so important!

KRC Michigan Tech

Notes

AAA, Borg Warner Torque Transfer Systems, Chrysler LLC, General Motors Corporation, and the Robert Bosch Corporation have kindly provided donations of vehicles or funding to support the KRC Winter Driving School. The KRC Winter Driving School gratefully acknowledges these donations and these companies' efforts to promote safe winter driving.