Prior to starting the Parent Taught Driver Education Model Program Course 101, you must receive your student’s Parent Taught Packet from the Texas Department of Public Safety. To receive the packet, the parent must submit the application (DL92 — Request For a Parent Taught Packet). Each student should be registered separately with the Texas Department of Public Safety for the Parent Taught Driver Education Program. You can locate the application on the following web site:

http://www.txdps.state.tx.us/internetforms/Forms/DL-92.pdf

Acknowledgements

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The information provided herein is accurate and current pursuant to the Program of Organized Instruction for Driver Education and Traffic Safety adopted by rule on February 2009.
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Instructional Objectives

The student legally and responsibly performs Adverse Conditions reduced-risk driving practices in the Highway Transportation System (HTS) by managing adverse conditions resulting from weather, reduced visibility, traction loss, and emergencies.

- **Adverse Weather and Reduced Visibility Conditions.** The student reduces risk by legally and responsibly managing adverse weather and reduced visibility conditions.

- **Traction Loss.** The student reduces risk by legally and responsibly managing vehicle balance and utilizing reduced-risk driving practices during traction loss.

- **Emergencies.** The student reduces risk by legally and responsibly utilizing reduced-risk driving practices in emergency situations.

- **Comprehensive In-Car Progress Assessment Tool.** The student reduces risk by legally and responsibly utilizing in-car progress assessment tools to evaluate and improve behind-the-wheel skill level (mastery equals 70% or above).

- **Driving Plan.** The student formulates a Driving Plan to endorse and promote lifelong legal and responsible reduced-risk driving practices in the Highway Transportation System (HTS).

- **Classroom Progress Assessment.** The student reduces risk by legally and responsibly completing a Progress Assessment to evaluate classroom knowledge and understanding and measure progress (mastery equals 70% or above).
Adverse Weather and Reduced Visibility Conditions

- Characteristics and distractions associated with adverse weather and reduced visibility conditions.
- Reduce-risk driving practices necessary to compensate for adverse weather and reduced visibility conditions.
- Weather and reduced visibility conditions change driving environments and other roadway users including vulnerable roadway users.
- National Weather Service's —“Turn Around, Don’t Drown” program.
- Reduce risk by legally and responsibly utilizing reduced-risk driving practices in adverse weather conditions and reduced visibility conditions.

Weather and Conditions of Limited Visibility

The majority of the information discussed prior to this Module has focused on how to develop an effective search pattern, use manage space around your vehicle, gather information, and perform reduced risk driving practices under normal conditions by managing line of sight and path of travel.

The information that will addressed in this Module will be situations that adverse conditions. The adverse conditions include weather conditions and imitations placed on visibility including the reduced risk driving practices to assist your driving with limited visibility, at night, and in hazardous road conditions such as fog, rain, snow, smoke, strong steady or gusting cross winds.
Changing Visibility at Night

Driving after sunset presents a new set of challenges. The obvious ones are glare and reduced visibility. Visibility, as presented in this lesson, deals with limitations placed on gathering and processing information when driving at night due to factors of reduced illumination and the ability of the eyes to adjust to glare.

Our eyes adjust very quickly to light but very slowly to darkness. When our eyes are struck by powerful lights from oncoming cars, they adjust reasonably quickly to this light change. But when there is a limited light source, our eyes are much slower to adjust to these darker conditions.

Some drivers’ eyes are unable to adjust to darkness. These drivers should not drive at night. No corrective lenses exist to help the driver’s eyes compensate for low-light situations.

Gathering Information (Searching). We know 90 percent of a driver’s ability to identify risks depends on vision. At night visual acuity is severely limited. The two major factors for night driving loss of visual acuity are reduced illumination and glare.

Reduced illumination — Darkness not only makes it more difficult for you to see, but for others to see you. An inexperienced novice driver will also find it difficult to determine size, color, distance, and speed of objects ahead, making stopping within the distance lighted by your headlights much more challenging.

Whenever visibility is reduced, a driver will need more time to:

- identify hazards early and scan in and around the path of travel to the target area, and
- scan the road beyond the lighted zone. (If you only scan the lighted zone, you can adjust only to that zone and may not notice clues that would warn you of a hazard ahead).

At twilight, when the sun light begins to fade, turn your headlights ON to make your vehicle more visible to others. Texas law requires you to use your headlights from one-half hour after sunset to one-half hour before sunrise and when you cannot see clearly for at least 1,000 feet such as during inclement weather, such as rain, fog, or snow (Some states require you to use your headlights whenever you use your windshield wipers.)

Low-Beam headlights — when driving in cities and towns (except on streets where there is no lighting) switch to low-beams. Whenever you are within 500 feet of oncoming traffic, switch to low beams to avoid blinding the other driver. When following another vehicle, use low-beams whenever you are within 300 feet of the vehicle ahead.

Properly Aligned Low-Beams

- Lights should be adjusted so that they illuminate the roadway 100 to 150 feet ahead, and light the area 300 to 500 feet above the roadway.
- Load distribution and vehicle height affect light beam distance.
- Maximum safe speed illuminated by low beam headlights is 40 to 45 mph.
Changing Visibility at Night/Glare

Sources of glare include:
- Oncoming and following vehicle headlights
- High beam headlights
- Misaligned headlights
- Improperly loaded vehicles
- Dirty windshield
- Paper on dashboard
- Snow-covered landscape
- Facing the sun at dawn or dusk
- Flashing neon signs
- Flood lights on buildings next to the roadway
- Traditional versus contemporary side mirror settings

Ability to adjust to glare conditions —
Staring into the headlights of oncoming vehicles can blind you, especially if the driver of the oncoming vehicle is using high beams. To avoid being blinded by headlights of oncoming vehicles, reduce speed and look to the right-hand side of the road; make brief glances ahead to monitor path of travel. To avoid being blinded by headlights of following vehicles, use contemporary side mirror settings; adjust your inside mirror to the "night" setting.

NOTE: You should never attempt to compensate for headlight glare by wearing sunglasses. At night, or in other low light conditions the use of such glasses will further reduce your visual acuity.
Headlight Alignment

**High-Beam Headlights** — on highways when no other vehicle is approaching within 500 feet. If the high-beams of an oncoming car are not dimmed, avoid looking directly at the bright lights. Glance toward the side of the road, then look quickly ahead to determine the other vehicle’s position. Keep doing this until you have passed the other vehicle. Even though the other driver does not dim his headlights, do not retaliate by turning on your high-beam headlights.

**Properly Aligned High-Beams**
- Lights should be adjusted so that they illuminate the roadway 300 to 350 feet ahead, and light the area 500 to 1800 feet above road.
- Load, load distribution, and vehicle height affect light beam distance.
- Maximum safe speed is 55 to 60 mph.

**When using high-beams you should lower (dim) your headlights when you are:**
- Within 500 feet of an approaching vehicle
- When following closely (within 200 feet) behind another vehicle
- When driving on lighted roads
- When driving in fog, heavy rain, sleet, snow, or dust

A vehicle’s narrow headlight beams will limit the driver’s view of the area ahead, and the off-road area may not be visible at all. Novice drivers often overdrive their headlight mistakenly believing that as long as they drive the posted speed limit they will be able to determine the size, speed, color, and distance of objects.

**Overdriving your headlights** occurs when the vehicle’s speed is greater than the stopping distance lighted by the headlights. To determine whether you are overdriving your headlights, select an object the moment the headlights pick it up, and count off six seconds. If the object is still ahead of the vehicle, you are driving at a safe speed. If you have passed it, you are driving too fast. The posted speed limits are calculated for daylight driving and are often too fast for nighttime conditions. Dirty headlights and improper headlight alignment will also add to this problem.

**Night speed limit** — Driving at 55-65 mph on a freeway in adverse conditions with low visibility is a danger to everyone and may lead an officer to charge you with dangerous driving even though you were driving the posted speed limit. As soon as visibility or traction is reduced, the law requires that your speed be adapted to conditions. On roadways where visibility is reduced, night speed limits may be posted to help alert drivers to potential dangers.

Whenever you are driving on a roadway at night and you have difficulty seeing, **SLOW DOWN**, adjust your speed even if it is below the posted limit.
Headlight Alignment and Speed

Nighttime Precautionary Measures

- **Clean windshield inside and out** — diffused light gives an appearance of a halo around the headlights of oncoming vehicles
- **Clean all lights** — 50 to 90 percent loss of headlight efficiency is due to road grime on the lens
- **Reduce daytime speed**
- **Increase following interval**
- **Look to the right of oncoming vehicles**

Headlights — passing or being passed

When you are being passed or when passing another vehicle in darkness, both drivers involved must make sure they do not blind each other.

- Before passing (approximately 600 feet), the driver passing may flash his/her headlights to warn the other driver.
- Drive with low beams on.
- When two vehicles are side by side, the passing driver may switch to high beams, and the driver being passed to low beams.

Pedestrian safety

Be alert for pedestrians walking on unlighted roadways after dark. If you must walk on a dark roadway due to vehicle breakdown or any other reason, carry a white handkerchief or wear light colored clothing. If possible, wear reflective vests or other reflective clothing if you must be on or near a road at night. Having reflective stripes also increases your chances of being seen.

In snow conditions, it is advisable to wear dark clothing to create a contrast.
Visibility Limitations in Bad Weather

Unfortunately, driving conditions are not always ideal. There are times when you may have to drive in undesirable conditions. Bad weather produces many challenges for drivers. The major ones are the loss of traction and reduced visibility.

*Visibility*, depends on atmospheric conditions beyond the control of the vehicle operator. While many of these conditions limit visibility, additional traction and vehicle control problems are associated with rain, and snow in gusting or continuous high wind conditions. In contrast, fog and smoke settles over the roadway in a virtual blanket, limiting sight distance.

For Safety: Turn on your headlights whenever windshield wipers are needed due to fog, rain, sleet, or snowy conditions.

General Traffic Tips/Driving in Wet Weather
http://www.texasdriversquiz.org/

Rainbow Bridge. Bridge City, Orange County. Clearing the Neches River at approximately 176 feet, the steel structure was the tallest highway bridge in the South upon its completion. Today, the Veterans Memorial Bridge serves northbound traffic and the Rainbow Bridge serves southbound traffic. Kevin Stillman/TxDOT 7/9/2006
Visibility Limitations in Bad Weather

**Fog.** When driving in fog, your vehicle’s headlights will be reflected back off the water particles in the fog, making it very difficult for you to see. Your ability to see can be even further reduced if you use your vehicle’s high-beam headlights.

**Fog Reflects Light —** Whenever driving in fog you must drive at a speed that permits you to stop within the area lighted by your headlights. As a rule, low beams are more efficient in fog because they reflect less light back at the driver.

**Fog Effects Distance Perception —** Fog will also affect your ability to judge distances and vehicle speeds. Oncoming vehicles may be closer than they appear. Avoid possible conflicts by slowing down and increasing the space cushion around your vehicle.

**Driving in Fog —** Persons involved in multi-vehicle crashes in fog often state that they had driven through patches of light, drifting fog, and had continued to travel at the prevailing speed of traffic. Suddenly you may find it impossible to see and braking hard only to run into a stopped vehicle in the road ahead or to be rear-ended.

**The correct response as soon as you become aware of drifting fog should be:**
- Reduce speed.
- Make sure headlights are on low beam to reduce reflected glare (day or night).
- Turn on windshield wipers.
- Turn on defroster or air conditioner to dissipate moisture on the windshield.

**Driving in Heavy Fog —** Thick fog, and in some situations heavy smoke, produces very dangerous driving conditions. The heavier the fog the more restricted your field of vision will be. Visibility may be reduced to the point that driving safely is impossible.

**Before entering heavy fog be prepared to:**
- Reduce speed but do not stop in a travel lane.
- Turn on emergency flashers.
- Look for an exit from the highway.
- Leave the highway, or stop beyond the end of the guardrail, back up to the inside of the outboard of the guardrail, turn off all lights and wait for the fog to lift.
Visibility Limitations in Bad Weather

**Rain.** A vehicle equipped with good tires, brakes, and wipers can usually be driven safely in the rain. But drivers should not assume good equipment alone guarantees vehicle traction control. Heavy rains not only limit visibility, but may also flood roads, and overwhelm the ability of the tires to channel water.

*Driving in Heavy Rain — will reduce your ability to see and be seen by other motorists.*

Driving in heavy rain can be as hazardous as driving in fog, especially when the wind is blowing. Rain-spattered windows make it especially difficult to see other vehicles to the rear and in blind spot areas.

**Drivers need to be alert and drive with caution:**

- Keep the vehicle's windshield clear, use your wipers and put your defroster on high.
- Use your low beam headlights to see and be seen.
- Slow down to compensate for reduced visibility.
- Heavy rain or heavy fog may reduce your visibility to a level where it is unsafe to drive. So, pull off the road and sit out the storm in a safe location.

**Hydroplaning** — One of the dangers of driving in heavy rain is the vehicle’s tires may lose all contact with the road’s surface. Water cannot be compressed. Tires push water ahead until, at a certain speed, a tongue of water is formed in front of the contact area. When this occurs, the tires are lifted and ride on a layer of rolling molecules of water. This is called hydroplaning.

*If your vehicle begins to hydroplane:*

- Take your foot off the accelerator.
- Do not brake and, if possible, avoid steering changes.
- Hold the steering-wheel firmly until your tires grip the road again.

**In wet roadway conditions, be careful passing or being passed by trucks as water from the roadway will spray from the truck’s tires onto your vehicle, limiting your visibility.**

*Photo Courtesy AAA Foundation for Traffic Safety*
Visibility Limitations in Bad Weather

Snow. Snow presents a special type of problem. Not only will it reduce your visibility, but it will also produce different levels of traction as you drive. When fresh snow falls, vehicle traction may be fairly good. But as traffic packs the snow, (especially at intersections) tire traction is reduced because roads become much more slippery. Temperatures may rise, and tire heat or hot exhaust may cause snow to melt and then freeze again creating dangerous icy road conditions.

Use caution and be alert if you have to drive.

Before you start driving, remove snow and ice from your entire car, including the roof, hood and rear of the vehicle. Be sure to clear all your windows, side view mirrors and front and rear lights of snow or ice so you can see and be able to communicate with other drivers.

Equip your car with all-weather snow tires or chains to increase tire traction, prevent skidding and improve stopping distance.

Driving on Snow and Ice. Safe driving requires you to have good tire contact with the road (traction). But when snow and ice are between your tires and the road there is a lot less tire grip on the road surface resulting in limited vehicle control. Whatever the situation — smooth ice, packed, blowing or loose snow — you need to be very careful.

Accelerate gently, if you accelerate too quickly, the drive wheels will spin and loose contact with the road. Increase your following distance. Allow a much larger space between your car and the vehicle ahead. Stay far enough behind other vehicles so you only have to brake when absolutely necessary.

Significantly reduce your speed on snow–covered or icy roads. Execute all maneuvers slowly and smoothly to avoid disrupting vehicle balance and causing your tires to skid. Whenever you feel the drive wheels start to slip, immediately ease off on the gas pedal until traction returns.

DO NOT USE CRUISE CONTROL ON SLIPPERY ROADWAYS!

Maintain an open line of sight and path of travel. Visibility will be reduced in blowing snow or on snow covered roads. Use extra effort to watch for ice, especially on bridges, (bridges freeze before other road surfaces) and in shaded areas.

Give yourself extra room to stop when approaching signs, signals and intersections. You can easily get involved in a conflict if your vehicle begins to slide because of packed snow or ice. Slow down before stopping or turning, and if you have to brake, apply the brakes gently.

Braking distances at 20 mph with conventional tires on different pavement conditions.

<table>
<thead>
<tr>
<th>Pavement Condition</th>
<th>Braking Distance</th>
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<tbody>
<tr>
<td>Dry</td>
<td>20 feet</td>
</tr>
<tr>
<td>Wet</td>
<td>25 feet</td>
</tr>
<tr>
<td>Packed Snow</td>
<td>60 feet</td>
</tr>
<tr>
<td>Glare Ice</td>
<td>150 feet</td>
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</tbody>
</table>
Heavy Smoke, Rain, or Snow — Mother Nature can be very unpredictable ...

- Smoke is evident ahead — billows of smoke and ash from a large brush fire suddenly cover the roadway making it very difficult to see.
- It’s sprinkling — a few moments later, rain falls in sheets, slashing across the roadway.
- Snow is falling in large, lazy flakes — Two miles down the road, there is a whiteout and visibility is reduced to inches.

Begin taking precautionary measures as soon as any of the initial conditions become evident. In most instances, brush fires are restricted to a limited area and torrential rains are of short duration. A snow storm-induced whiteout could cover a much greater area.

In all three bad weather situations:

- Continue to reduce speed to limits imposed by visibility, but do not stop in the travel lane or on the shoulder.*
- Turn headlights to low beam.
- Turn on emergency flashers.
- Maintain lane position 1.
- Turn on windshield wipers.**
- Be alert for vehicles stopped in the roadway.
- Be prepared for effects of gusting or strong, steady crosswinds.
- Make steering, acceleration, and braking actions gently and smoothly.

* For snow conditions, look for an exit from the highway, turn on the radio and tune into a weather report. When it is impossible to leave the highway, stop beyond the guardrail. If you have a cell phone and it is functioning, call and check on road conditions.

** Snow and smoke may require use of windshield washer fluid.

Extreme Weather Conditions. Under normal weather conditions, situations arise that challenge a driver’s ability to control a vehicle. These challenges can be both hazardous and difficult. But if a driver encounters similar situations under extreme weather conditions, they now become extremely dangerous.

Before beginning any trip, know the current weather forecast and road conditions. For information 24-hours-a-day, call the Texas Department of Transportation Highway Helpline at (800) 452-9292 or http://www.txdot.gov/travel/upcoming_conditions.htm.
Low Water Crossings

In the previous lesson we examined challenges and procedures for driving your vehicle in heavy rains and on wet, slippery roadways. In this lesson we will be examining a different type of water challenge that results from prolonged heavy rainfall. This challenge is referred to as Low Water Crossings. However, don’t let the word “LOW” fool you. These conditions are very dangerous — especially “flash flood” conditions. “Turn Around, Don’t Drown”

http://tadd.weather.gov/

Types of Flooding

River Flood — Flooding along rivers is a natural and inevitable part of nature. River flooding will generally occur seasonally when winter or spring rains, coupled with melting snows, fill river basins with too much water too quickly. Torrential rains from hurricanes or tropical systems will also produce an excessive volume of water in rivers and streams causing flooding to occur.

Coastal Flood — Coastal flooding occurs in coastal areas where winds generated by tropical storms and hurricanes or intense offshore low pressure systems drive ocean water inland. Significant flooding can cause escape routes to be cut off and blocked by high water. Coastal flooding can also be produced by sea waves called tsunamis, sometimes referred to as tidal waves, which are produced by earthquakes or volcanic activity in the sea.

Urban Flood — Urbanization increases water runoff 2 to 6 times over what would occur on natural terrain. As land is converted from fields or woodlands to roads and parking lots, it loses its ability to absorb water. During periods of urban flooding, streets can become swift moving rivers.

Flash Flooding — is a sudden, unexpected rush of water. Most flash flooding is caused by slow-moving thunderstorms, thunderstorms repeatedly moving over the same area, or heavy rains from hurricanes and tropical storms. Occasionally, floating debris or ice can accumulate at a natural or man-made obstruction and restrict the flow of water, causing flooding upstream and subsequently flash flooding will result downstream when the obstruction is removed.

Videos & PSAs

Flash Flood Safety In a Car
A True TADD Story About a Loss of Life
TADD Making the Right Decision
Low Water Crossings: The Hidden Danger
Water’s Fury
Turn Around Don’t Drown
http://tadd.weather.gov/tadd-resources.shtml
Low Water Crossings

Facts About Water. Flowing water is very deceptive. It is difficult to tell exactly how deep the water is before you enter the stream. Although vehicles are heavy and stable on dry ground, they can become very buoyant and float easily in as little as a foot or two of water. Your vehicle can be swept away before you realize you are in trouble. We have all seen scenes on television of people who try to cross flooded roadways and must be rescued. Remember, before becoming stranded, those drivers all thought the water was shallow enough for them to make it across.

Why does a vehicle float and drift in as little as a foot or two of water?

- Water weighs 62.4 lbs. per cubic foot and typically flows downstream at 6 to 12 miles an hour.

- When a vehicle stalls in water, the water’s momentum is transferred to the car. For each foot the water rises, 500 lbs. of lateral force is applied to the car.

- The biggest factor is buoyancy. For each foot the water rises up the side of the car, the car displaces 1,500 lbs. of water. In effect, the car loses 1,500 lbs. for each foot the water rises. Two feet of water will carry away most automobiles.

What YOU Can Do

Know your flood risk and elevation above flood stage. Do your local streams or rivers flood easily? If so, be prepared to move to a place of safety. Know your evacuation routes. Keep your automobile fueled; if electric power is cut off, gas stations may not be able to operate pumps for several days. Store drinking water in clean bathtubs and in various containers; water service may be interrupted. Keep a stock of food that requires little cooking and no refrigeration; electric power may be interrupted. Keep first aid supplies on hand. Keep a NOAA Weather Radio, a battery-powered portable radio, emergency cooking equipment, and flashlights in working order. Install check valves in building sewer traps to prevent flood water from backing up into the drains of your home.

Nearly half of all flash flood fatalities are vehicle related.

In severe rainstorms, watch for flooding at highway dips, bridges, and low areas.
**Low Water Crossings**

**Dangers at Low Water Crossings**

- Nearly half of all flash flood fatalities are vehicle related. In severe rainstorms, keep a look out for flooding at highway dips, bridges, and low areas.
- Even the largest and heaviest of vehicles will float. As little as six inches of water may cause you to lose control of your vehicle. Two feet of water will carry most cars away. Do not drive through flowing water.
- A hidden danger awaits most motorists where a road without a bridge dips across a creek bed. Motorists develop false confidence when they normally or frequently pass through dry low-water crossings.
- Roadbeds may have been scoured or even washed away during flooding, creating unsafe driving conditions. People who repeatedly drive through flooded low-water crossings often do not recognize the dangers of a small increase in the water level.
- Driving too fast through low water will cause the vehicle to hydroplane and lose contact with the road surface. Driving at night, when visibility is limited, increases the vulnerability of the driver to any hidden dangers.
- Heed all flood and flash flood watches and warnings. Keep abreast of road conditions through the news media.

There are many unseen dangers presented by heavy rains when there are flooded roadways. Some of the most common problems from driving through water is having your vehicle stranded because of a stalled engine or hitting a hidden pothole that damages your vehicle. If at all possible, avoid driving in deep water.

**Check the water depth** — Before you attempt to cross a roadway that is flooded, try to look for items that will help you estimate how deep the water is, such as, fence posts, fire hydrants, parked cars or other objects along the roadside.

**If the water comes up to the bottom of your vehicle, DO NOT PROCEED.**

**"Turn Around, Don't Drown"**

When other vehicles are present, watch what they are doing, and remember two vehicles should not meet in deep water. One vehicle should go entirely through before the next vehicle starts regardless of the direction the vehicles are traveling. This will reduce the possibility of your engine stalling caused by waves created by the other vehicle you are passing or following.

The trip through deep water must be made at a slow, steady speed. If the water is lower than the bottom of your vehicle but over the rim of your tires, drive through using low gear on the highest section of the roadway and try to stay away from the shoulder. Applying the brakes gently with your left foot at the same time as you accelerate may help keep the brakes dry. But you should always check your brakes after leaving the deep water to see if they stop slowly and evenly. Wet brakes may grab and pull to one side. If this happens, dry them by accelerating slowly for a few seconds while lightly holding down the brake pedal.

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Too many people have lost their lives attempting to cross flooded areas. Be a safe driver — DO NOT drive through flooded areas — *Turn Around Don't Drown*
Low Water Crossings

Driving through Deep Water

TURN AROUND DON'T DROWN® — National Weather Service  http://www.srh.noaa.gov/tadd/

Each year, more deaths occur due to flooding than from any other thunderstorm related hazard. Why? The main reason is people underestimate the force and power of water. Many of the deaths occur in automobiles as they are swept downstream. Of these drownings, many are preventable, but too many people continue to drive around the barriers that warn you the road is flooded.

Whether you are driving or walking, if you come to a flooded road, Turn Around Don't Drown® You will not know the depth of the water nor will you know the condition of the road under the water.

Follow these safety rules:

- Monitor the NOAA Weather Radio, or your favorite news source for vital weather related information.
- If flooding occurs, get to higher ground. Get out of areas subject to flooding. This includes dips, low spots, canyons, washes etc.
- Avoid areas already flooded, especially if the water is flowing fast. Do not attempt to cross flowing streams. Turn Around Don't Drown ®
- Road beds may be washed out under flood waters. NEVER drive through flooded roadways. Turn Around Don't Drown ® If your vehicle is suddenly caught in rising water, leave it immediately and seek higher ground.
- Do not camp or park your vehicle along streams and washes, particularly during threatening conditions.
- Be especially cautious at night when it is harder to recognize flood dangers.
Hot Temperatures

Vehicles are designed to operate in a wide range of temperatures, from very hot to extremely cold. But this does not mean problems will not arise during these extreme conditions.

**Hot or cold temperatures** place special demands on a vehicle’s tires, radiator coolant, hoses, connections, and drive belts. Check these items prior to driving during these conditions. To help deal with hot and cold temperatures, vehicles are equipped with a cooling system for hot temperatures and a heating system for cold. But in extreme conditions, engine problems may occur.

**HOT Weather** Extreme heat is not only tough on you but it is tough on your vehicle. Careful preparation is the key to weathering the hottest temperatures. To help prepare your vehicle follow these suggestions.

- Switch to a motor oil with higher viscosity — motor oil plays an important role in keeping the engine cool, so check oil level and condition. Check the owner’s manual for specific oil recommendations for your vehicle.
- Heat can be as tough on vehicle batteries as the cold weather. Batteries more than two years old should be tested by a qualified technician to make sure they have the starting power to handle the stress of extreme temperatures.
- Inspect antifreeze/coolant level and condition, to make sure the proper 50/50 mixture of water and coolant is present.
- If your car overheats, never attempt to remove the radiator cap until the engine has cooled. Coolant in the radiator is under pressure and the steam released when you remove the cap can cause severe burns.
- Check brake fluid level and condition. It is essential to maintain the proper level and fluid free of contaminants to ensure reliable hot-weather braking.
- Check the performance of the air conditioning system. If needed, have it serviced by a qualified technician.
- Other under-the-hood components such as belts and hoses are also stressed by extreme heat and should be regularly inspected. Be sure the vehicle engine is turned off before inspecting these items.
- Since even the best maintained vehicles can break down, motorists should equip their vehicles with emergency kits containing the following items: container of water, flashlight with extra batteries, warning devices such as flares or reflective triangles, jumper cables and a first-aid kit.
- Because temperatures inside parked cars can quickly reach dangerous levels, never leave children or animals unattended in a car — not even for a short period of time.
- When parked, use a sun shield to cover the windshield to minimize heat build-up and to help protect the car’s interior. Cover metal and plastic parts on seat belts and child safety seats to prevent burns.
- Open the vehicle’s doors and let the interior cool for a few minutes before entering.
**Hot Temperatures**

**Desert Driving**  The combination of extremely hot temperatures and isolation make desert regions a dangerous place to drive especially during the summer months. When attempting to drive across a desert region, remember that deserts are often a lot larger and hotter than you may realize and that this heat will affect the vehicle, occupants and the road condition. Special precautions need to be taken. Take the necessary steps to prepare yourself and your vehicle.

*During threatening weather, listen to commercial radio or television or NOAA Weather Radio for dust and/or sand storm warnings.*

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Doing too much on a hot day, spending too much time in the sun, or staying too long in an overheated vehicle can cause heat-related illnesses. To avoid developing these illnesses, drink a lot of water, learn the symptoms of heat disorders and overexposure to the sun, and be ready to administer first aid treatment.

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**Effects of HEAT**

<table>
<thead>
<tr>
<th><strong>On vehicle Occupants</strong></th>
<th><strong>On the Vehicle</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Sameness of scenery can lull a driver into a trance-like state — creating a false sense of security.</td>
<td>• Extended desert driving requires frequent vehicle service.</td>
</tr>
<tr>
<td>• Glare from intense sunlight can reduce vision.</td>
<td>• Battery fluids should be checked daily if you do not have a sealed battery.</td>
</tr>
<tr>
<td><strong>To counter these effects:</strong></td>
<td>• Radiator fluid levels should be checked at every fuel stop. (Never remove a hot radiator cap — steam and hot fluids could seriously burn you.)</td>
</tr>
<tr>
<td>• Wear UV ray reducing sunglasses to minimize the effects of glare.</td>
<td>• Check tire pressure regularly. (Pressure in the tires will increase as you drive — never reduce the tire pressure lower than the manufacturer’s recommended pressure.)</td>
</tr>
<tr>
<td>• Make frequent stops and change drivers often.</td>
<td></td>
</tr>
<tr>
<td>• Carry an adequate supply of water.</td>
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</table>
Hot/Cold Weather Temperatures

Sand Storms and Dust Storms. When driving in extreme hot, dry temperatures you must be prepared for sand or dust storms. Check with national and local weather stations for information on the storm situation when traveling in desert conditions.

A Dust Storm or Sand Storm warning means: Visibility of 1/2 mile or less due to blowing dust or sand, and wind speeds of 30 miles an hour or more.

These storms usually arrive suddenly in the form of an advancing wall of dust and debris which may be miles long and several thousand feet high. They strike with little warning, making driving conditions hazardous. Blinding, choking dust can quickly reduce visibility, causing crashes that may involve chain collisions, creating massive pileups. The storms usually last only a few minutes, but the actions a motorist takes during the storm may significantly impact his or her life.

DUST and SAND Storm SAFETY measures:

- If dense dust is observed blowing across or approaching a roadway, pull your vehicle off the pavement as far as possible. Stop, turn off lights, set the emergency brake, take your foot off of the brake pedal to be sure the tail lights are not illuminated and turn on your hazard flashers.
- Don't enter the dust storm area if you can avoid it.
- If you cannot pull off the roadway, proceed at a speed suitable for visibility, turn on lights and sound horn occasionally. Use the painted center line to help guide you. Look for a safe place to pull off the roadway.
- Never stop on the traveled portion of the roadway.
- Wait in your vehicle until the storm passes.
- As soon as you can after the storm, have your vehicle serviced. Dirt particles may be in the oil and air filters.

Snow, ice, and extreme cold can make driving treacherous. As temperatures drop and the weather gets colder, an added strain is put on your engine, especially when it is started. The colder weather will affect many of your vehicles parts — the battery will have less power; the engine is forced to work harder to reach normal operating temperature because engine oil, transmission fluid, and other lubricants all tend to be thicker. **Before winter arrives, have your car tuned up.**

- Check the level of antifreeze, the battery and your tire tread, or put on snow tires.
- Keep the following emergency gear in your car at all times:
  - Cell phone
  - Flashlight
  - Jumper cables
  - Sand or kitty litter (for traction)
  - Ice scraper, snow brush, and small shovel
  - Blankets
  - Warning devices (e.g., flares, reflectors)

The leading cause of death during winter storms is transportation crashes. Experienced and novice drivers alike can find their skills tested by cold temperatures brought on by winter conditions. Therefore, a driver needs to be prepared. Extremely cold temperatures, winter storms and gusting winds do not happen without any warning. Weather forecasts on TV and radio will often warn you well in advance of the approaching conditions. Knowing when and where a storm will hit does not mean it is safe to drive. Winter storms are unpredictable, with many unexpected hazards such as slippery and icy roads, white-out conditions resulting in little or no visibility for the driver. Any or all of these conditions can catch even the most experienced driver off-guard.
Cold Weather Temperatures

**Starting your Vehicle:**

- If your vehicle is parked outside, make sure the exhaust pipe and the area around it are free of snow before you start the engine. Snow packed in or around the exhaust pipe can cause high levels of carbon monoxide in your vehicle.
- Don't sit in your vehicle when parked with the engine running unless a window is slightly open to let in fresh air. Do not let your vehicle run while parked in a garage. Carbon monoxide kills.
- Clear all snow and ice from your vehicle windows and do not start driving until your windshield is completely defrosted.

**Before driving in a winter storm, ask yourself, “Is this trip really necessary?”** If you decide the trip cannot be delayed, following the advice below will increase your chance of having a safe trip.

- Check weather conditions along your travel route. Listen to weather forecasts on the TV and radio.
- If possible do not travel alone. If you must take a trip, inform someone of where you are going, the primary and alternate routes you will travel, and when you expect to arrive. When you reach your destination, call to report you have arrived safely. If for some reason you do not arrive at the planned destination and have not contacted the individuals to inform them of your situation, they can alert authorities of your travel plans and failure to arrive at your destination.
- Before you leave town, fill your gas tank. While traveling, frequently refill the gas tank. Not only will this prevent ice in the tank and fuel lines, but the stops will relieve tense muscles and increase your alertness.
- Be prepared to turn back or seek shelter if conditions become threatening. *(Avoid driving in snow or ice storms.)*
- Drive slower and increase your following distance.
- Roadway conditions may vary depending on the sun, shade, or roadway surface. Watch for slick spots especially on bridges, overpasses and in shaded spots. *(Be prepared to react physically and mentally.)*
- If your car stalls or gets stuck in snow, light two flares and place one at each end of the car, a safe distance away. Make sure snow has not blocked the exhaust pipe. Then stay in your vehicle and open a window slightly to let in fresh air. Wrap yourself in blankets and run your vehicle's heater for a few minutes every hour to keep warm.
- If the pavement is snow or ice-covered, start slowly and brake gently. Begin braking early when you come to an intersection. If you start to slide, ease off the gas pedal or brakes. Steer into the direction you want to go until you feel you have regained traction, and then straighten your vehicle.
- When a snow plow is coming towards you, allow plenty of room for it to pass. When the center line is being cleared and salted, the plow tip may be on or over the center line.
- When you approach a snow plow from behind, pass with care and only when you can see the road ahead of the plow. You should not try to pass in blowing snow — there may be a vehicle in that cloud of snow.
- Be alert when you approach a cloud of snow which covers the road, especially on passing lanes of interstates or freeways. A snow plow may be at work clearing the lane or preparing to turn around.
- Be careful after a rear-end crash. Do not exit your vehicle if you feel uncomfortable — motion the other driver to follow you and drive to the nearest police station, 24-hour store, service station, hospital, or fire station.
High Winds

Strong winds create a problem called buffeting. This condition may cause a driver to lose control of the vehicle. The effects of wind gusts increases on bridges such as the Chesapeake Bay Bridge, when driving through mountain passes and ravines, and when being passed on the road by large trucks. Buffeting becomes more dangerous, when pulling a camper, towing a trailer, or traveling in a large recreational vehicle.

Driving in Strong Wind Conditions

When driving on a highway with steady strong crosswinds, drivers should be alert to the prevailing wind direction and velocity, the terrain through which they are passing, and the condition of the road surface. Driving out of a wooded area, from behind a long ridge, or from under an overpass on an ice packed road are all examples of situations where being suddenly struck by a strong gust of wind can easily cause a vehicle to move into the lane to the left or right, or spin completely out of control.

To control the situation you should:

- Reduce speed
- Check for oncoming and following traffic
- Limit time exposure to wind when clear of traffic
- Adjust position to lane placement 2 or 3 into the wind
- Just prior to exposure to wind, steer against the wind toward lane placement 2 or 3
- be prepared to countersteer
- Stay off brake (unless necessary to stop)

When you are driving in a strong headwind, you may need to accelerate more to maintain speed and steering may become more difficult.

When you are driving with a tailwind, the tailwind will increase your speed so you will have to decelerate and begin braking earlier in order to stop.
Building roadways involves design, engineering and construction. Whether a roadway construction is new, old or under repair, safety has become a key focus for engineers and designers. Roadway signs, signals and pavement markings help take the uncertainty out of driving, providing drivers with information when traveling the nation’s roadways. But signage alone was not enough. The number of vehicle crashes that result in people being injured or killed has made it necessary to incorporate many safety features into road and vehicle designs.

Highway safety design features have existed for many years to help protect road users. Motor vehicle designers have also added safety design features in vehicles to help lower to crash fatalities. Modern technologies and new engineering designs are being applied to make roadways even safer. Many of the roadway design feature have taken into account the changes in today’s vehicle weight and size, along with safety improvements to freeways and high-speed highways.

**Some highway safety design features to enhance occupant safety include:**

- Elimination of grade intersections
- Wide, clearly-marked lanes and clear highway shoulders
- Rumble strips installed at the road edge to alert drivers
- Redesign of median barriers
- Traffic calming devices
- Breakaway sign support posts
- Guard rails designed with ends angled away from roadway and buried
- Crash attenuators such as vinyl liquid or sand filled drums
- Protected left and right turn bays
- Collector/distributor lanes on high speed, high density highways (separates slower moving entering/exiting traffic from the higher speed through traffic flow)
- Message signs to alert drivers to problems

When fixed objects cannot be removed from the roadside, relocated to a safer location, or modified with breakaway devices, they are often shielded with a barrier. These barriers whether made of concrete, steel, or cables, are designed and located to safely contain a vehicle that leaves the roadway, as well as to redirect the vehicle adjacent to the barrier, so the driver can regain control. This reengineering of crash barriers to meet the changes in modern vehicle design has also helped in reducing crash fatalities.
Highway Safety Design Features

Wide, clearly-marked lanes and clear highway shoulders — A "forgiving" roadside provides a recovery area to safely regain control of your vehicle before you encounter a fixed object. While a clear roadside is desirable for safety, in some cases, highway hardware must be located near the edge of the road. Hardware such as sign supports and guardrails, are designed to lessen the potential for injury if hit by out-of-control vehicles. These types of devices are designed to "breakaway" when they are hit; this greatly reduces the severity of collisions with these fixtures.

Breakaway Sign Support Posts — Post break-away systems are designed to cause less damage to vehicles and make it safer for drivers upon impact.

Rumble strips — are grooves or rows of raised pavement markers placed perpendicular to the direction of travel to alert inattentive drivers. As a vehicle passes over the rumble strips, it produces noise and vibration, alerting the driver they are approaching a hazard or have run off the road.

- Roadway rumble strips are placed across the traveled way to alert drivers approaching a roadway condition change or hazard that requires substantial speed reduction or other maneuvering.
- Shoulder rumble strips are placed on the shoulders just beyond the travel path to warn drivers they are entering a part of the roadway not intended for routine traffic use.
- Centerline Rumble Strips are placed on centerline of non-divided highways to warn drivers they are leaving their intended lane of travel.
- Median Rumble Strips are placed on yellow line near the median of a divided highways to warn drivers they are entering a part of the roadway not intended for routine traffic use.
Highway Safety Design Features

**Crash attenuators** — are vinyl liquid or sand filled drums that have been installed in a specific geometric array in front of the hazard. When hit by a vehicle, the canisters will spread out the force of impact, dissipating the energy reducing the severity of the impact, while helping to stop the vehicle.

**Collector/distributor lanes** — are used on high speed, high density highways to separate slower moving and/or traffic entering/Exiting from the higher speed through-lane traffic flow.

**Message signs** — these electronic signs provide drivers with up-to-date information about lane and exit closings, delays, collisions, weather problems and other important information that can affect driving conditions. They are usually posted in areas of high density traffic or where bad weather is common.

**A guard rail made of lightweight crushable concrete**s and a conventional concrete base. When hit by a vehicle the concrete modules crush under the force of the impact, dissipating the energy and bringing the vehicle to a controlled, safe stop. The keys to performance are lightweight crushable concrete modules and the inclined concrete base, locked together to act as a unit.

**Guard Rails — The extruder terminal designed guard rail** minimizes the hazard of guardrail ends. Since initial introduction, thousands have been installed throughout the United States and around the world. Upon impact, the vehicle forces the extruder "head" along the guardrail, breaking the wooden posts and flattening and curving the guardrail away from traffic as it brings the vehicle to a controlled stop. In the extruding process, the kinetic energy of the impacting vehicle is absorbed by the force required to reduce the W-Beam shape of the guardrail to a flatter section.

**Median Barriers** — consist of a pre-fabricated mountable island. The island is placed in the center of the roadway leading up to a highway-rail grade crossing. The concept behind median barriers is that a barrier placed in the center of the roadway will provide an obstacle so that a vehicle cannot attempt to drive around a crossing gate arm. When a roadway is not wide enough to accommodate a median barrier, yellow and black reflectorized paddle delineators are mounted to the curb barrier. The delineators are mounted on either a rubber boot or concrete, or a yellow and black tubular marker that can be mounted directly onto the roadway's centerline.
Automotive Technology

Over the past several years new vehicle technology has been designed for vehicles to protect drivers in a crash. Enhanced control technologies to aid the driver in maintaining balance control of the vehicle when attempting any avoidance maneuvers have also been developed.

Motor vehicle manufacturer engineers and their suppliers have also developed an array of stability enhancement systems. These systems are all computer-controlled and use various sensors to monitor vehicle parameters. They improve vehicle stability and handling by optimizing the use of friction between the tires of the vehicle and the road surface.

Enhanced control is provided through technologies such as the following:

**Anti-lock brake systems** are designed to allow steering and simultaneous braking without losing vehicle balance. Anti-lock brakes do not necessarily shorten stopping distance on dry pavement. However, they do prevent tires from sliding and generally shorten stopping distances on wet surfaces where traction loss can be a serious problem.

**Traction control systems** are designed to activate brake sensors, which do not allow the wheels to spin. The process is basically the reverse of anti-lock brakes. The device allows acceleration input to the tires without loss of vehicle balance.

**Suspension control systems** adjust vehicle balance through adjustment of fluid or air pressure when too much weight is suddenly transferred to a given shock absorber or strut.

**Electronic Stability Program (ESP)** compares where a driver is steering the vehicle to with where the vehicle is actually going. When ESP senses a disparity between the two, it selectively applies any one of the vehicle's brakes to reduce the discrepancy to help the driver retain control and stability.
### Automotive Technology

#### Stability Enhancement System

Automotive system use and integration of microprocessor and sensor technologies has made possible an array of electronically controlled vehicle stability enhancement systems. Each of these systems have the capability of applying or regulating the brake force at the wheels to influence the stability and/or steering and handling of the vehicle.

Designed to optimize use of the friction at the tire/road interface (the friction between the patches of tire and the road surface allows optimization of this force), they provide enhanced vehicle stability and handling.

There are many automotive stability enhancement systems on the market today, with more arriving almost daily. These systems each have an acronym unique to their design, performance, or marketing features. Some of these names and acronyms are trade names of the system or vehicle manufacturers.

### Currently Known Acronyms

#### Traction Control Systems

- ASC (Automatic Stability Control)
- ASR (Automatic Stability Regulation)
- Brake Only Traction
- ETS (Enhanced Traction System)
- TCB (Traction with Brake Interface.)
- TRAC
- EDS

#### Antilock Braking Systems

- ABS (Anti-lock Braking System)
- RWAL (Rear Wheel Anti-lock brakes)
- SCS (Stop Control System)

#### Active Yaw Control Systems

- Active Brake
- Active Handling
- Active Safety
- Advance Trac
- ASMS (Automotive Stability Management System)
- ATTS
- CBC (Cornering Brake Control)
- DSC (Dynamic Stability Control)
- DTSC (Dynamic Stability and Traction Control)
- ESBS
- ESP (Electronic Stability Program)
- ICCS (Integrated Chassis Control System)
- IVD (Integrated Vehicle Dynamics)
- PCS (Precision Control System)
- PSM
- SCS (Stability Control System)
- StabiliTrac
- Traxxar
- VDC (Vehicle Dynamics Control)
- VSA (Vehicle Stability Assist)
- VSC (Vehicle Stability Control)
- YCS (Yaw Control Stability)

Some of these systems — such as ABS, have widespread application in the market and already are contributing to improved handling and control of vehicles. Others, such as Active Yaw Control, are beginning to penetrate the market and demonstrate their benefits in assisting driver control and making further contributions to vehicle safety.
Automotive Technology

Anti-Lock Braking Systems (ABS) A system is identified as an Antilock Braking System if it:

- Is computer controlled.
- Has a means to determine if any wheel is about to lock/slide.
- Has the capability of regulating the brake torque at the wheels to limit wheel lock.
- Controls the brake torque to each of the front wheels independently and the rear wheels either independently, or as a pair.

ABS systems monitor the vehicle wheel speeds and regulate the brake forces to control the slip between the tire and the road surface. By avoiding wheel lock, vehicle stability is improved and the driver retains the ability to steer the vehicle. On most surfaces, the stopping distance of a vehicle with ABS is improved when compared to the same vehicle without ABS. Whether the rear wheels are controlled individually or as a pair depends on the specific characteristics of the vehicle including load distribution and inherent vehicle stability, and the target market for the vehicle.

Rear Wheel Anti-Lock (RWAL) A system is defined as a Rear Wheel Anti-lock System if it:

- Is computer controlled.
- Has a means to determine if a rear wheel of the vehicle is about to lock/slide.
- Has the capability of regulating the brake torque at the rear wheels to limit wheel lock.

RWAL systems monitor the vehicle’s wheel speeds and limit the rear wheel brake torques to reduce rear wheel lock-up. By avoiding rear wheel lock-up, the vehicle stability is improved. This system does not control the vehicle’s front wheels and does not provide steering or stopping distance improvement.

Brake Traction Control System (BTCS) A system is defined as a Brake Traction Control System if it:

- Is computer controlled.
- Has a means to determine if a drive wheel is spinning.
- Has the capability of applying brake force individually to the drive wheels to limit spinning.

Brake Traction Control Systems monitor the wheel speeds and apply brake torque to the drive wheels as necessary to control tire spinning during acceleration. By controlling wheel spin, the vehicle stability, steerability, and acceleration are improved. Also, since the brakes can be applied to the drive wheels individually, engine torque can be transferred through the differential from one wheel to another. This can improve vehicle mobility and acceleration on surfaces that have non-uniform frictions (such as a condition where one drive wheel is on a slippery surface and another is on a higher-friction surface.) Since the Brake Traction Control Systems do not have the capability of reducing engine torque, the duration of their activation must be limited, especially at high speeds. These systems may be deactivated at high speeds and may include algorithms to estimate brake temperatures and disable the system if the temperatures exceed a certain limit.

Engine Only Traction Systems (ETS) A system is defined as an Engine Only Traction System if it:

- Is computer controlled.
- Has a means to determine if a drive wheel is spinning.
- Has the capability of controlling engine torque to limit wheel spin.

Engine Only Traction Systems monitor vehicle wheel speeds to determine if a drive wheel is spinning during acceleration, and reduce engine torque to control spinning. Controlling wheel spin can improve vehicle stability, steerability, and acceleration capability. No brake applications are used with this system, and it does not have any ability to transfer torque from one wheel to another.
Automotive Technology

Engine and Brake Traction Control Systems (EBTCS) A system is defined as an Engine and Brake Traction Control System if it:
- Is computer controlled.
- Has a means to determine if a drive wheel is spinning.
- Has the capability of applying brake force individually to the drive wheels to limit wheel spin.
- Has the capability of controlling engine torque to reduce the brake torque needed to limit wheel spin.

Traction Control Systems monitor the wheel speeds and apply brake torques and/or control engine torque to the drive wheels as necessary to control tire spinning during acceleration. By controlling wheel spin, the vehicle stability, steerability, and acceleration are improved. Also, since the brakes can be applied to the drive wheels individually, engine torque can be transferred through the differential from one wheel to another. This can improve vehicle mobility and acceleration on surfaces that have non-uniform frictions (such as a condition where one drive wheel is on a slippery surface and another is on a higher-friction surface). The capability for controlling engine torque allows the system to minimize use of the brakes by reducing engine torque.

Active Yaw Control Systems (AYC)
A system is defined as an Active Yaw Control System if it:
- Is computer controlled and the computer contains a closed-loop algorithm designed to limit understeer and oversteer of the vehicle.
- Has a means to determine vehicle yaw velocity and side slip.
- Has a means to monitor driver steering input.
- Has a means of applying and adjusting the vehicle brakes to induce correcting yaw torques to the vehicle.
- Is operational over the full speed range of the vehicle (except below a minimum speed where loss of control is unlikely).

All Active Yaw Control Systems are assumed to include ABS. The vehicles may also include other brake-related or stability enhancement features such as:
- Traction control to control wheel spin during acceleration.
- Dynamic brake proportioning to control the vehicle front/rear brake balance.
- Engine drag control to prevent excessive wheel slip due to throttle lift-off or down shifting.
- Other computer-controlled features which can activate or modify vehicle braking.
- Other computer-controlled stability enhancement features.

If any of these features are included on the vehicle, the Active Yaw Control System must be capable of coordinating their activities to aid the driver in maintaining control of the vehicle and to prevent undesirable interactions.

Active Yaw Control Systems use various sensors (typically wheel speed sensors, steering angle sensors, yaw rate sensors, and accelerometers) to monitor the dynamic state of the vehicle and the driver’s commands. They then apply the vehicle’s brakes (and adjust engine torque) to make appropriate adjustments to the rotational movement about the vehicle’s vertical axis and correct the path of the vehicle to the driver’s intended path. These systems improve the vehicle’s stability, the driver’s control of the vehicle, and correct understeer and oversteer conditions that occur.

Integrated Vehicle Systems
[Vehicle Dynamics Control (VDC), Integrated Chassis Control System (ICCS), Electronic Stability Programs (ESP), Dynamic Stability Control (DSC)]

These systems combine vehicle stability features such as ABS, Traction Control, Electronic Brake Distribution (Dynamic Rear Proportioning), Active Yaw Control Systems, Suspension Controls, and Steering Controls on one vehicle. Each manufacturer may package and name these combinations to suit their specific vehicle and customer needs. These names may be trademarks of individual manufacturers.
Traction Loss

- Potential traction loss related to adverse weather conditions.
- How traction loss results in roll, pitch, and yaw and impacts vehicle maneuvers.
- How performing vehicle operation and control tasks to manage vehicle balance may result in an imbalance situation.
- Situations where the vehicle maneuvers of other roadway users may force surrounding roadway users including vulnerable roadway users to perform vehicle maneuvers that results in traction loss.
- Plans to avoid or compensate for the traction loss of other roadway users including vulnerable roadway users.
- How traction loss from roadway grade and shoulder conditions impacts vehicle maneuvers and vehicle balance and formulate plans to avoid or compensate for variances.
- How the adverse conditions of vehicle imbalance and traction loss in roll, pitch, and yaw situations change lane placement.
- How vehicle balance varies from vehicle to vehicle and formulate plans to compensate for variances including utilizing the vehicle owner’s manual as a resource.
- Reduced-risk driving practices necessary to compensate for traction loss.
- How vehicle technology systems are designed to increase vehicle balance and traction control.
- Reduce risk by legally and responsibly managing vehicle balance and utilizing reduced-risk driving practices during traction loss.

Traction. Traction, or adhesion, refers to the grip between the tires and the surface upon which they travel. Traction allows a vehicle to start, stop, and/or change direction. Three types of traction influence the control or movement of a motor vehicle. They are: static, rolling (dynamic), and sliding.

An example of static traction is a stationary vehicle parked on a flat surface with its brakes set. Static traction has the greatest resistance to movement.

There is greater traction between a stationary wheel and the road than there is between a rolling or sliding wheel and the road. Rolling or sliding traction does not grip the road as well as static traction.

There is more traction between a rolling wheel and the road than there is between a sliding wheel and the road. Consequently, when trying to steer or stop a vehicle, a driver must keep the wheels rolling and not lock the brakes.

Another aspect of traction to keep in mind is that it does not remain constant. There are many factors that can affect tire traction. New drivers need to be aware of the causes of decreased traction and when traction loss occurs, they need to respond appropriately in order to lessen skidding or sliding tires.
Traction Loss Concerns

Recognizing Traction Loss

In any given situation, the front or rear of a vehicle can lose traction when the driver steers, brakes, or accelerates improperly. This is because the resulting traction loss will initially be a loss of traction to the front or rear tires. If the driver can recognize the traction loss to the front, then ABS is a helpful tool to regain steering while slowing.

Keep in mind that this runs contrary to the past practice of keeping your foot off the pedals in a skid. If the driver can recognize traction loss to the rear tires, then the TCS is a helpful tool to regain steering while accelerating gently. The concept of gentle acceleration also runs contrary to past instruction for handling traction loss.

The difference in controlling a front and rear traction loss in modern vehicles is using braking and acceleration to increase traction. By commencing these actions, the driver creates a vehicle weight transfer to aid in maintaining the rolling traction, rather than the sliding traction of times past. A vehicle has significantly more traction with rolling traction versus sliding tire/ traction.

As a driver, you must understand the process of vehicle weight transfer and traction loss, and recognize which part of the vehicle is losing traction in order to prevent this loss from occurring. The first indication to the driver that the vehicle is experiencing traction loss is the motion-based sensory stimuli that he/she receives. Motion-based sensory stimuli is generated by vehicle movements away from the intended path of travel.

By the time a driver is visually aware that the front or rear of the vehicle has deviated from the desired direction, the situation has already become more difficult to correct. Therefore, it is critically important that the driver’s sensory perception is fine tuned to identify the situation early.

The strategies for responding to traction loss have changed due to innovative traction technologies that have become available in many new vehicles on the market today. Check the vehicle’s owner manual for the type of systems your vehicle has and review the proper procedures for activating and operating these traction technologies.
Changing Traction Condition on Road Surfaces

*Road surfaces* produce different degrees of traction. Surface materials, surface conditions, roadway design and weather conditions all affect vehicle traction and control. When driving a vehicle on a straight and even dry road, the traction between the tires and the road will be substantial. This helpful type of traction allows the driver to easily keep control over his/her vehicle. But if you drive the same vehicle on the same road on a day when adverse conditions such as rain or snow are present, vehicle traction and control will be reduced dramatically with the possibility of skidding or sliding increasing.

**Facts show — skidding is a major contributor to traffic crashes at all times of the year.** Over 50 percent of all occupant deaths in running-off-the-roadway crashes result from loss of vehicle control due to traction loss.

**Road surface conditions that decrease the level of traction are:**

- Ice, snow, or frost covered roads
- Wet roads, particularly first 15 minutes of rain after a long dry period when drops of oil and rubber particles have collected on the road surface
- Hard rain or water standing on the road
- Mud near farm entrances, construction sites, and truck crossings
- Wet leaves
- Uneven road surfaces
- Sand or gravel-covered areas
- Negative-banked curves
Traction Loss Causes

Condition of the Vehicle  As the vehicle ages the owner must ensure the vehicle remains in top working condition in order to maintain top performance. If the owner allow tires, shock absorbers, brakes and steering systems to wear, traction and control will be reduced.

Tires:  Good traction starts with your vehicle’s tires. In order to sustain a proper grip on the road surface and ensure vehicle control, the tires must be kept in good condition. Worn or improperly inflated tires are dangerous and will not grip road surfaces properly. This loss of traction results in decreasing vehicle control. Check tire pressure and tread wear frequently. (Tire wear can be checked with a gauge or a penny; just be sure you have at least one-sixteenth of an inch of thread.)

Shock Absorbers:  Shock absorbers are also very important in maintaining good traction. Worn shock absorbers result in bouncing tires and a rough ride when traveling over any rough surfaces on the roadway. To ward against traction loss, worn shock absorbers should be replaced as soon as possible.

Brakes:  Brakes are essential in maintaining good vehicle control. Brakes must be evenly adjusted to prevent pulling in one direction or the other, and to avoid a resulting skid. Unaligned wheels can also cause the vehicle to skid when brakes are applied.

Steering System:  The steering system allows a driver to control the direction the vehicle is moving in. When parts become worn, the steering system gains more free movement, and vehicle control and response become slack, often requiring excessive steering action to control the direction of the vehicle.

Traction Loss caused by Driver Actions
Vehicle suspension, geometry, and tire pressure are basic components of balance when at rest. When in motion, simultaneous steering, braking and/or acceleration creates shifts in vehicle balance. Any sudden shifts in vehicle balance whether to the left or right, forward or backward, can cause traction loss.
Traction Loss Causes

When brakes are applied too hard or quickly the vehicle will pitch forward.

- Weight or center of mass transfers to the FRONT of the vehicle.
- **Weight movement or brake force causes a**
  - noticeable drop of the hood
  - noticeable rise of the rear deck
  - forward movement of driver and passengers

When acceleration is applied too hard or quickly the vehicle will pitch backward.

- Weight or center of mass transfers to the REAR of the vehicle
- **Weight movement or acceleration force causes a**
  - Noticeable rise of the hood
  - Noticeable drop of the rear deck
  - Rearward movement of driver and passengers
Traction Loss Causes

When steering is applied too hard or too quickly

- Weight or center of mass transfers to the OPPOSITE CORNER (front right or left) of the vehicle.
- **Weight movement causes**
  - A noticeable drop and tilt (roll) of the hood
  - A noticeable rise and tilt of the rear deck
  - Driver and passenger movement in the opposite direction of the turn

To help prevent traction loss avoid:

- Sudden steering action on a slippery surface
- Abrupt or sudden changes in vehicle speed
- Panic stop or applying brakes too hard on hills, curves or slippery surfaces
- Sudden engagement of clutch on slippery surfaces (for manual transmission equipped vehicles)

Any abrupt movements or changes of the vehicle are transferred to the vehicle suspension and will have a significant affect on vehicle balance. The key to reducing the risk of traction loss is smooth and efficient steering, braking, and accelerator movements.
Traction Loss to Front Tires

**Front wheel loss of traction** called understeer occurs when the steering wheels move from rolling traction to sliding traction. Typically, understeer occurs on a slippery surface when a driver attempts to steer the vehicle through a curve or around a corner. It also may occur as a result of approaching a curve or turning too fast and braking hard or suddenly providing too much steering input.

In front-wheel drive cars, understeer can result from excessive speed while cornering. Understeer is just what it sounds like: the vehicle is not turning as much as you need it to or the front tires are sliding. Being in a vehicle that refuses to turn can be very intimidating, especially on slippery roads where understeer is very difficult to control.

Like most bad situations, understeer is best overcome through avoidance. Always remember to adjust your speed properly before entering a corner and be very cautious of your speed and steering action on slippery roads.

**Identifying and Responding to Loss of Front Wheel Traction.** Traction loss can be very subtle. Drivers identify traction loss visually when the front of the vehicle moves outward, away from the path of travel, even though they continue to turn toward it. The driver's vision picks up the movement straight ahead, instead of through the curve or around the corner.

Since the tires are designed to go straight ahead, if the wheels are turned too sharply or abruptly, the sidewalls tend to roll under and the smooth sidewall rather than the tire tread makes contact with the road (turning force cannot be developed out of sliding traction). At the same time, the rolling rear wheels push to keep the vehicle moving in a straight line.

If you lock the brakes while attempting to steer around an obstacle, the vehicle simply skids into whatever you were attempting to avoid. It is critical that you direct your vision to the targeted path of travel and not to the skid path. Release the pedal, brake or accelerator, so the weight of the vehicle allows the tires to reform from the sidewall to the tread and reestablish rolling traction. Ease off the steering.

If the vehicle does not respond to the path of travel, jab the brake to shift weight to the front of the vehicle. The steering should respond quickly when the vehicle regains rolling traction, so be prepared for a sudden movement of the vehicle toward the planned path of travel.

**How Should You Steer?** Having identified a visual targeted path of travel turn the steering wheel in the direction you want the vehicle to go. This may take small readjustments as the vehicle responds to your initial steering input, especially in a front tire traction loss. Fast steering wheel movement produces more sliding traction or less rolling traction as the tire sidewall moves sideways. The key is not to steer more than necessary in attempting to keep the vehicle directed toward your path of travel.

**Most driver-induced skids are caused by:**
- Excessive speed coupled with excessive steering input or improper braking when turning
- same actions at normal speed on ice/snow or on roadways covered by sand, gravel, or

If your vehicle is equipped with an ABS Brake System:
- Activate it.
- Steer toward targeted path of travel.
- DO NOT jab the brake to shift some weight to the front of the vehicle. ABS performs this function automatically.
Traction Loss to Rear Tires

Rear wheel loss of traction, termed oversteer is exactly what it sounds like — your vehicle turns more than you want it to. It occurs when rolling traction moves to sliding traction on the rear wheels of the vehicle. In this type of skid, unless corrective action is initiated quickly, the tires with less traction try to move to the front and the vehicle’s natural tendency will be to rotate 180 degrees and end up going backward. As with front wheel loss of traction, rear wheel traction loss may occur on a slippery surface when trying to steer a vehicle through a curve or around a corner. It also may occur as a result of approaching a curve or turning too fast and braking hard, suddenly providing too much steering input or acceleration.

**Identifying and Responding to Rear Wheel Loss of Traction.** On a slippery surface, the driver should recognize rear wheel loss of traction when observing that the front of the vehicle is moving to the left or right away from the targeted path of travel, even though he/she is not steering the vehicle in that direction. The best response is to keep targeting the path of travel, ease off the brake or accelerator, continually steer toward the travel path, and use a very light and progressive acceleration (2 mph will move weight to the rear) as the rear of the vehicle recovers from sliding to rolling traction.

**If your vehicle is equipped with a Traction Control System:**
- Activate it
- Steer toward targeted path of travel
The traction control system will adjust the speed and brakes automatically while activated.

The key to this problem is to keep targeting the travel lane and not the side of the road and to steer back to the lane. At this point of the slide or skid, the driver may not have steered enough to regain his path of travel, so he may have to increase steering inputs until rolling traction begins to help. This is where light and progressive acceleration can transfer weight and help rolling traction return from rear tire sliding traction.

**How should you Steer?** Having identified a visual target, path of travel, turn the steering wheel in the direction you want the vehicle to go. This may take some rapid readjustments as the vehicle responds to your initial steering input, especially in a rear tire traction loss. Lateral forces in a rear wheel traction loss also will affect the movement of the vehicle. Lateral acceleration is the sideways movement of the vehicle and is determined by how fast the steering wheel is turned and the momentum of the vehicle. Fast steering wheel movement produces more side or lateral acceleration. The key is not to steer more than necessary to keep the vehicle directed toward your path of travel. When the vehicle stops moving in one direction, this energy will want to quickly move in the opposite direction; being able to respond with the steering wheel demands constant attention until the vehicle is safely back on the desired path of travel.
Off-Road Recovery

Running off roadway: Running off the roadway is a frequent cause of fatal crashes for novice drivers. Crashes occur when a driver loses traction control and then fails to correct his/her mistake properly. Frequently, when two or all four of the vehicle’s tires drop onto the shoulder of the road, the driver panics, and oversteers in a desperate attempt to get back onto the pavement, or he/she inadvertently locks the brakes.

When driving off the roadway, you must deal with unstable surfaces that make traction unpredictable. Different surfaces give rise to different degrees of traction. The tires on the paved area have more traction than the tires on the unpaved area. Applying the brakes in an unpaved area may cause the car to skid. Turning the wheel too sharply could cause the car to skid out of control, flip over, or shoot back across the roadway into the opposite traffic flow.

Off-road Recovery

When you find yourself in this situation, avoid quick steering, and regain control of your vehicle before returning to the road. If you experience the effects of traction loss and vehicle control:

- Don’t panic and oversteer.
- Ease off the accelerator and do not brake.
- Sight/align the vehicle with the edge of the roadway.
- Check all traffic.
- When clear, bring the wheel back to the road’s surface by turning the steering wheel 1/8 to 1/4 turn.
- As the wheels touch the road surface, countersteer 1/4 or 1/2 turn and turn to straighten wheels.
- If you end up in a ditch, “ride” the ditch until you regain control.
Immediate Emergency – An unforeseen combination of circumstances or the resulting state that calls for immediate action.

Potential Emergency – unforeseen combination of circumstances or the resulting state that may need action.

Off-Road Recovery – Regaining lane placement after going off-roadway.

Controlling Consequences – Lessening the results of an impending crash.

A driver should be able to recognize and assess emergency and non-emergency situations including:

- Impending crash
- Crash
- Vehicle malfunction
  - Tire failure
  - Accelerator failure
  - Engine failure
  - Total Steering failure
  - Power steering failure
  - The car catches on fire
  - Brake failure
  - Power brake failure

- Traction loss

**Reduce Consequences of an Impending Crash.** A driver should try to reduce the consequence of an impending crash. Types of crashes include:

**Head-On Crash.** The possibility of serious injury and death is more likely with a front-impact crash. Head-on collisions are more likely to occur on 2-lane highways, in narrow lanes, and in construction zones.

**Rear-End Crashes.** Rear-end collisions are one of the most common types of multiple vehicle collisions. Tailgaters are especially at risk.

**Side-Impact Crash.** Despite recent safety advances in side protection such as reinforced steel beams in doors and side-mounted airbags, most vehicles are less well-equipped to withstand a side impact than they are a head-on impact.

If you are at risk of colliding with the side of another vehicle, honk your horn and flash your lights to warn the other driver. Swerve right rather than left when there is no time to look first.

If your car is about to be hit, your best option is to accelerate rather than brake if the way is clear. Accelerating will get you past the danger more quickly. Braking may actually contribute to a side-impact collision, especially if the other driver has judged that your speed is sufficient to avoid a crash.

If the way ahead is not clear, another alternative is to turn in the direction that the other vehicle is moving to force the impact behind you to the rear of your vehicle. If you turn in the direction of the approaching car, you risk having a head

**Transportation Code 550.022.** Crash Involving damage to vehicle. b) If an accident occurs on a main lane, ramp, shoulder, median, or adjacent area of a freeway in a metropolitan area and each vehicle involved can be normally and safely driven, each operator shall move the operator's vehicle as soon as possible to a designated accident investigation site, if available, a location on the frontage road, the nearest suitable cross street, or other suitable location to minimize interference with freeway traffic.
Controlling Consequences.
- Avoid head-on collisions.
- Drive off road rather than skid off road.
- Hit something soft before something hard.
- Hit something going your way rather than something stationary.
- Hit stationary object with glancing blow.
- Hit stationary object rather than an approaching object.
- Steer to avoid oncoming traffic.

A driver should know the risk reduction techniques to avoid single vehicle, off-road, speeding, and alcohol-related crashes. When driving off the roadway, one must deal with unstable surfaces that make traction unpredictable. Slamming on the brakes and steering changes often result in a rollover.

Risk Reduction Techniques for Running Off-Road
- Direct vision on targeted path of travel.
- Ease off accelerator pedal and activate ABS
- Direct steering to targeted path of travel until traction is regained to rear.
- Don’t panic and oversteer.
- Check all traffic.
- When clear, bring wheel back to road surface by turning steering wheel 1/8 to 1/4 turn.
- As wheels touch the road surface, counter steer 1/4 or 1/2 turn, turn steer straight.

Responsibilities in a Crash
- Move car, if possible, to avoid blocking traffic and to protect it from further loss or damage.
- Call the police if somebody is killed or injured—a vehicle cannot be moved—or the accident involved a hit-and-run driver. Uninsured motorist coverage pays for hit-and-run accidents only if reported to the police.
- Help the injured and send for skilled help as soon as possible.
- Get the other driver’s name, address, telephone number, license plate number, driver license number, and insurance information. Provide the same information to the other driver.
- Record the insurance company name and the policy number exactly as shown on the other driver’s proof-of-insurance card.
- Obtain names, addresses, and telephone numbers of witnesses.
- If you damage an unattended vehicle, you must either locate the owner or leave your name, address, the name of the owner of the vehicle you were driving, and a statement (where the owner will find it) of what happened on the damaged vehicle.
- If you damage property, you must make a reasonable effort to locate the owner and provide all the necessary information.
- If you are involved in a hit-and-run crash, report this to a law enforcement agency for investigation.

What to do Upon Arrival to the Crash Scene
- Do not assume that a person is uninjured simply because the person says.
- Send for skilled help as quickly as possible.
- Unskilled handling can do more harm than good.
- Do not move or lift the victim unless it is absolutely necessary.
- Stop serious bleeding with thick cloth pads, as clean as possible, applied with pressure.
- Keep the victim warm.
- Secure the crash scene and warn other traffic by
  - Turning on hazard lights
  - Using Flares
Comprehensive In-Car Progress Assessment

**Comprehensive In-Car Progress Assessment Tool** located in **Module 13: In-Car Instruction**

The student reduces risk by legally and responsibly utilizing in-car progress assessment tools to evaluate and improve behind-the-wheel skill level (mastery equals 70% or above). The student is assessed with an In-Car Progress Assessment Tool while demonstrating the ability to:

- perform pre-drive tasks including pre-start and pre-drive maintenance procedures performed prior to and after entering the vehicle;
- utilize occupant protection and correct posture, seating, steering wheel, and hand positions;
- locate, identify, and respond appropriately to vehicle symbols (alert and warning);
- utilize vehicle devices (control, information, safety, communication, convenience, and comfort);
- perform starting tasks including engine starting, engine operation, and starting-maintenance procedures;
- describe vehicle operating space;
- perform vehicle operation and control tasks to accelerate, decelerate, steer (straight, right, and left), move forward, back, turn (left and right), perform lateral and turnabout maneuvers, stop, and park at various speeds;
- perform blindspot and mirror checks;
- perform multi-task performances utilizing countermeasure to compensate for divided attention;
- sustain visual attention and communicate while executing vehicle maneuvers;
- utilize a space management system; and
- perform post-drive tasks including stopping, engine shut-down, post-drive maintenance, exiting including a visual check to ensure that all passengers especially children and animals are out of the vehicle, and securing procedures.
Driving Plan

A **Driving Plan** incorporates the Knowledge and Skills of Module 9: Adverse Conditions into the Driving Plan whereby the student may utilize the Driving Plan to develop and sustain legal and responsible reduced-risk driving practices. When describing a Driving Plan, the student will use the information learned from Module 9: Adverse Conditions to develop a positive driving culture as it relates to “**Safety, Economy, and Civility.**”

**Safety** or the reduction of risk or injury. Legal and responsible reduced risk driving practices.

**Economy** or the reduction in the use of our environmental resources. Consumer responsibility, conservation, environmental protection, and litter prevention.

**Civility** or the increase in polite and respectful acts—Share the Road. Sharing the roadway with other roadway users including but not limited to motorcyclists, bicyclists, pedestrians, trucks, work zone/construction workers, animals, trains, etc.

The student will describe his/her **Driving Plan** in the Student Workbook.

**Driving Plan Structure:**

**Safety:** I will use the information I learned in Module 9: Adverse Conditions to develop legal and responsible reduced risk driving practices by …(student completes statement)

**Economy:** I will use the information I learned in Module 9: Adverse Conditions to conserve our environmental resources and develop environmentally friendly driving practices by … (student completes statement)

**Civility:** I will use the information I learned in Module 9: Adverse Conditions to develop courteous driving behaviors to share the roadways with other roadway users by … (student completes statement)
To achieve mastery of Module 9: Adverse Conditions, the student must score 70% or above on the classroom progress assessment. The student may want to discuss the results of the scored Progress Assessment tool with the instructor. The student should utilize the scored assessment tool to improve classroom knowledge and understanding.

**Classroom Progress Assessment**

The Module 9: Adverse Conditions classroom progress assessment can be located in the Classroom Progress Assessment Booklet.