Operate and Recover 4WD Vehicles (V2ORV)

Learner Guide

NTPFES College

Project 2030
BACK TO BASICS TO SET OUR FUTURE

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Contents

Overview

This learner guide covers member requirements to drive NTFRS operational vehicles safely, including the systematic, safe and efficient control of all vehicle's functions and effective management of hazardous situations under operational conditions, specifically related to the operation and recovery of 4WD vehicles.

Legislation, Policy and Procedures

The following legislation/standards/regulations are applicable to this module:

- Australian Road Rules. Exemptions to the Australian Road rules are listed in Traffic Regulations (Schedule 3) Australian Road Rules, Part 19, Division 3, section 306 and 307.
- *Traffic Act 1987*. Exemptions to the Northern Territory (NT) *Traffic Act* are listed in Part VI, Section 30 and 30a.
- NTFRS Instruction - Emergency Vehicle Driving
- *Work Health and Safety (National Uniform Legislation) Act 2011 (As in force at 1 February 2020)*
- *Fire and Emergency Act 1996 (As in force at 16 July 2024)*
- *All members must hold PUAVEH001B (or current equivalent) or drive at normal road speeds.*

PART 1 –Vehicle support systems

Introduction

As the driver of an emergency vehicle, you must always have regard for your own safety, your passengers and also that of other road users. Always drive your vehicle carefully and in a safe and controlled way as you are responsible for a very expensive piece of equipment. You must also know and operate within state and territory road laws; and abide by any additional agency regulations governing the driving of such vehicles.

Driving a large vehicle requires considerably more skill than driving the typical family car. You must know and understand the vehicle's support systems, pre-use and pre-drive checks and drills and techniques for parking and securing the vehicle.

This Learner Guide (LG) provides you with an overview of the skills and knowledge required to drive an emergency vehicle without injury to passengers or other road users in both emergency and non-emergency response conditions and off-road. The content focuses on defensive driving techniques and how to apply these skills in a variety of traffic, road and terrain conditions. The content also addresses the procedures for conducting recovery of a vehicle using jacking equipment and winching systems.

Many of us treat our family or work cars rather casually. We know where the petrol goes in, how to top up the coolant, how to add oil, what to do to check the tyre pressure and a few other maintenance procedures. It is not until we have a breakdown, which typically occurs at a time or location which is inconvenient, that we wish we knew more about how the breakdown could have been avoided.

A motor vehicle is a fairly basic piece of engineering despite the increasing sophistication of microprocessors, digital displays and electronic fuel injection systems. If steam is pouring from under the bonnet, for example, it is a clear indication that the cooling system requires attention and that driving any further is likely to damage the engine.

This section is designed to provide you with an overview of vehicle support systems, so that you can:

- drive in a way that does not place unnecessary stress on the vehicle if something goes wrong
- make an informed decision about what to do to correct a problem.

Many individuals who own and drive a family or work car will only have a general understanding of the systems operating within their vehicle. For emergency response personnel who are required to operate their vehicles in a range of situations and conditions, knowledge of the seven support systems is vital. By understanding the functions of each of these systems, where they are located and how they will contribute to the smooth operation of the vehicle, you will be able to identify irregularities and take appropriate action to rectify them. You will need to familiarise yourself with the systems in the vehicles you may be required to drive and with the maintenance checks required by your organisation. These will be detailed in organisational procedures and will vary depending on each type of vehicle.

Types of support systems

Support systems are the parts in a vehicle that ensure its continuing operation. Support systems involve the delivery of fuel, electrical supply and cooling of the engine and the supply of power and braking to the wheels.

There are 7 support systems in the average vehicle and each one has a number of essential components. For example, the essential components of the cooling system are the radiator, thermostat and water pump. The 7 support systems are:

1. electrical
2. cooling
3. lubrication
4. ignition
5. fuel
6. braking
7. drive-line.

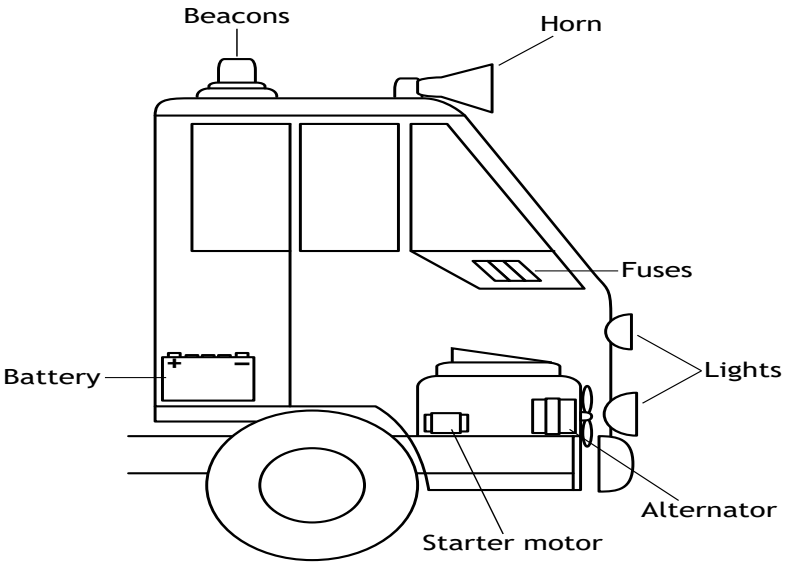
When regularly checking any of these systems, it is important that you refer to the NTFRS Instruction 'Drivers and Vehicles' which will outline appropriate action and any specific maintenance requirements.

1. Electrical

The electrical system consists of various components and wiring that produce, store, distribute and use electrical energy. The electrical system provides power to the starter motor and other electrical components such as lights, horn, windscreen wipers and radio. Vehicles will have either a 24 volt or 12 volt electrical system. You should know the voltage involved when undertaking maintenance checks such as changing fuses and light bulbs in order to avoid any damage to the electrical equipment. This information is also required when trying to jump-start a vehicle.

The table below summarises the function of each component of a vehicle's electrical system that should be checked on a regular basis.

Primary components of a vehicle's electrical system	
Component	**Function**
Alternator	Generates electricity.
Battery	Stores electricity.
Electrical circuits	Components and wiring that connect the starter motor, lights, horn, siren, windscreen wipers, and radio.
Fuses/circuit breakers	Protect electrical circuits from overload.
Warning lights and gauges	Located on the instrument panel (refer to image below); they monitor all systems and indicate faults and system status.

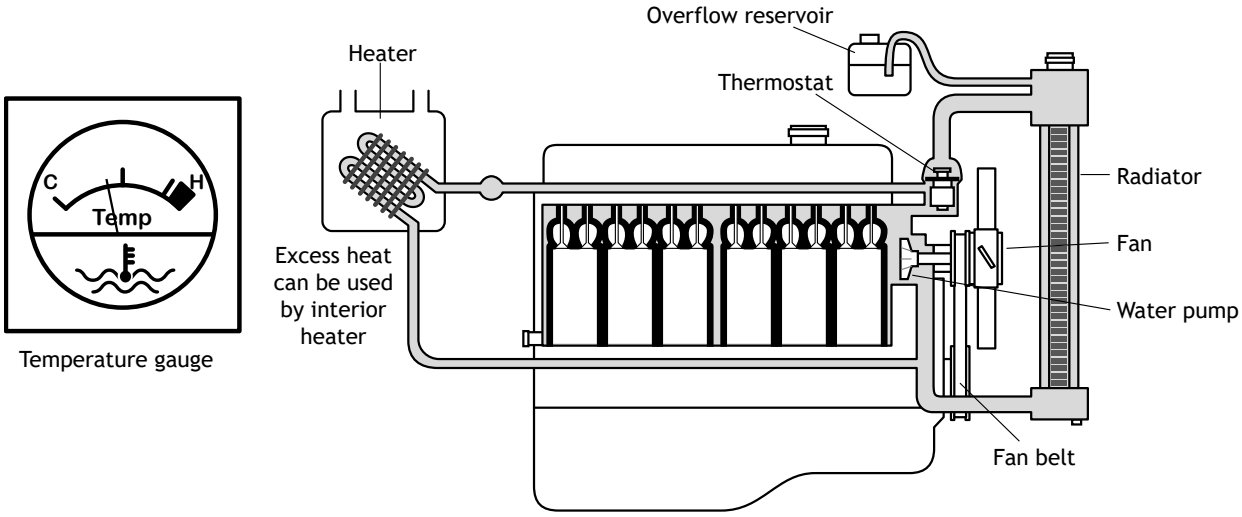


Drawing: Electrical system.

2. Cooling

The cooling system uses water or other liquid coolants flowing through, the engine to remove excess heat generated by combustion in the engine. The cooling system maintains the ideal operating temperature and prevents overheating damage to the engine. A pump pushes water through the hollow passages, especially around the cylinders and combustion chambers, carrying the heated water away. The hot water travels to the radiator, where incoming air cools it, ready to circulate again.

Primary components of a vehicle's cooling system	
Component	**Function**
Fan	Draws air through the radiator.
Fan belt	Drives the fan, alternator, generator and water pump. Some vehicles are fitted with electrically driven fans and do not have a fan belt.
Heater	Uses heat from the cooling system to heat the cabin.
Overflow reservoir	Holds overflow water until engine cools down and coolant is drawn back into the radiator.
Radiator	Cools and stores the water and/or coolant fluid.
Temperature warning light/gauge/alarm	Alerts driver of low coolant levels and high engine temperature.
Thermostat	Regulates engine temperature by restricting water flow when engine is cold and opening as engine warms. This minimises the time taken to heat the engine to normal operating temperature and reduces engine wear.
Water pump	Circulates water and/or coolant.



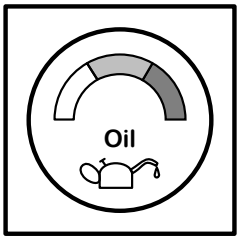
Drawing: Cooling system.

3. Lubrication

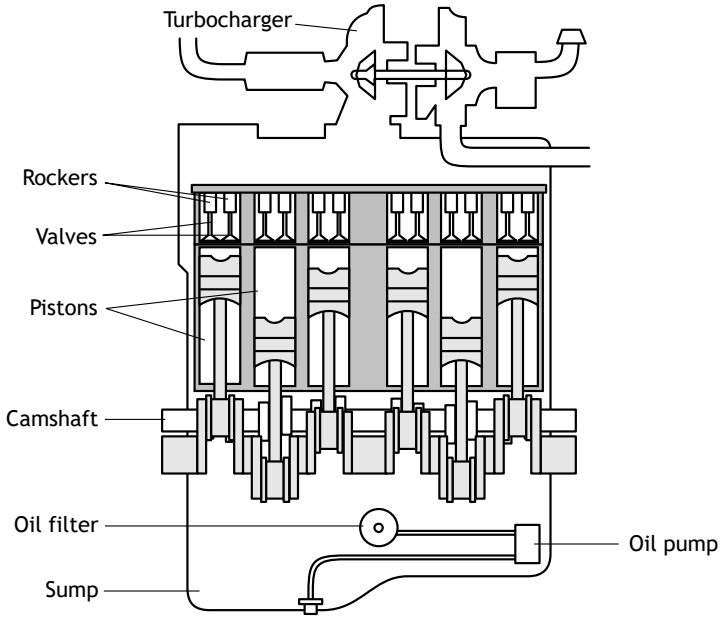
An oil-based lubrication system reduces wear in the engine. It does this by applying a film of oil between all the metal moving parts constantly allowing them to operate smoothly. A pump at the feeds oil through narrow passageways and is fed through small holes throughout the engine onto all of the moving parts. It then gradually drains down into the sump, where the pump picks it up and circulates it again.

The table below summarises primary function of each of the components of a vehicle's lubrication system that should be checked on a regular basis.

Functions of a lubrication system	
Component	**Function**
Oil pump	Circulates oil to the crankshaft, camshaft, rockers, timing gears, valves and pistons. On some four-wheel drive and heavy vehicles, a separate system lubricates the chassis.
Oil filter	Cleans the oil as it circulates around the engine.
Oil pressure warning light	Indicates when oil pressure is too low.
Sump	Serves as an oil reservoir for draining and collecting oil within a motor vehicle engine.
Turbo lubricator	Supplies oil to the turbocharger bearings and eliminates bearing damage if there is an emergency engine shutdown.



Oil pressure gauge

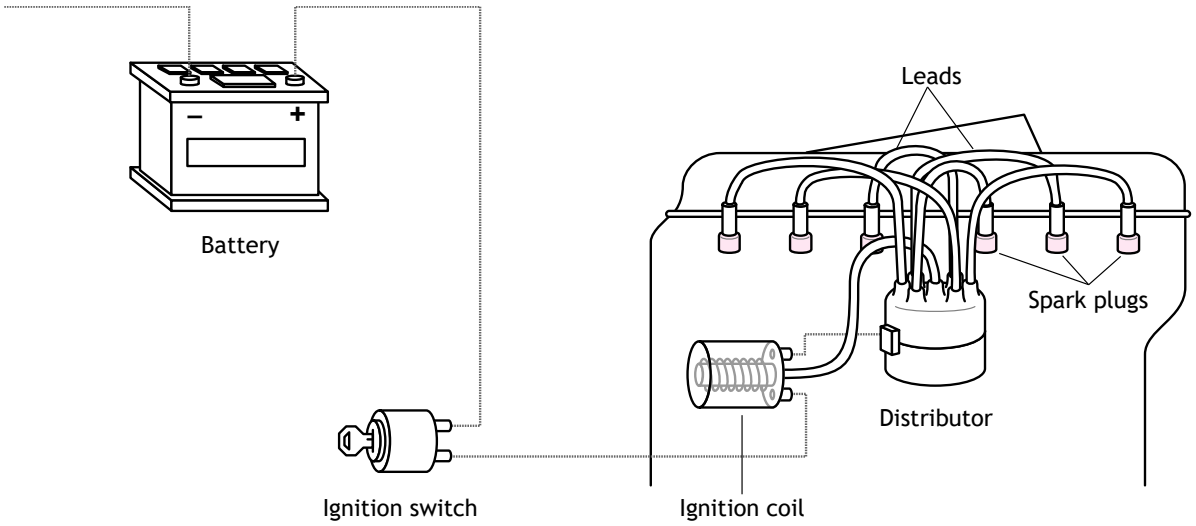


Drawing: Location of primary components of a vehicle's lubrication system.

4. Ignition

An ignition system ignites the air/fuel mixture in the combustion chamber of a petrol engine and so provides the force which drives the pistons. The downward force of the pistons turns the crankshaft which provides the rotary motion to the transmission and hence to the wheels.

Primary components of a vehicle's ignition system	
Component	**Function**
Battery	Stores and supplies electrical power to the system.
Ignition coil	Supplies pulses of high voltage current to the distributor.
Distributor	Distributes the pulses of high voltage current to the right cylinder at the right time.
Leads	Connect the coil to the distributor and spark plugs.
Spark plugs	Ignite the air/fuel mixture in the cylinders.

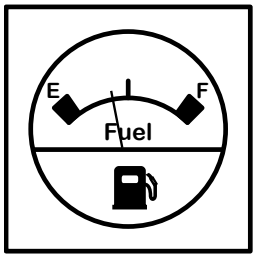


Drawing: Location of components in an ignition system.

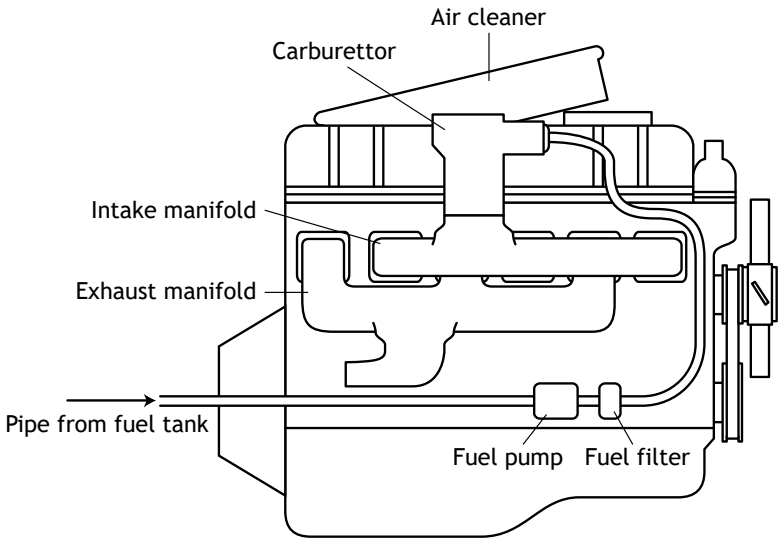
5. Electrical ignition

The table below outlines the primary function of each of the components of the electrical ignition fuel system of a petrol-powered vehicle that should be checked on a regular basis. Figure 5 shows where most of the components are located in the electrical ignition fuel system.

Primary components of the fuel system of a vehicle with electronic ignition	
Component	**Function**
Air cleaner	Removes dust from the air being drawn into the carburettor.
Carburettor	Controls the air/fuel ratio that feeds the engine. This mixture forms a combustible vapour.
Fuel injection	An alternative system to the carburettor; a computer chip that monitors engine systems and requirements to adjust the fuel flow to match.
Intake manifold	Passes the air/fuel mixture from the carburettor or fuel injector to the combustion chambers.
Exhaust manifold	Passes burnt gases from the cylinders into the exhaust system.
Fuel filter	Strains and suspends any impurities from the fuel system before they reach the engine.
Fuel gauge	Indicates the amount of petrol in the tank.
Fuel pump	Pumps petrol from the tank to the carburettor or fuel injector.
Fuel tank	Stores petrol.
Tank cap	Prevents fuel spills and stops foreign matter from entering the tank.



Fuel gauge

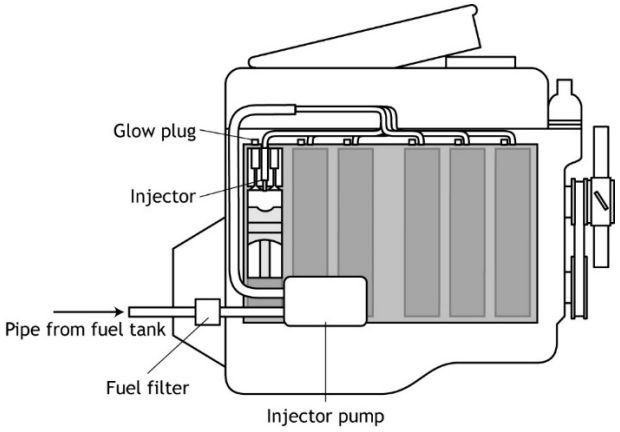


Drawing: Location of components of an electrical ignition fuel system.

6. Compression ignition

In a diesel engine, the fuel injectors spray fuel into each combustion chamber as the piston completes the compression stroke and the air inside the cylinder is at maximum compression. The high pressure makes the air extremely hot. At the moment of maximum compression, diesel fuel is pushed at high pressure through an injector by the injector pump and is sprayed as a vapour into the cylinder. There is no need for a spark from a spark plug, as the super-compressed air is already hot enough to combust the fuel. Diesel engines have no carburettor to make an air/fuel mixture, as the combustion cylinder is fed air and fuel separately.

Primary functions of the fuel system of a vehicle with compression ignition	
Component	**Function**
Fuel filter	Strains and suspends any impurities from the fuel before they reach the engine.
Glow plug	Pre-heats air for easier cold starting (in some engines).
Injector	Injects and vaporises fuel into the combustion chambers.
Injector pump	Pumps high pressure fuel to the injectors.



Drawing: Location of components in a compression ignition fuel system.

Fuel

The fuel system regulates the air/fuel mixture in the engine. Pressing the accelerator down delivers more air/fuel mixture to the engine and provides greater power.

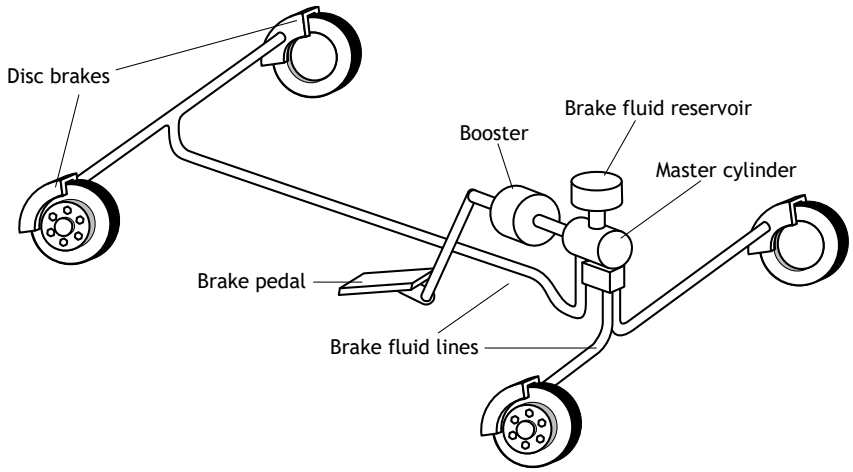
Braking

Once a vehicle is moving, it requires a braking system to slow it down or to bring the vehicle to a stop. There are two basic types, hydraulic (the name relates to how fluids behave), which uses fluid to transfer pressure to the brakes; and air, which uses compressed air to activate the brakes.

Hydraulic brakes

A hydraulic brake system has a master cylinder that is activated by the foot brake pedal. When pressure is applied to the brake pedal, the master cylinder pressurises hydraulic fluid via brake fluid lines connected to cylinders at each wheel. These cylinders press the brake linings or pads against the brake drums or discs. Harder application to the brake pedal will cause greater pressure to be applied to each brake cylinder via the brake fluid. This will result in speed reduction.

Primary function of components in a vehicle's hydraulic brake system	
Component	**Function**
Brake pedal	Applies pressure to the master cylinder.
Booster	In a power brake system, vacuum provides added thrust which reduces the amount of pressure needed on the pedal.
Master cylinder	Applies hydraulic pressure via the brake fluid lines to the wheel cylinders.
Brake fluid line	Contains fluid to carry hydraulic pressure to the wheel cylinders.
Brake fluid	High boiling-point hydraulic liquid which transmits hydraulic pressure from the master cylinder to the wheel cylinders.
Brake fluid reservoir	Stores brake fluid.
Brake lining/pad	Forced by wheel cylinders against the wheel drum or disc.
Park brake	Provides braking for a stationary vehicle.
Warning light	Indicates fault within the brake system.
Disc brake	Type of braking system in which a steel or iron disc is squeezed between 2 brake pads.



Drawing: Location of components in a hydraulic braking system.

Air brakes

Foot brakes

Applying pressure to the foot brake pedal opens a valve that releases compressed air from the compressed air reservoir. The air reaches the brakes through the air lines and forces the brake shoes onto the drums.

Harder brake pedal application results in more air being released from the compressed air reservoir and thus more pressure being applied on the brake shoes.

Air is supplied to the brakes via a proportioning valve. This valve not only supplies air to the system, but it also regulates how much air goes to each axle group.

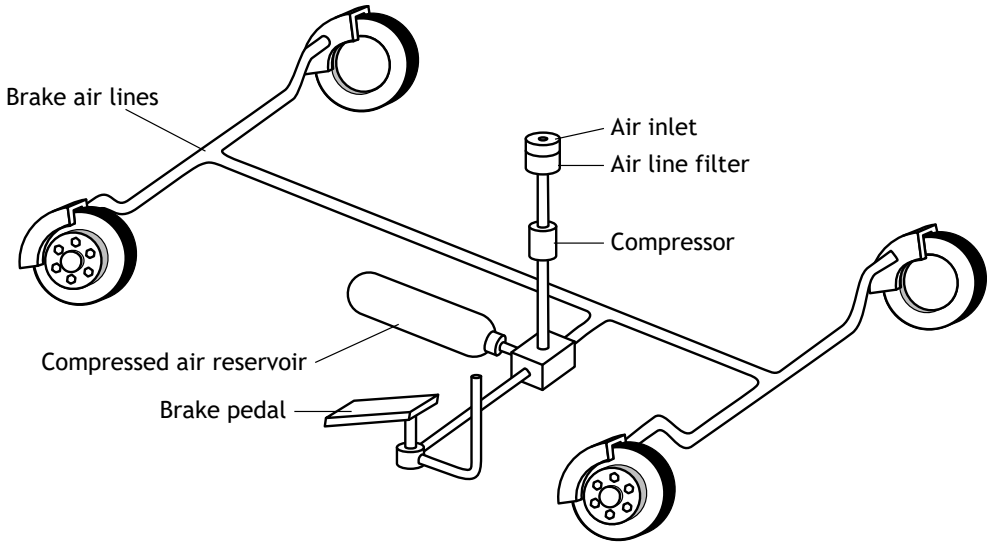
Air brakes feel different from hydraulic brakes. After application of pressure to the brake pedal, there is a short delay for air to reach the brakes. At 60 km/h your vehicle will travel approximately 17 metres from when you begin to push the pedal until the brakes start to work, and then it will take more time to stop. In consequence, it is necessary to anticipate traffic and road conditions ahead.

Spring brakes

Spring brakes, often referred to as parking brakes or emergency brakes) are connected to the brake shoes and are held back by air pressure. When the air pressure is removed by applying the spring brake control, or when there is a series loss of air due to an air leak, the spring forces the shoes onto the drums.

The first diagram on the following page shows the primary function of each component of a vehicle's air brake system that require checking on a regular basis. The second diagram shows where most of the components are located.

Primary components of an air brake system	
Component	**Function**
Brake pedal	Releases compressed air into the brake air lines.
Brake air line	Carries compressed air between components.
Air inlet	Entry point for air.
Air dryer	Removes moisture from the air brake system.
Airline filter	Removes dust from the system.
Compressor	Compresses air to supply pressure for the system.
Air reservoir	Stores compressed air.
Brake lining/pad	Forced by the wheel cylinder against the brake drum or disc.
Park brake	Provides braking for a stationary vehicle.
Pressure gauge	Indicates air pressure in the system.
Warning light	Indicates fault within the brake system.



Drawing: Location of components in an air braking system.

Drive-line

The drive-line system is the propulsion arrangement that enables the driver to vary the speed, direction (forwards or backwards) and power of a vehicle. This includes the engine, transmission (manual gearbox or automatic), transfer case, drive shaft/s and differential/s.

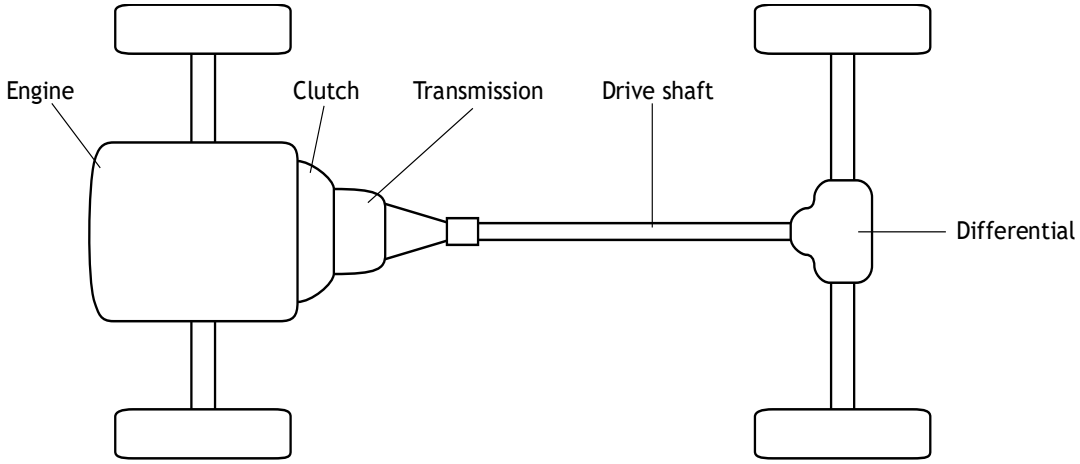
A vehicle fitted with a manual transmission has a series of gears (the gearbox) that are engaged or disengaged by means of a gear lever, using a clutch. As already mentioned, the gears enable you to vary the vehicle's speed according to its load, road and traffic conditions and gradient. A vehicle equipped with automatic transmission receives its power through a fluid coupling (the torque converter) that works automatically and serves the same purpose as the clutch. The transmission responds to the way the driver sets the drive selector and presses the accelerator. It also reacts to the engine load, depending on the gradient and vehicle mass.

A transfer case, if fitted, enables you to select two or four-wheel drive and to vary the gearbox ratios for on or off-road use.

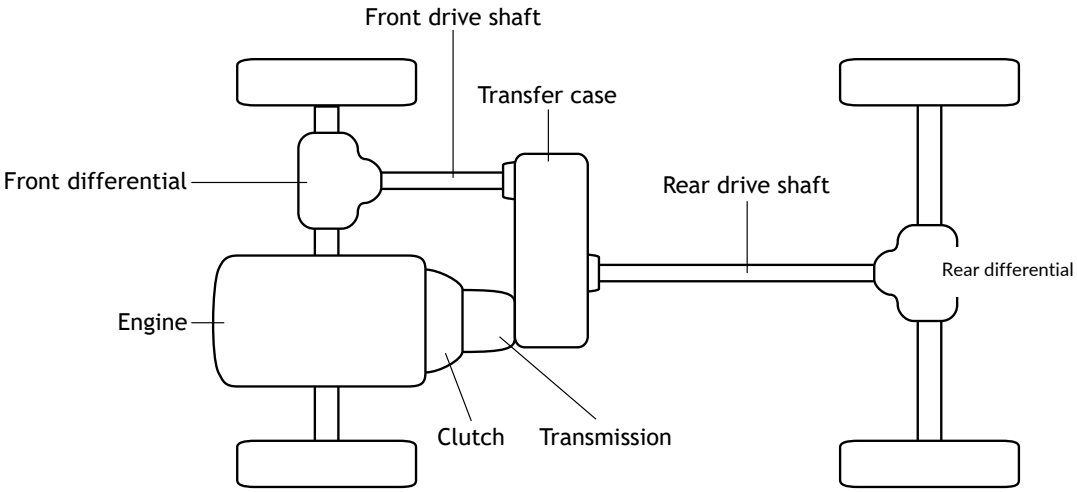
The differential is mounted on a driven axle between the wheels. Its purpose is to permit different speeds in each wheel when the vehicle is cornering.

In a conventional vehicle, power is provided from the engine via a series of shafts to the front or rear axle. A four-wheel drive (4WD) vehicle has a transfer case that enables the driver to transfer power to both the front and rear axles and to engage various ranges when negotiating difficult terrain or soft surfaces.

Primary components of a vehicle's drive-line	
Component	**Function**
Clutch	Disconnects drive from the engine to the transmission to allow gear shifting and provides a means of smoothly and gradually moving a vehicle from rest.
Torque converter	A fluid filled clutch-type assembly used in automatic transmissions to transfer the torque (twisting force) of the engine to the transmission.
Constant velocity joint	Enables a wheel to be driven under power and, at the same time, to be steered left or right.
Differential	Transfers power from the drive shaft to the axles and allows for the different rotation speeds of each wheel.
Drive shaft	Transfers power from the gearbox to the differential.
Engine	Provides the power that moves the vehicle.
Transfer case	Transfers power to the front axle in a 4WD vehicle and provides various ranges.
Transmission	Provides a range of ratios between engine revolutions and drive shaft revolutions which enables a driver to vary the vehicle speed according to load, road and traffic conditions, and gradient.



Drawing: Location of components in a drive-line system of a 2WD.



Drawing: Location of components in a drive-line system of a 4WD vehicle.

Summary

There are 7 support systems in a vehicle; each of which contributes to its effective operation. They are:

1.	**Electrical**	The cooling system uses water or other liquid coolants flowing through, or air flowing around, the engine to remove excess heat generated by combustion in the engine.
2.	**Cooling**	The cooling system uses water or other liquid coolants flowing through, or air flowing around, the engine to remove excess heat generated by combustion in the engine.
3.	**Lubrication**	An oil-based lubrication system reduces friction wear in the engine.

4.	**Ignition**	An ignition system ignites the fuel/air mixture in a petrol engine and so provides the combustion in the combustion chamber which drives the pistons. The petrol engine is an electrical ignition fuel system. The diesel engine is a compression ignition fuel system.
5.	**Fuel**	The fuel system regulates the air/fuel mixture in the engine. Pressing the accelerator down delivers more air/fuel mixture to the engine and provides greater power.
6.	**Braking**	There are 2 basic types of braking systems: hydraulic and air.
7.	**Drive-line**	The drive-line system is the propulsion arrangement that enables the driver to vary the speed, direction (forwards or backwards) and power of a vehicle.

PART 1 - Self-Assessment

7. **Why is it important as a driver to be familiar with your vehicle's support systems?**
8. **What are the 7 support systems found in a vehicle and explain how each contributes to its smooth operation?**
9. **List and explain the principal components of any 3 of the 7 support systems. Select the 3 that you are least familiar with.**
10. **What type of ignition fuel systems do petrol and diesel engines have?**
11. **How is the fuel ignited in a diesel engine?**
12. **How does a manual transmission differ from an automatic transmission?**

PART 2 –Vehicle checks and drills

The content in this section and the information on vehicle support systems from the previous section will help you to prepare a vehicle for driving and to carry out a test run. This section includes information about:

- raising and lowering a forward-control vehicle's cabin
- carrying out a pre-use check
- conducting a pre-drive drill
- carrying out a test run
- parking and securing the vehicle.

Preparing a vehicle for driving

Cabin raising and lowering

When conducting maintenance checks on many forward-control vehicles, you will need to raise the cabin to gain access to the engine. For safety reasons, it is important that you carry out this procedure with a colleague to minimise the risk of injury to yourself or damage to the cabin.

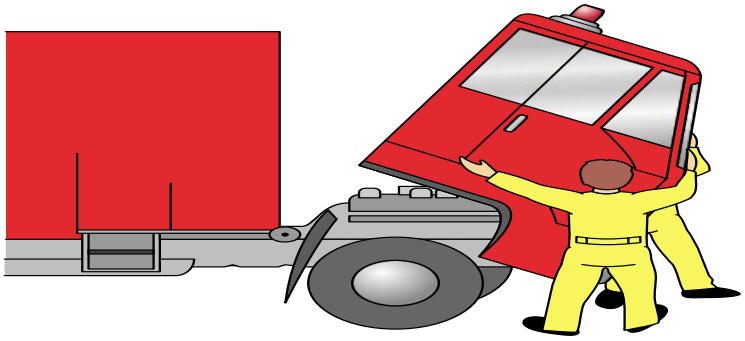


Image: Raising the cabin with 2 people.

Guidelines for cabin raising	Guidelines for cabin lowering
• **Do not** raise in excessive wind conditions. • Where possible, ensure vehicle is on level ground. • Apply park brake. • Check clearance for cabin movement. • Ensure that everyone not involved in the procedure is clear of the area. • Remove ladder if necessary. • Secure loose items in cabin. • Disengage the locking mechanism. This may vary from vehicle to vehicle, and you should check the information in your vehicle handbook.	• Ensure all tools or rags are removed from the engine bay. • Check that people not involved in the procedure are clear of the area. • Check clearance for cabin movement. • Release safety stays. • Lower cabin. • Engage locking mechanism. • Replace ladder if appropriate. • Secure bulbar or brush bar if appropriate. • Recheck that securing procedures have been carried out.

• Check doors are closed. • Disengage bulbar or brush bar if applicable. • Raise cabin (preferably using two people). • Secure the safety stays before carrying out under-cabin checks. A safety stay is a metal rod or bracket which, when locked in place, ensures that the cabin cannot be lowered.	

Pre-use vehicle inspection (preliminary check)

At the change of shift a check must be conducted on all vehicles to ensure that the vehicle is roadworthy, will perform reliably and is fully equipped to handle the assigned task.

A useful way of doing this is to undertake a pre-use check. A pre-use check is an inspection (using a checklist) that is carried out at the change of each shift to ensure its road worthiness and effective operation.

It is important that you carry out pre-use checks conscientiously as your life and that of your crew may depend on how thoroughly your pre-use checks have been performed. Remember: 'If in doubt – check it out!'

NOTE

You will need to refer to vehicle manufacturers' manuals and to relevant organisational policies and procedures to help you conduct pre-use checks on your vehicle.

The following is a typical pre-use checklist for a vehicle. It covers external and internal checks.

NOTE

Some checks require the vehicle to be started in order to avoid draining the battery.

Vehicle pre-use checklist
EXTERNAL checks should include:
Wheels: ☐ tyres and treads, (including spare), are roadworthy (visual) ☐ wheel nut tension is adjusted according to organisation procedure ☐ correct air pressure in tyres (including spare) ☐ no objects between rear dual wheels

Vehicle pre-use checklist (continued)
All reservoirs within operational levels: ☐ clutch reservoir ☐ brake reservoir ☐ engine oil ☐ hydraulic fluid ☐ automatic transmission oil ☐ radiator header tank ☐ windscreen washer reservoir ☐ power steering reservoir
☐ windscreen is clean and undamaged
☐ no paint and panel damage
☐ locker catches are secure
☐ water tank is full (if fitted)
☐ foam tank is full (if fitted)
☐ rear vision mirrors are clean and undamaged
☐ all firefighting equipment is present and secure
☐ ground checks for fluid leaks (oil, water, coolant and other)
☐ No loose cables and hoses
Drive belts within operational limits for: ☐ wear ☐ tension
Engine air cleaner ☐ indicator gauge (if fitted) within limits ☐ pre-cleaner is clean
Battery ☐ electrolyte level correct ☐ tightness and condition of terminals (lubricate with petroleum jelly if required) ☐ secure in mounting tray
All ancillary equipment present and operational ☐ jack and associated equipment ☐ shovel ☐ bolt cutters ☐ wheel chains ☐ axe ☐ jumper leads ☐ wire slings/tow ropes and cables ☐ first-aid equipment ☐ torch

Vehicle pre-use checklist (continued)
Wheels: ☐ tyres and treads, (including spare), are roadworthy (visual) ☐ wheel nut tension is adjusted according to organisation procedure ☐ correct air pressure in tyres (including spare) ☐ no objects between rear dual wheels
Lights are operational: ☐ headlights ☐ fog lamps ☐ tail lights ☐ stop lights ☐ turn indicators ☐ number plate light ☐ reversing lights ☐ hazard lights ☐ clearance lights (those fitted to the cabin, bodywork and possibly the rear vision mirrors to alert other drivers to the vehicle's size) ☐ warning beacons
All reservoirs within operational levels: ☐ clutch reservoir ☐ brake reservoir ☐ engine oil ☐ hydraulic fluid ☐ automatic transmission oil ☐ radiator header tank ☐ windscreen washer reservoir ☐ power steering reservoir
☐ windscreen is clean and undamaged
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All ancillary equipment present and operational ☐ jack and associated equipment ☐ shovel ☐ bolt cutters ☐ wheel chains ☐ axe ☐ jumper leads ☐ wire slings/tow ropes and cables ☐ first-aid equipment ☐ torch
Log book-SMS ☐ consult log for previous use, check distance recorded in log against odometer reading
Warning devices are operational ☐ warning beacons ☐ audible warning devices
Communication equipment operational ☐ radio ☐ external speaker ☐ crew intercom
☐ upholstery undamaged
☐ fuel tank level is more than ¾ full
☐ no excess play (looseness) in steering wheel
☐ steering lock secure
☐ no excess brake pedal play
☐ no excess clutch pedal play
☐ wipers and washer operational
☐ interior lights are working

Vehicle pre-use checklist (continued)
☐ seat belts undamaged and operational
☐ fully equipped first-aid kit in cabin
☐ On completion of the pre-use checklist, complete the NTFRS Vehicle Inventory Form.
☐ Any vehicle faults are to be noted in the vehicle log book and the Station Officer (SO) is to be informed.

Cabin and pre-drive drill

A pre-drive drill is a list of checks that must be carried out each time a driver enters the cabin prior to starting a vehicle. The cabin and pre-drive drills that must be conducted are listed in the table below.

Pre-drive checks:
☐ locate and become familiar with all gauges and instruments
☐ locate and become familiar with all levers and switches
☐ ensure adequate fuel for journey – note: ensure correct fuel is used when refuelling
☐ become familiar with transmission layout
☐ secure all loose objects in cabin
☐ close all doors
☐ place seat in correct position
☐ adjust rear vision mirrors
☐ adjust steering wheel
☐ ensure all crew seat belts are fastened and correctly adjusted
☐ ensure that the vehicle is started in accordance with the manufactures specifications
☐ check that all instrument readings are within operational limits and that there are no unusual noises (after start-up)
☐ fully equipped first-aid kit in cabin
☐ On completion of the pre-use checklist, complete the NTFRS Vehicle Inventory Form.
☐ Any vehicle faults are to be noted in the vehicle logbook and the SO is to be informed.

To complete the pre-drive drill, it is important to familiarise yourself with the function of the gauges and instruments in the vehicle, e.g. the speedometer, tachometer, fuel gauge, ammeter, temperature gauge, oil pressure gauge and warning lights. These give you an indication that the vehicle is operating correctly or can provide an early warning that a faulty or unsafe condition is developing.

NOTE

The frequency of the pre-use checks and pre-drive drills will be detailed in the manufacturer's manual and your organisational procedures. These procedures must be followed. You will need to refer to vehicle manufacturers' manuals and to relevant organisational policies and procedures to help you conduct pre-use checks on your vehicle.

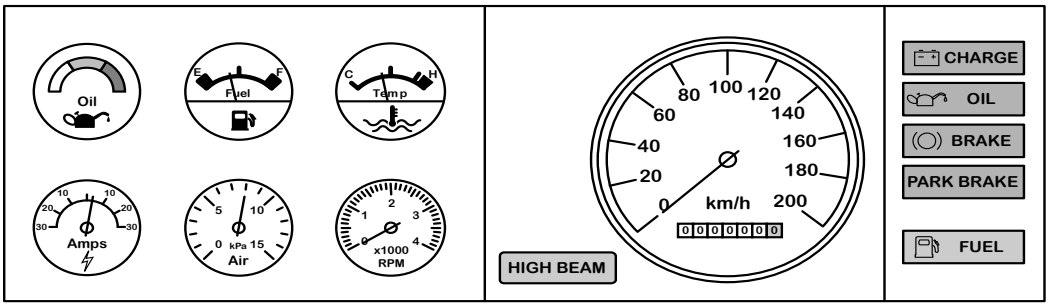


Image: A typical vehicle instrument panel.

Test run

As a driver, your primary responsibilities are the safety of the crew travelling in the vehicle, the safety of other road users, the safety of the general public and property; and, also to ensure that the vehicle itself is appropriately used.

An important way of achieving this is to road test each emergency response vehicle regularly. Your organisation will have specific requirements and you should check what they are. Depending on the vehicle's frequency of use, your organisation may require that the vehicle is test-run a nominated minimum distance each day or week.

In some cases, where the response requirements are fairly low, an organisation may require that its vehicles travel a minimum distance per week, say at least 30 kilometres. The road test is critical because it enables you to conduct checks on mechanical components during actual driving conditions and to assess if there are any problems with the vehicle.

NOTE

- Always start your engine as per the manufacturer's instructions.
- The manual should be stored in the glove compartment.

Test Run Checks:
☐ oil pressure is within operational limits
☐ gauges are reading normal
Engine operation: ☐ is smooth ☐ has no unusual sounds
☐ foot brake is effective when: ☐ tested in a safe area ☐ tested during both forward and reverse movements
☐ park brake is functioning correctly
☐ steering is correct with no evidence of under or oversteer
Transmission: ☐ is smooth ☐ has no unusual sounds

NOTE

Vehicles with a low air pressure are not to be left unattended or moved until a satisfactory air pressure is achieved.

Vehicle maintenance log-SMS

A vehicle maintenance log is used to record checks and drills and the results of your test run. It also has provision for reporting mechanical problems with the vehicle. Some organisations may combine the maintenance log with a vehicle logbook.

Writing up a fault in a log does not excuse you from ensuring that the vehicle is capable of performing reliably and safely the next time it is required. Your organisation will have specific procedures for dealing with a vehicle that is not performing properly. In some cases, it may be necessary for the vehicle to be taken out of service.

Parking and securing a vehicle

The parking and securing of an emergency vehicle can present quite different problems from those encountered with your own vehicle. As the driver, it is your responsibility to ensure that the vehicle is locked and secure before leaving it unattended. Any load and loose items must be secured against theft, vandalism and unauthorised entry and use.

It is likely that you were tested about road signs and parking regulations that apply in your state or territory when you undertook your driving licence test. Regulations do change however, and if it has been some time since you last checked them, it may be appropriate to use a traffic handbook to review the regulations.

Familiar regulatory signs include 'no parking' or 'no standing', 'keep clear', 'restricted zone', 'clearway' and specific areas. Failure to comply with these signs will result in a penalty.

Some of the parking regulations which you may need to check relate to:

• double parking • intersections • freeways • lanes or driveways • narrow roads or bridges • wrong side of the road • footpaths or reservations • unbroken double white lines • traffic lights	• bus stops • children's crossings • railway crossings • tram or light railway reservations and stops • safety zones or traffic islands • pedestrian crossings • letter boxes • fire hydrants

In addition, there are locations where parking is legal but unsuitable, especially if you are driving a large vehicle. Always park in a position which:

- allows personnel to safely exit from the vehicle
- is on stable ground
- allows clearance for other road users
- provides easy access to the vehicle
- allows for easy exit when called to an incident
- does not obscure the vision of other road users:
    - at bends
    - at intersections
    - at crests of hills.

NOTE

- If the vehicle is parked at the workplace, leave the ignition and door keys in a location designated by your organisational procedures.
- Some NTFRS vehicles ignition keys do not unlock the doors).

Summary

- In many forward-control vehicles, the cabin needs to be raised to allow access to the engine.
- A pre-use check is a series of inspections (using a checklist) that are carried out, at least once each day a vehicle is used, to ensure its road worthiness and effective operation.
- At the commencement of each shift you need to check a vehicle to ensure that it:
    - is roadworthy
    - is fully equipped to handle the assigned task
    - will perform reliably.

- A pre-drive drill is a list of checks that must be carried out each time a driver enters the cabin prior to starting the vehicle.
- Before parking a vehicle, ensure that the parking location is both legal and suitable.
- When parked, vehicles must be secured as required by your organisation's procedures.

PART 2 - Self-Assessment

1. **What is the purpose of the safety stay on a forward-control vehicle?**
2. **Why does a driver need to regularly undertake a pre-use check of a vehicle?**
3. **What is a pre-drive drill?**
4. **How do the gauges and instruments in the vehicle assist you?**
5. **What is the purpose of a vehicle maintenance log?**
6. **What are the guidelines for securing a vehicle before leaving it unattended?**

PART 3 – Defensive driving

Defensive driving is about driving in a manner which prevents accidents from occurring despite the actions of other road users. It also involves driving a vehicle safely in adverse road or weather conditions. This section includes information about:

- safety while driving or being a passenger in a vehicle
- steering
- the Smith system
- communication with other road users
- driver limitations
- vehicle operation
- braking
- vehicle monitoring
- manoeuvring with a guide
- convoy driving.

Emergency response personnel are often required to drive under a range of hazardous conditions. Knowing how to drive your vehicle safely will minimise the potential for injury to yourself and other road users. To be an effective defensive driver you need to:

- have a commitment to safe, non-aggressive driving
- have knowledge of defensive driving techniques
- remain calm
- always concentrate on the task of safe driving
- obey road rules
- have knowledge of the Smith system of vehicle control, or a similar system.

Causes of accidents

The major factors that have contributed to fatal crashes in Australia for 1996 are a combination of 3 elements:

1. Human error, such as speed, alcohol, fatigue, inattention, or misinterpretation of signs or signals.
2. Environmental factors, such as heavy rain, fog, or smoke.
3. Poor vehicle condition, such as a lack of headlight or windscreen wipers.

Seat belts

Road traffic authorities in Australia and internationally recognise the importance of seat belts and have legislated accordingly to ensure that drivers and their passengers wear them. Even though legislation of this type has been in place for many years, each year hundreds of drivers and passengers are needlessly killed or injured because of failing to wear an appropriate restraint. Unfortunately, many individuals who wear the proper restraint when undertaking long journeys fail to do so when travelling only a short distance.

'Statistics indicate that most road crashes occur within 10 km of home.' Failure to wear a seat belt when travelling in a vehicle endangers not only the individual, but any accompanying passengers. 'An unrestrained passenger in a crash is a lethal missile capable of injuring others in a car'.

The benefits of wearing seatbelts are clear. Statistics show that the use of seat belts significantly reduces fatalities and serious injuries. **Do not** be complacent when driving or travelling in a vehicle. Even when travelling slowly in a car, failure to wear a seat belt can be highly dangerous. 'A crash at 40km/h into a brick wall is the same as falling from a 2-storey building onto concrete. Even in a low speed crash or a sudden stop, injuries can be severe.

"If you're not wearing a seat belt, what's stopping you?"
Vic Roads, Seat Belts. June 1992.

Loose objects

As drivers and passengers need a proper restraint in vehicles, so should equipment, hard objects and breakables be firmly secured in a vehicle. Be aware that in a front-end collision, objects on the rear window shelf or on the rear seat will fly forward and may seriously injure you or other passengers in the vehicle. When possible, any loose object in the vehicle should be firmly packed away to prevent it from becoming a hazard in an accident. In station wagons either a barrier or cargo restraint mesh should be fitted.

Head restraints

Head restraints provide valuable protection against neck whiplash, particularly in the event of a rear-end collision. Your head restraint should be adjusted to protect the back of your skull. Set it correctly to minimise injury in the event of a collision. If set too low, it can cause violent whiplash; if too high, it will offer no protection.

Accidents involving NTFRS vehicles

All NTFRS employees involved in a motor vehicle crash/incident are to comply with the NTPFES Fleet policy found at NTPFES Intranet.

1) A crash in which an NTPFES vehicle is involved is to be reported to the Joint Emergency Service Communications Centre (JESSC) who will contact the Territory Duty Superintendent as per NTPF Police Practice and Procedure – Crashes Departmental. JESSC is to advise the NTFRS Watch Commander NTFRS Territory Duty Officer of any crash involving a NTFRS vehicle

2) In the case where a civilian employee is involved in the crash, the COO, BOSS is also to be notified

3) The Fleet Manager is to be notified within 24 hours, or the next working day if damage occurs on a weekend, of any damage to an NTPFES vehicle

4) Once released from the crash scene, regardless of the extent of damage, the vehicle is to be presented at the Fleet Mechanical Workshop in either Darwin or Alice Springs to have a damage assessment completed. Vehicles outside of these centers are to send photos of the damage to FMS to enable a repair plan to be established. A PF134 (Vehicle Accident Report Form) is to be commenced at the scene and be completed before the end of shift. and forwarded to FMS via the employee's chain of command. Vehicles are to be approved for repair prior to forwarding the form to FMS by ensuring that the Divisional Officer or equivalent has signed Part A of the form. Completed vehicle accident report forms will be retained and filed by the FMS. The flowchart at Appendix E details the PF134 Vehicle Accident Report Procedure

5) The driver of an NTPFES vehicle involved in a crash or a member investigating such a crash will not engage in argument or admit any liability to any other party or person

6) The NTPFES employee, if possible, or the investigating member is to ensure that any person who sustained injuries or possible injuries is treated or examined without delay

7) A crash involving an NTPFES vehicle is always to be the subject of a Crash Report. The incident is to be investigated by an appropriate investigating officer and a file submitted as soon as possible as per each agencies internal policy, for transmission to their Commissioned Officer, the Director NTFRS, Director NTES or COO BOSS. On receipt of such file the Director or Commissioned Officer is to forward it through normal channels with such comments or recommendations as are necessary.

Employee's using fleet vehicles are not covered for the following:

- drink or drug driving. Any employee involved in an incident and found guilty of driving under the influence of alcohol or other drugs or driving a vehicle without authorisation may be subject to investigation by Professional Standards Command and disciplinary action
- where the vehicle is used outside the terms of the authorisations provided for in this Policy; and
- where a vehicle is driven recklessly. Employees should be aware that action may be taken to recover the costs of the damage from the driver of the vehicle.

Pull push steering

One of the main requirements in the proper control of a motor vehicle is to ensure that it is always in the right place on the road, what-ever the circumstances. Obviously this is done by the driver's ability to steer accurately and safely. In order to do this any deviations from the straight course can be made by following the under-mentioned guiding principles:

- The hand on that side of the wheel corresponding to the turn to be made should pull down on the wheel from a high position.
- The other hand should allow the wheel rim to slide through it, or, if the turn is severe, it may drop to a low position ready to push upwards if necessary.

Such hand and arm movements alternately pulling down and pushing up may have to be repeated if the turn to be made is of a sharp 'hairpin' nature, or if the car has particularly low-geared steering.

Having turned the vehicle sufficiently, it must be straightened again or it will continue in a circular path. Accordingly, the steering wheel should be fed back by hand movements similar to those previously mentioned, but in the reverse direction. The steering on most vehicles has an automatic self-straightening action; on some, this may be quite powerful and restraint will have to be exercised on the wheel to prevent the car straightening up too soon.

By the methods previously mentioned, steering into a turn and out again will be accomplished either slowly or quickly according to the road speed but in any case smoothly and progressively. The driver should note, from the description of the position of the hands and their movements on the steering wheel that each hand keeps to its own side of the wheel.

NOTE

When the car is being driven forward, neither hand should pass the 12 o'clock position.

'Pull-push' steering is favoured for four main reasons:

It provides a better sitting position:	The most common reason that drivers lose control of a vehicle in an emergency is that they move in their seats owing to poor positioning. Pull-push steering provides the best control during steering because the arms are always at the same height and the hands never cross to the opposite side of the wheel. This will also mean that the driver will experience less fatigue, especially when driving on a winding road.
It provides better grip:	It is natural to grip a vertical object with the thumb up rather than the little finger up. With pull-push steering, the thumb always remains up, unlike hand-over-hand or cross-arm. Pull-push steering is the only style that enables the driver to hold the wheel locked still while negotiating a bend. As one hand pulls the wheel into the bend, the other hand slides down the wheel to remain opposite. When sufficient steering is achieved, both hands hold the wheel still. With either cross-arm or hand-over-hand styles, one hand would now be above the other and both hands pulling in the same direction. This situation is not conducive to holding the wheel steady.
It is smoother:	It is easier to experience this fact than it is to describe it. When the technique has been mastered, try a turn in a car park or other area away from traffic; make the same turn at the same speed using hand-over-hand. It makes sense that pull-push will be smoother when you think about the hand action of the various styles of steering. Pull-push is a natural, symmetrical hand movement which allows easy passing of the wheel from one hand to the other at the top and bottom of each stroke.
It is the most efficient method of steering:	No other steering style consistently provides half a turn of the wheel for each hand movement. This means that you are able to move your hands slower on the wheel to provide the same amount of steering in the same time.

NOTE

It is understood that in driving there are other issues of more importance than steering, however new drivers have to learn some form of steering. Why not learn the best there at the outset? This means it won't be necessary to unlearn bad habits later.

Mistakes to watch for

1. Timing of the steering in or out. It is common for new drivers to wait until the vehicle has completed the turn before feeding the wheel back to straight. The earlier the feedback, the slower the wheel may be turned.
2. Hands not reaching to the top or the bottom of the wheel before changing grips.
3. Hands not staying the same height as one another.
4. Trying to move the hands too fast.

The Smith System

As the driver of a vehicle, you need to have some knowledge of defensive driving as you are responsible for your actions while in charge of the vehicle, the safety of your passengers, other road users and the safe operation of the vehicle in both stationary and mobile situations. The Smith System was invented by Harold Smith in 1952 to increase safety of commercial drivers and revolves around employing 5 rules when operating a motor vehicle. These 5 rules can dramatically reduce the risk of major accidents on both highways and roads.

A '***hazard***' in this context is defined as anything which might cause you to change course or alter speed, for example:

- an intersection
- a bend
- a hill crest
- vehicles overtaking pedestrians and cyclists
- road defects
- a road construction site
- any potentially dangerous traffic situation.

The Smith System is the basis on which the whole technique of good driving is built and its application requires skills that can only be acquired through practice. By implementing the Smith System of driving, you will anticipate and deal effectively with many of the traffic problems that other motorists find difficult.

Three golden rules

By the correct application of this system, the vehicle will at all times be:

1. in the right place on the road
2. travelling at the right speed
3. with the right gear engaged.

Driving plans

A really good driver will formulate their driving plans on the correct assessment of the ever changing scene ahead and to the rear of their vehicle. They should have a deliberate and calculating temperament, able to make driving decisions without hesitation in a methodical manner at any moment. All decisions must be based on the principle of safety for others as well as themselves.

Drivers must realise that these driving plans and decisions are made on a combination of:

- what they can see
- what they cannot see; and
- the possible circumstances which may reasonably be expected to develop.

Motoring conditions in Australia are such that a driver can rarely base their decisions solely on what they can see, because there are many stretches of road where the layout and traffic conditions do not permit an unobstructed view. The greatest difficulties arise from conditions in areas into which the driver cannot see, such as round bends and corners, behind trees and buildings, at places where roads converge, or where other traffic obstructs the view of the road beyond.

Five rules of the Smith System

1. Aim high

The first rule for this method is '**Aim high in steering'**. Staying alert of the dangers and traffic ahead not only avoids rear-end collisions, but also alerts other drivers behind your vehicle to slow down. The driver should steer and focus their attention high, so as to view the road as whole and not just a few feet ahead.

2. The big picture

'**Be aware of your surroundings at all times'** may seem obvious to say, but distracted drivers are just as dangerous as intoxicated ones. Erratic and angry drivers take up a large portion of the traffic we see daily, so avoid major accidents by noticing how other drivers behave on the road. Having the whole picture means that you are doing your part to keep your vehicle as safe as possible while moving 1000 ft a second. There are a variety of hazards between your own vehicle and other drivers, and a keen awareness of these dangers will reduce these risks.

3. Keep your eyes moving

The third standard of the Smith System asks drivers to **remain alert**. Energy drinks can only do so much before they cause the body to crash, and any repetitive motion sends us into a trance. Consistent eye movement prevents your body from entering the trance state, keeping you alert to every driving condition ahead of you.

4. Leave yourself an out

The fourth principle of the Smith System states to **leave yourself a way out**. This means ensure that other drivers do not box you in while selecting their lanes. Do not tailgate other vehicles too closely, and always anticipate other driver's moves.

5. Make sure they see you

The worst thing a driver can do is assume. Assume other drivers can see them, assume other drivers are not dangerous, or even assume that they will just get to their destination safely. The final rule for the Smith System is '**Make sure you are seen**'. This rule prevents accidents by removing assumptions made behind the wheel. As a driver, make sure that other drivers can see you and anticipate your move. If you feel you are coming into another driver's blind spot, use the horn to get their attention.

Quick tips to ensure your safety while driving

- **Listen and stay alert**: remain focused on the road at all times by not engaging in distracted driving. Use your mirrors to view oncoming vehicles. 16% of fatal crashes involve driver distraction.
- **Proceed with caution**: pull to the right side of the road and do so swiftly, but cautiously when approached by emergency vehicles.
- **Resume entry slowly**: use your turn signal! Slowly merge back onto the road or highway while checking your surroundings for others when re-entering roadways.

Stay vigilant, prepared, and remember to be a proactive driver. As a motorist, it is our responsibility to operate vehicles safely and in a sensible manner. Consider taking an online refresher driving course to stay current with law changes and best driving practices.

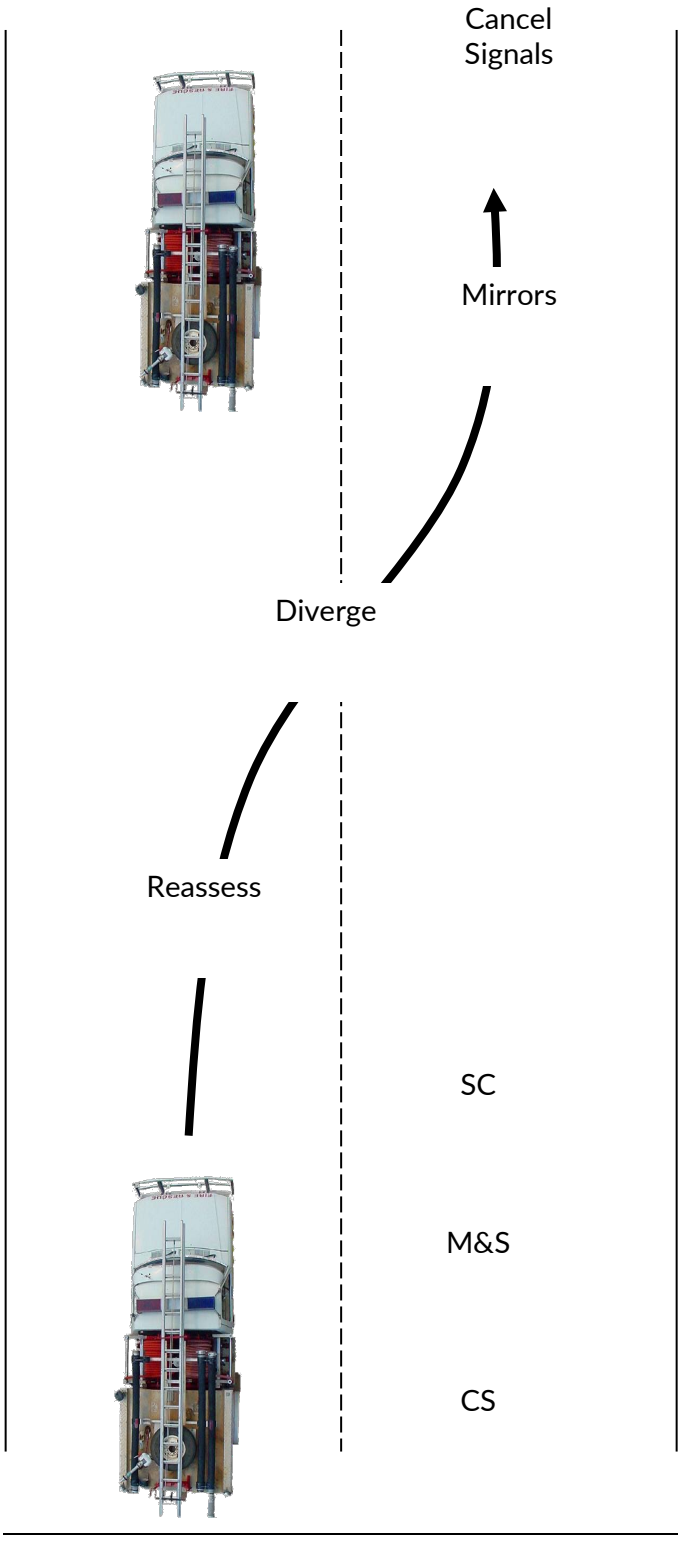
Changing lanes

This is simply an extension of the 'SVC' as it applies to making a lane change. While each feature of the entire system is considered, only some of them are used and they are used in their correct order as per the system. The difference here is the 'REASSESS' feature in which you again look to the front after having completed your shoulder check and ensure that the lane you wish to change into is still the best option open to you. If it is not you can then take whatever action is appropriate at the time or diverge into the lane you had planned on moving into.

Whilst conducting the first 5 of the system features your vehicle should remain in the lane in which you are currently travelling, not weaving about erratically as you check your mirrors and then carry out a shoulder check in order to check the blind spot. There is no need to turn your whole body to the left or right as the case may be, to carry out a shoulder check. You should only need to turn your head in the direction you wish to diverge and check over your shoulder that it is safe to proceed with your intended manoeuvre. Your vehicle should remain in your lane until you actually begin to diverge and should not start to move beforehand.

See diagram over page.

System of vehicle control as it relates to lane changes:



CS Course Select

MS = Mirrors and Signals

SC = Shoulder Check

Reassess = Look forward and reassess

Diverge = Change into chosen lane

Mirrors = Re-check mirrors

Cancel signals = Once fully within your chosen lane

Zones of visibility and invisibility

The type of vehicles you drive and the conditions under which they are driven means that there will always be areas around the vehicle where it is difficult to see clearly (the zone of invisibility). You must allow for zones of invisibility which may be present at intersections, on bends, or caused by moving, or parked vehicles. The design of a vehicle and driving at night can also create a zone of invisibility. When your vehicle gets close to any zone of invisibility, your position, speed and gear selection must be such that you are able to take one of 2 alternatives:

- slow down or stop to enable other road users to have free passage
- accelerate across and out of the zone of danger if satisfied that no other road user will be endangered or inconvenienced

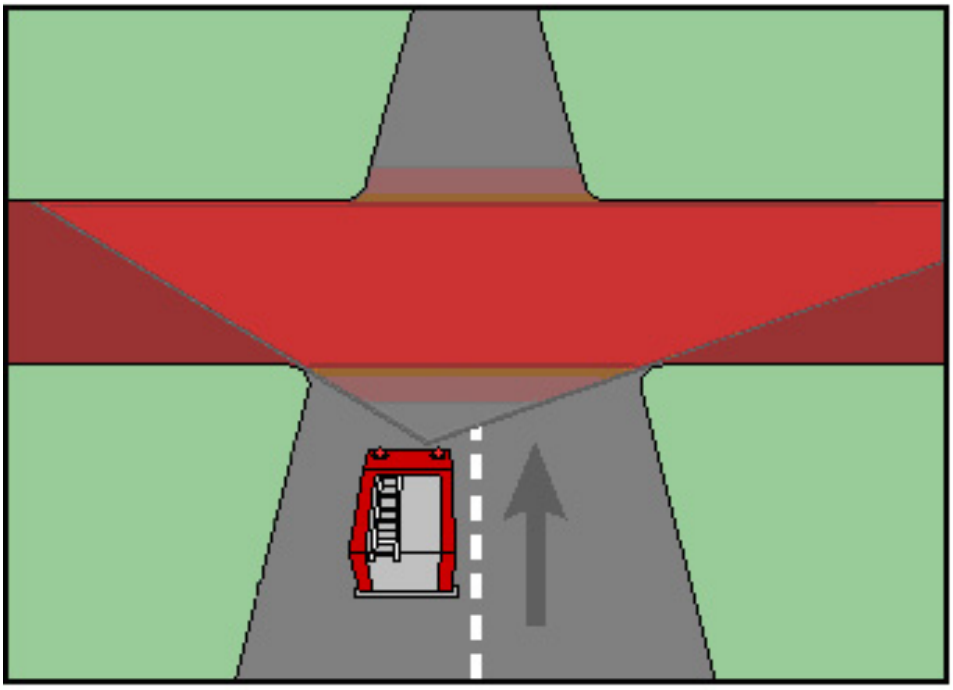


Diagram: Zones of visibility and invisibility at an intersection.

The diagram above shows an intersection in a suburban area. A driver approaching from the bottom of the diagram and intending to go straight ahead will become aware of the intersection in plenty of time and be able to prepare for any eventuality by applying the Smith System of vehicle control.

The shaded portion on the intersection may be referred to as the zone of danger for it is here that an accident may occur. The darker shaded areas in the converging roads are the zones of invisibility. At point **X** they have receded to a minimum and the zone of visibility is now reaching maximum size.

Zones of invisibility can also be caused by other vehicles (see diagram next page) and by the road shape, hedges, fences, or walls (see diagram next page).

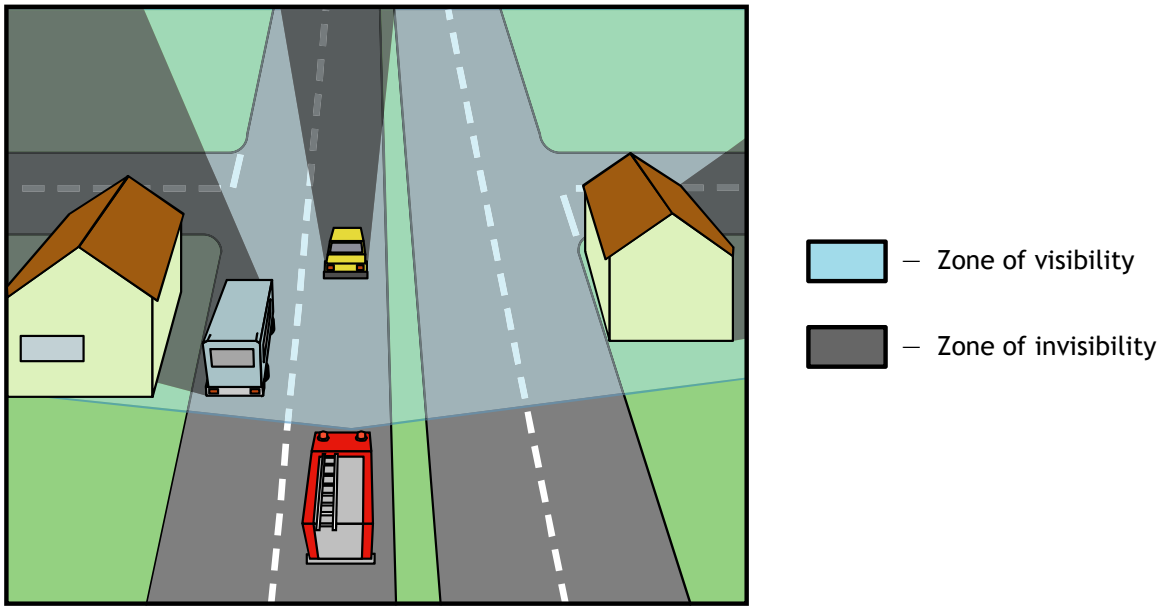


Diagram: Zones of visibility and invisibility involving other vehicles.

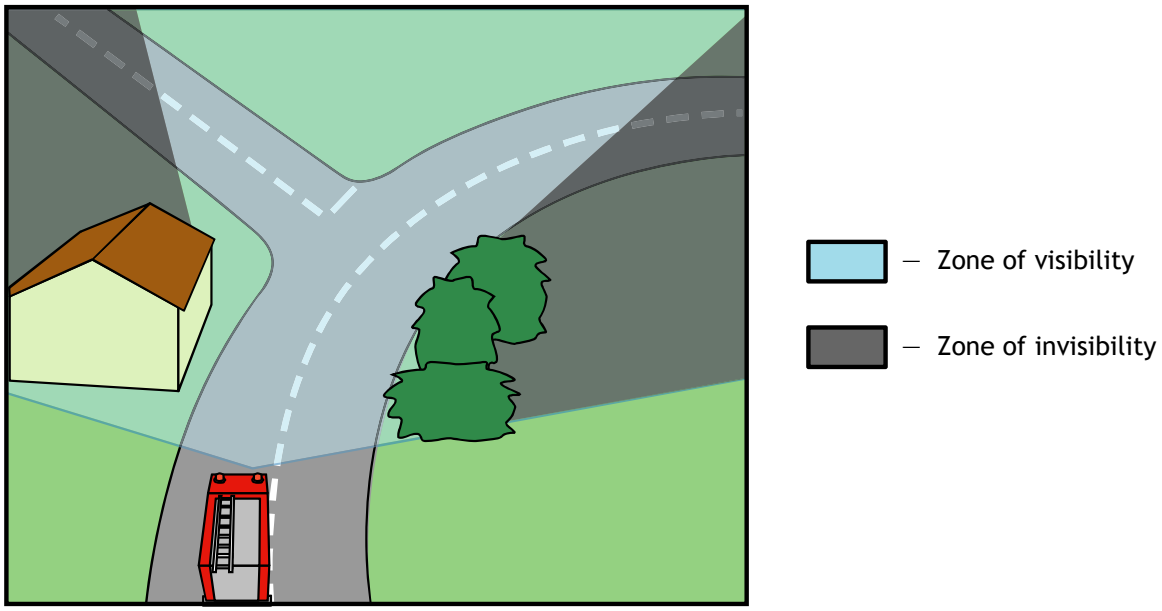


Diagram: Zones of visibility and invisibility involving obstacles and road shape.

Communication with other road users

You must make your intentions clear to other road users. You must make certain that your intended actions are communicated to them in sufficient time for them to respond. Successful communication depends on the fact that all lights, horns and signalling devices on your vehicle are in good working order. These devices are the primary means for direct communication with other drivers. Signal your intentions in a clear, unambiguous and timely way, neither not too soon nor too late. **Do not** rely entirely on others responding to your signals and to signals provided by other road users.

Signals

Turning signals and stop lights are the most common means of signalling. Caution should be taken when giving signals to following vehicles as the signal may have more than one meaning.

FOR EXAMPLE

The diverge and right turn signal are the same and may be confusing to the driver following, who may not know whether you are simply diverging right or about to make a right-hand turn into a street ahead.

It is also appropriate, on occasions, for a driver to give an appreciative signal in acknowledgment of a courteous action by another road user.

Signalling devices

Turning	Indicate intention to turn left or right, or to U-turn.
Stop lights	Indicate that brakes are currently being applied. By tapping the foot brake you can indicate your possible intention to brake.
Horn	Should be used only when necessary as a traffic warning.
Hazard lights	Indicate that a vehicle is stopped in an unusual or dangerous place due to a breakdown or accident.
Hand	Indicate your intention to turn or to stop.
Reversing	May be both visual and audible, operating automatically as soon as reverse is selected.

Driver limitations

Recognise your limitations as a driver. You should not exceed your current knowledge and skills because you will jeopardise the safety of yourself and others. Driver limitations include health and fitness and the ability to react in time. Drivers should always operate well within the vehicles and their own limitations. Other limiting factors are:

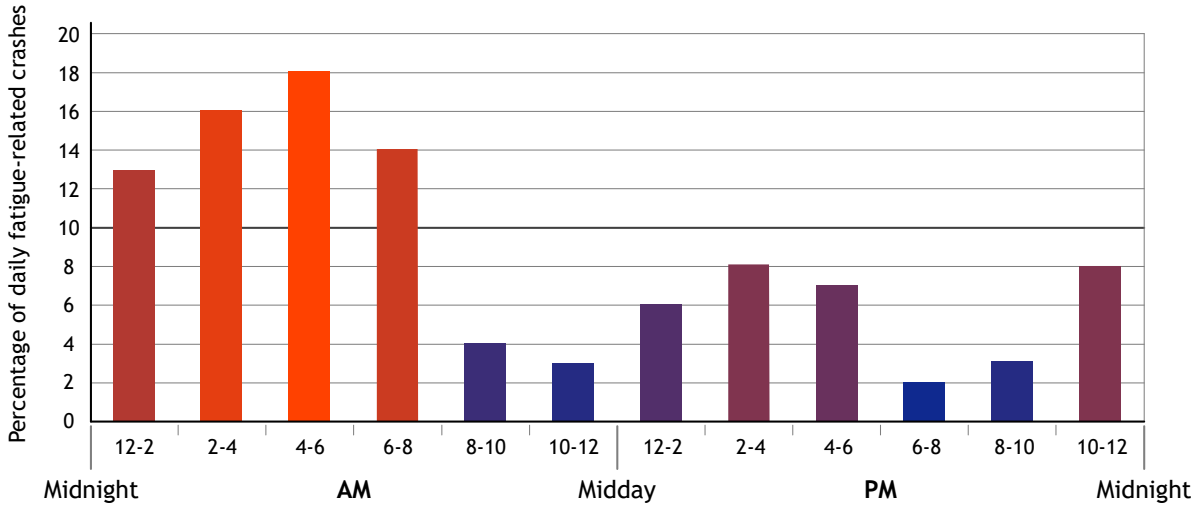
- state or territory regulations
- prevailing road and other conditions
- the driver's ability to concentrate at the time
- the condition of the vehicle
- other road users.

Driver fatigue

Driving an emergency response vehicle is both physically and mentally demanding. A driver must be in peak condition when in control of a vehicle. To maintain health and fitness, a driver should have a proper diet, an ongoing fitness or exercise program and appropriate periods of sleep. A fit and healthy driver will generally concentrate better and react faster. A fatigued driver is a potential risk on the road.

Fatigue is a major cause of serious road crashes in Australia. Crashes of this type seem to relate more to what drivers do before they set out than to the driving task itself, and one of the key contributions is a lack of sleep. A driver can experience fatigue on a long or short trip. Fatigue is a factor in around 25 per cent of crashes and in almost one-third of rural single vehicle crashes. Most fatigue-related crashes occur during normal sleeping hours.

The table below, compiled by the Federal Office of Road Safety in 1999, shows the highest proportion of fatigue-related crashes occur between four and six in the morning.



Times of day during which fatigue-related crashes occur
Source: Commonwealth Department of Transport and Regional Services, Federal Office of Road Safety, 1999.

Drivers do not often realise they are too tired to drive safely. It is only when the vehicle's left side wheels leave the bitumen and hit the gravel, or when the car veers over the centre-line that drivers realise they have lost concentration.

Signs of driver fatigue are:

- blurring and dimming of vision
- seeing things
- daydreaming and lack of concentration
- feeling impatient
- feeling hungry or thirsty
- sweaty hands
- slow reactions
- driving speed creeps up or down
- driving the vehicle over the centre-line or on the road's edge.

To avoid driver fatigue:

- restrict the hours of continuous driving
- share the driving
- **do not** travel for more than 8 to 10 hours in any one day
- allow a flow of fresh air into the vehicle as a warm car can lead to drowsiness
- take regular rest breaks, at least every 2 hours
- eat proper, well-balanced meals on journeys, not too much and not too little, at your usual meal times; this will also ensure that you take proper breaks
- make use of rest areas along major highways
- comply with your organisational policies and procedures.

All of the above strategies should be employed **before** warning signs of driver fatigue appear.

NTFRS rules for drivers are as follows:

- drivers must comply with road rules and organisational policy on alcohol or drugs
- drivers must ask to be relieved of the driving task if they are emotionally distressed or unwell as their judgment and powers of observation may be impaired
- drivers who suspect that their vision or hearing is impaired must inform the appropriate personnel; an inability to see or hear clearly can seriously affect an individual's driving ability
- if the driver's licence is endorsed for spectacle wearing they must wear them at all times
- to avoid injury, the driver should use the correct procedures/drills for mounting and dismounting a vehicle.

NOTE

Some medications for minor ailments such as sinus, colds and influenza can make you drowsy and may affect your performance as a driver. If in doubt, check the warning label on the packaging for further advice.

Reaction time

Driver reaction time is the time period from the moment you as a driver observe the need for action (for example, avoiding a hazard), to the moment when you take that action. This time period can be measured in seconds and is of major importance when applied to braking. You should be able to react to an emergency situation by commencing the appropriate action within one second. In assessing hazards, it is vital to consider:

- the speed of your vehicle
- the road and other conditions
- your personal reaction time
- the reaction times of other road users.

A good driver uses a distance called 'thinking distance' to improve time available to react. Thinking distance involves maintaining an adequate distance from the vehicle ahead of yours, no matter what your speed.

Following distance

Situation	Travelling time
Between light vehicles	2 – 4 seconds
Between heavy vehicles	4 – 8 seconds
This time will double in adverse conditions.	

Stationary hang-back distance

These times apply to vehicles with good tyres and brakes travelling on a good road surface. The average person in good health has a reaction time of approximately one second. That is the time it takes to respond to a hazard ahead, move the foot from accelerator to brake pedal, and commence braking of the vehicle.

In one second, your vehicle will have travelled:

- at 60 km/h, 17 metres
- at 80 km/h, 22 metres
- at 100 km/h, 28 metres.

In Australia, the average house block is about 15 metres wide. At 60 km/h, it would take most drivers one block to respond to a hazard. At 100 km/h, it is nearly 2 average house blocks just for the response time. They then need to add the braking distance for the vehicle that they are driving to identify the total braking distance.

Three points to keep in mind when maintaining distance between vehicles are:

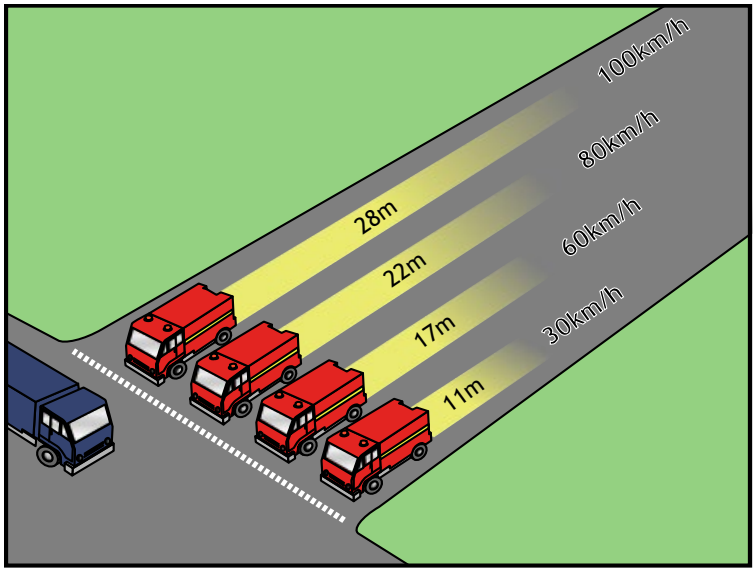
1. Create space to react and stop.
2. Small vehicles usually stop faster than trucks.
3. Air brakes can take up to 1 second to start acting.

To check the space between your vehicle and the one in front, count the seconds from the vehicle in front passing a stationary object until you pass the same object. A good way to count seconds is to say to yourself 'One thousand and one, one thousand and two, one thousand and three' and so on.

If your organisation has set a minimum space between vehicles, then you should become familiar with estimating that distance at various speeds. For example, you may be required to maintain at least one vehicle length for every 10 km/h of road speed. It is also important to remember that the space will need to be increased under adverse conditions such as smoke, fog, rain, snow or ice. This is the distance that you stop from the rear of the vehicle in front of you. You should position your heavy vehicle so that you have at least a vehicle length between vehicles or in the case of smaller vehicles you can see the rear tyres of the vehicle in front of you in contact with the road surface.

The benefits of this will be a reasonable safety margin in case the vehicle following you collides with the rear of your vehicle, hopefully you won't be pushed into the rear of the vehicle in front of you. The vehicle in front of you may stall or roll back into you if you are too close. In the case of heavy vehicles you have room to manoeuvre your vehicle out of this position should you have to do so.

Reaction time + braking distance = total braking distance.



Reaction distance...

...at 30 km/h – 11 m
...at 60 km/h – 17 m
...at 80 km/h – 22 m
...at 100 km/h – 28 m

Image: Reaction distances.

Vehicle operation

Driving a vehicle on-road requires that you are aware of a complex array of changing conditions, while at the same time concentrating on achieving the best possible performance from your vehicle. You need to take into account the design features of the vehicle, which cannot be changed. These determine the vehicle's limitations and include the vehicle's acceleration, maximum speed, braking capacity, cornering speed (with and without a load), and its weight, width, height and length. Operational limitations refer to the maximum load permitted by your organisation or the vehicle manufacturer, engine revolution limits for each gear and the conditions under which the vehicle may be used. These limitations are described in the manufacturer's operator manual or your organisational procedures.

NOTE

Operational specifications are found in the vehicle manuals, generally located in the glove compartment.

A vehicle with a cold engine is likely to have unreliable acceleration and be prone to stalling. Unless you are taking an organisation's vehicle on the road in an emergency response situation, you should perform a vehicle 'warm-up'. If you do not have time, you must drive in a way that allows for the possibility of stalling or unreliable acceleration. A cold start refers to starting an engine that is not at an operational temperature.

The following checklist can be used as a general guide for a cold start, but consult your organisation and manufacturer's manuals to ensure that you comply with the correct procedures:

- check that the park brake is on
- check the engine stop device is disengaged (if applicable)
- in a manual transmission vehicle, press the clutch to reduce the load on the starter motor and battery
- ensure the vehicle is in neutral transmission in case your foot slips

- use enough pressure on the accelerator to start the motor, but don't over-rev the engine: generally 500 – 700 rpm is adequate for a diesel engine
- engage the starter and release it as soon as the engine starts
- be aware that some diesel engines require a pre-heat phase
- run the engine until the temperature gauge indicates operational range
- secondary warm-up occurs once the vehicle is moving. Avoid stalls and unreliable acceleration problems by driving a little longer in each gear, making the gear selection slow and deliberate, as the transmission oil is also cold, and change up at lower engine revolutions.

NOTE

Electronically managed engines do not require any accelerator pressure when starting.

Changing gears

One of the key qualities of a good driver is the ability to make use of the vehicle's gears correctly. Correct and timely selection of gears and smoothness require practice. One of the most common errors in changing gears is failing to adjust engine speed to the newly selected gear, with the result that a jerk is felt at each change. This is particularly common when changing to a lower gear. As discussed in Part 1, gears are used to control engine load and speed under a range of conditions and to avoid straining the engine.

The various conditions involved include:

- accelerating the vehicle
- climbing steep slopes
- decelerating the vehicle
- descending steep slopes.

Gear changes should occur within the range of engine speeds described in the operator's manual. The engine speed is indicated by the tachometer (or rev counter) and the sound of the engine. Drivers will find gear changing from 1st to 2nd gear easier and smoother, especially in trucks, if it is undertaken using low engine revolutions, normally around 1,000 rpm.

Experienced drivers talk about 'feeling the gears'. 'Feel' is based on an understanding of what load the engine can and cannot reasonably deal with. It allows the driver to control the vehicle with a degree of delicacy and smoothness. Good use of gears comes from continued practice and an appreciation of the engine's capabilities, the vehicle's load, and road conditions. Anticipate when a gear change will be required. Ensure that you are in the correct gear before you approach a hazard, intersection, corner or steep descent. This will allow you to focus your attention on manoeuvring the vehicle in the appropriate direction.

Common errors novice drivers make when changing gears

- Failing to appreciate the basic working principles of the gear box.
- Failing to listen to the 'sound' of the engine.
- Failing to assess vehicle speed correctly before selecting a particular gear.
- Failing to properly grip the gear lever when moving it from one position to another.

- Not having sufficiently precise co-ordination between foot and hand movements to effect a smooth gear change.
- Releasing the clutch pedal too quickly, or accelerating before the clutch is fully engaged.
- Late gear changing, both up and down.
- Failing to recognise the engine sound when 'over-revving' in a low gear.
- Failing to recognise the need to change driving habits when changing between diesel and petrol-powered vehicles.
- Not understanding the difference between power and torque, and the requirements of electronically-managed engines.

Accelerating

Proper accelerator control takes practice and familiarisation with the vehicle being driven. Each vehicle's acceleration capability is different. Familiarise yourself with the acceleration performance of any vehicle you are required to drive. A simple test drive of a vehicle will give you a feel for the acceleration capability.

Various road surfaces and incorrect use of the accelerator can affect the vehicle's responsiveness and control. A competent driver, however, will maintain smooth control of a vehicle largely by varying the use of the accelerator when negotiating curves, slowing down or speeding up. Effective use of the accelerator will also minimise the amount of wear on the engine and lead to the efficient use of fuel. When accelerating avoid wheel spin, as it may cause loss of control, transmission damage, tyre damage, passenger discomfort and load shift.

Cornering

It is most important to have a consistent arc through all bends. Steering wheel movement or a change of direction when in the bend increases dramatically the extent of the forces acting on the vehicle during cornering. When a vehicle is travelling in a curved path, such as when going round a corner or bend (see below), it is subjected to forces that tend to push it off the course the driver is trying to take onto the wheels on one side of the vehicle.

In these circumstances, the vehicle's road-holding performance is tested. The problem is compounded on vehicles fitted with no-spin differentials, which limit the amount of wheel spin on loose or slippery surfaces.

REMEMBER

A good cornering line has the effect of straightening out the bend, reducing the stress on the vehicle during cornering.

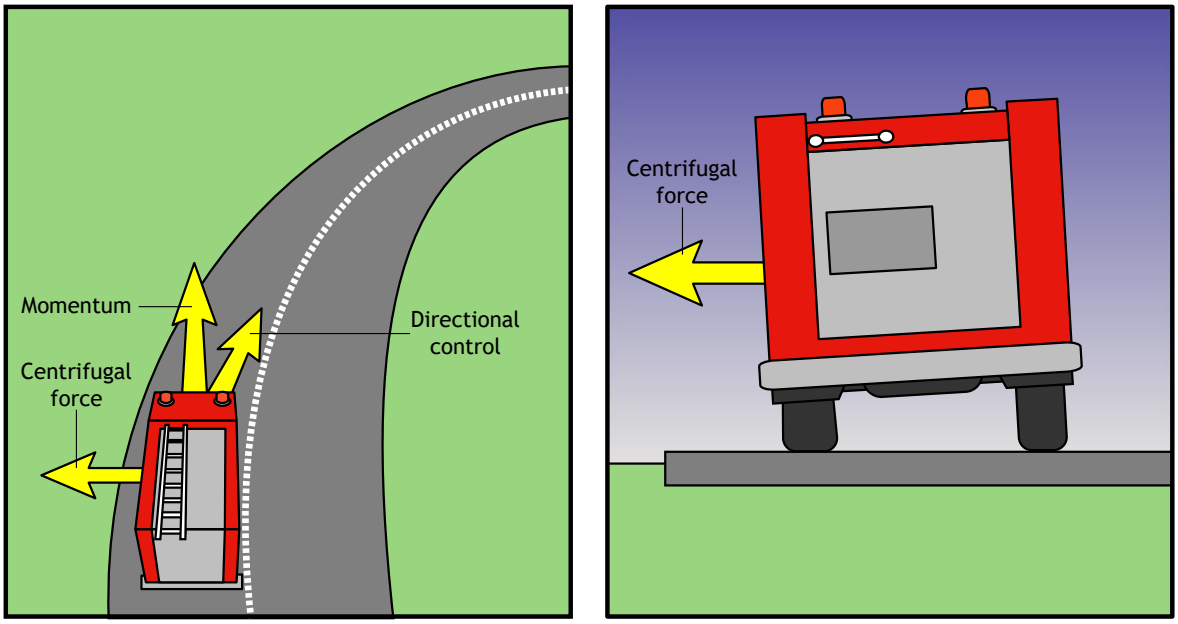


Image: Cornering forces.

When negotiating corners and bends, divide the bend into 3 sections:

1.	**Entry**	• Select the most appropriate speed and gear before entering the corner. • If the road surface is wet, icy or loose, enter at a slower speed and delay the acceleration (remember S1 and S2). • Maintain a position in the middle of the lane. • Before reaching the bend, reduce speed and break early. • Choose the correct gear. This will be mostly top gear on sweeping curves. Change down a gear on sharp or uphill bends or on steep continuously winding sections. A lower gear still should be used on hairpin bends.
2.	**Apex**	• Maintain constant speed with the accelerator. If the entry was too fast or the bend downhill, keep the brake applied. • Avoid heavy braking in the corner. • Accelerate gently through the corner (remember A1 and A2).
3.	**Exit**	Observe all traffic, then accelerate smoothly out of the bend

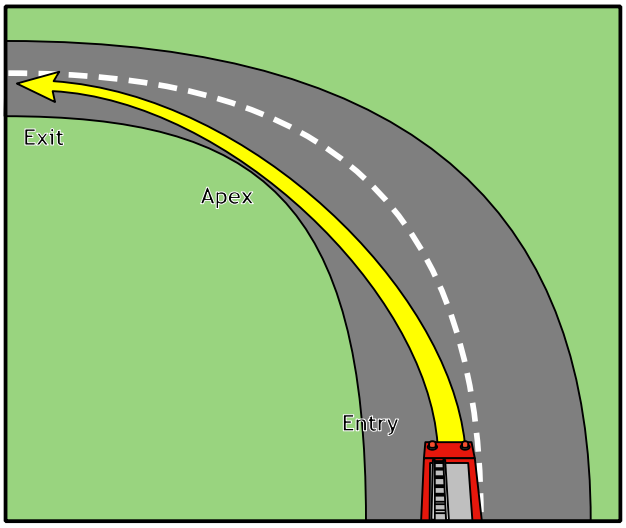


Image: Negotiating a bend.

Conditions affecting suitable speed

The most suitable speed for your vehicle will be affected by the condition of the road (including what effect weather will have on the road surface), by traffic, and by reduced visibility. Speed, acceleration and braking will be very much affected by different road conditions. The following list indicates the factors, which should be considered in various road conditions.

Sealed roads

Even though in most urban areas roads are generally sealed, you should be aware that the surface may be worn smooth, which can cause skidding. Off-road tyres offer less traction on sealed surfaces.

Unsealed roads

There are many thousands of kilometres of unsealed road surfaces in rural areas. The reduced adhesion caused by the loose surface has a marked effect on a vehicle's stability. Therefore:

- traction (grip) is poorer than on sealed roads
- ruts and loose gravel are more likely
- heavy braking will lock wheels (unless the vehicle is fitted with ABS (Anti-skid Brake System) and cause the vehicle to skid on the loose surface.
- wheel spin under acceleration is easily caused. Rear-wheel drive vehicles will tend to sway at speed.

Wet roads

Driving on wet roads, particularly after an extended hot spell, can create certain hazards. Visibility may be impeded and traction may be reduced especially if the vehicle has heavy lug (off-road) tyres. After a dry spell, dust and oil on the road make it slippery. Skidding is also possible when you change direction suddenly, brake sharply or accelerate quickly.

Ice

In some places, 'black ice' can form on the road during the colder parts of the year. 'Black ice', as the title suggests, is a thin film of ice through which the road surface is still visible. In very cold weather, it is possible for the road surface to freeze over because of heavy frost or water from run-off or poor road drainage.

Be aware that you can drive for hours on a winter's night on a road which is both dry and fast and then come upon a patch of ice which might be no more than 5 or 10 metres wide. This may be sufficient to cause you to lose control of the vehicle. Usually roads prone to ice and frost will be signposted accordingly. **Do not** disregard these signs, even if the road appears quite safe. Take special care driving into blind corners and over crests; in fact, anywhere where you cannot see ahead. Even on a sunny morning there may be ice in the shade of a roadside. It will look like a patch of shade and darker against the sunlit grey road. If you are uncertain about the presence of black ice, stop the vehicle and inspect the surface. If ice is anticipated, travel very slowly and keep in mind that skidding is possible when you change direction suddenly, brake sharply or accelerate quickly.

Snow

For those inexperienced in driving on roads covered in a layer of snow, be aware that bogging and skidding are more likely in these conditions and that there may be ice below the snow. The snow may also block the vehicle lights, radiator vents and air intakes. When driving in snow, chains must be fitted to the vehicle in accordance with agency requirements.

Bridges

Be aware when crossing or going under a bridge that the road sometimes narrows and the road surface can change. On bridges there may be a load limit and a height clearance limit for under the bridge.

Road works

While road works are in progress, be alert to the fact that speed limits may apply; hand-held Stop/Slow signs may be in use; and temporary traffic lights may be in operation. Road surfaces may also vary and people and machinery may cause a hazard. When confronted with any of these road conditions you will need to adjust your speed accordingly.

Traffic conditions

Every experienced driver knows that traffic conditions affect how fast you can drive. In urban areas there are more potential hazards to deal with. The roads are more complex, and there are more signs and signals, more traffic, more zones of invisibility and more distractions. Reaction times may need to be shorter. In heavy traffic conditions, you may also have to allow for the dangerous behaviour of other frustrated drivers.

Reduced visibility

Other conditions can also affect the speed at which you should be driving. The most common are fog, dust and smoke and driving at night.

Fog

- Visibility is reduced, especially in higher vehicles.
- Low or dipped headlights are used because they reduce glare.
- Use fog lights if available (with head lights on).
- Adjust speed to be able to stop within your field of vision.
- Remain a safe distance behind any vehicle in front.
- Use centre line or pavement edge markings in both day and night.
- **Do not** use high-beams because the light reflects back from the moisture-laden air, further affecting visibility.

Dust and smoke

- Visibility is reduced.
- Adjust speed to be able to stop within your field of vision.

> **NOTE**
>
> **Do not** attempt to overtake a vehicle that is creating a dust cloud. On these occasions, visibility is reduced significantly. Should you find yourself behind a vehicle creating sufficient dust to obscure your vision, it is safer to slow down and keep a safe distance behind the vehicle in front.

Driving at night

- To maximise vision at night, it is important that the windscreen and rear window are clean, both inside and outside. Where there are no oncoming vehicles, the driver should use high-beam lights to give visibility over a maximum distance. You must, of course, lower the beams (dip them) if there is an oncoming vehicle. Some guidelines to consider when driving at night:
- Dip your headlights as soon as you think they will affect an oncoming driver's vision. On straight roads, this could be over a kilometre away from the oncoming vehicle.
- Avoid looking directly at oncoming lights; direct your vision to the left and past the oncoming vehicle. Guide your vehicle by watching the left side or shoulder of the road, in preference to the centre line, even if this is marked. Reduce speed and move to the left.
- On right bends you will receive more headlight dazzle than on left bends. Be prepared for this.
- When following another vehicle, dip your headlights so that you don't confuse the leading driver by directing your headlights into their rear-view mirrors.

The safest way to travel on an open road at night is to select a vehicle that is travelling at your comfortable speed and remain 100 to 200 metres behind. The headlights and path followed by the leading vehicle will clearly show up bends and curves. The stop lights will warn in advance of sections where you may need to reduce speed. Oncoming vehicles will dip their headlights for the vehicle in front and stay on low beam for you.' O'Sullivan, The Complete Learn-to-Drive Handbook, Aust 1988, pg. 101-102 Be alert for any parked vehicles or objects on the side of the road.

Check for warning signs of potential hazards or for road-works in progress. Awareness of these hazards will enable you to navigate around them safely. Always remember, animals are more active at night and are difficult to spot because of a driver's reduced peripheral vision.

Proper use of road lanes

Road lanes are designed for efficient flow of traffic. In multi-lane conditions avoid unnecessary lane changing and when changing lanes signal for a reasonable distance to allow adequate time and warning to other road users of your decision, move to the edge of the lane, check your rear view mirrors and check over your shoulder to observe any vehicle out of sight of your mirrors. Check your State or NT legislation for specific information.

Unbroken lines	You may only drive a vehicle across double unbroken lines or a single unbroken line to the left of a broken dividing line to overtake an obstruction.
Broken lines	In this situation, you will need to make a judgment on when it is safe to overtake. These lines do not provide a driver with guidelines on how safe it is to overtake the vehicle ahead.
Single lane conditions	In many densely populated and industrial urban areas, a significant amount of traffic passes through single-lane streets and roads. Extra care is required when overtaking in this environment. It is important that the driver of the vehicle you wish to overtake is aware of your intentions. A light sounding of the horn and/or flashing of the headlights is a permitted form of warning.

Overtaking

Overtaking may be necessary to pass slower vehicles and can be a cause of road accidents. Even in excellent road conditions, the most experienced driver may feel some nervousness when crossing the centre line to overtake. You must know when it is not legal or safe to overtake another vehicle. To minimise potential problems, you must also know the capability of your vehicle and apply the following rules, whether in single or multi-lane conditions.

A major potential hazard when overtaking another vehicle is a head-on collision. This occurs when there is a failure to judge accurately the speed of the vehicle being overtaken and the speed of oncoming traffic. It can also be a result of not seeing other vehicles while focussing on overtaking the one in front. At all times, plan your actions carefully and ensure that you overtake only when the conditions are right. Remember, if you feel that there is some risk involved, or if you are not confident about overtaking, do not overtake.

Guidelines for overtaking

- Gauge the speed of vehicle ahead, and always maintain a safe distance.
- **Do not** overtake unless you have a clear and unobstructed view ahead of not less than 150 metres during the entire manoeuvre.
- Gauge the distance to any oncoming vehicles — remember it is almost impossible to judge their speed.
- Plan and judge when it is safe to overtake.
- Watch oncoming traffic for a suitable opportunity.
- Check your rear-view mirror and glance over your shoulder for any fast vehicle overtaking you.
- If in doubt, do not overtake.
- Signal for at least 3 seconds before moving to the right. This should warn any driver that might be in your blind spot.
- Move to the right.
- Accelerate.
- Overtake as quickly as safety allows.
- When clear of the overtaken vehicle, signal a move to the left. (Vision may be restricted on the left side of your vehicle, so (if necessary) ask a crew member to indicate when all is clear.)
- Move back to the left side of the road.

NOTE

The law does not accept the act of overtaking as a legitimate reason for speeding.

Multi-lane conditions

In multi-lane roads and streets, care must still be applied when overtaking. Be aware of possible blind spots and:

- as a rule drive in the left lane in multi-lane conditions
- always maintain a safe distance from the vehicle ahead
- plan and judge when it is safe to overtake
- check mirror and glance over your shoulder for any vehicle overtaking you
- if in doubt, do not overtake
- change one lane at a time
- signal for at least 3 seconds a move to the right (or left, if you are not in the left lane)
- move to the left or right lane
- accelerate
- overtake as quickly as safety allows
- when clear of the overtaken vehicle, signal for at least 3 seconds after a move to the left (or right).

When not to overtake

Do not overtake at:

- pedestrian crossings
- intersections
- corners or sharp bends
- humps or bridges
- crests of hills
- rail crossings
- a point where the road narrows
- double or unbroken lines or other places where regulation prohibits overtaking
- when visibility is impaired
- when you suspect that the driver in front will deliberately increase speed to avoid being overtaken
- when there are distractions such as animals on the side of the road or the possibility of cars pulling out of a side street.

Evasive action

Situations may occur where you need to take sure and effective evasive action. You may need to avoid hitting a road user or vehicle which has cut across your vehicle's path. Sudden evasive action may involve uncontrolled braking and un-signalled changes of direction. These are potentially dangerous situations and you must drive in a way that minimises the chances of them occurring.

As already discussed, choose a distance from other vehicles and a level of speed that gives you time to avoid trouble in a controlled way. Always have a plan for evasive action. Good, defensive drivers will have thought about and discussed hypothetical situations involving the need for evasive action, and will have developed plans in their minds. The safety of the crew and the dynamics of a fully laden vehicle must also be taken into account when taking any evasive action.

Soft shoulders

In some circumstances, road works or the vegetation by the side of the road may cause your vehicle to react unexpectedly. The wheels may strike loose gravel, mud, grass or water, and you will need to be able to correct any unwanted movement or skidding created by these soft shoulders.

Two possible effects of soft shoulders are that the left side drags and pulls the vehicle to the left or the left side sinks into soft surface and, and subject to the conditions, the vehicle may overturn. The problem can be compounded in a vehicle with a limited or no-spin differential. Care needs to be taken to ensure that the wheel still driving on the hard surface does not push the vehicle further off the road.

Gravel surfaces

As discussed previously, gravel surfaces can have a marked effect on a vehicle's stability.

> *'Consequently, when cornering on a gravel surface it should be done with a minimum of centrifugal force applied to the vehicle, braking should be commenced early and gentle pressure applied to the pedal. A reduced acceleration rate and lower speeds are used in these circumstances. If 100 km/h is a comfortable freeway speed, 70 km/h is a comfortable good gravel road speed. On gravel roads, there are no centre lines and on many occasions no warning signs.*
>
> *On bends and curves with reduced visibility, stay as far as possible to the left and only overtake when visibility is excellent. When following other vehicles, leave a gap of about 100 metres. This will reduce stone damage to your vehicle.'*
>
> O'Sullivan, 1988, The Complete Learn-to-Drive Handbook, Australia, pages 101-102

Skidding

Skidding indicates that the vehicle is out of control, a situation you should avoid if at all possible.

Causes of skidding include:

- under-inflated tyres
- worn tyres
- faulty steering
- excessive acceleration
- excessive speed in corners
- excessive speed for road conditions
- sudden braking
- uneven braking
- sudden changes of direction
- poor road surfaces and badly maintained brakes

To avoid a skid make sure:

- you do not drive faster than road conditions allow
- tyres have plenty of tread
- tyre pressures are correct
- steering is not faulty.

Responding to a skid

In a skid, a driver must recognise the cause and then take the appropriate action as follows:

Braking	Take your foot off the brake (refer to: Emergency braking)
Acceleration	Ease your foot off the accelerator until traction is restored
Front wheels skidding while cornering	Turn the steering wheel the other way (into the skid), being careful not to over-correct

There are 3 types of skids:

1. Front wheel skid.
2. Rear wheel skid.
3. Four wheel skid.

Guiding principles for correcting skidding

Immediately the sensation of skidding is felt, it is imperative that the driver exercise a controlling influence over the vehicle, or the skid will develop to alarming proportions very quickly. The following notes are given as guiding principles, but practice in the art is essential.

1. Front wheel skid:

Cause	Is caused by (a) **excessive speed** and usually occurs on a corner or bend, which is the basic cause, and/or (b) **coarse steering** in relation to speed.
Sensation	The sensation is that of a complete loss of steering control, the vehicle wants to continue going straight ahead instead of following the desired course. It undoubtedly arises from excessive speed.
Correction	First eliminate the cause by removing your foot from the accelerator pedal, (this reduces speed and causes weight transfer to the front wheels which assists grip), and at the same time straighten the front wheels, (in order to regain a pure rolling motion and therefore steering ability). Once traction has been re-established turn back in the direction of travel and renegotiate the hazard. This correction may have to be done in a series of small turns, depending upon your entry speed. If skid continues apply gentle braking until the vehicle has reduced speed sufficiently to follow your desired course, then renegotiate the hazard.

2. Rear wheel skid:

Cause	Is caused by (a) **excessive speed**, (b) **coarse steering in relation to speed which in itself is not excessive and/or** (c) **rough acceleration**.
Sensation	The vehicle feels unbalanced, a feeling produced by the vehicle endeavouring to turn about its vertical axis. Steering feels extremely light and the vehicle turns broadside, if left unchecked, will turn completely around.
Correction	To correct this type of skid we must first eliminate the causes by **removing your foot from the accelerator pedal *and at the same time* turn the front wheels into the direction of the skid**. For example, if the rear of the vehicle skids to the right, turn the steering wheel to the right, until the vehicle becomes stable or balanced. Be careful to avoid prolonged or excessive corrective steering or you may induce another skid back in the opposite direction. Once the vehicle has become stabilised and regained traction, begin to steer back in the desired direction and apply gentle acceleration to renegotiate the hazard.

Four Wheel Skid:

Cause	Is caused by (d) **excessive or sudden braking,** demanded by excessive speed.
Sensation	The vehicle will feel as if it is increasing in speed rather than losing it and the vehicle will slide forward following its own momentum
Correction	Eliminate the cause by **immediately easing the pressure on the brake pedal** momentarily and allowing the wheels to unlock. You do not need to fully release the brakes, you only need to ease the pressure **in order to unlock the wheels so that steering control can be maintained.** Once the wheels have been unlocked, you may again reapply brakes with a reduced initial pressure, **gradually increasing pressure as necessary** to avoid re-locking the wheels again.

Conclusions on skidding

Concentration and quick reaction play a highly important part in driving on slippery roads without skidding. The best control over the speed of the vehicle on a slippery road is through the accelerator pedal. This is only possible through the clutch and a suitable gear ratio, so the driver is advised that, when controlling a skid in an average private vehicle, it is generally best to leave the clutch engaged. If speed is excessive, normal braking is not advised, but if a lower gear is within road speed range a quick change down may be effected to reduce road speed. In this case, when the lower gear is engaged, great care must be taken to ensure smooth transmission of engine power through the clutch to the road wheels.

Reversing

Reversing a large vehicle is usually more difficult than controlling the same vehicle moving forward. You can reverse using direct observation over your shoulder, using the vehicle mirrors, or with a person outside the vehicle guiding you (described later).

Always use a guide if possible. Ensure the mirrors are correctly adjusted. Reverse only when you are sure the rear of your vehicle is clear of pedestrians, vehicles, obstructions and hazards. If you are unsure, get out and check.

Braking

A driver's ability to use the brakes to stop a vehicle safely and smoothly will avoid unnecessary damage or loss of control of the vehicle. In a vehicle equipped with a modern braking system, the practice of down-changing gears while braking should no longer be necessary. It is safer to use the vehicle's brakes and to keep both hands on the steering wheel, maintaining the intended braking line. Remember that from higher speeds it takes a considerably longer distance and greater pressure to slow or stop the vehicle.

You should aim to stop in a smooth and gradual manner by:

- braking early and gently
- braking, where possible, when travelling in a straight line
- varying brake pressure to suit the road surface
- braking smoothly to avoid locking wheels and skidding
- braking before changing down a gear
- avoiding brake fade (reduction in brake's effectiveness) by selecting a lower gear before a steep descent
- preventing load shift
- avoiding passenger discomfort.

Brake effectiveness	Be aware of how your vehicle's brakes will react under various conditions so that you can compensate when necessary for brake type, road conditions, vehicle design and load. The effectiveness of a vehicle's brakes depends on:
Brake type	• drum • disk • air brakes • transmission brakes • engine/exhaust brake • anti-skid braking system – ABS The advantages of the ABS system is that it reduces stopping distances under emergency braking conditions without affecting your ability to steer, on most surfaces, including wet or slippery surfaces.
Vehicle weight	Including momentum of load the 'wave' effect of part-filled water tanks
Road surface	Poorer traction on unsealed surface
Road condition	Poorer traction on wet or icy surface
Downhill brake fade (reduced effect)	Caused by overheating through over-use.

Other road users

Problems can arise when you stop the vehicle suddenly or even just slow down a heavy vehicle. A driver behind your large vehicle may not be able to see potential problems ahead of you. You need to consider other road users and anticipate the effect you're slowing down or stopping may have on them.

Some general guidelines are to minimise the need to stop abruptly by driving at a suitable distance from a vehicle in front of you and anticipate the possible actions of other road users. Signal to other road users by indicating a left turn if you are pulling over or by tapping the foot brake to warn of a possible need to stop.

Emergency braking

Under emergency braking situations, the rear of the vehicle tends to lift, and weight is thrown forward and downward onto the front wheels. The resulting unequal distribution of weight makes the steering heavier and reduces the general stability of the vehicle, especially at the rear wheels. When performing emergency braking, do not touch the clutch or change gears. Apply the brakes just hard enough to avoid locking the wheels. If the vehicle starts to skid, release the brakes so that the vehicle straightens and as soon as the wheels are rolling again, apply the brakes more gently. If necessary, stall in gear and if ABS is fitted, maintain firm brake pedal pressure.

Braking on long winding descents

When a vehicle is required to descend a large hill or mountain and the driver controls the rate of the vehicle's descent by using the primary braking system, i.e. foot brake, it would result in a situation called 'brake fade'. This is the overheating of the braking components through overuse. Instead, a driver must use the ancillary braking systems in conjunction with lower gear. It is a good idea to consult the manufacturer's specifications in regard to vehicle performance when descending hills.

The gear that should be selected will depend on the:

- grade of the descent
- vehicle weight
- type of ancillary braking system fitted (e.g. exhaust, engine, and transmission)

Vehicle monitoring

While driving and when parked, you should be conducting ongoing checks on your vehicle. These types of checks should be undertaken in accordance with your organisation's policy and procedures and the manufacturer's operator manual.

Observation while moving	Be alert to the actions of other road users and to events taking place around you by checking the road ahead and the mirror (every 10 seconds, or as appropriate), for other traffic and vehicle speed. Check over the appropriate shoulder and the load/equipment (through mirrors). Listen for unusual sounds.
Ongoing instrument checks while moving	Monitoring the vehicle's instruments will ensure the smooth operation of your vehicle. Conduct regular checks of the fuel level, engine temperature, oil and brake pressure, warning lights and other specific instruments in the vehicle to assist you to identify any potential problems:

Checks while parked	When parked, check wheel and tyre temperature and inflation, wheel nuts (visual), objects between dual wheels, load security, engine or transmission fluid leaks and cracked or broken lights.

Manoeuvring with a guide

There will be times when you need to manoeuvre a vehicle with the aid of a guide who uses recognised arm signals. The benefits of using a guide are that the person covers the invisible zones, two people are watching for hazards and you are not relying on shouted instructions in a noisy environment. The guide should position themselves either to the front or to the rear of the vehicle, facing the vehicle at all times and remaining visible to the driver at all times.

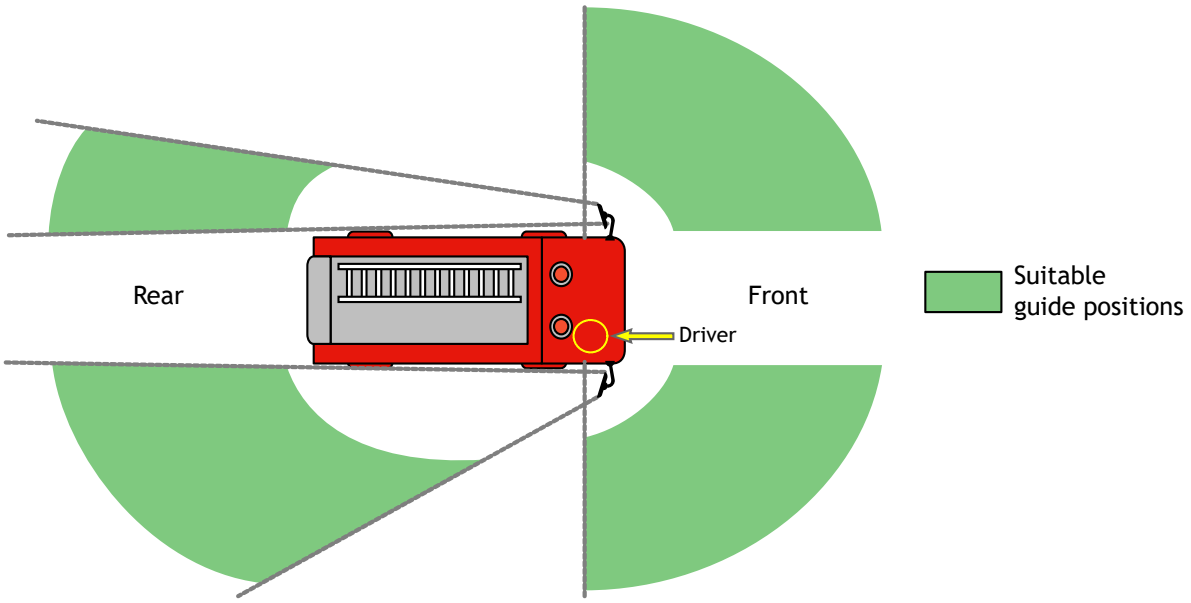


Image: Suitable positions for a guide.

Hand and arm signals

To drive with the help of a guide or to function as a guide yourself, learn the appropriate hand signals. The driver must have an unobstructed view of the guide.

Signals generally used by a guide are:

Stop	Both arms extended towards the vehicle with hands up and palms towards the vehicle.
Move towards the guide	Both arms raised towards the vehicle with hands up and palms away from the vehicle, hands moved in 'come here' motion.
Move away from the guide	Both arms raised towards the vehicle, hands up with palms towards the vehicle, hands moved in a 'go away' motion.
Turn steering wheel	The guide's arm is extended horizontally to the side the wheel should be turned. The driver continues to turn the wheel while the signal is being given.
Hold existing lock	The driver holds the existing steering lock unless the guide indicates to turn the wheel.

If the guide is out of your line of vision or a signal is not clear, stop.

When the vehicle is approaching an obstacle, the guide may represent the closing distance by holding their hands apart.

The guide must advise the driver when their role as a guide is finished. Both the driver and the guide must clarify what signals will be used and what they mean prior to directing the vehicle.

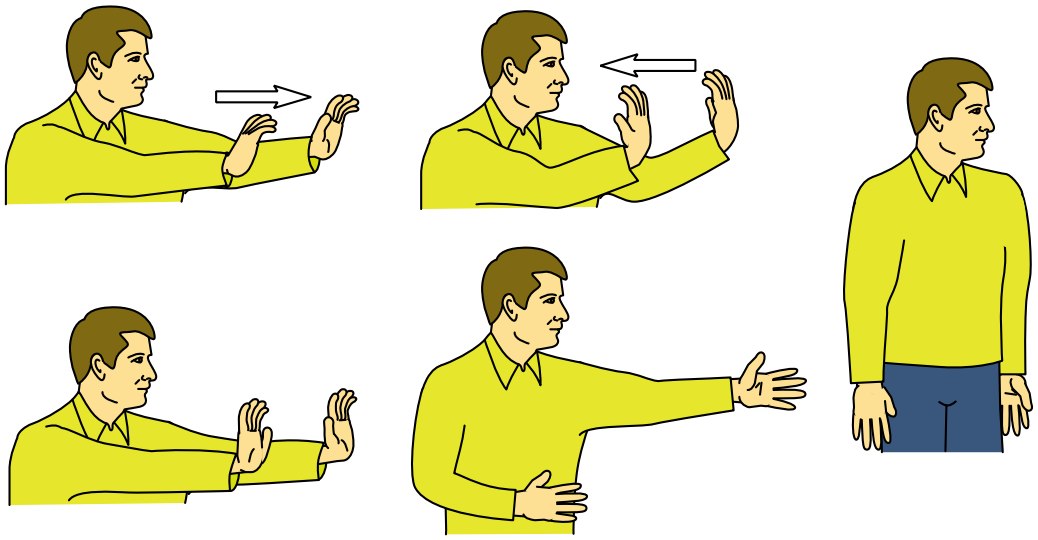


Image: Hand and arm signals used by a guide.

NOTE

A guide should not walk backwards when guiding the driver of a vehicle.

Convoy driving

A convoy refers to 2 or more vehicles driving together under the control of a single Convoy Leader. If driving in a convoy, you need to:

- identify the lead vehicle (usually the slowest in the group)
- identify the convoy leader and follow his/her instructions
- maintain appropriate vehicle separation distances to reduce the impact on traffic flow:
- under escort conditions, maintain the distance specified by the organisation (usually police) providing the escort
- under emergency response conditions, the minimum distance is 100 m
- under normal conditions, the minimum is the distance specified in legislation or your organisation's procedures.

Summary

- Defensive driving is about driving in a manner which prevents accidents in spite of the actions of others, or in the presence of adverse road or weather conditions.
- The causes of road crashes consist of a combination of three elements, human error, environmental factors and the condition of the vehicle.
- The Smith System of vehicle control is a method of defensive driving which emphasises the features to be considered in sequence by, the driver, on approaching a hazard. A hazard is anything which might cause you to change course or alter speed.
- Zones of invisibility may be present at intersections, on bends or caused by other moving or parked vehicles. The design of a vehicle and driving at night can also create a zone of invisibility.
- When communicating with other road users, you should:
    - signal your intentions in a clear and unambiguous way
    - signal your intentions in a timely way (not too soon or too late)
    - not rely entirely on others responding to your signals
    - not rely entirely on other's signals.
- Driver limitations include health and fitness and the ability to react in time.
- Driver reaction time is the time period from the moment you as a driver observe the need for action (for example, avoiding a hazard), to the moment when you take that action.
- A vehicle with a cold engine is likely to have unreliable acceleration and be prone to stalling.
- The vehicle's gears are used to control engine load and speed under a range of conditions, and to avoid straining the engine.
- Each vehicle's acceleration capability is different and you should be aware of the acceleration performance of any vehicle you are required to drive.
- When a vehicle is travelling in a curved path, such as when going round a corner or bend, it is subjected to forces that tend to push it:
    - off the course the driver is trying to take
    - onto the wheels on one side of the vehicle.
- The most suitable speed for your vehicle will be affected by the condition of the road (including what effect weather will have on the road surface), by traffic, and by reduced visibility.
- Overtaking may be necessary to pass slower vehicles. This can be another cause of many road accidents.
- Situations may occur where you need to take sure and effective evasive action.
- The 2 possible effects of soft shoulders are:
    - left side drags and pulls the vehicle to the left
    - left side sinks into soft surface and, subject to the conditions, the vehicle may overturn.
- Skidding indicates that the vehicle is out of control. It is always to be avoided
- Reversing a large vehicle is usually more difficult than controlling a vehicle moving forward
- You should aim to brake your vehicle to a stop in a smooth and gradual manner by:
    - braking early and gently
    - braking, where possible, when travelling in a straight line
    - varying brake pressure to suit the road surface
    - braking smoothly to avoid locking wheels and skidding
    - braking before changing down a gear
    - avoiding brake fade (reduction in brake's effectiveness) by selecting a lower gear before a steep descent

  - preventing load shift
  - avoiding passenger discomfort
- Three types of vehicle monitoring checks are observation while moving, instrument checks while moving and checks while parked.
- The benefits of using a guide when manoeuvring are:
  - the guide covers the invisible zones
  - two people are watching for hazards
  - you are not relying on shouted instructions in a noisy environment.
- A convoy refers to two or more vehicles driving together under the control of a single Convoy Leader.

PART 3 - Self-Assessment

1. **To be an effective defensive driver, what do you need to do?**
2. **What does the Smith System of vehicle control involve?**
3. **Where is a driver likely to encounter zones of invisibility?**
4. **Why should caution be taken when giving signals to following vehicles?**
5. **What are the general health and fitness rules that a driver must observe?**
6. **What is meant by driver reaction time?**
7. **List some of the mistakes made by drivers when changing gears.**
8. **What determines the effectiveness of a vehicle's brakes?**
9. **What do you need to do if driving in a convoy?**

PART 4 – Driving vehicles off-road

The purpose of this section is to introduce you to the knowledge and skills you will need to drive a vehicle in off-road conditions.

When driving a vehicle off-road, you are likely to be faced with a variety of operational conditions. These will include adverse driving and terrain conditions. This section explores the following topics:

- Operating 4WD vehicles.
- Driving vehicles off-road.

Operating 4WD vehicles

Many organisations use 4WD vehicles extensively because they provide greater traction in difficult terrain than 2WD vehicles, and they are generally stronger. The NTFRS use 4WD vehicles for wildfire control and rescue operations. However, like any other piece of equipment, it is important to remember that 4WD vehicles have limitations.

Capable 4WD will enable you to get where you want to go safely and without damaging the vehicle. Safe driving in difficult terrain and under adverse conditions requires alertness, good judgement and skill.

As a driver of a NTFRS 4WD vehicle, it is your responsibility to ensure that you know the limitations of yourself and the vehicle and can identify the situations in which it can be driven correctly and safely. It is also your responsibility to ensure that the vehicle and crew arrive at the incident scene in optimum condition.

The principles of 4WD operation are the same regardless of the size or type of vehicle being driven.

Characteristics of 4WD vehicles

There are basic design differences between a conventional car or truck and a 4WD vehicle. Compared with a two-wheel drive vehicle, a 4WD is

- usually a little heavier, has a higher centre of gravity, has greater ground clearance, a larger turning circle and is fitted with tyres suitable for off-road conditions.
- there are 2 driving axles and a transfer case in a 4WD vehicle. The transfer case enables the driver to select a high or low range (fast or slow speed) while in 4WD mode. It may also have a neutral position to allow a power take-off to be operated through the gear box without the vehicle moving.

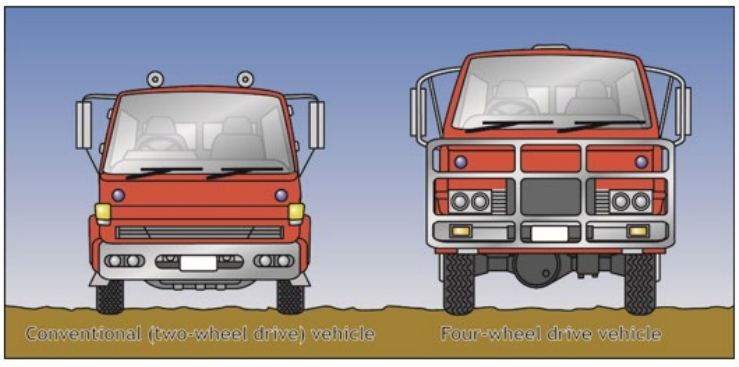


Image: Comparison of a conventional vehicle and a four-wheel drive vehicle.

Transfer case

The transfer case is a device that splits power and torque between the front and rear axles on a 4WD vehicle.

The transfer case in an all-wheel-drive system contains a device that allows for a speed difference between the front and rear wheels. This could be a viscous coupling, centre differential or other type of gear set. These devices allow an all-wheel-drive system to function properly on any surface.

The transfer case on a part-time 4WD system locks the front-axle driveshaft to the rear-axle driveshaft, so the wheels are forced to spin at the same speed. This requires that the tires slip when the car goes around a turn. Part-time systems like this should only be used in low -traction situations in which it is relatively easy for the tires to slip or transmission wind-up may occur.

Some transfer cases, more commonly those in part-time systems, also contain an additional set of gears that give the vehicle a low range. This extra gear ratio gives the vehicle extra torque and a super-slow output speed. In first gear in low range, the vehicle might have a top speed of about 8 km/h, but incredible torque is produced at the wheels. This allows drivers to slowly and smoothly creep up very steep hills etc.

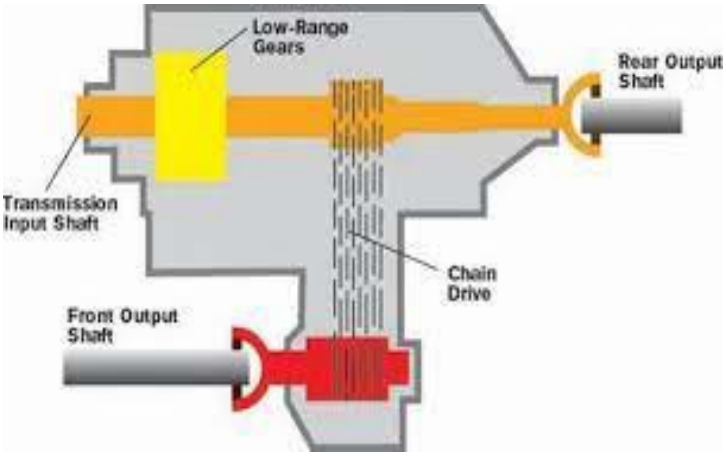


Image: Transfer case.

Gear selection in a 4WD vehicle

In addition to the normal manual or automatic transmission, a four-wheel drive vehicle is fitted with an auxiliary transmission or transfer case to enable it to more easily negotiate difficult terrain. A transfer shift lever or switch is used to select the most appropriate range for the driving conditions. The lever or switch is used to change between:

- 2WD (2H)
- 4WD high range (4H)
- 4WD low range (4L)

With the lever in the 2H position and free-wheeling hubs (if fitted) in the 'free' position, only the 2 rear wheels will be engaged. This selection should be used for normal on-road driving conditions.

With the lever in the 4H position and hubs in the ‘lock’ position, all four-wheels are engaged. This selection is used when driving at normal speed on sand, shallow mud or rough, unsealed roads (low traction surfaces).

With the lever in the 4L position and hubs in the 'lock' position, again all four-wheels will be driven, but at a reduced speed with increased torque. This selection should be used when increased control is needed at slow speeds. Use it for ascending or descending steep grades, deep mud, and soft sand or very rocky terrain.

Free wheeling hubs

Some 4WD vehicles have free-wheeling hubs fitted to the ends of the front drive axles, (Rotor lock mechanism, which allow the front wheels to rotate independently of the drive-line, when unlocked). This enables the front drive hubs to engage the drive axle, when driving off-road. The hubs have two positions: 'free' and 'lock'. They must be in the 'lock' position for 4WD mode. When in the 'free' position, the front wheels are not connected to the drive axle and noise, wear, and fuel consumption are reduced. Hub locking may be either manual or automatic.

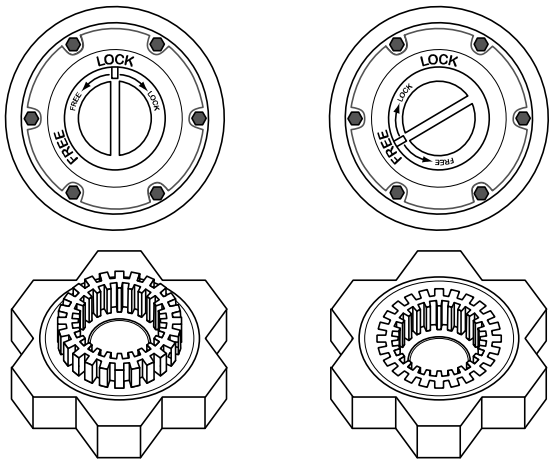
The vehicle's operator manual will explain how to operate the hubs. The hubs can get quite hot after extended use of the brakes, for example after descending a steep slope. Let the hubs cool off before touching them.

When you are travelling on a bitumen or hard surface road, the hubs should be in the 'free' position. Free-wheeling hubs should be engaged:

- according to the manufacturer's guidelines
- prior to engaging four-wheel drive (if possible, approximately 30 minutes before intended use to lubricate and warm up the hub components)

The NTFRS generally leave Hubs in the 'locked' position on grassfire units.

Image:
Free-wheeling hubs



Situations for using 4WD

In areas where greater traction may be required for operations, 4WD vehicles are used extensively. Situations where the use of 4WD is beneficial include: driving cross country where maximum traction is required and high speeds are impossible; driving on rough, uneven, or rocky terrain where you should use low range. This will lower speed, reduce vehicle bounce and give better steering, increase safety and reduce damage to vehicles.

When negotiating uneven or rocky terrain, always try to ensure that the vehicle wheels follow the path that offers the least resistance and minimises strain on the vehicle.

While 4WD vehicles have some degree of flexibility, enabling them to cross uneven terrain, it is preferable to reduce the potential for damage and remember that a 4WD vehicle have their limitations. In fact, many people have found themselves in a worse predicament than normal because they over-estimated the capabilities of a vehicle or themselves.

Limitations of 4WD vehicles

As the driver, you are totally responsible for the safe arrival of the vehicle and the crew. If you have any doubts in a particular situation you should not proceed because your uncertainty may lead to mistakes. One option is to ask a more experienced off-road driver to take over. All vehicles and their drivers have limitations and you should remember the following:

- use a vehicle in 2WD mode if possible
- before using a 4WD vehicle, find out its limitations in the vehicle's operator manual
- ascending or descending steep slopes risks straining the engine and drive line or overturning the vehicle
- clearance problems can occur caused by not having enough space to:
    - pass between 2 obstacles
    - pass under an obstacle
    - avoid bottoming out when traversing a hump
    - avoid scraping the front or rear of the vehicle with too great an angle of entry or departure from a depression such as a creek crossing.

Off-Road driver safety

Driver safety when operating in rugged terrain is very important (see diagram below). Procedures for driving in four-wheel drive mode are as follows:

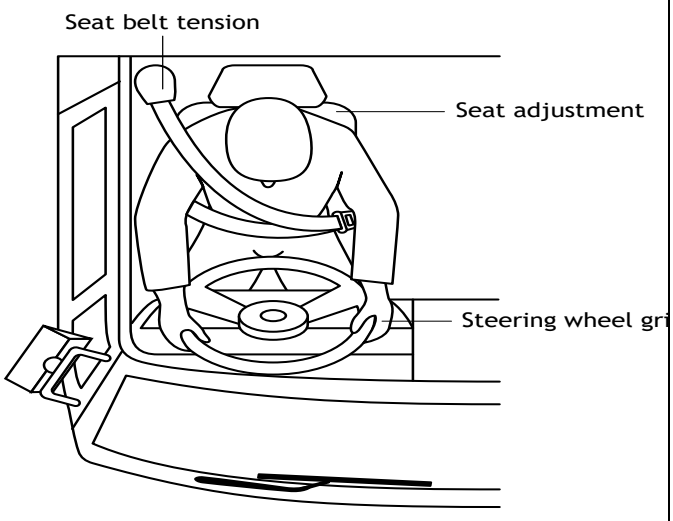
Seat adjustment
Move the seat slightly forward for better vision in difficult or steep terrain.

Foot position
Ensure left foot is braced on foot rest to provide best stability.

Seat belt

NOTE

Seat belts must be worn by all occupants of NTFRS vehicles in both on-road and off-road situations!



Driver fatigue

Drivers do not often realise they are too tired to drive safely. It is only when the vehicle's left side wheels leave the bitumen and hit the gravel, or when the car veers over the centre-line that drivers realise they have lost concentration. NTFRS personal can easily become fatigued while at grass fires, this may be caused by dehydration, heat stress, prolonged physical exertion and working in lowered oxygen environments (smoke).

Signs of driver fatigue are:

- blurring and dimming of vision
- seeing things
- daydreaming and lack of concentration
- feeling impatient
- feeling hungry or thirsty
- sweaty hands
- slow reactions
- driving speed creeps up or down
- driving the vehicle over the centre-line or on the road's edge.

To avoid driver fatigue:

- restrict the hours of continuous driving
- share the driving,
- do not travel for more than eight to ten hours in any one day
- allow a flow of fresh air into the vehicle as a warm car can lead to drowsiness
- take regular rest breaks, at least every two hours
- eat proper, well-balanced meals on journeys, not too much and not too little, at your usual meal times; this will also ensure that you take proper breaks
- make use of rest areas along major highways
- comply with your organisational policies and procedures
- stay well hydrated.

All of the above strategies should be employed **before** warning signs of driver fatigue appear.

Maintaining control when In 4WD mode

Grip on steering wheel

Hold the steering wheel with both hands at all times. Keep your thumbs outside the centre of the wheel rim to avoid broken thumbs if the wheel spins unexpectedly.

Occupant safety

Safety of vehicle occupants is the responsibility of the driver who should ensure that:

- seat belts are worn and firmly adjusted by all occupants
- windows are at least 3/4 closed so that tree branches and scrub do not strike occupants
- crew members on the rear of trucks are within the confines of the vehicle
- sufficient warning is given to crew of impending hazardous conditions
- crew get off and keep clear if vehicle location, condition or situation becomes dangerous

Driving vehicles in off-road conditions

Before you contemplate driving a vehicle off-road, particularly in steep country, it is important to know how you are going to get yourself out of difficult situations. This may require negotiating a range of difficult situations in various circumstances and devising solutions for them including:

• sand	• side slopes
• long grass	• steep ascents and descents
• short vertical rises, humps and ditches	• Crew on rear of vehicle
• mud	• park brake start
• water crossings	• stall recovery
• Low visibility (smoke)	• transmission wind-up
• rocky terrain	• the operation of tankers

Before taking a route off-road you should:

- take up the correct driving position
- (seat position, seat belt and steering wheel grip),
- foot position
- check the safety of your passengers (seat belts and windows).

As with most other skills, the key to mastering off-road driving is practice. Your skills will improve with experience and by adhering to the driving principles that you have covered in this learner resource.

Driving in difficult terrain requires you to be alert, make sound judgements and use skill. If you fail to identify obstacles, or if you select an incorrect gear, the vehicle may stall, skid or become ditched or bogged. This may result in injury to you or the crew, damage to the vehicle or equipment, and unnecessary time delays.

When you drive over difficult terrain behind another vehicle, allow sufficient space for the vehicle ahead to successfully negotiate the obstacle, before you begin to negotiate it.

Park brake start

A park brake start is the procedure used when the vehicle is stopped or stalled on a slope and you want to proceed up the slope.

The procedure is:

- ignition key off, foot brake firmly on and park brake on
- ease in the clutch and select the appropriate gear, keep the clutch depressed
- key ignition on and ensure that engine is running smoothly
- ease off foot brake while ensuring the park brake is holding
- increase engine revolutions
- slowly release clutch until it 'bites' (that is, you can feel the clutch beginning to engage)
- slowly release park brake in unison with clutch, while gently increasing throttle, ensuring that the vehicle does not roll down the slope
- release clutch fully and accelerate smoothly
- should the vehicle again stall, refer to 'Stopping and Stalling Procedure'.

Stopping or Stalling Procedure

One of the most common difficulties arises when the vehicle is negotiating a steep slope and it stalls or has to stop. When it becomes apparent that the vehicle cannot continue the climb or you wish to stop the vehicle:

- gradually allow the engine revs to fall
- turn ignition off and firmly apply the foot brake simultaneously
- do not use the clutch
- apply the brake.

This procedure applies when ascending or descending a slope. Once you have safely stopped the vehicle and secured it, you should assess your situation and consider the options. In most cases, there will be no need to hurry, and it is more important that you take the time to assess your situation, check that you can see clearly around you, and that there are no vehicles or personnel in your intended line of travel.

To continue down the slope either forwards or backwards:

- ignition key off, foot brake on (firmly) and park brake on (holding foot on brake)
- select the course of retreat, observing any potential hazards before commencing
- ensure that front wheels point correctly in the direction you intend to take
- **do not** make any violent or sharp steering wheel movements
- ease in the clutch and select the appropriate gear
- let the clutch out, and move left foot away from the clutch pedal
- slowly release the park brake
- ease off the foot brake, ensuring that correct gear is engaged and that vehicle holds on engine compression
- keep your foot covering the foot brake pedal (some braking may be required)
- key the ignition on and start the engine.

This procedure should be performed while the vehicle is in low range (4L). The above procedure requires constant practice to ensure that you will stop the vehicle, and not depress the clutch, which is a natural reaction. If you do depress the clutch, then control of the vehicle might be lost. You should use this procedure each time you intend to stop on a steep slope, or where momentum is lost due to a lack of power or traction.

Using this procedure to stop ensures that the vehicle is held stationary on the slope by means of engine braking (the stalled engine locking up the transmission and drive line) in addition to the use of the foot and park brakes.

Extreme caution must be observed when you are carrying out a stopping or stalling procedure because there is potential for an accident even if the correct procedure has been used. For example, if the front wheels are not pointed correctly, you could veer off the selected course, or strike a tree or rock.

If you are likely to drive a vehicle off-road, it is important that you are skilled in these procedures. Continually review and practise the steps involved in the procedure so that they become second nature to you. Even under pressure, your actions will become an instinctive response.

Ascending and descending steep slopes

Steep slopes are those that require the use of 1st or 2nd gear in high range, or the use of low range. Before you commit yourself to using your 4WD vehicle to ascend or descend a slope, stop and check the grades, the surface condition and the points where the vehicle can safely leave the slope. If possible, ascend or descend a steep slope square on to the slope.

Unless absolutely necessary, **do not** drive across a slope because the vehicle may tip over, especially if there are rocks, depressions or animal holes on the slope. When ascending a steep slope, the rear drive wheels have the most traction. In descending a steep slope you may need to gently apply the brakes to hold a moderate speed. However, if you need to regain traction and steering, gently accelerate.

Steep ascents

Use the following procedure when considering the ascent of a steep slope:

- Stop and plan your route to avoid both the steepest inclines and the need to climb at an angle to the slope. Walk up the slope if necessary.
- If you cannot see the entire slope, intended rout, then walk the rout first.
- Select the appropriate gear for the ascent and stay in that gear.
- Select 4WD, low range and, if fitted, ‘lock’ the front hubs.
- Maintain traction by avoiding wheel spin.
- Keep engine revolutions low but sufficient to maintain momentum.
- If the wheels spin, ease off the throttle, until traction is regained, then gently accelerate again.
- On a loose surface, you can turn the front wheels slightly from side to side to feel for better traction.
- If the vehicle cannot make the climb, use the stopping or stalling procedure.

Steep descents

Descending a steep slope requires the same planning as climbing a slope. It can be more difficult because if you encounter an unforeseen obstacle part way down the slope, you may have to reverse the vehicle up to your starting point.

A useful procedure is as follows:

- Stop and plan your route to avoid both the steepest grades and the need to descend at an angle to the slope; ensure you can complete the decent, walk down the slope if necessary.
- Select the appropriate gear for the descent and stay in that gear.
- Select 4WD, low range and, if fitted, 'lock' the front hubs.
- Let the vehicle descend under engine compression (letting the engine revolutions help to slow the vehicle).
- Use only gentle applications of the foot brake.
- If the surface is slippery:
    - **do not** use the brake
    - **do not** use the clutch.
- If you start to lose control, increase speed slightly to improve traction.
- When descending a rocky track, you may need to gently use the brakes to protect the vehicle's suspension.
- If the vehicle stalls or stops, use the stopping or stalling procedure.

'On steep muddy upgrades sheer momentum is often the only successful approach but remember that wet tracks are easily damaged. Winching may prove more appropriate. On steep downgrades the vehicle can easily skid on greasy surfaces. When descending hills do not use the brakes, travel as slowly as possible using the engine for braking and apply the accelerator gently when correcting a skid.'

Gregory's Scientific Publications, Four Wheel Drive Handbook, Aust. 1985, pages 28-29.

Guidelines for negotiating vertical rises, humps and ditches

Generally, a vehicle can negotiate a short vertical rise or drop provided the vehicle's front bumper bar or front springs can clear the rise. The angle from the bottom of the front wheel to the front of the vehicle body is important in such clearance. It is known as the 'angle of approach'. To avoid 'bellying' the vehicle, it is also important that the top of the hump or base of the ditch is longer than the vehicle if you are making a square-on approach. Finally, check that the rear of the vehicle will not scrape or become wedged on the surface (the angle of departure) as the front wheels mount the hump or the rear wheels descend into the ditch.

Stop, assess the situation and decide on the best route, walk the rout if necessary:

- check the clearance levels
- consider the angles of approach and departure
- negotiate the obstacle in a low gear at a low speed
- if the vehicle has four-wheel drive, engage it, select low range and, if fitted, 'lock' the hubs
- where appropriate, use existing wheel ruts, taking care that the vehicle does not 'belly'
- gently apply the foot brake, if necessary, to give a slow and controlled descent after crossing a hump or when descending into a ditch.

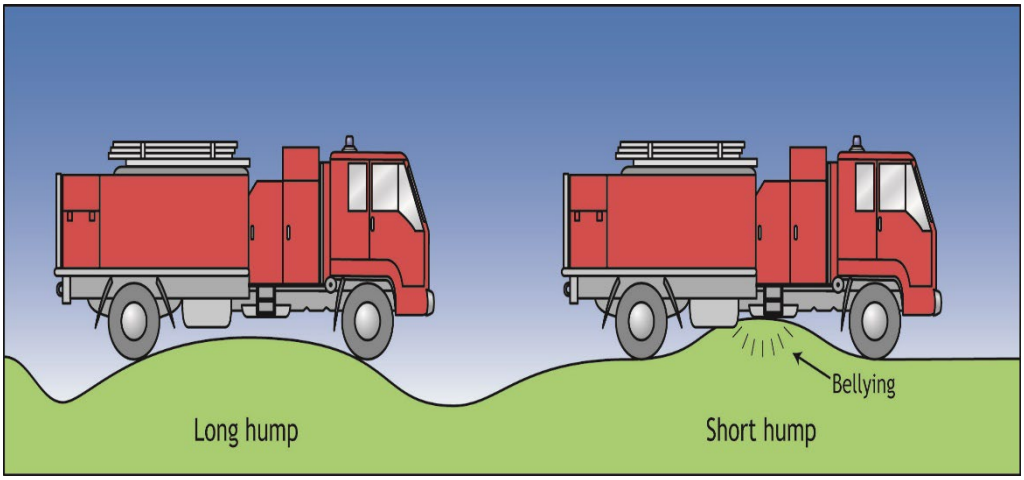


Diagram: Negotiating a hump.

Side slopes

Driving on side or cross slopes should be avoided if at all possible because of the risk of overturning the vehicle. However, on some occasions, there is no alternative but to take a vehicle across a slope.

The recommended maximum side slope should be about 50% of that which would cause a vehicle to roll over under perfect conditions. The vehicle's centre of gravity must stay within the wheels as indicated on the diagram below. As a general rule, appliances should not attempt to traverse side slopes in excess of 15 degrees, and not above 20 degrees in recreational 4WD vehicles. These limits allow for obstacles on the high side of the vehicle, holes on the low side and, in the case of a tanker, movement due to water.

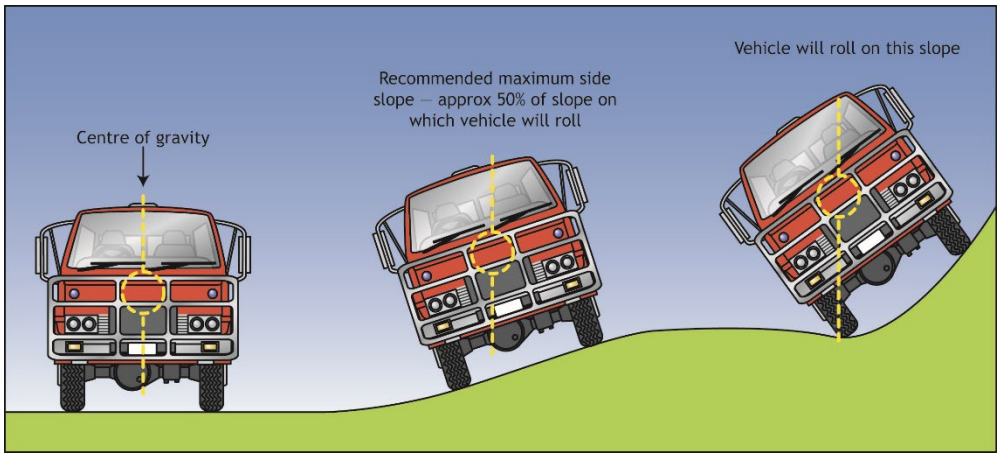


Diagram: Driving on a side slope.

Water surge

Water reacts to the movement of the vehicle, and the reaction can be violent if the vehicle is being driven across rough country. The water's lateral (sideways) motion will be aggravated if the vehicle has a partially filled tank, which will usually be the case during wildfire operations. As a result, you need to drive with additional care to avoid tipping the vehicle over. The sensation of water movement in a tanker vehicle is often referred to as 'surge'.

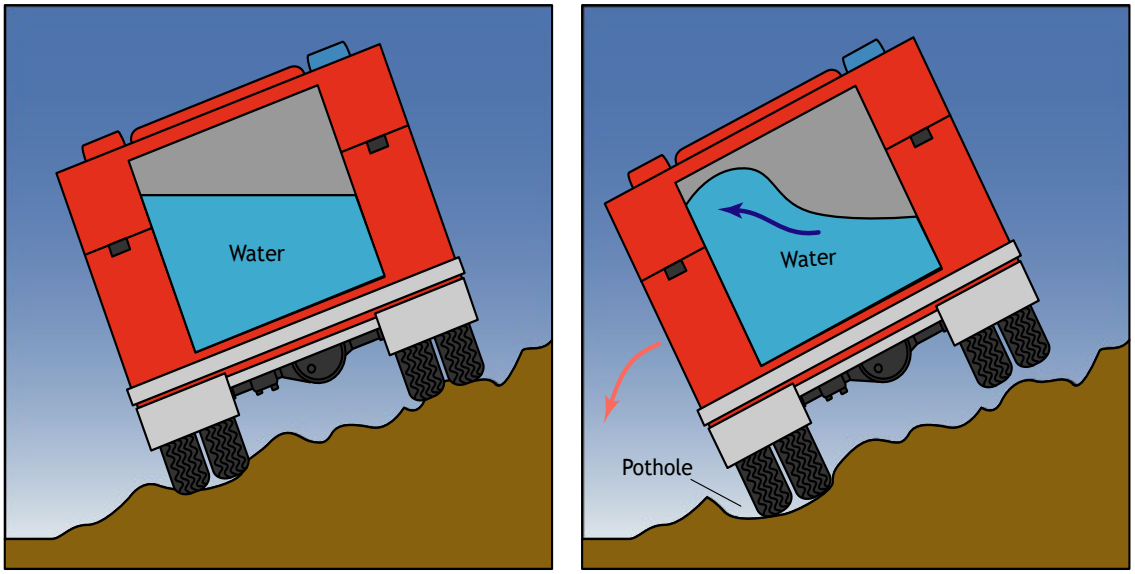


Diagram: Surge.

Guidelines for driving on sand

Driving on sand is much more difficult than it appears. A number of different driving techniques may be required. For example, if there is a crust of hard sand over drift sand, a fairly high speed is best. Sand is very hard on vehicles and has the ability to get into moving parts, potentially causing excessive wear and expensive damage. You will need to wash the underside of your vehicle thoroughly after any operation in sand.

Gear changes must be made at higher speeds than in normal driving, and changing down, particularly to second gear, needs to be made in a way that minimises loss of momentum.

Sand allows the tyres to sink in, so the vehicle is continually climbing hills in front of each tyre. When that hill gets steep the tyre loses grip, the wheels start to spin and the vehicle can quickly become bogged.

Early visual assessment of the area and a reduction in tyre pressures will help your progress.

- Stop and decide on the best route, identify any hard or soft sand, walk if necessary.
- Provided you can re-inflate the tyres, lower their pressure by 50 per cent.
- Engage 4WD, (if fitted) select low range and ‘lock’ the hubs.
- Use existing wheel ruts if the sand appears to be more compacted.
- Keep engine revolutions in the mid-range.
- Within reason, do not fight the steering wheel.
- Avoid wheel spin by minimising hard acceleration.
- Avoid any sharp turns.
- Avoid sudden braking.
- If stuck, try reversing.
- If you have to turn the vehicle around, turn down hill to keep up speed.
- Move aggressively from side to side on the steering wheel, if vehicle is bogged.

Guidelines for driving through long grass

Avoid the temptation of travelling at high speed because long grass may hide many obstacles and hazards. When you are driving in long grass, especially in a bonneted vehicle, it is advisable to have someone walk in front of the vehicle to detect holes, logs, stumps, rocks or other obstacles.

Where possible, during firefighting operations in heavy or high grass situations, it is preferable to travel on the burnt side of the fire line. After travelling in long grass, remember to check under the vehicle for any build-up of grass around the radiator, engine and exhaust system. This build-up may cause overheating and result in the vehicle being damaged, or catching fire, or it may start grass fires. At night, the grass may obscure the headlights of vehicles reducing visibility.

When driving through long grass:

- stop and plan the route
- use a guide if possible or walk the route yourself
- check for hidden obstacles or hazards
- during firefighting, drive on burnt ground if possible
- after driving in long grass, remove any built-up grass from the vehicle's:
    - radiator
    - engine
    - exhaust system
    - drive shafts
    - protection plates.

Rocky terrain

Operating in rocky terrain can cause substantial damage to both the vehicle and tyres unless care is taken.

- Select a course which will maintain maximum vehicle clearance and traction.
- If fitted, consider engaging four-wheel drive, low range.
- Travel as slowly as possible, allowing the vehicle to climb over obstacles using engine torque.
- Beware of rocks on the high side of the track which may increase the side angle of the vehicle beyond its safe limits.
- Avoid wheel spin by careful smooth use of the accelerator.
- Ensure that rocks are not thrown up under the vehicle, or become dislodged, possibly causing the vehicle to slip sideways.
- If it is necessary to straddle obstacles, check the vehicle's ground clearance as the obstruction is passed over.
- When clear, check for damage.

'Speed is generally not necessary since traction on dry rocky surfaces is usually good.
As a general rule, place your wheels on the high spots, not in the ruts or gullies, when negotiating ground which varies in relief more than your ground clearance can cope with.'

Gregory's Scientific Publications, Four Wheel Drive Handbook, Aust. 1985, pages 27

Transmission wind-up

Transmission wind-up is a condition which places great stress on a vehicle and may make it difficult to drive. You need to know what transmission wind-up is, its effects and how to release it.

When a 4WD vehicle is used in the 4WD mode on hard surfaces, including bitumen roads or hard packed dirt, stresses can build up in the transmission and drive line. The stress is caused by the differences in rotation between the front and rear wheels, and occurs mainly when negotiating corners, but also when there are differences between the rolling circumference of front and rear tyres. This may be due to differences in tyre wear, pressure, type and size. This built up stress is called wind-up.

The main effects of wind-up are steering difficulties, rapid tyre wear, difficulty selecting 2WD mode after 4WD operation and, in extreme cases, mechanical damage.

Releasing transmission wind-up

Once wind-up has occurred, the recommended methods for releasing the stress in the drive line are to:

- drive with one side of the vehicle on lose ground for a short distance. This usually allows a front wheel to slip
- reverse the vehicle until wind-up is removed
- jack up one front wheel — the wheel will rotate slightly, relieving the internal stress.

Driving tankers

As indicated previously, if driving a tanker off-road, you need to consider the additional factor of the effect of the movement of water in the vehicle's water tank (see diagram below). Many of the tankers operated by firefighting organisations carry a 2,000, 3,000 or 4,000 litre tank. This means that, when fully loaded, the tanker is carrying between 2 and 4 tonnes of water.

Water reacts to the movement of the vehicle, and the reaction can be violent if the vehicle is being driven across rough country. The water's lateral (sideways) motion will be aggravated if the vehicle has a partially filled tank, which will usually be the case during wildfire operations. As a result, you need to drive with additional care to avoid tipping the vehicle over. The sensation of water movement in a tanker vehicle is often referred to as 'surge'.

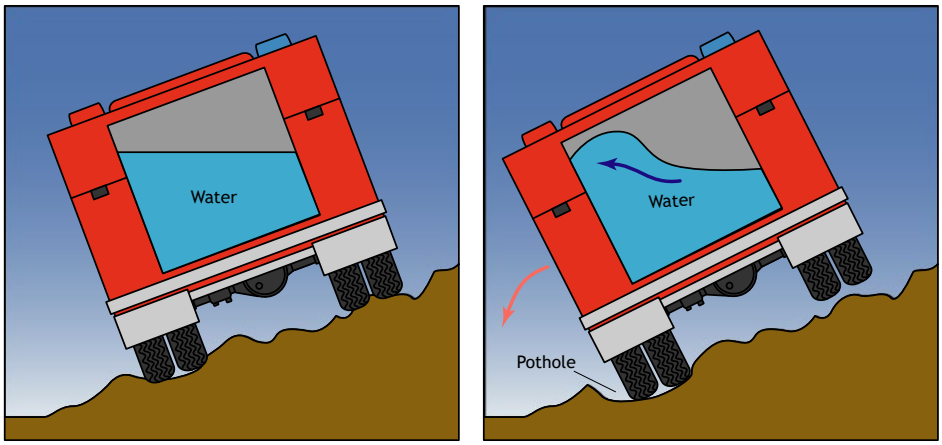


Diagram: Effect of water movement.

Summary

- Adverse off-road driving conditions can include decreased vision, poor traction, obscured or uneven terrain, shifting load, limited space for maneuvering, steep slopes or driving alone.
- You can overcome many of these adverse conditions if you:
  - analyse the situation
  - slow down
  - get out and look, or use a guide
  - use another route.
- The operation of 4WD vehicles involves a knowledge of:
  - their characteristics
  - gear selections
  - situations where their use is necessary
  - limitations
  - key features of the off-road driving position
  - considerations for crew safety
  - function and operation of free-wheeling hubs.
- When driving in off-road conditions, a range of difficult situations may have to be negotiated including:
  - park brake start
  - stopping or stalling procedure
  - steep ascent and descent
  - short vertical rises, humps and ditches
  - side slopes
  - mud
  - sand
  - long grass
  - low visibility (smoke/grass)
  - rocky terrain
  - transmission wind-up
  - operation of tankers.
- Transmission wind-up in a 4WD vehicle occurs as a result of stress caused by the differences in rotation between the front and rear wheels.

PART 4 - Self-Assessment

1. **What distinguishes a 2WD from a 4WD vehicle?**
2. **What is the procedure for a park brake start when you want to ascend a steep slope?**
3. **What is the procedure for stopping or stalling on a steep slope?**
4. **What are the guidelines for driving through long grass?**
5. **How can transmission wind-up in a 4WD vehicle be released?**

PART 5 – Vehicles recovery

Inevitably, when driving organisation vehicles, on or off-road, occasions will occur when the vehicle becomes immobilised. The cause may be a flat tyre, mechanical malfunction or the vehicle may be bogged. Procedures for the recovery of vehicles will vary depending on terrain, break down type or bogging, so you need to be familiar with several techniques for vehicle recovery.

This section covers the topics intended to assist you to safely carry out vehicle recovery procedures:

- vehicle jacking systems
- winching systems
- rigging for winching
- towing.

Vehicle jacking systems

The jack supplied with the average vehicle is designed to raise the vehicle sufficiently to enable a wheel to be changed. The NTFRS also permit a jack to be used to raise a bogged vehicle in order to place material under a wheel to get better traction.

If a vehicle is bogged, rather than using a jack, it may be better to wait for a recovery vehicle to arrive and tow the bogged vehicle to firm ground, however, this is not always an option.

Many drivers have never used a jack and jacking can be a potentially dangerous operation. A vehicle which is resting on three wheels and a jack is less stable than one resting on four wheels. For this reason, before you drive, it is important to familiarise yourself with jacking equipment and associated procedures.

Due to the range of jacks carried on emergency vehicle, this section concentrates on the broad principles of the use of vehicle jacks.

Items discussed include:

- jacking equipment
- issues to be considered before jacking a vehicle
- jacking a vehicle
- changing a wheel.

The operation of vehicle-mounted jacks fitted to aerial appliances is not covered in this learner resource.

Types of jacks

A hydraulic jack works on the principal of pressurising oil to force a cylinder upwards in order to raise a vehicle, change a road wheel or to allow access to components under the vehicle.

The high lift jack is a versatile piece of equipment which can be used for many tasks including conventional vehicle jacking, hand winching and shifting falling trees from tracks. This type of jack is designed primarily for off-road use. It is able to raise one end of a vehicle off the ground.

When used for lifting a vehicle, the high lift jack is usually placed under the front bumper bar mount or rear cross-member. Under these conditions, when the vehicle is raised the jack can become unstable and dangerous so care must be taken not to place any part of your body under the vehicle or wheel. Packing material can then be placed under wheels to release a bogged vehicle.
It is important that you practise using a jack in a simulated event before you have to use it in a real-life situation. The types of jacks you may be required to use include hydraulic and high-lift jacks, illustrated in diagrams below.

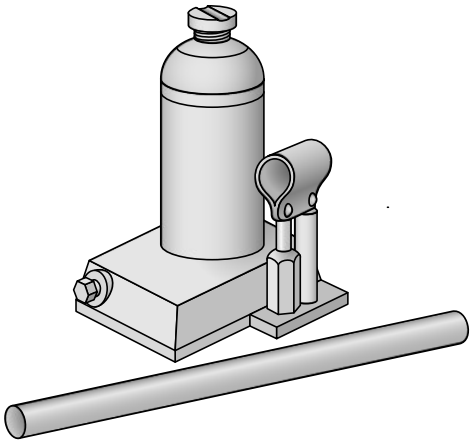


Image: Hydraulic jack

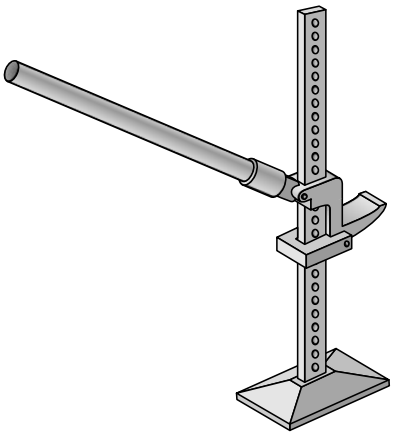


Image: High lift jack

Jacking equipment

Before driving a vehicle you should know where the jack is, how the jack operates, where the jack can be placed under the vehicle and how high the jack lifts the vehicle.

The equipment needed to safely jack up a vehicle includes a:

- jack
- jack handle (if separate from the jack)
- wheel brace to loosen wheel nuts (if changing a wheel)
- jack pad (to provide a stable base for the jack) chocks (to ensure the vehicle does not roll)
- safety triangles (to warn other road users)

NOTE

Never put any part of your body under a jacked vehicle.

Before jacking

Before you carry out any jacking of a vehicle, you need to ask yourself these questions:

- Is there enough clearance under the vehicle?
- What are the maximum and minimum height limits of the jack?
- What is the jack's lifting capacity?

- Is the condition of the ground:
  - flat or sloping?
  - firm or soft?
  - stable or unstable?
- Where will the jack be best positioned in relation to the:
  - ground?
  - vehicle?
- How stable is the vehicle:
  - before jacking commences?
  - while resting on the jack?

NOTE

The effect of the movement of liquid in a heavy vehicle's fuel or water tank.

Jacking the vehicle (7 points in jacking a vehicle)

If you are satisfied that it is safe to raise the vehicle, then:

- engage the park brake
- clear the area of people
- chock the wheels
- put the vehicle in gear (and in 4-WD if so equipped) and apply the handbrake
- select the most suitable position for the jack
- position a jack pad if available
- raise the vehicle.

Pause regularly to check the stability of:

- the jack
- the vehicle
- the ground
- if the ground is unsuitable, call for recovery support.

Never jack a vehicle on a slope or unstable ground!
Move the vehicle to flat, solid ground if jacking is required!

Changing a wheel

As stated earlier, the most common reason for jacking a vehicle is to change a wheel. The procedure for changing a wheel is:

- clear the area
- engage the park brake
- unload the spare wheel and the jacking equipment
- follow the procedure shown in 'Jacking the vehicle'
- loosen the wheel nuts
- jack up the vehicle to the required height (height to fit replacement wheel)
- remove the wheel nuts
- remove wheel and clean the axle hub
- replace the wheel
- ensure valve stems are opposite each other on dual wheels
- when matching dual wheels, fit the larger diameter wheel to the outside to ensure maximum vehicle stability (wheels may vary in diameter due to different tyre tread patterns or to the amount of tyre wear)
- replace the wheel nuts and tighten up as per manufacturers sequence
- lower the jack
- recheck the wheel nut tension
- check all the wheel-changing equipment before replacing it on the vehicle
- remove the chocks
- recheck the wheel nut tension after travelling approximately 50km.

Do not place any part of your body under the vehicle while wheel/wheel nuts are removed!

Winching systems

Driving a vehicle off-road involves the risk of becoming bogged in mud or sand or becoming stuck in a ditch. Generally it is better to wait for a recovery vehicle to arrive and tow the bogged vehicle to firm ground. This is not always an option and, to help deal with these situations, some four-wheel drive vehicles are equipped with a winch.

A winching operation is quite technical and has an associated high risk factor. Make sure you know the correct and safe operating procedures for the types of winch you may be required to use. Like any piece of equipment, a winch has been designed for a specific purpose and needs to be used within its limits and in accordance with the manufacturer's instructions.

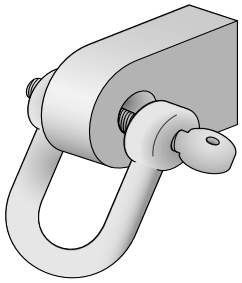
Types of winching systems

Winch type	Operation	Advantages	Disadvantages
Power take-off drum winch	• Powered by the vehicle's engine, through a power take-off and drive shaft to the winch's worm drive. • The worm drive has a threaded shaft (the worm) on which the cable drum is mounted. It mates at right angle with a geared wheel driven by the drive shaft.	• Does not rely on the vehicle's electrical system. • Designed to provide 'high pulling power' on a long-term basis.	• Can only be fitted to vehicles equipped with a power take off. Is difficult, if not impossible, to use in moving the vehicle backwards or sideways. • Heavy, and has many components that require maintenance.
Electric drum winch	• Is powered by the vehicle's battery. • Has a worm drive and drum. • The engine must be run at a fast idle to maintain a charge in the battery when operating the winch. • Is single speed, forward or reverse.	• Can be fitted to many vehicles. • Powered operation does not require engine power. • May work under water provided sufficient battery power is available.	• Draws enormous amounts of current from the battery when it is being operated. • Has a single speed and slow wind-in, especially under heavy loads.
Hand-operated winch	• Operated by a lever. • The tension of the rope is applied by means of 2 pairs of self-energised jaws which apply a grip onto the wire rope in sections. The effort is transferred to the jaws by 2 parallel levers, one for forward operation and the other for reverse operation.	• Can be easily carried by one person. • Versatile and can be used for pulling vehicles forward, backwards, sidewards and righting overturned vehicles. • Comes with own cable and extension cable.	• Requires considerable physical effort, especially if winching a vehicle up a slope or out of a bog. • Operation is relatively slow and preparations for winching take time.

Equipment for winching and towing

Equipment used in winching and towing operations typically includes tow/snatch straps, shackles, pulley blocks and slings.

Precautions for each of them are included as follows.

<table>
<tr><th colspan="3">Only use rated recovery equipment and rated recovery points</th></tr>
<tr><td>Tow and Snatch Straps</td><td colspan="2">A strap is a length of heavy duty webbing or synthetic material with a ‘D’ closure at each end. Avoid dragging straps through sand or mud. It is important that the strap is never pulled, passed, or laid over sharp edges. Remember, damaged straps should never be used. After you have completed using the strap it should be cleaned and allow it to dry naturally.</td></tr>
<tr><td rowspan="2">Shackles</td><td colspan="2">A shackle is used when you need to couple a strap or winch cable to a vehicle. It consists of a ‘U’ shaped metal casting through which a threaded pin is inserted to form an elongated ‘D’.</td></tr>
<tr><td>An example of a shackle is shown in Figure 34. Precautions when using this equipment are:
do not place a side load on shackles
only use shackles marked with their safe working load (SWL)
ensure that the shackle pin is screwed all the way in before loading, then loosen 1/4 of a turn
ensure the heads of screwed pins are always uppermost when a snatch block is under load.</td><td> 
Shackle and vehicle tow point
Figure 34</td></tr>
<tr><td>Pulley Block</td><td>A ‘Pulley Block’ consists of a wheel (the sheave), grooved around its circumference, which is fitted in metal wings that can pivot to allow rope cable to be passed through. When using a pulley:
ensure that the wings are closed and the pulley block is secured with a rated shackle.
keep sheave grooves clear of dirt and mud
ensure that the sheave is the correct size for the cable/rope being used.</td><td>  </td></tr>
<tr><td>Slings</td><td colspan="2">A sling is a length of heavy duty webbing or synthetic material with a ‘D’ closure at each end. It is slung around a tree or post and connected by a hook or shackle to a winch cable or pulley block. When using a sling, you need to inspect it for defects prior to use and distribute the load evenly on each leg of the sling when loading. Keep your hands clear of slings under the load and if there is any doubt about the condition of a sling, do not use it!</td></tr>
</table>

Using an electric winch

An electric winch can be fitted to most vehicles. The winch consists of an electric motor (which is similar to a car starter motor) a worm drive and drum. Guidelines for using an electric winch are as follows:

- when using the electric winch, keep the engine running in the winching vehicle
- when winching out under power, ensure that tension is kept on the winch cable
- use the control switch intermittently to take up cable slack; avoid sudden or 'shock' loads because they can momentarily exceed the winch and cable load rating
- never winch with less than five wraps of cable on the drum
- periodically check the winch drum during operation to ensure that the winch cable is winding on to the drum correctly
- stop winching when the cable hook is within two metres of the fair lead; use the switch intermittently to wind on the remaining cable
- Keep the winch's clutch disengaged while the winch is not in use. This can avoid damage if the winch is accidentally actuated
- before rewinding the winch cable, ensure that there are no loops, kinks or fouling
- when rewinding the cable, keep it under light tension.

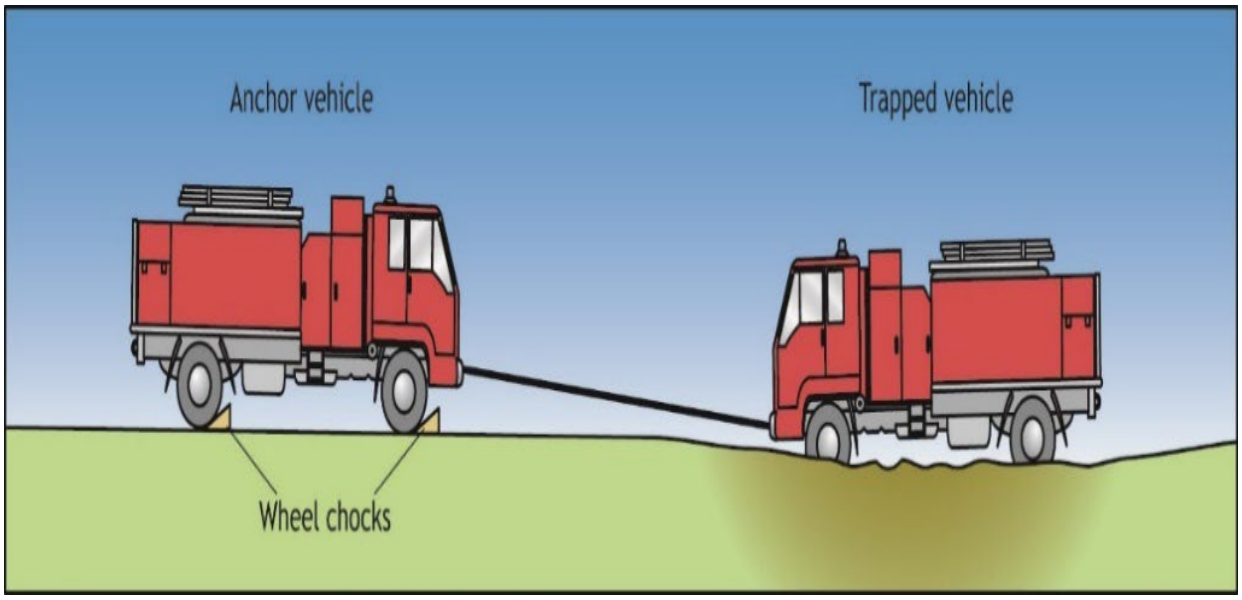


Diagram: Winching a vehicle.

General winching safety principles

All winches involve an element of risk in their use. A wire rope can break causing a violent and dangerous whip. Keep clear of winch ropes and cables while they are in use and keep others away. Only use equipment which is in good condition.

In general the principles of operating any type of winch are:

- drivers need to be thoroughly familiar with a vehicle's winch operation before taking the vehicle off-road
- one person only is in charge of the winching operation
- the person in charge of winching appoints another person as the winch operator
- all people not involved must be at least 1.5 times the cable length away from the operation
- the winch operator only responds to directions from the person in charge of the operation
- people involved in rigging the winch must always wear heavy gloves when handling the winch cable
- the winch operator must have an uninterrupted view of the person in charge. If not, winching must be stopped immediately
- never handle the winch cable when winching is in progress
- never step over a rigged winch rope
- fouled rigging should only be cleared using hand tools
- disconnect the winch rigging from the vehicle before disassembly or working on the rigging
- **do not** allow the cable to twist
- **do not** use the cable if you suspect that it has been damaged
- the winch cable should never be used for towing, even for a few metres, as this could result in damage to both the cable and the winch
- if a vehicle is being used as an anchor in a winching operation, before commencing winching, ensure that the vehicle's brakes are applied and that wheel chocks are used when necessary (
- always pull in as straight a line as possible. The fair leads (the rollers fitted to the winch) are designed to help with minor misalignment but cable strength is severely reduced when forced to go around a corner
- a winch-equipped vehicle should not be left unattended when its winch is under a strain
- if possible, lay sandbags or soil over the winch cable to prevent cable whip (back-lash) in the event of cable breakage. If they are not available, a heavy coat or blanket will help
- after using the winch, pull the cable out to its full length, check that it is clean and undamaged, and rewind it correctly onto the drum

Rigging for winching operations

Winching a vehicle can be a very dangerous practice if care is not taken. Setting up the rigging and establishing a safe anchor is critical. There are several rigging methods. The selection of the most suitable method will depend on the nature of the recovery operation and any variables that may influence the recovery procedure. Before winching a vehicle, you need to think about where you will secure the winch cable, slings and anchors are a critical part of the rigging.

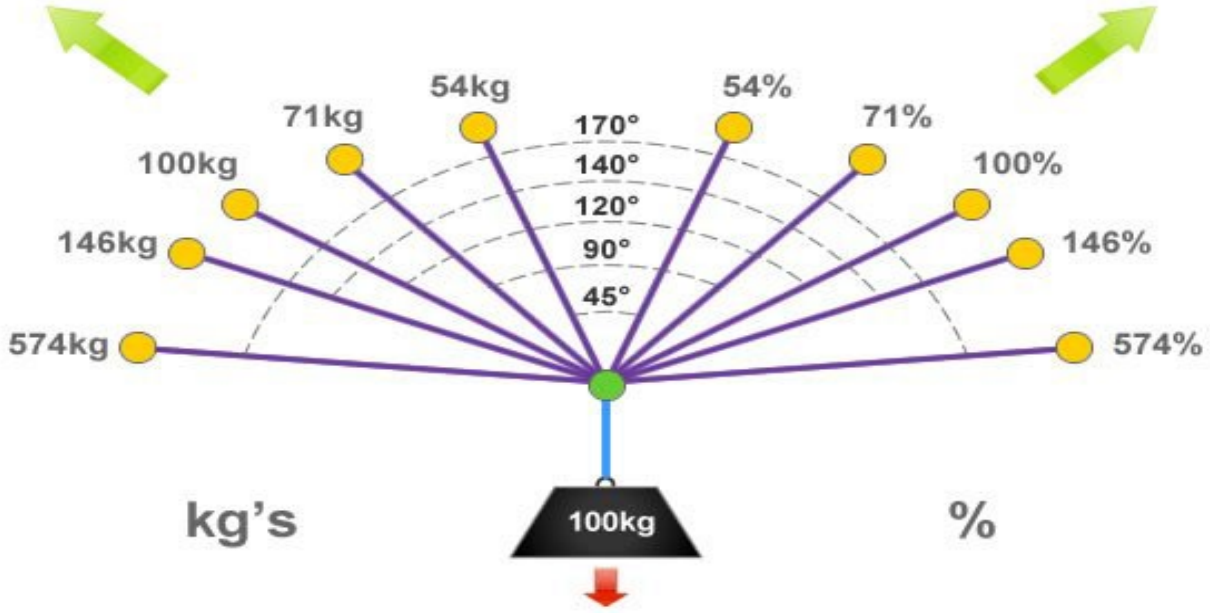
Slings and anchors

To enable you to carry out a vehicle recovery safely, you will need to be aware of the function of slings and anchors as well as their advantages and limitations.

Slings

Web slings are the most versatile as they do less damage to trees used as anchors as they are designed to take some of the shock loading. The smaller the angle in the sling (see below), the stronger the rigging. The sling must be as strong as every other part of the rigging.

Image: NTFRS



Natural anchors

Natural anchors can be convenient and easy to use. Trees are ideal natural anchors, but you should always check to ensure that the tree is solid and able to take the load that is required. **Do not** use

hollow trees particularly at a 'mop-up' after a fire. If using a tree as an anchor, wrap a hessian bag or something similar around it to avoid damage to the trunk. Locate the sling as far down the tree trunk as possible. Be aware that dead or loosened branches can be safety hazards.

Image: NTFRS

Artificial anchors

Artificial anchors may be required where trees aren't available. They rely on the tenacity of the soil and are not suitable for muddy, lose or sandy conditions. There is no one best anchor. Your selection will depend on the conditions you are dealing with and the scope of your winching task. Two simple forms of artificial anchors are the stake and the dead-man.

Stake anchor

A stake anchor is made with three or more strong stakes, such as star pickets, each approximately one metre long. The stakes are driven into the ground to about two thirds of their length at an angle away from the intended pull. Once firmly embedded, the pickets are lashed together with rope. With the top of the first stake lashed to the second stake at ground level, the second stake lashed to the third, and so on if more than three are used.

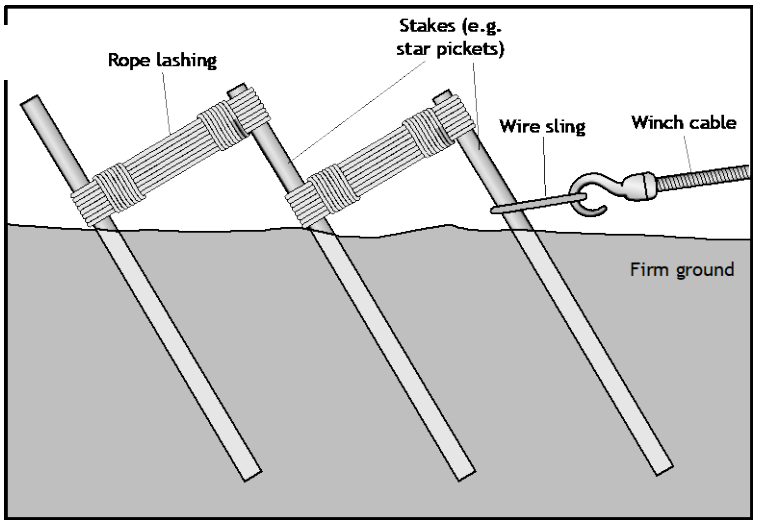
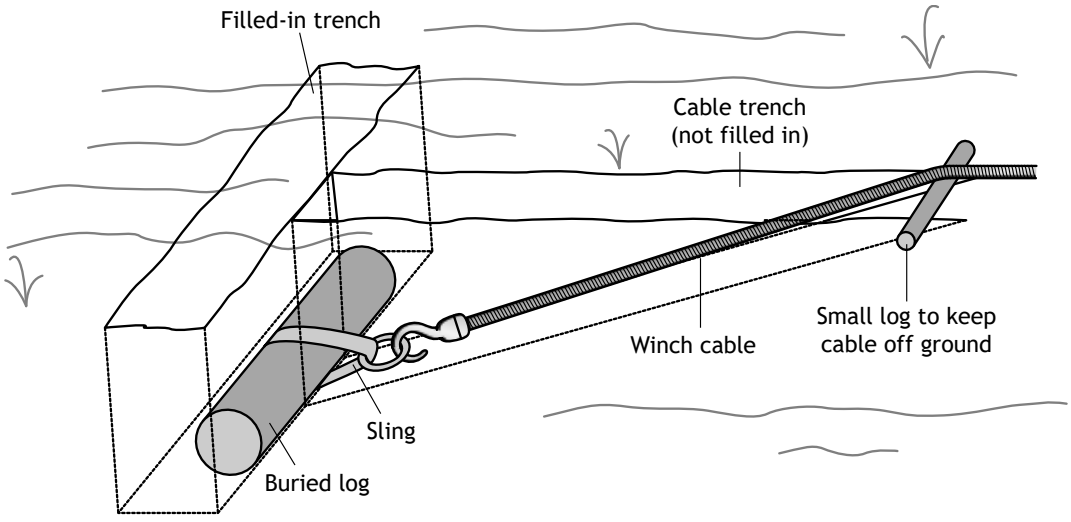


Image: Stake anchor.

Dead-man anchor

A dead-man anchor is made with a log or the spare wheel. A trench is dug as deep as possible, at right angles to the intended direction of pull. The log or wheel is positioned in the trench, and secured if possible. A sling is used to attach the winch cable hook to the log or tyre, and the trench is filled in. A narrow trench is dug along the line of the cable to prevent it from pulling the anchor out of the ground. A small log or piece of wood is positioned at the start of the cable trench to keep the cable off the ground.



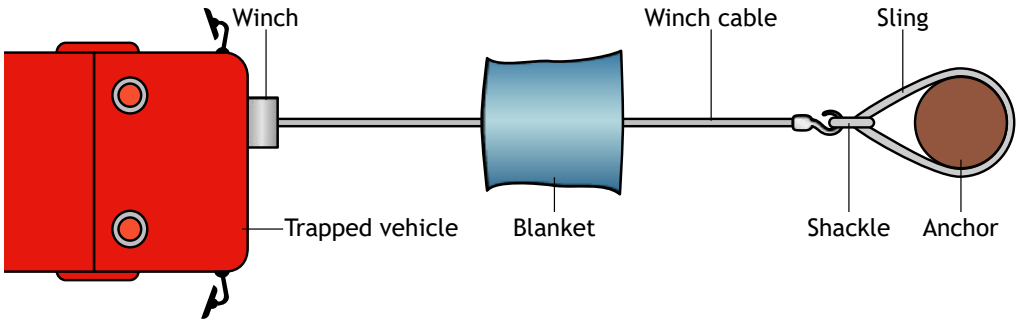
Drawing: Dead-man anchor using a log

Rigging methods

Single-pull rigging

This is the simplest rigging method. The winch cable is attached to the anchor by a web sling. The winch cable must not be looped around the anchor because that would reduce the strength of the rigging. Slings should be positioned as low down on the anchor point as possible. If the winch cable or part of the rigging should break under strain, there is a danger of serious injury from the cable whipping back.

A blanket (or something similar) should be placed over the middle of the cable to absorb some of the momentum of a snapped cable, lowering the risk of injury. The figure below shows single-pull rigging.

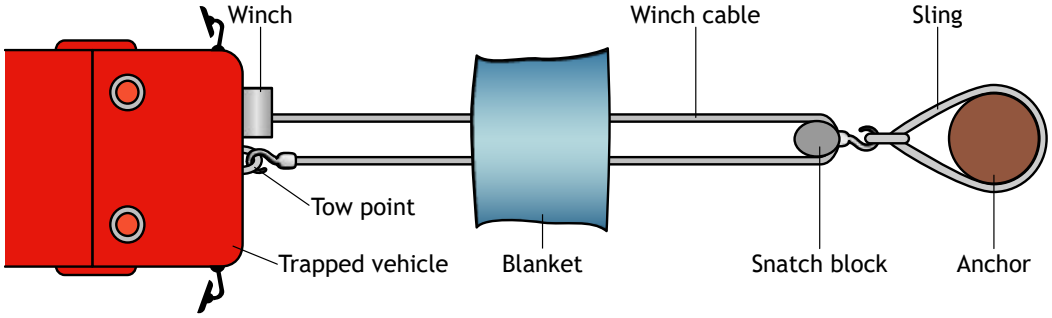


Drawing: Winching using single-pull rigging.

Double-pull rigging

The double-pull method of rigging involves running out the winch cable to the anchor point, looping it through a pulley block, bringing the cable back to the stalled or bogged vehicle and connecting the cable hook or a shackle to the vehicle's recovery point. This is a preferred method of rigging.

The use of a pulley block at the anchor point provides 2:1 mechanical advantages that will almost double your winch's pulling capacity, reducing the load on the line and winch by approximately one half. If using an electric winch, the method allows the motor to run faster and therefore reduces the drain on the battery. Longer pulls can be made without overheating the motor.

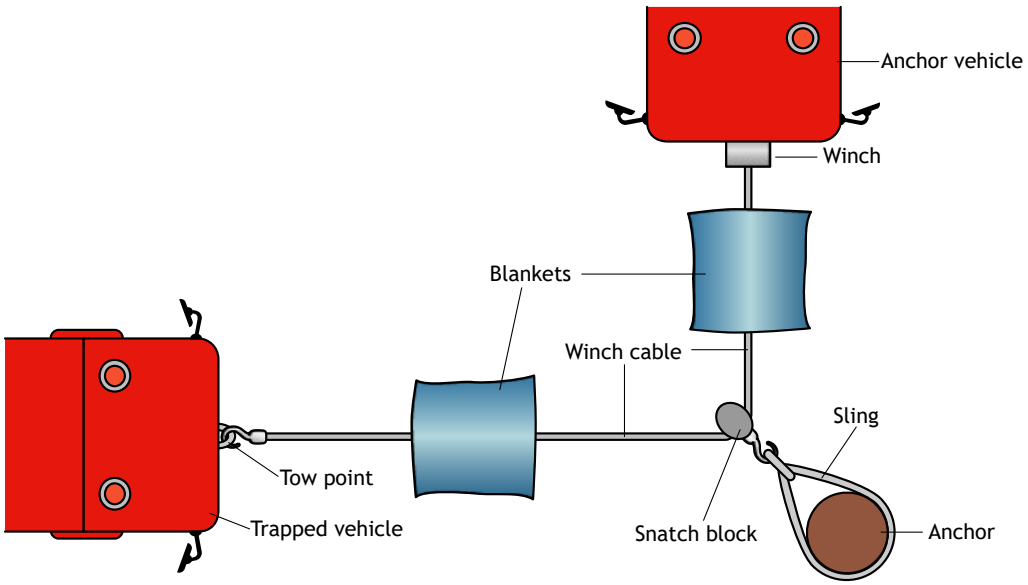


Drawing: Double-pull rigging.

Side-pull (angle-pull) rigging

A side pull is useful when the vehicle being used to winch a bogged vehicle cannot be anchored in a position suitable for a straight pull. A pulley block is attached to an anchor by a sling. The recovery vehicle, with a winch, is located on solid ground. The winch cable is run through the pulley block and connected to the recovery hook of the stranded vehicle.

For additional mechanical advantage another pulley block can be attached to the stranded vehicle. The winch cable is run through this pulley block and back to the anchor point.



Drawing: Side-pull rigging.

Towing

The NTFRS only permits towing to return a bogged vehicle to firm ground or to remove an immobilised vehicle from danger.

Both of these operations should only require short journeys. In general, any vehicle which has been immobilised through mechanical breakdown should only be towed by a specialised tow truck.

Towing is an operation that requires knowledge and skill. It needs practice if it is to be carried out safely and effectively.

Towing issues

The following analysis of the situation needs to be undertaken whenever you have to tow a vehicle:

- identify any obstacles, slopes, humps or ditches that may interfere with the operation; make sure that they can be negotiated before starting to tow
- identify the safest direction for the tow
- ensure that the path for the towing vehicle is stable
- identify suitable recovery points on each vehicle
- ensure that the tow strap or snatch strap is strong enough. Remember that obstacles may increase the load
- ensure that the towing vehicle is strong enough. Again, remember the effect of negotiating obstacles
- ensure that the brakes on the towed vehicle are fully operational
- ensure that there are trained and competent drivers in each vehicle.

Image: Towing

If any of the above conditions cannot be met, do not proceed with the operation.

Hook-ups

The way the 2 vehicles are connected is critical. The connection is called a hook-up.

Hook-ups should only be made to rated recovery points. They should never be made to axles or suspension because a shock load can damage them.

Image: Hook-up

Only use rated recovery points and rated recovery equipment for towing or recovery.

Guidelines for Towing

The following guidelines for towing a vehicle have been established to create a safe environment and minimise the risk of accidents.

- One person is to be in charge of the towing operation.
- The person in charge allocates tasks and briefs the participants.
- Any people not involved are to remain clear of the area.
- People handling towing equipment must wear gloves at all times.
- **Do not** step over any part of the towing equipment once it is connected.
- Drivers must agree on signals beforehand:
    - one from the towed driver to signal ‘stop pulling’
    - another from the towing driver to signal ‘brake’.

- The towing driver will:
  - try to keep a steady tension on the snatch strap
  - avoid braking, unless signaled by the towed vehicle driver
  - allow for increased load due to obstacles.
- The towed driver is to:
  - try to keep the snatch strap taut
  - brake for both vehicles.
- Before the slack is taken up, the person in charge will:
  - check the towing equipment
  - check the area is clear
  - order all personnel not in vehicles to move a minimum of 1½ times the snatch strap length away.
- The person in charge will:
  - order the slack take up
  - check the towing equipment under stress.
- The person in charge will order the start of the tow.
- If adjustments are needed, the:
  - operation must stop
  - person in charge will nominate a crew member to make the adjustment.
- Once the operation is complete:
  - secure the vehicles
  - disconnect the rigging at both ends
  - person in charge shouts ‘safe’.

Summary

- Your vehicle may require recovery as a result of a flat tyre, mechanical malfunction or the vehicle may be bogged.
- A jack is a device for lifting heavy objects. It is designed to raise a vehicle sufficiently to change a wheel or, if bogged, to place material under a wheel.
- Two common types of jack are the hydraulic jack and the high lift jack.
- Before driving a vehicle, you should know:
  - how the jack operates
  - where the jack can be placed under the vehicle
  - how high the jack lifts the vehicle
- **It is important to never put any part of your body under a jacked vehicle.**
- Common types of winches include power take-off, electric and hand operated.
- Equipment used in winch operations typically includes shackles, web straps, pulley blocks and slings.
- An anchor is a critical part of winching. It may be natural or artificial. Natural anchors include trees. Artificial anchors need to be constructed using stakes, logs or the spare wheel.

- Rigging methods used in winching operations include:
  - single pull
  - double pull
  - angle pull.
- Towing may be required to:
  - return a bogged vehicle to firm ground.
  - remove an immobilised vehicle from danger.
- The connection of two vehicles is called a hook-up.
- **Only use rated recovery points and rated recovery equipment for towing or recovery.**
- Towing guidelines are established to create a safe environment and minimise the risk of accidents.

PART 5 - Self-Assessment

1. **What are the steps in jacking a vehicle?**
2. **What are the advantages and disadvantages of an electric winch?**
3. **What is involved in creating a dead-man anchor?**
4. **Why shouldn't a hook-up be made to a vehicle's axle?**