



THE ULTIMATE 4X4 DRIVING GUIDE



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For more than 40 years, our never-satisfied approach to tire making has built our reputation as an off-road leader. After years of industry firsts, creating a desert racing dynasty and countless overlanding adventures, we've learned this: If you're not pushing yourself to do it better, then there's no point in doing it at all.

THE ORIGINAL OFF-ROADER

Whoever coined the phrase “those who can’t do, teach” clearly never met Mark A. Smith. A trailblazer, pioneer and all-around badass, Mark was affectionately known as the father of modern four-wheeling, and for good reason.



**HIS IMPACT ON
THE SPORT WAS
BOUND BY NO
BORDER.**



As the founder of Jeep Jamboree, Mark popularized the sport of recreational off-roading in the western United States and turned the Rubicon Trail from exotic foothill into one of the most respected off-road trails in the world.

But his impact on the sport was bound by no border. In search of the ultimate off-road conquest, Mark led the Expedicion de las Americas, a 20,000-mile trek from the southernmost tip of South America near Tierra del Fuego to Prudhoe Bay, Alaska, above the Arctic Circle. This was the first nonmilitary expedition to cross the Darien Gap, an impossible landscape that took the only successful army detachment an excruciating 100 days to traverse. But in typical Mark fashion, his team did it in only 30.

While he could have retired right then and there, with nothing left to prove and a new Jeep tattoo on his rear, he helped scout and brief contestants at the 1987 Camel Trophy event, quite possibly

the world's most intense overlanding adventure. Competitors from around the world traversed the entire island of Madagascar, the first ever north-to-south crossing of its kind.

Mark dedicated his life to learning and teaching safe and practical off-road driving techniques to all who would listen. Many of the techniques depicted in this book were developed and continually shared by Mark himself. Sadly, Mark passed in 2014, but his impact on the sport of off-roading will be felt forever.

On behalf of BFGoodrich® Tires and the entire off-roading community, we dedicate this book to the life's work of off-roading legend Mark A. Smith. His passion and leadership have paved the way for us all.

OUR STORY BEGINS OFF-ROAD

There was a time in the not-so-distant past when off-roading wasn't accessible to many. While there have been many advancements to vehicles and suspension systems over the years, none have been more impactful than those made to tires. Something we at BFGoodrich® Tires hold near and dear to our hearts.

Until the late 1970s, the recreational light truck market ran solely on bias tires. For those who aren't tire nerds like us, driving on bias tires was basically the equivalent of driving on old tractor tires. Sure, they were tough, but also incredibly stiff, prone to tire slip and designed to bulldoze rather than grip. Since this design absorbed little to no shock, you literally felt every bump along the way. Even a short off-road drive was taxing to both vehicle and driver.

You could say the entire industry was stuck between a rock and a hard tire. Passionate off-road drivers of the time just accepted the tire torment as a necessary evil, but our engineers were determined to find a better way.



B.F. Goodrich

1976

DEBUT OF THE RADIAL BFGOODRICH® ALL-TERRAIN T/A®

First radial light truck performance tire in the world.

1977

FRANK VESSELS SWEEPS BAJA 500 AND 1000 (CLASS 8)

On the Radial BFGoodrich® All-Terrain T/A®

1980

DEBUT OF THE RADIAL BFGOODRICH® MUD-TERRAIN T/A®

First radial light truck performance mud tire in the world.

FIRST SCORE BAJA 500 OVERALL WIN

Bob Gordon starts the Baja 500 winning streak.

1984

35" RADIAL BFGOODRICH® MUD-TERRAIN T/A® RELEASED

Becoming the tallest light truck radial tire in the world.

1986

FIRST SCORE BAJA 1000 OVERALL WIN

Mark McMillin and Ralph Paxton start another winning streak.

1990

SCORE BAJA 500: 1ST OVERALL WINNING STREAK REACHES 11

Robby Gordon takes home the checkered flag.

1991

BAJA T/A® DEBUTS

BFGoodrich® Tires releases their first tire designed specifically for off-road racing.

10TH CONSECUTIVE OVERALL BAJA 1000 VICTORY

Larry Ragland takes home the trophy.

They began toying with the radical idea of developing a radial tire that could withstand the rigors of off-road driving while remaining suitable for highway use. But if we were going to convince the world these tires were up to the task, we were going to have to prove it – because no one out there was listening.

THE ENTIRE INDUSTRY WAS STUCK BETWEEN A ROCK AND A HARD TIRE.

So, we did the unthinkable. We entered our radial all-terrain tires in the Baja 1000, the toughest off-road endurance race in North America. And like every great underdog story of the 20th century, we shocked the world by not only surviving but winning. In that moment we created a category that we still dominate today.

To honor that triumph, many new BFGoodrich® tire prototypes are tested at Baja, the place where it all began. Our flagship tires in both the all-terrain and mud-terrain categories have special sidewall markings to designate their victorious runs in the desert. And when it's tough enough to win Baja, it's tough enough for you.



1999

BFGOODRICH® TIRES WINS THE DAKAR RALLY

With John-Louis Schlessler.

2002

20TH OVERALL BAJA 500 WIN

With Troy Herbst and Larry Roeseler.

2003

BFGOODRICH® KRAWLER™ T/A® KX TIRE IS RELEASED

The ultimate in off-road traction and toughness.

2005

20TH CONSECUTIVE BAJA 1000 VICTORY

Troy Herbst and Larry Roeseler take the overall win.

2009

BFGOODRICH® TIRES DOMINATES AT KING OF THE HAMMERS

The brand wins the top 9 positions.

2014

THE BFGOODRICH® ALL-TERRAIN T/A® KO2 TIRE IS RELEASED

Becoming our toughest all-terrain tire to date.

2018

THE BFGOODRICH® MUD-TERRAIN T/A® KM3 TIRE IS RELEASED

Providing serious off-road enthusiasts with extreme toughness and traction.

SAFETY CHECK

Let's make this clear. What you see depicted in video games and movies is far from a normal trail ride. The majority of off-roading happens in low gears and relatively low speeds. A common phrase from the legendary Camel Trophy events perfectly sums up how you should approach the trail: *As slowly as possible, as fast as necessary.*

Make no mistake, venturing off the pavement isn't an easy task. Even the simplest trail rides require much knowledge and technique. There are inherent risks to taking your vehicle off-road. The more aware you are of those risks, the safer you'll be.

Being prepared and staying safe will gain you credibility within the recreational 4X4 community. Being stupid won't. Like your mother always said, "Don't be the person who ruins it for everyone." Doing something dangerous or reckless for the sake of a few likes on social media has no place in this sport. Be courteous and respectful to all fellow drivers and the environment.



WEAR YOUR SEATBELT

By this point in your life, you should know to always wear your seatbelt, **UNLESS** you are crossing a river or stream. This is the only exception, ensuring that you can quickly evacuate the vehicle. *See page 43 for more.*

KNOW YOUR SURROUNDINGS

Survey the land before driving, and adhere to all environmental regulations. *See page 32 for more.*



NEVER STAND OR LET ANYONE STAND IN YOUR VEHICLE

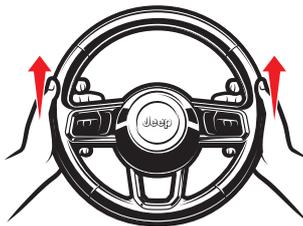
Keep arms and legs inside the vehicle at all times.

SOFT-TOP VEHICLES MUST HAVE A ROLL BAR

This is imperative for your safety in the event that your vehicle flips.

NEVER TRAVEL ALONE

If you must go solo, let someone know where you'll be.



THUMBS UP

Avoid steering with your thumbs inside the steering wheel. Obstacles may cause the steering wheel to spin out of your hands, and the spokes can injure or even break your thumbs.

BE AWARE DURING RECOVERY

Stay clear of winches, tow straps or any recovery equipment used on the trail. These may break and can cause severe injury.

See page 50 for more.



NO DRUGS OR ALCOHOL

Keep it off the trail.

PROPERLY DISPOSE OF CIGARETTE BUTTS

Beyond the fact that littering is completely uncool, cigarette butts can start a brush or forest fire.

If you're going to smoke, submerge the cigarette in water for 3 seconds before disposing of it in a proper receptacle.

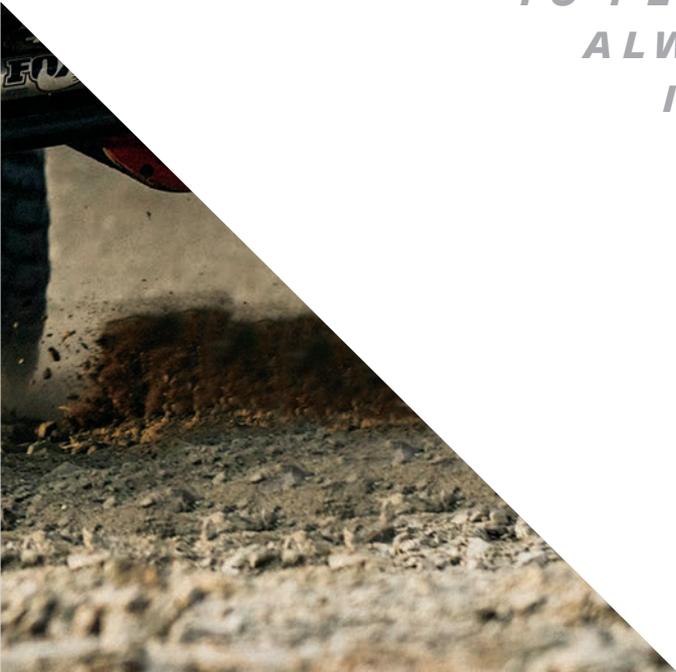
GEAR UP BEFORE YOU GO

According to Jim Allen, author of the critically-acclaimed *Four-Wheeler's Bible*, there are basic vehicle supplies that should be packed before embarking on any four-wheel adventure.

- Front and rear towing points
- Tow strap
- Full-sized spare tire
- Trusted tool kit
- More-capable-than-stock jack
- Spare vehicle parts
- Basic first aid kit
- Portable air compressor
- Duct tape
- Jumper cables
- WD-40
- Bailing wire
- Zip ties

TIRE SELECTION





*THE TIRE'S ABILITY
TO PERFORM SHOULD
ALWAYS OUTWEIGH
ITS AESTHETICS.*

ALL-TERRAIN vs. MUD-TERRAIN

Choosing the right tire is a crucial part of preparing your vehicle for off-road. Unless you are into racing or extreme rock crawling, you'll probably be looking at either an all-terrain or mud-terrain tire. Don't be fooled into thinking the tougher-looking mud-terrain tire is always the better option – the tire's ability to perform should always outweigh its aesthetics.

Knowing your driving style and the types of terrain you'll likely encounter is key to making a well-informed decision. Do your research, ask questions and be realistic about what you need from your tires.

ALL-TERRAIN TIRES

As the name indicates, all-terrain tires are designed to provide considerable traction over a wide range of terrains. The less aggressive tread design provides a quieter highway ride than mud-terrain tires and offers better handling on pavement as well.

IDEAL FOR:

- Long-distance overlanding expeditions.
- Intermittent trail-to-highway driving.
- 4x4 trucks built for hauling or towing.
- Winter conditions.

BALANCED TREAD PATTERN

Allows the tire to perform well in both off-road and on-road situations. This is why we call them "all-terrain" tires, you know.

MORE SIPES

Increase the number of biting edges, meaning more traction in winter conditions.

KEY OFFERING

**BFGOODRICH®
ALL-TERRAIN T/A® KO2 TIRE.**



PRO TIP

Alignment gets knocked out all the time, but it's easy to adjust right in your driveway. To properly set your front tires inward, compare the width between the front and back of your front tires. Then loosen the sleeves on both ends of the tie-rod and rotate 1/16" to 1/8". Once your toe-in is set, re-tighten the tie-rod sleeves and center up that steering wheel.

SIDEWALL LUGS

Act like paddles to add considerable traction on mud and soft ground compared to street tires.



MUD-TERRAIN TIRES

The large tread blocks and voids associated with a mud-terrain tire's tread effectively evacuate mud and soft soil while maintaining traction on rocky and uneven trails.

The aggressive tread design can lead to more noise and reduced fuel economy when compared to an all-terrain tire. But for those who plan to be off-road more than on, a mud-terrain tire is ready to take on the toughest terrain imaginable.

IDEAL FOR:

- Deep mud and loose soil like sand and silt.
- Uneven, rocky trail surfaces.
- Aired-down, crawling situations.



SUPERIOR SIDEWALL STRENGTH

Helps prevent sidewall splitting and puncturing when navigating extreme terrain.

LARGE TREAD BLOCKS

Grip mud and soft soil, and lock onto rock edges.

LARGE VOIDS

Evacuate mud and soft soil with every rotation of the tire.



EXTREME SPECIALTY TIRES

Not everyone drives their rig to the trail. For the most extreme off-roader, many manufacturers have niche offerings for specialized sports. For example, BFGoodrich offers the Baja T/A® KR3 for desert racing and the Krawler™ T/A® KX for extreme rock crawling.

You won't be able to grab these tires off the shelf, so check with a local dealer to order what you need.



KEY OFFERING

BFGOODRICH®
MUD-TERRAIN T/A® KM3 TIRE.



SIZING

In the world of four-wheeling, size really does matter. The correct tire size can help your vehicle clear obstacles and even perform better in softer terrains. But before you buy, make sure you know they'll fit or that you know how to make 'em fit.

Increasing the tire size beyond factory specifications may require aftermarket modifications, like a lift kit. But jacking up your rig may require further alterations such as extending the brake lines, modifying the steering and other complicated modifications that may not be worth the few extra inches. And be aware of how vehicle alterations will affect your vehicle – making the vehicle taller can affect handling and make the vehicle more prone to rolling.

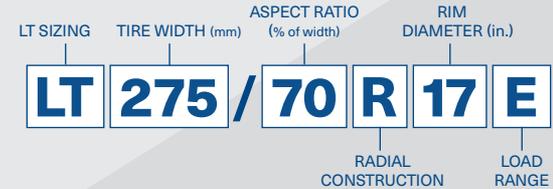
Remember, tow trucks stay on the pavement. So before you get stuck miles from civilization, make sure you pick the tire best suited for your adventure. Most tires suitable for off-road will be classified into one of two sizes: LT-metric or high-flotation.

LT-METRIC SIZES

LT-metric tires are designed specifically for light trucks. They have more reinforcement and a higher load range than typical passenger tires, meaning they can handle more punishment and are better suited for towing, which is why LT-metric tires are also used as the original equipment tires on heavy-duty trucks.

SIZE IT BEFORE YOU BUY IT

If you opt for larger replacement tires, make sure your new size will fit. Here's what the numbers mean:



NEVER REPLACE ORIGINAL EQUIPMENT LT TIRES WITH P-METRIC TIRES.
This will result in lower load capacity ratings at maximum air pressure.

HIGH-FLOTATION SIZES

Flotation tires perform like LT-metric tires, but the sizing for flotation tires is much easier to understand than the sizing for LT-metric tires. Even though LT-metric tires have some additional load-carrying capacity, flotation tires are becoming the go-to upgrade for anyone who wants bigger tires on their vehicle.

KNOW THE DIFFERENCE

High-flotation sizing is structured differently than LT-metric tires. Make sure you are calculating correctly.



ORIGINAL EQUIPMENT CHECK

Never assume that the tire that comes on a new vehicle is designed for the rigors of off-road. Light trucks and SUVs may come equipped with P-metric (passenger) tires as their original equipment. This is done to uphold fuel efficiency promises from the manufacturer.

P 265 / 70 R 17 C

INDICATES P-METRIC SIZING

If your off-road vehicle comes with P-metric tires, give them back or build your kids some tire swings. These are designed for highway use only and should be replaced with an LT or flotation size immediately.





TIRE PRESSURE

You don't need a PHD in biochemistry to know that proper tire pressure will affect the performance of your vehicle. It will help prolong the life of your tires and can help your vehicle navigate certain terrains. Since the optimum tire pressure depends on the specific situation, it's important to travel with a reliable pressure gauge and air compressor at all times.



ON-ROAD AIR PRESSURE

Tire pressure can affect your vehicle's handling, traction and treadwear while driving on pavement. To calculate the correct pressure for driving on-road with OE tires, always follow the recommendation from your vehicle's manufacturer for front and rear. This can be found in the owner's manual or on the tire placard located inside the driver's side door.

However, if you've moved from an OE P-metric size to an LT-metric or high-flotation size, then that's a whole new ballgame. Consult the specific recommendation for that tire's psi to ensure it's at the correct pressure on your vehicle.

FLAT TIRE PREP

Routinely inspect your tires for cuts, bulges, or any other signs of damage. And be prepared in case you get a flat. Always carry the following equipment:

- Full-size spare tire and wheel (+/- 1 inch of the diameter of the main tires).
- 4x6 block to give your jack extra reach.
- Tire plug kit (temporary trail fix).
- Air compressor and gauge.

Once you're back on paved road, see an expert to repair or replace your tire. Tires must be replaced if:

- The sidewall has been punctured.
- The tire has any cuts or gashes.



ALWAYS AIR UP WHEN RETURNING TO SURFACED ROADS.

Underinflated tires will negatively impact your handling, traction and treadwear on the road. Underinflated tires also run hotter, which can lead to tire failure.

OFF-ROAD AIR PRESSURE

Lowering the tire pressure, or airing down, can offer a smoother ride while driving off-highway. It also expands your tire's footprint, resulting in better traction over rocks and loose terrain. How much to air down has a lot to do with your personal preference, so it's a good idea to consult an experienced driver before airing down for the first time.

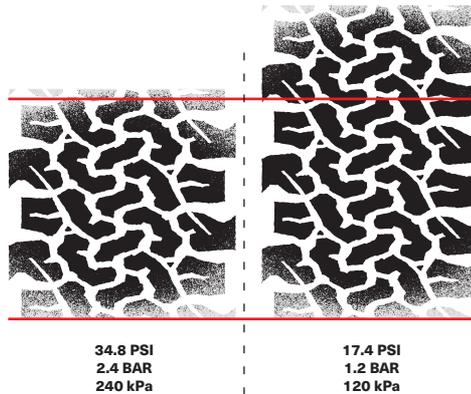
Just in case you weren't listening in science class, remember that gas expands when heated and contracts when the temperature declines.

- Check your tire in the morning prerin, before ambient temperature rises.
- Direct sun exposure will significantly increase pressure.
- If the pressure is correct while a tire is warm, it will likely be underinflated when it cools down.
- Lowering pressure too much could push the tire of the rim, damaging the tire and wheel. (You may want to invest in beadlock wheels to prevent dismounting.)

PRO TIP

Never air down without the proper equipment to air back up. Always carry a portable compressor or a CO₂ tank to ensure you can reinflate your tires to a safe pressure when returning to the pavement.

AIRING DOWN EXPANDS YOUR TIRE'S FOOTPRINT



CHANGING TIRE SIZE AFFECTS MANUFACTURER-RECOMMENDED TIRE PRESSURES.

Once tire size is increased, the pressures listed on the placard and in the owner's manual are void. Generally, when the size of the tire increases, the pressure needed to carry the same load decreases. Talk to a tire professional to determine correct pressures.

KNOW YOUR VEHICLE





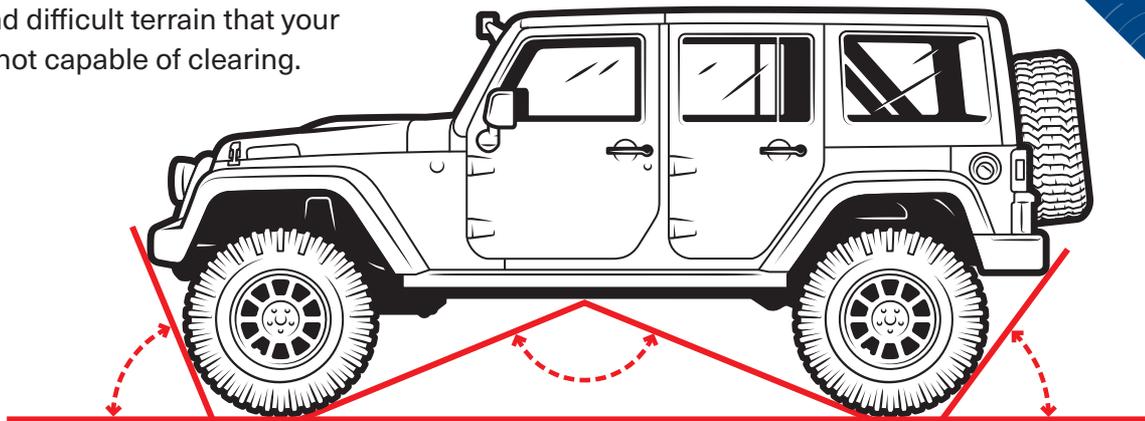
***KNOW YOUR
VEHICLE, INSIDE
AND OUT.***

Whether fresh from the factory or built in your garage, no two vehicles are alike. Just like no two drivers' experience and skill levels are the same. Which is why one of the most important ways you can prepare for the rigors of recreational off-roading is to know your vehicle, inside and out.

A great way to start is by attending a local off-road driving course. Here you'll learn the inner workings of a 4x4 vehicle as well as get expert-guided instruction on how your vehicle performs off the pavement. In the world of four-wheeling, knowledge is power – and a good place to find that knowledge is by actually reading your owner's manual.

DO THE MATH

Your 17-year-old self will be pleased to know that you can finally put that geometry knowledge to use. Before you head out to the trail, you'll need to know a few basic angles that will help you identify problematic objects and difficult terrain that your vehicle is not capable of clearing.



APPROACH ANGLE

The maximum angle at which a vehicle can enter an upward slope without the front of the vehicle touching the ground.

BREAK-OVER ANGLE

This determines the angle at which a vehicle can drive over a ridge or obstacle without scraping its underside. It is measured as the angle created when two lines are drawn from the lowest part of the undercarriage to the ground at the front and rear tires.

DEPARTURE ANGLE

The maximum angle a vehicle can exit a downward slope without the rear coming in contact with the ground.

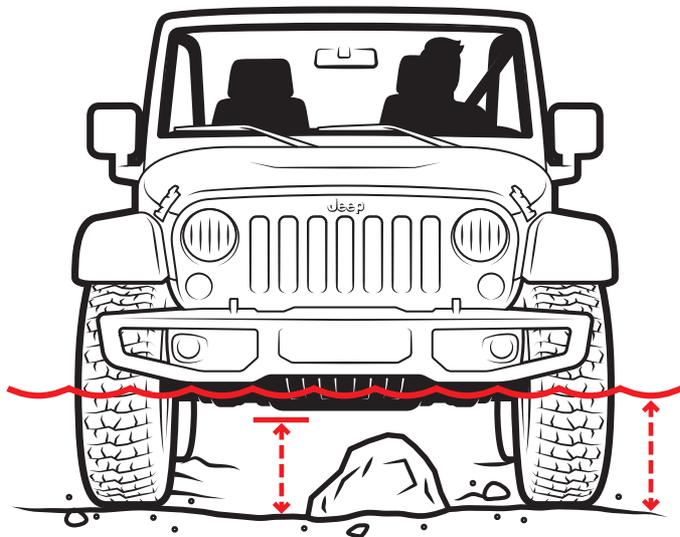
PRO TIP

To better gauge your vehicle's angles, place your rig up against a real obstacle, then get out and give it the old eye test. Compare what you see to what you saw from the driver's seat. Eventually you'll be able to translate what you see while driving to what the vehicle is actually capable of doing.



**AFTER-MARKET MODIFICATIONS
CAN ALTER THESE ANGLES**

If you're customizing, know how your vehicle will change.

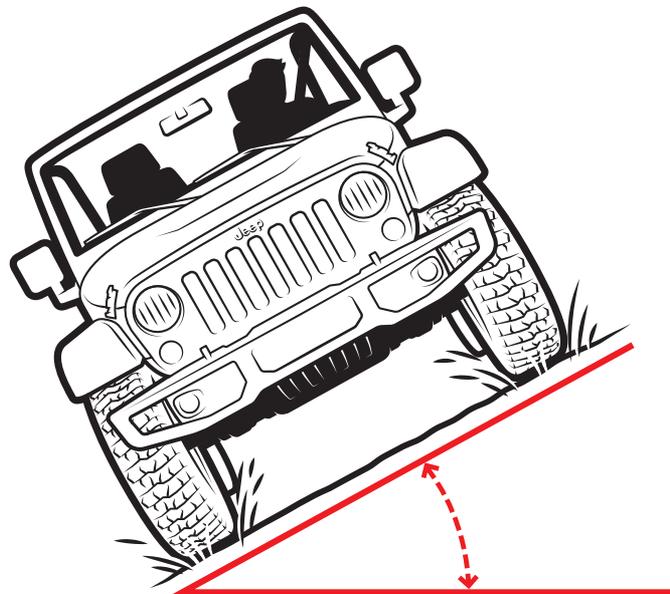


GROUND CLEARANCE

The distance between the lowest part of the vehicle and the ground or obstacle to be cleared.

FORDING DEPTH

The maximum depth of water a vehicle can pass through at a given speed without ingesting water into the motor. Not all manufacturers provide this info in the owner's manual, so if there is any doubt, a safe depth is typically the level of the wheel hubs.



ROLLOVER ANGLE

The maximum angle a driver can drive a side hill without turning over. This will vary by vehicle, and modifications like a lift kit, taller tires and a loaded roof rack can significantly increase your chances of rolling. Things start getting hairy when the bottom of the uphill tire is even with the top of the downhill tire.

TRANSMISSIONS

There are two common types of transmissions, automatic and manual. In many parts of North America, driving a manual transmission has become a lost art. But for most countries around the world, this is much more common. Each transmission type has advantages and disadvantages for off-road driving. Know how to best utilize your specific transmission.

AUTOMATIC

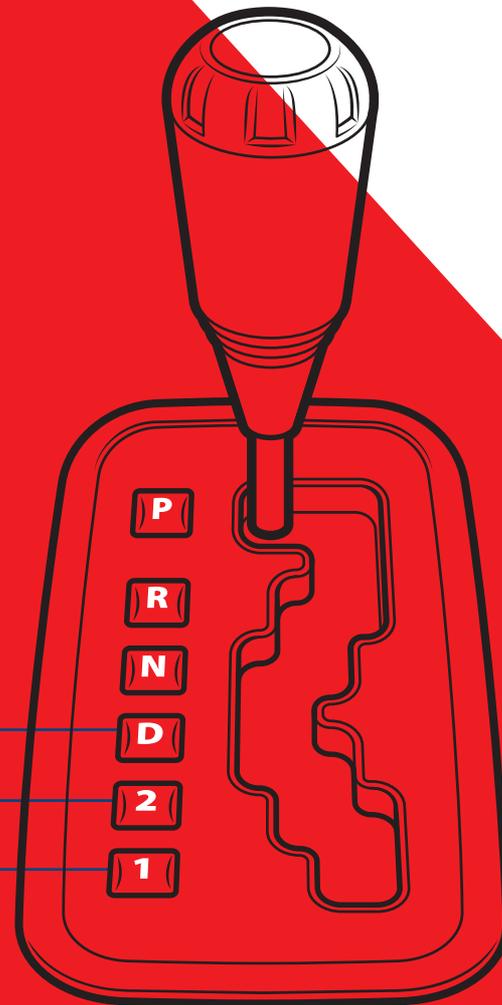
As simple as it may sound, the first thing you'll need to know is how to put your vehicle in gear. Make sure you can properly locate the gear selector in your vehicle. In older vehicles, the gear shift may be located on the steering column, whereas in newer vehicles, it is often located near the center console. There may appear to be two gear shifters on the floor. The other is actually the transfer case, which will allow you to engage four-wheel drive.

Automatics are generally easier to control because you let the transmission do most of the work. Remember, speed is not the answer. Let the vehicle do what it was designed to do.

The vehicle will shift between all gears as needed. Allows you to efficiently reach high speeds. Typically used for highway driving.

Holds the vehicle to second gear and eliminates an unexpected downshift or upshift.

Limits the vehicle to first gear. Slows down the engine and provides max torque. Used when tackling tough terrain at very low speeds.



USING YOUR AUTOMATIC TRANSMISSION

- Engine braking may be limited with automatic transmissions. Supply sufficient brake and throttle as your vehicle speeds and slows.
- Gearing down to D1 or D2 and using 4WD Low (see four-wheel drive systems, page 24) should allow the vehicle to crawl and idle over obstacles with little to no throttle.
- Use the highest gears possible for climbing. Descend in the lowest gears.

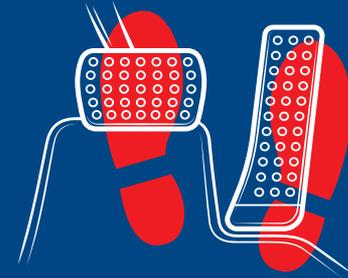
- Using the overdrive button will lock the vehicle out of its highest gear. This is useful when navigating steep hills and difficult terrain – as well as in on-road towing situations.

ADVANTAGES

- More user-friendly
- Smooth transition of power
- Less effort
- Easier for towing
- No clutch to burn
- More adaptable to four-wheeling

DISADVANTAGES

- Runs away on downhill slopes
- Cannot push-start
- Cannot stall-start
- Higher repair expenses
- May overheat in tough terrain



LEFT-FOOT BRAKING

Yes, when navigating the real tough stuff, you should actually brake with your left foot. This allows you to lightly feather both the brake and throttle to control your speed over difficult obstacles. Unless your off-road rig comes equipped with a crawl assistance feature to control your brake and throttle, get that left foot ready to work.

MANUAL

If you have never driven a manual transmission, the trail is not the place to start. Make sure you have mastered the basics before heading off the pavement. Monitoring three pedals and choosing gears must be second nature, so you can focus completely on the ever-changing conditions of the trail.

ADVANTAGES

- Controlled descent
- Able to stall-/push-/pull-start
- Generates less heat
- Less fuel consumption
- Cheaper/easier to maintain
- Driver controls the vehicle

DISADVANTAGES

- Clutch can overheat
- Requires good hand/foot coordination
- Not as smooth
- Can be harder to negotiate on difficult terrain
- Less user-friendly on the trail with OE axle ratios

USING YOUR MANUAL TRANSMISSION

- Keep your foot off the clutch as much as possible. Otherwise not only will you lose forward momentum, but it can also cause the clutch to burn up.
- Only press the clutch when you need to shift; otherwise keep your left foot on the floor.
- Do not cover the clutch pedal with your foot, even if you aren't actively riding it. Rough terrain can bounce your foot into the pedal and accidentally depress the pedal.
- Stick to first and second gears when navigating difficult terrain.
- Never change gears while negotiating hills or obstacles. Forward momentum could be gained in descents and lost in ascents.
- If a stall occurs on an obstacle, and your vehicle will allow it, turn the key and restart the engine without the use of the clutch. The starter should get you over the obstacle.



STARTING WITHOUT THE CLUTCH

Modern manual transmissions require the driver to depress the clutch to start the vehicle, which can be tricky when stalled on a rock. Some vehicles are designed with off-roaders in mind and offer a bypass switch to allow you to start in gear, so you can keep one foot on the brake and one on the gas. The starter motor alone may even pull you out of a precarious situation. Refer to your owner's manual for complete info.

STALL-START RECOVERY

When a hill becomes too steep to crest, your vehicle will likely stall. The stall-start recovery method is a timeless technique that allows the driver with a manual transmission to return to safety without losing control of the vehicle.



- 1** Turn the ignition off and place your right foot firmly on the brake.
- 2** With your foot still on the brake, depress the clutch and put the vehicle in reverse.
- 3** Slowly release the clutch and then the brake. The stalled vehicle will not roll down the hill due to the engine being in reverse gear.
- 4** Make sure the hill behind you is clear and turn the ignition to On with your feet off the pedals.
- 5** The vehicle is now running in reverse gear, and you can progress smoothly downhill with your vehicle safely in gear the entire descent.
- 6** Use the brake as necessary without using the clutch or accelerator.



ALWAYS USE YOUR PARKING BRAKE WHEN PARKED ON SLOPED GROUND

If the hill is steep enough, a vehicle can still move when it's in gear. Set the parking brake before releasing the clutch so that the weight is on the brake first – the gear is just the backup plan if the brake fails. It's best to park in first gear when facing uphill and in reverse if facing downhill.

FOUR-WHEEL DRIVE SYSTEMS

If you're an off-road enthusiast, it won't be a question of *if* you'll need four-wheel drive, but how soon you'll need it. Putting your vehicle into four-wheel drive distributes torque and traction to all four wheels to help limit the chances of your vehicle getting stuck. Not all four-wheel drive systems function the same way, so before things start getting hairy in no-man's-land, you better make sure you know how to use your setup.

PART-TIME 4WD

Part-time 4WD, or on-demand 4WD, is a system that allows 4WD to be called upon when needed. When 4WD is not engaged, the vehicle acts like a 2WD vehicle, with the rear wheels receiving all of the torque. Operating in 2WD provides significantly better fuel economy on the highway. Part-time 4WD vehicles should only be driven in 2WD on-road to avoid transmission wind-up. When engaged in 4WD, part-time systems will not allow the front and rear axles to operate at different speeds because there's not a differential in the transfer case. A part-time 4WD vehicle can operate in 2WD, 4WD High and 4WD Low.

FULL-TIME 4WD

Full-time 4WD, or permanent 4WD, is a system that powers all four wheels at all times. A differential in the transfer case makes it possible to be in constant 4WD on all surfaces. This differential prevents transmission wind-up by enabling the front and rear driveshafts to rotate at different speeds. When you turn, this allows the inside tire to slow down and the outside tire to speed up. Many full-time rigs have a center differential lock, which may be controlled by an electronic traction control system or a manual lock. A full-time 4WD vehicle can operate in 4WD High and 4WD Low.

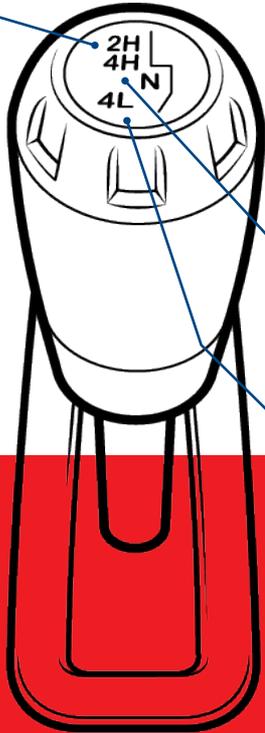
PUTTING IT IN FOUR-WHEEL DRIVE

Engaging 4WD is done by the transfer case, which transfers power from the driveshaft to the front and rear axles. With an older vehicle, you may need to come to a complete stop and put your vehicle in neutral or park before manually shifting into 4WD with a gear stick or lever. In modern vehicles,

4WD can be engaged with just the push of a button. There are many types of 4WD systems, and each will work slightly differently. Check your owner's manual to ensure that that you know how to properly use your 4WD system.

2WD HIGH

Used for normal highway driving. Torque is only provided to the front or rear wheels, resulting in better fuel economy.

**ALL-WHEEL DRIVE**

Like vehicles with full-time 4WD, AWD vehicles utilize a center differential to deliver power to all four wheels. But most AWD vehicles don't have a transfer case that splits and locks the power 50/50 front to back, so they will operate like front-wheel drive vehicles most of the time – only delivering torque to the rear wheels as needed. Automatic sensors determine when a wheel is losing traction and applies torque to the wheels that have traction. AWD is primarily used on-road. It may help in some light off-road situations, but should not be confused with a truly 4WD-capable vehicle.

TRACTION CONTROL

Many newer vehicles come equipped with some version of traction control. Traction control will keep the vehicle moving forward by alerting the computer to brake as necessary in order to keep the wheels from spinning and losing traction. It may have a simple on/off switch or come with multiple settings. Refer to your owner's manual to learn more about its capabilities.

4WD LOW

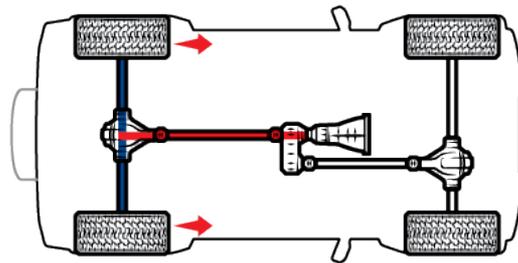
Provides more torque, not traction. 4WD Low is used to negotiate difficult terrain when slower speeds and greater torque are required. It can also be helpful when towing.

4WD HIGH

Will be used on dirt roads and easier trails that require steady momentum. Reduces the likelihood of slipping and spinning wheels on surfaces like snowy roads and muddy dirt.

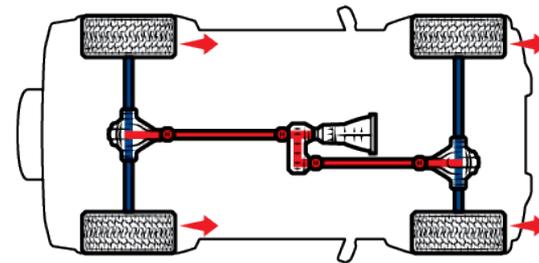
DIFFERENTIALS

If it weren't for differentials, driving would be incredibly difficult. Differentials are designed to allow wheels on a single axle to move at different speeds. This is important when cornering, because the outside wheels must spin faster than the inside wheels, since they have a greater distance to travel in a shorter amount of time. Without the differential, the inside tire would break traction and possibly cause the vehicle to skid. This is hard on the tires and drivetrain components, not to mention the lack of control around corners.



TWO-WHEEL DRIVE

On high-traction surfaces (like the highway), power is delivered through the transmission and the transfer case to provide power to both axles.



FOUR-WHEEL DRIVE, OPEN DIFFERENTIAL

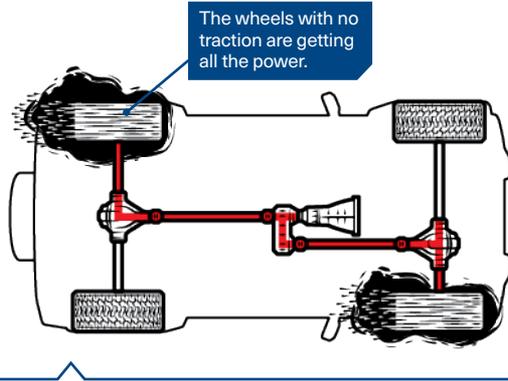
The front and rear differentials provide power equally to all four wheels when a part-time 4WD vehicle is engaged in 4WD.

OPEN DIFFERENTIALS

For the same reason that open differentials are great on the highway, they can cause severe headaches off-road. The torque flow in open differentials takes the path of least resistance. If one wheel is on the road and the other is in the mud, all the torque will go to the wheel in the mud – which is exactly what you don't want to happen. Luckily, manufacturers have developed solutions to combat this problem.

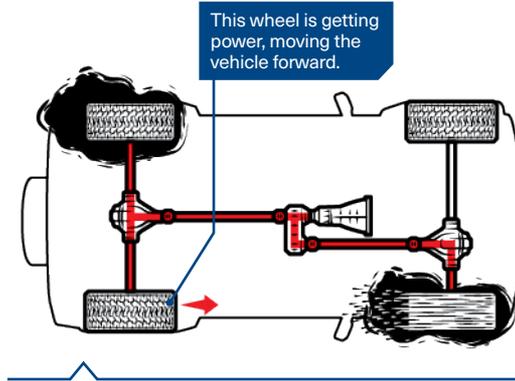
 = POTENTIAL POWER PATH
 = ABSOLUTE POWER PATH

■ = ABSOLUTE POWER PATH



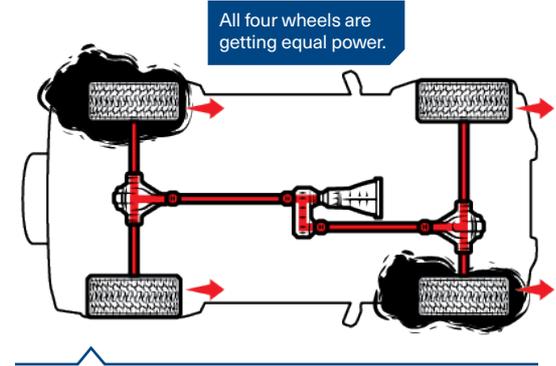
FOUR-WHEEL DRIVE, OPEN DIFFERENTIAL

In a part-time 4WD vehicle on low-traction surfaces, the power will often take the path of least resistance and go to the wheel that moves easiest. This means the tires with the most traction are not getting power, and you're stuck spinning.



FOUR-WHEEL DRIVE, LOCKED REAR DIFFERENTIAL

Locking the rear differential sends equal power to each of the rear wheels, no matter the traction level. So as long as one of those wheels has traction, you'll be able to creep out of the muck.



FOUR-WHEEL DRIVE, LOCKED FRONT AND REAR DIFFERENTIAL

A part-time 4WD vehicle engaged in 4WD with lockers in both axles will provide power to all four tires, no matter the surface. This means go-time.

LOCKING DIFFERENTIALS

For four-wheelers who aren't looking to mess around, locking differentials take the guesswork out of the equation. When a locker is engaged, equal power is distributed to each wheel, regardless of the traction it has. In situations where traction is hard to come by, this ensures that any wheel with a hint of traction can do its part to help move the vehicle. Locking differentials come two ways – driver-controlled or automatic – and depending

on the vehicle, the locking differential might only be on the rear axle (with an open or limited slip differential on the front). Or, you could have locking differentials on both the front and rear axles for the ultimate trail ride. Lockers on both axles make sure all four tires have the same amount of power, whether one tire is in a rut, all four tires are in mud or two tires are in the air.

LIMITED-SLIP DIFFERENTIAL

A limited-slip differential works a lot like an open differential, except for one big difference. Instead of sending 100% of the torque to the tire with the least resistance, it will automatically send some torque to the tires with the most traction, enabling your vehicle to move forward.

VEHICLE MODIFICATIONS

It's not hard to spot a poser in a tricked-out rig that only drives to the mall. You can't entirely blame them – a vehicle is a badge of honor – but a lot of money can be sunk into uneducated purchases. Wait to make any drastic modification decisions until you've taken your vehicle out on a trail. Only then will you better understand what mods are needed. A rig meant for rock crawling doesn't need the same equipment as one meant for overlanding. And before you buy, it's always best to talk to experienced drivers or join one of the many community forums to read what others in the sport are doing.

ROOF RACK

Provides additional storage for tools and gear needed for many types of off-road adventures.

REAR DRIVING LIGHTS

Designed to handle the rigors of the trail while providing significant lighting for safe reversing.

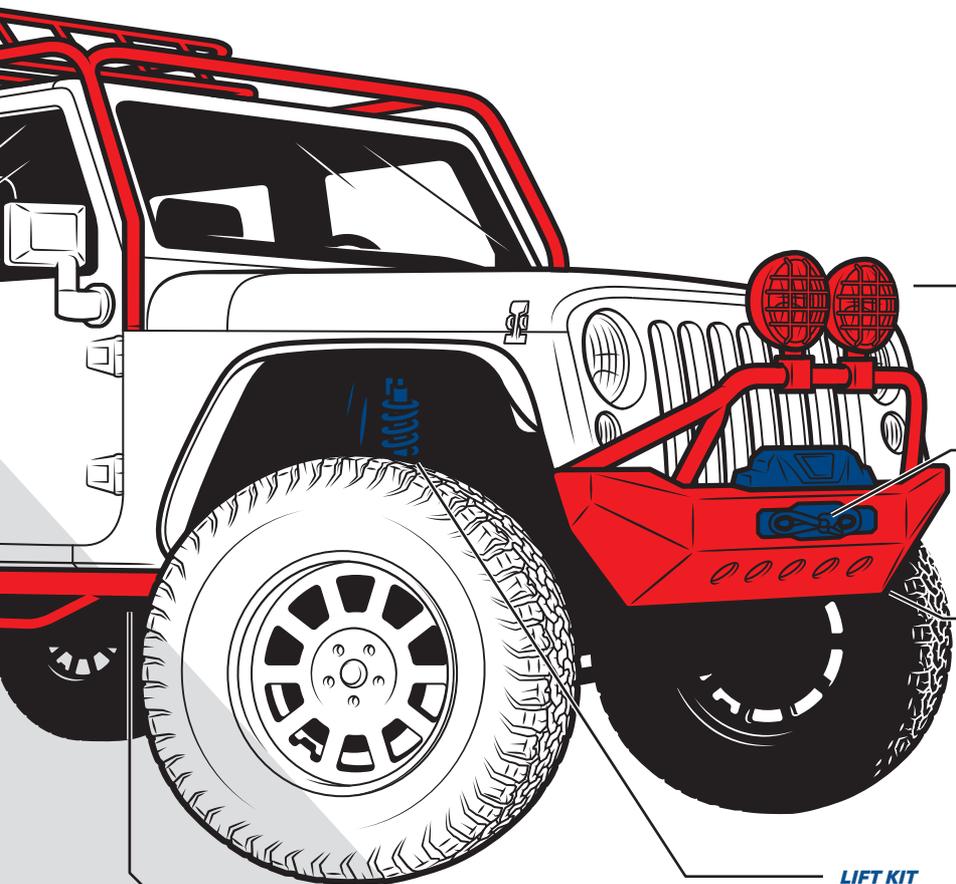
TIRES

The most noticeable performance boost you can give your vehicle is to upgrade its tires (p.10). Certain tires are designed to perform in certain types of terrain, so get the ones that fit your needs (p.12). Larger tires can even help your vehicle clear obstacles and increase your vehicle's load range.

LOCKING DIFFERENTIAL

When engaged, a locker distributes equal power to each wheel regardless of the traction the wheel has.





WARNING
Lifting your vehicle will cause changes to your vehicle's dimensions. The higher you lift, the higher the costs associated with all the adjustments needed to account for the vehicle's new height.

ROCK RAILS
Protect your vehicle's door sills and frame when clearing large obstacles like rocks or logs. They are attached to the vehicle's chassis.

FRONT DRIVING LIGHTS
Increase visibility on the trail at night or in bad weather. Can also be used to illuminate campsites for overlanders.

WINCH
Winds a heavy-duty cable around a rotating drum to pull whatever is attached to the cable. These are typically mounted to the front bumper and powered by the battery.

AFTER-MARKET BUMPER
Stronger and more durable than an OE bumper. Built for repeated abuse from rocks, logs and other obstacles on the trail.

LIFT KIT
Lifts the suspension of the vehicle to allow for larger diameter tires. Provides more ground clearance to improve your vehicle's ability to overcome obstacles.



TACKLING TOUGH TERRAIN



BRING A FRIEND: NEVER DRIVE ALONE.

If you get stuck in a sticky situation, who will be there to help? Always use the buddy system – or at the very least, let someone know where you are at and what time you expect to be back.



***BE EQUIPPED
TO HANDLE THE
SPECIFIC TERRAIN
YOU'LL ENCOUNTER.***

KNOW WHAT YOU'RE UP AGAINST

Let's be real – you started off-roading for a reason. You wanted to explore new places, take the path of most resistance and conquer challenges that most of your friends wouldn't even dream of. But with all that reward comes a great deal of risk.

Off-road trails will be unpredictable, terrain will vary and conditions can change in the blink of an eye. Before you head off the beaten path, make sure you and your vehicle are equipped to handle the specific terrain you'll encounter. Even though driving surfaces will vary, your pretrail approach should always remain the same.

ENVIRONMENTAL CONSIDERATIONS

Before embarking on your next off-road adventure, it never hurts to remind yourself about the importance of low impact travel. We know you've heard it before, but you're about to hear it again: pack it in; pack it out. We only have one Earth, so you better treat it right.

- Plan ahead and know what type of terrain you'll encounter to minimize the impact of unneeded trail damage.
- Always stick to established routes.
- Take all trash and rubbish home with you.
- Dig a hole 6 to 8 inches deep when disposing of human waste.
- Minimize the impact of your campfires by adhering to all fire restrictions.
- Respect private property.

BFGoodrich® Tires supports many groups dedicated to keeping off-roading safe and sustainable to the environment, including TREAD LIGHTY! This not-for-profit group is dedicated to enhancing recreational access and opportunities by promoting outdoor ethics. Learn more at treadlightly.org.

TREAD LIGHTLY'S CORE VALUES

TRAVEL RESPONSIBLY

RESPECT THE RIGHTS OF OTHERS

EDUcate YOURSELF

AVOID SENSITIVE AREAS

DO YOUR PART

TRAIL RATINGS

All trails vary in difficulty. Much of the public's perception of difficulty can be attributed to individual experience level. Inexperienced drivers may attempt to fight above their weight class and end up causing unnecessary damage to their vehicles. Be realistic about what you and your vehicle are capable of handling. Remember, the weather can have an impact on the condition of a trail and may cause a normally mild trail to become much more challenging.

Many trails are assigned a rating based on their level of difficulty. To help drivers choose the right trail for their abilities, Jeep Jamboree USA provides many trails with a number and colored shape to indicate how challenging they're likely to be.

TRAIL RATING

DESCRIPTION

1-2



EASY. A great option for beginners. Weather permitting, these trails are relatively easy for most drivers and vehicles to navigate. Continued use of 4WD may not be required. You're likely to encounter dirt, mud and rocks.

3-5



MODERATELY DEMANDING, especially for drivers without much off-road experience. 4WD with 4-LO is required because you're likely to encounter challenging obstacles such as boulders, mud holes and streams.

6-7



DEMANDING. A challenge for most skill levels. 4WD with 4WD Low is a must. You're likely to face steep climbs, deep mud and large boulders. Do not navigate these trails alone.

8-9



HIGHLY DEMANDING. These trails are reserved for skilled off-road drivers. Lift kits and lockers are extremely beneficial. There's a good chance your vehicle will get stuck. 4WD with 4WD Low is absolutely necessary. Mud holes are likely to be quite deep, and rock climbing is challenging.

10



EXPERTS ONLY. You're going to get stuck, but isn't that the point? This trail rating is reserved for the toughest off-road trails open to the public. Put your vehicle in 4WD Low before you even start. Good luck!

Source: JeepJamboreeUSA.com

HILLS

Extreme trail riding is known for deep mud pits and large boulders. But hills can be even more daunting than you expect when first tackling a trail.

Be realistic. If you don't feel confident that you and your vehicle can make it up the hill, then don't try. Take it easy and just do what you can to keep the shiny side up and the rubber side down.

PREPARING FOR THE ASCENT

- Make sure to scout the hill's crest by foot so you know exactly what's on the other side.
- Lock your differentials. You'll need all the traction you can get.
- Use the short run up to the slope as an opportunity to gain extra momentum that may be needed to clear the hill.

GOING UP SHIFT UP

- 
- 1 Point your vehicle straight up the hill.**
Take the most direct route up.
 - 2 Keep a constant, steady acceleration.**
Choose the highest gear possible to generate the most torque without losing traction.
 - 3 If your vehicle stalls, put it in reverse and back straight down the hill.** Never try to turn around on a hill; it increases the likelihood of your vehicle rolling.
If you have a manual, see page 23 on how to start from a stall.
 - 4 Slow or stop at the top.**
Ease up on the accelerator as you approach the crest of a hill to avoid launching your vehicle into orbit. But make sure you still have enough momentum to reach the top.
At the top of the hill, come to a full stop so you can evaluate the descent.



GOING DOWN SHIFT DOWN

- 5** Point your vehicle straight down the hill.
- 6** Maintain a slow, controlled speed.
- 7** Let the engine do most of the braking. Choose the lowest gear possible in both the transmission and the transfer case.
- 8** With an automatic transmission, feather the brake to control the descent. Engine braking may be limited.
- 9** With a manual transmission, avoid depressing the clutch. Keep your left foot on the floorboard to avoid the clutch all together. Engine braking doesn't work when out of gear.
- 10** If you start to slide, turn into the slide as you would on snow or ice. If counter steering is not enough, apply a little throttle to help straighten out the vehicle.

PRO TIP

Here's your chance to take what you've learned about your vehicle's clearance angles. Survey the hill ahead. Will your nose hit first? If so, approach it like you would an obstacle (p. 47), at an angle, one tire, then the other. Once up on the hill, adjust to go straight up the ascent.



SCOUT THE TERRAIN

This won't eliminate all surprises, but it will give you a better idea of what you're up against.

ROCKS

Rock beats scissors for a reason. It's one of the most unforgiving terrains you're likely to encounter on the trail, which is why it requires great caution.

Most rock crawling is done in low gear at a snail-like speed. We're talking 1 – 3 mph. Torque is much more important than power when it comes to climbing rocky slopes. And remember less is more, especially when it comes to your speed. Controlled throttle and braking is vital to successfully navigating rock.

It should go without saying, but if your vehicle has 8 inches (or 20cm) of ground clearance, you won't be able to clear a 10-inch (or 25cm) rock. Simple as that. Which is why choosing the best path is most important. Find a line that will keep all four tires on the most even plane, which might not be the lowest. Many 4x4 novices may not realize that the easiest path through difficult rock fields can be found by taking on the tallest rocks.

 **EQUIPMENT CHECK**
ROCK PROTECTION

If you're doing a lot of crawling over rocks and difficult trails, consider adding rock rails and skid plates to particularly sensitive areas underneath your vehicle. Aftermarket bumpers provide additional protection as well. (p. 28)

Use the left foot braking technique, page 21, to gently apply throttle up the rock and brake coming off of it.

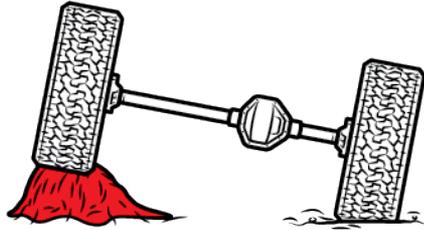
Avoid sharp and jagged rocks that may puncture your tire's sidewall.

Airing down will help your tires envelop objects for greater traction. See page 14 for recommendations.



TYPES OF ROCK

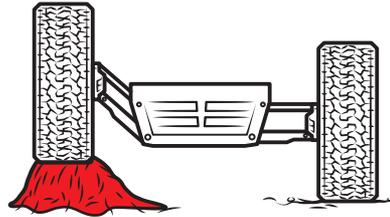
What you'll encounter will likely vary from loose rock to prehistoric boulders. It's important to know that loose rock should be treated like any other loose soil condition. Momentum is a must. Steady throttle is crucial in order to maintain the forward momentum needed, especially when driving up a rocky slope.



SOLID FRONT AXLE

Place your vehicle's tires on the highest obstacles to avoid damage to the important components located under your vehicle.

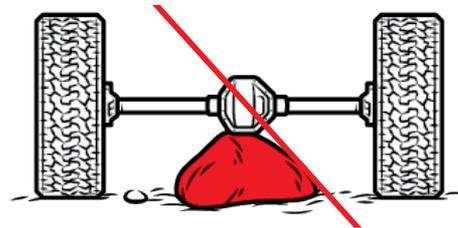
Boulders, on the other hand, are a completely different beast. This type of expert-level rock crawling can be very challenging, and most stock vehicles are not up to the task. You need a lifted vehicle with large tires, lockers and plenty of ground clearance.



INDEPENDENT FRONT SUSPENSION

In an IFS system, each wheel acts independently. Putting one wheel on an obstacle may not raise the rest of the vehicle like a solid front axle. Be aware of your rear axle (likely not independent) when crossing an obstacle.

WATCH YOUR DIFFERENTIAL
Avoid straddling rocks that are anywhere close to your minimum ground clearance. This could cause damage to your differential or even high-center the vehicle.



NO SHAME IN A SPOTTER

It may be difficult to locate the proper line from behind the steering wheel. A trusted spotter can save you from injuring yourself or causing costly damage to your vehicle.

Hand signals are always better than verbal commands, which can be misunderstood or drowned out by the engine. Make sure you and your spotter have agreed on signals that you'll both be able to recognize. Someone panicking and waving their arms around like a helicopter will only cause more confusion. Always ignore everyone but the chosen spotter.

While spotting, know the risks associated with being near a moving vehicle. Stand far enough away from the vehicle to avoid being crushed by an unexpected roll or sudden burst of throttle.

SAND

Don't let the thought of a beach vacation fool you. Sand can be one of the most difficult terrains to navigate. This has a lot to do with the fact that beneath the surface there's typically even more sand, making traction and flotation difficult to come by.

Driving pristine coastline is every overlander's dream. But if you get stuck on a beach, you could be the star of the internet's next fail video when your vehicle is swept out to sea. It happens more than you might think.

Don't be that person.

PREPARING FOR SAND

The most important aspect of driving on sand is your tire's flotation (p. 13). The more tread you have touching the sand, the better. You will need to air down your tires to some extent in order to increase your tire's footprint. How much depends on your vehicle and the type of sand in question. Refer to page 14 for pressure recommendations.

All-terrain tires tend to perform better in sand, but wide-profile mud-terrain tires can also work to your advantage and even perform like paddle tires at the correct pressure. While the right tires do matter, there is quite a bit of strategy when it comes to driving in sand. Air pressure, momentum and throttle application are the fundamentals that will ultimately keep you moving.

Airing down increases your tire's footprint, allowing it to "float" ride on top of the sand.



Soft, loose sand robs the power and traction from your 4X4 vehicle. So it's imperative to keep steady forward momentum to lessen the chance of getting stuck. There are so many variations of sand out there that it's always a good idea to check out the area by foot. If your feet become completely submerged, imagine how much your half-ton rig will sink. Regardless, if you do plan to drive on sand you should always remember the following:

- Once your vehicle is in motion, ride at the highest comfortable gear to maintain momentum.
- When you do need to stop, it's important to park your vehicle in a spot where you can easily gain momentum, such as a slight downhill slope.
- Sharp, sudden turns may cause your tires to dig deep into the sand.
- If forward progress ceases, **DO NOT** apply more throttle. This will only worsen the situation by causing your tires to dig down deeper into the sand.
- If you lose momentum, try to back up your rig gently. If your tires start to spin, it's time to get your shovel.
- If your vehicle gets stuck, you'll have to dig out around the wheels. Hub caps, Frisbees or your spotter's hat can serve as makeshift shovels if you've forgotten yours. If there's water near, wet the sand in front of the tires to provide firmer terrain to grab onto. You can even place your vehicle's floor mats under the tires for traction.



EQUIPMENT CHECK **DUNE FLAG**

When driving dunes, make sure your vehicle has a flag and/or whip light to allow drivers on the other side of a dune to know your location.



MUD

There's an ancient trail proverb that goes "mud maketh man." But in reality, mud maketh a mess. Don't get us wrong – it's fun, sticky and proof you've been on the trail. But before you go clogging your local car wash, it's important to know the challenges associated with mud on the trail.

PREPARING FOR MUD

Rather than trying to prove that you can do it, take a step back, analyze the situation and ask yourself if you really need to do it. If the answer is yes, then it's time to do a bit of detective work to ensure that your rig is actually going to make it to the other side.

- Are there tracks going in? And are there tracks coming out? If there are only tracks going in, then someone didn't make it, and chances are you won't either.
- You'll never know how deep it is until you check. Test the depth with a stick, shovel or anything you can get your hands on before entering.

COMMIT TO THE PIT

Driving with only two tires in the mud affects the clearance and weight distribution of your vehicle. Go all in or go around.



GETTING TO THE OTHER SIDE

So this is it. You've taken the proper precautions, decided you and your vehicle are prepared to make it and are ready to let the mud fly. But in order to avoid a few laughs from onlookers, keep in mind the following:

- Lock 'em if you got 'em. Engage both lockers and 4WD before entering mud.
- Avoid ruts when possible. Driving in existing ruts or tracks will only reduce your vehicle's ground clearance and increase your chances of getting stuck.
- Enter the mud with a good amount of momentum, and use light throttle to avoid wheel spin.
- Pick a straight line and commit. You need to live with your decision or live with getting stuck.
- DO NOT brake. This will only kill momentum.
- If you feel yourself losing traction, turn your steering wheel back and forth quickly, which will add the tire's cleated sidewall to the traction equation. The sidewalls will act like "paddles" that use the sides of the trench the tire has sunk into for extra traction.

POST-MUD BATH

If you make a mess, you must be prepared to clean it up. Check your differentials, transmission, transfer case and brakes to make sure nothing was displaced after driving through deep, thick mud. After a bit of mudslinging, it's always important to thoroughly clean your wheels, undercarriage and brakes with a pressure hose. Dried mud can pack into your wheels and brakes, which will cause vibrations and may affect your vehicle's ability to brake properly when you return to the highway.



EQUIPMENT CHECK MUD-TERRAIN TIRES

Make sure your tires are equipped to take on mud. Many wide-footprint mud-terrain tires excel in these conditions, while average all-terrain tires don't have the self-cleaning capabilities required to sustain traction and will quickly turn into big mud balls.

PRO TIP

Did you know that Pam® works for more than just baking cookies? Apply nonstick cooking spray to the undercarriage of your vehicle. This will keep mud from sticking and allow for easier cleanup.

CROSSING STREAMS

It's not a matter *if* you'll need to cross a stream but *when*. So make sure you've taken every single precaution. It's most important to know your vehicle's fording limits. For stock vehicles, this may be found in the owner's manual, but will change on a heavily modified, lifted vehicle.

PREPARING TO CROSS

If you take away one thing from this chapter, make it this: ***Do not drive across a stream that you wouldn't attempt to cross on foot.*** It's always a good idea to check the depth before you cross, especially in murky, muddy water. Bottom conditions will affect your vehicle as much as water depth, so it's important know what kind of surface you'll be driving on.

Areas of faster moving water will generally be rockier, which can be good for traction but could easily puncture a tire. You won't be able to see and avoid jagged edges.

Stagnant, slow-moving water is typically muddy and can make it difficult to gain traction.



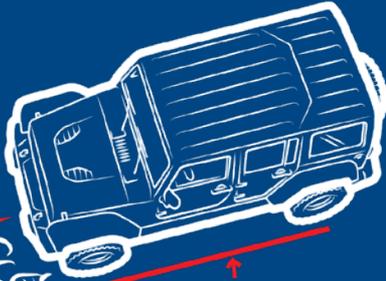
IS IT SAFE TO CROSS?

BOTTOM OF HEADLIGHTS: Avoid if possible.

BUMPER DEPTH: Proceed with caution.

UP TO THE AXLES: You're probably OK.

WATER IS DEEPEST WHERE IT'S CALMEST.



DRIVE DIAGONALLY TO THE CURRENT

Don't fight the current. You won't win. In fast-moving water, it's best to cross at a diagonal to the current. This lessens the amount of surface area for water to push your vehicle downstream.

DRIVING ACROSS

Once you've determined the water is safe to cross, practice the following:

- Enter the water slowly in order to avoid creating a wave that can splash into your vehicle's intake.
- Use low range and gear. Do not change gears midstream.
- Drive at a diagonal into the current.
- Keep steady forward momentum while being careful of large objects.
- If an engine stalls because of overly deep water or the ignition getting wet, DO NOT restart it.
- If you start to lose traction on a soft bottom crossing, quickly turn your wheels left, right, left, right, to reestablish traction.

POST-CROSS

Always inspect your rig after crossing water to make sure no damage has been done to the undercarriage. It's also a good idea to test your brakes when you return to dry land. You can accelerate the drying process with a few sudden, hard stops to generate some extra heat.



REMEMBER THIS:

Crossing deep water is the only time you should unfasten your seat belt. Keep your window open and seat belt unbuckled for easier escape in the event of an emergency.

SNOW AND ICE

Navigating snow can be a lot like navigating mud and other loose conditions – it's just a helluva lot colder and there's a lot more of it. Maintaining momentum is crucial. You've got to be able to keep your vehicle moving or you're as good as stuck. But avoid spinning your tires and creating ruts your vehicle is unable to escape.

Sometimes snow is just too deep to navigate. Your vehicle only has so much clearance. If your undercarriage is touching snow, it's only a matter of time before you won't be able to budge. Snow can be tricky because it covers ruts, rocks and other obstacles normally seen in the summer months. If you are familiar with the trail, try to avoid any rough spots you remember, but if you are new to the trail, proceed with caution.

Never slam on your brakes, as this will inevitably cause your vehicle to skid. If your vehicle begins to skid, back off the brakes while turning into the slide. Stay calm and do your best not to overcorrect, because this will only make matters worse.



ARE YOUR TIRES WINTER-RATED?

All-terrain tires are much more adept on snowy and icy highways, due to increased siping and the closed tread design. However, in really deep snow, mud-terrain tires become the better option. For all-around snow performance, look for the three-peak mountain snowflake symbol on BFGoodrich® tires, signifying that the tire meets or exceeds the minimum requirements needed to be classified as a winter-rated tire.

3-POINT TURN

Every four-wheeler will reach a time in their career when there is no other choice but to turn around, whether due to a washed-out trail, impassable object or unforeseen act of nature. So you'll need to be sure you can properly execute a 3-point turn on a narrow trail. In extreme circumstances, this could prevent you from plummeting to an untimely death.

Using low range and first gear, pull up to the edge of the trail and reverse back up the hill.

1

2

Apply the throttle as needed to back up the bank far enough to turn your wheel in the direction you want to go.

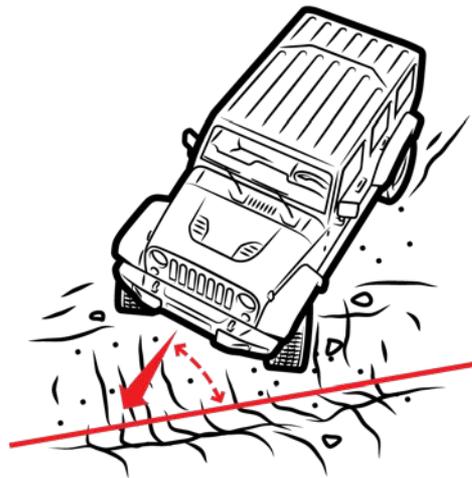
3

Drive back onto the trail in the opposite direction.



RUTS AND GULLIES

If you wanted level surfaces you'd stick to the highway. But since you've made it to page 46 of this book, we know you're after adventure. No matter the trail or geographical location, you will encounter numerous ruts and gullies along your journeys. That's a promise. So make sure you know what you're doing when you get out there.



LIMITED CLEARANCE

How you approach a rut or gully depends on the level of clearance your vehicle has. If your vehicle has adequate ground clearance, you are able to enter the hole straight on. This method will provide the best traction.

When clearance is a problem, you may need to enter the hole diagonally. This will lessen the clearance needed to clear the hole but can also lessen traction.

Know your vehicle and choose the scenario that best fits the situation.

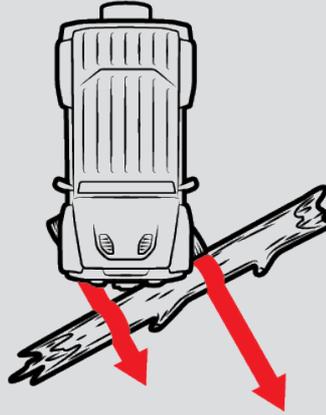
STRADDLING

If your vehicle has the wheel width, it's best to straddle ruts or gullies when possible. Go slow and do your best not to let one set of wheels slip into the crevice. Straddling will offer a more comfortable drive and keep your vehicle in an upright position to allow a better view of the trail.

OBSTACLES

Hitting the trail will give you the opportunity to see lush forests, natural beauty and some of the most memorable views on Earth. The only problem with the scenic route is there's always something blocking you. When traversing trails in heavily wooded areas, there's a good chance you'll encounter a dead log obstructing your path.

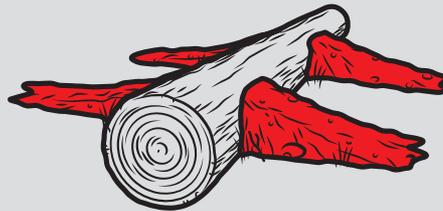
As with other objects, getting over the log will depend on your vehicle's clearance. But if you don't have the clearance, you may not need to turn around. There are a few other things you can do to get your vehicle up and over.



Cross the log at an angle, one tire at a time. This will decrease the clearance needed to cross.



If you are unable to cross an obstacle, you may be able to clear a path for your vehicle. Use your winch to pull things like a fallen tree out of your way. See page 52 for the proper way to use your winch.



If driving at an angle still won't get you over, you can build a makeshift ramp with the materials around you, such as small logs, rocks or dirt.

RECOVERY TECHNIQUES





***SAFETY SHOULD
BE THE HIGHEST
PRIORITY IN
RECOVERY
SITUATIONS.***

Let's not beat around the bush. If you venture off the pavement with any regularity, you'll eventually get stuck. But that doesn't have to be a bad thing. As long as you're operating in a safe and responsible manner, getting your vehicle unstuck can be a rewarding challenge in itself. It takes practice and skill, not guesswork, so you need to find experienced professionals and get some training beyond this guide to succeed in these situations – and make sure you're not featured in one of those internet "fail" videos.

There are countless ways that your vehicle can become immobilized on the trail. Recovery techniques and the gear you'll need will depend on the situation. They say a driver is only as good as their gear, but in terms of recovery, it's how well you know how to use it.



STRAP AND ROPE RECOVERY

When you are stuck, self-recovery should always be your first option. There are many ways this can be done, from digging out your tires with a shovel to using one of the winching techniques shown later in the guide. These techniques are your safest alternatives, so only after you've exhausted all other options should you bring another vehicle into the process.

Using straps or ropes to pull vehicles free has been around since drivers started getting stuck. This can be one of the simplest methods of freeing a vehicle, but don't let the convenience fool you. There are many risks involved. However, this technique can be extremely useful when a recovery needs to happen quickly. For instance, if you're stuck on a beach and the tide's a comin', it's time to strap up. There are two common types of recovery straps.



RECOVERY STRAPS

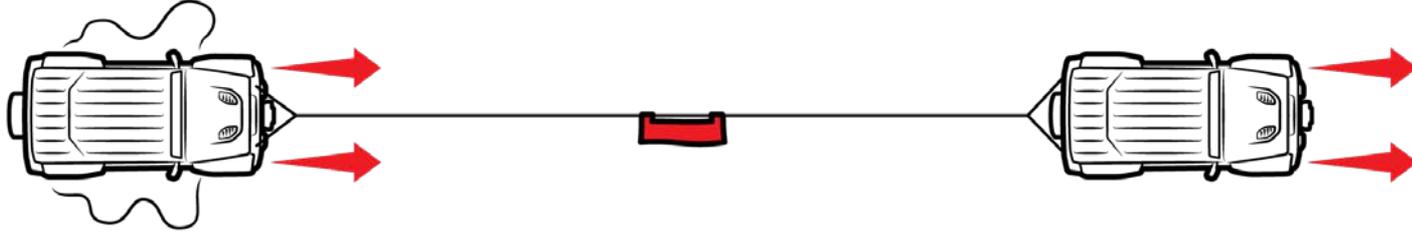
In a low-energy recovery, a mobile vehicle pulls a bogged vehicle free with the use of a strap. Many drivers gravitate to recovery straps because they are cheap and convenient. Made of flat nylon webbing with open loops, a snatch strap will stretch approximately 15%, allowing the strap to store kinetic energy that will be used to free the bogged vehicle. Slack is left in the line to allow the mobile vehicle to sling the stuck vehicle free.



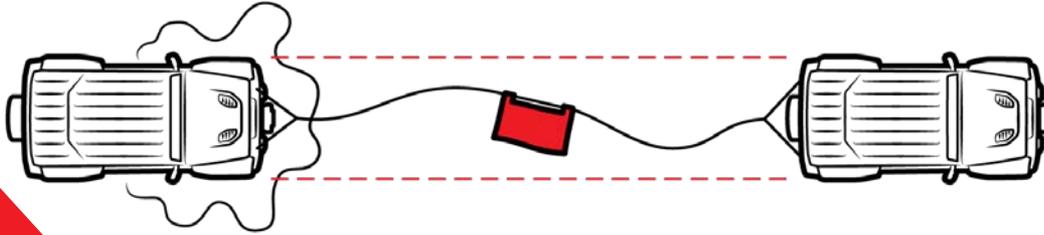
KINETIC RECOVERY ROPE

Kinetic recovery ropes are made of stretchy, high-tenacity nylon. These are based on the same concept as the snatch strap, but kinetic recovery ropes rely even more on elasticity to sling the bogged vehicle free – like a rubber band. A kinetic recovery rope will stretch up to 30%, which is significantly more than a recovery strap will stretch. The rope's capacity to stretch is not only safer, but it is much easier on both vehicles' recovery points. While it does cost more, a kinetic recovery rope has proven to be the safer and more effective option.

RECOVERY TECHNIQUE



- 1.** Line up the mobile recovery vehicle in as straight a line as possible with the bogged vehicle. It should be positioned to allow around 3 feet of slack in the strap or rope.
- 2.** Attach the rope to each vehicle's recovery points with a D-ring.
- 3.** Place a dampener over the rope to protect individuals in the event of a rope snapping.
- 4.** Pull forward until the slack is gone, and try to slowly pull the bogged vehicle free.



- 5.** If recovery fails, repeat the process, but give the recovery rope slightly more slack to create more of a whip. The mobile vehicle can also slightly increase its speed.

CAUTION

NEVER join two straps or ropes with a shackle. If the shackle snaps, the kinetic energy can cause a chunk of metal to be hurled at you at the speed of a bullet.

NEVER step over a strap when it is connected at both ends or you could get your leg caught.

DO NOT subject recovery points to side loads.

DO NOT attach a strap to a ball or bumper tow hitch.

DO NOT use a strap for a vehicle completely bogged in mud.



WINCHING 101

The moment has finally arrived – you’re stuck. You’ve tried the old-fashioned way of rocking your vehicle free, but it’s clear your vehicle isn’t going anywhere. Lucky for you, where there’s a winch, there’s a way. A winch is a vital tool for off-roaders and can free up a large vehicle that normally wouldn’t have a prayer. There are many pieces of equipment that go into a safe winching operation, so it’s a good idea to purchase a winch kit. This will provide all of the accessories you’ll need. Before you start your recovery, review these basic techniques that can get your vehicle moving and keep your crew safe.

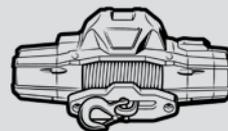
KEY EQUIPMENT



BOW SHACKLE

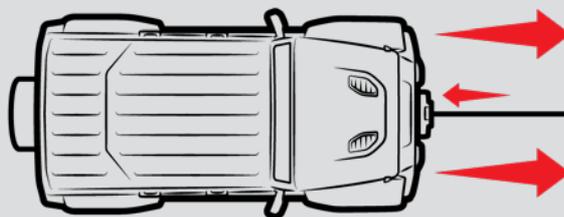


SNATCH BLOCK



WINCH

- 1.** Find a suitable winch anchor, such as a rock, a tree or even another vehicle. When using a tree, make sure you use a strap or tree protector. Never wrap the cable around the tree or hook the cable to itself — make sure you are not damaging a defenseless living organism or your equipment.
- 2.** Choose a winch anchor close enough to the vehicle to allow 4 or 5 wraps around the drum to ensure enough grip on the drum. Any fewer could risk the cable being pulled off the drum, leaving you stranded.
- 3.** Wearing gloves, drag out your winch cable and connect your winch to the strap using a bow shackle. The hook should be attached open end up to place the load on the hook.



SINGLE-LINE RECOVERY

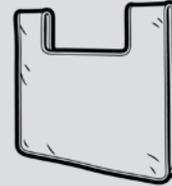
Single-line or self-recovery is a basic winching technique where a driver uses a large anchor to pull their vehicle free.



GLOVES



TREE STRAP



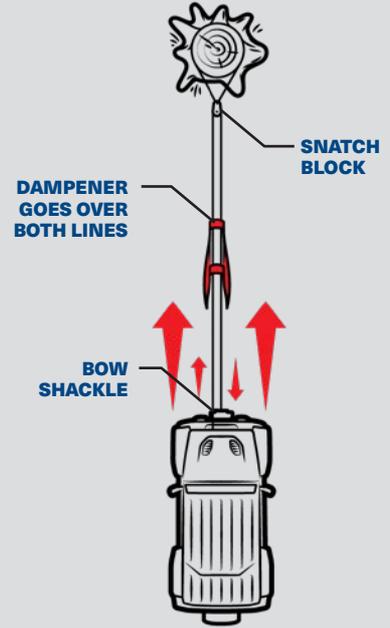
LINE DAMPENER

4. Always place a line dampener over the winch cable to slow it down in case it snaps. This could be a blanket, coat or even a floor mat.

5. When controlling the winch, the best and safest place to be is in your vehicle. Your power cable will reach through the driver's window, which will allow you to gently use both the power of the vehicle and the winch to pull you out.

6. Take time to inspect the winch and make sure it's spooling property. Take periodic breaks to make sure that the motor of an electric winch won't overheat.

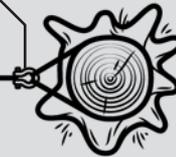
7. If you are not an essential part of the operation, stay clear of the cable. A good rule of thumb is to stay back farther than the length of the cable.



DOUBLE-LINE RECOVERY

Sometimes your anchor point will be too close to spool out enough cable to effectively winch your vehicle — or your winch simply doesn't have the power to free it. Instead of hooking your winch directly to the tree strap, you can run a line through a pulley, called a snatch block, and back to your vehicle's tow point. This will double the pulling power of your winch and lessen the recovery time.

TREE STRAP AND BOW SHACKLE



SYNTHETIC ROPE

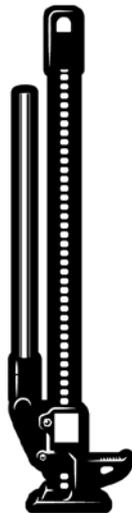
has become the industry standard. While it is susceptible to chafe, it has a much higher breaking point and is safer than traditional wire rope.



RECOVERY TOOLS

The beauty of four-wheeling is that no two trips or recoveries will ever be the same. Not every recovery situation lends itself to winching or pulling out with another vehicle. At times you'll need to get creative.

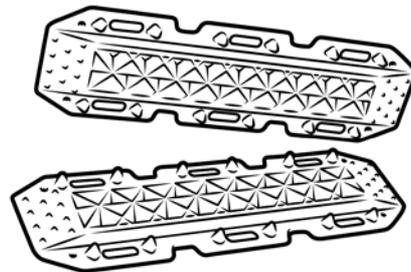
Drivers will use a number of tools as well as anything they can get their hands on in the environment. You'll see everything from jacking out of trouble to using recovery boards or even using the vehicle's floor mats to aid in regaining traction. There are countless recovery tools out there, but here are a few common pieces of equipment you'll see.



HI-LIFT JACK

Since many off-road vehicles are lifted, a hi-lift jack can come in handy when making a repair or jacking your vehicle out of trouble. The bumpers of many newer vehicles are not solid enough to support the weight of the vehicle on the jack, so make sure your vehicle has proper jacking points. If it does not, there are accessories you can buy, such as lift mates, that are hook attachments to lift the wheel.

CAUTION: Hi-lift jacks are known for being unsteady, especially in soft terrain. If you are using a hi-lift jack on a soft surface, make sure you increase its base. You can buy a plastic accessory to widen your base or use a simple piece of plywood.



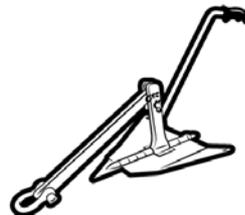
RECOVERY BOARDS

Lightweight ramps are designed to help you regain traction in soft terrains like sand and mud. If you do much driving in sand, you'll quickly see how useful these become. Sand ladders are also available.



BOTTLE JACK

This compact hydraulic jack can lift immense amounts of weight. They have less reach than a traditional crank jack.



GROUND ANCHOR

A device that can be buried in the ground to serve as a winching anchor point.

RECOVERY WATCH-OUTS

Recovery safety should not be taken lightly. One careless error could cause severe damage to your vehicle – or even serious injury or death. Here are a few things you should never do during winch or rope recoveries.

WINCH RECOVERY

- DO NOT** winch without gloves.
- DO NOT** stand next to or straddle a winch cable.
- DO NOT** jerk the line or use like a snatch strap.
- DO NOT** drive over your winch cable.
- DO NOT** hook onto your winch cable.
- DO NOT** wrap a tree without a tree strap.
- DO NOT** wrap a tree strap above the base of the tree.
- DO NOT** winch without a line dampener.
- DO NOT** run rope over a jagged rock.
- DO NOT** subject recovery points to side loads.
- DO NOT** winch at an angle.

ROPE RECOVERY

- DO NOT** use a rope or strap to winch.
- DO NOT** step over a strap when it is connected at both ends.
- DO NOT** join two straps or rope with a shackle.
- DO NOT** attach a strap to a ball or bumper tow hitch.
- DO NOT** use a frayed or damaged strap.
- DO NOT** recover from non-tow-rated points.
- DO NOT** use a strap for a vehicle completely bogged in mud.

GLOSSARY

2WD – In a 2WD vehicle, two wheels receive all the torque. Operating in 2WD provides significantly better highway fuel economy.

4WD High – 4WD High gives you extra traction on dirt roads and easier trails that require steady momentum. It reduces the likelihood of slipping and spinning your wheels on surfaces like snowy roads and muddy dirt.

4WD Low – 4WD Low provides maximum traction and power to negotiate difficult terrain when slower speeds and greater torque are required. It can also be helpful when towing.

4x4 – A vehicle that has four wheels and four-wheel drive.

Acceleration – The capacity to gain speed within a short timeframe.

After-Market Modifications – Changes made to a vehicle beyond factory specifications. After-market parts may or may not be manufactured by the original equipment manufacturer.

Aired/Airing Down – Lowering the tire pressure to offer a smoother ride while driving off-highway. It also increases your tire's footprint, resulting in better traction over rocks and loose terrain.

All-Terrain Tires – All-terrain tires are designed to provide considerable traction over a wide range of terrains. Their less aggressive tread design provides a much smoother and quieter highway ride than a mud-terrain tire.

All-Wheel Drive (AWD) – AWD vehicles utilize a center differential to deliver power to all four wheels. But most AWD vehicles don't have a transfer case that splits and locks the power 50/50 front to back, so they will operate like front-wheel

drive vehicles most of the time – only delivering torque to the rear wheels as needed.

Approach Angle – The maximum angle at which a vehicle can enter an upward slope without the front of the vehicle touching the ground.

Ascent – Driving up to the summit of a mountain or hill.

Automatic Transmission – Shifts between gears internally, freeing the driver from having to shift gears manually. An automatic transmission allows you to efficiently reach high speeds and is typically used for highway driving.

Axle – A central shaft for a rotating wheel that may be fixed to the wheels and rotating with them or fixed to the vehicle with the wheels rotating around the axle.

Axle Ratio – A comparison of the number of gear teeth on the rear axle and the pinion gear on the driveshaft.

Baja – Mexico's Baja California Peninsula, it's considered a mecca for off-road racing.

Bias Tire – A type of recreational light truck tire popular until the 1970s. Bias tires were tough but also incredibly stiff, prone to tire slip and designed to bulldoze rather than grip.

Biting Edges – Portions of the tire tread that is designed for increased wet and snow traction.

Bogged Vehicle – A vehicle that has become stuck in water, mud or sand.

Bottle Jacks – Also called hydraulic jacks, bottle jacks are very compact and can lift immense amounts of weight. They have less reach than traditional crank jacks.

Bow Shackle – A key equipment recovery tool shaped like a large loop to take loads from many directions without developing as much side load.

Break-Over Angle – The maximum angle at which a vehicle can drive over a ridge or obstacle without scraping its underside.

Camel Trophy – Was an annual competition held from 1980 – 2000. It was best known for its use of Land Rover vehicles over the world's most challenging terrain.

Center Console – The control-bearing surfaces in the front center of the vehicle interior.

Clutch – A mechanism for connecting and disconnecting a vehicle engine from its transmission system.

Clutch Start Cancel Button – Allows you to start your rig with your key in the ON position without applying the clutch.

Crank Jack – A traditional device that employs a screw thread for lifting heavy equipment.

Crawl Assistance – An intuitive sensor system that is designed to control your brake and throttle in low-speed off-road driving over difficult terrain.

Crawling – Most crawling is done in low gear at a snail-like speed. We're talking 1-3 mph.

Crest – The top or extreme point of a mountain or hill.

Dakar Rally – An annual off-road endurance event requiring amateur and professional drivers to traverse terrain much tougher than conventional rallying with true off-road vehicles rather than modified on-road vehicles.

Departure Angle – The maximum angle a vehicle can exit a downward slope without the rear coming in contact with the ground.

Descent – Moving downward, dropping or falling from the summit of a mountain or hill.

Differential – Differentials are designed to allow wheels on a single axle to move at different speeds.

Double-Line Recovery – Doubles the pulling power of your winch by running a line through a snatch block.

Driveshaft – The component in a drivetrain that transmits torque and rotation from the transmission to the differential.

Drivetrain – A group of components that delivers power to the driving wheels. This excludes the engine or motor that generates the power. In contrast, the powertrain is considered to include both the engine or motor and the drivetrain.

Engine Braking – Using the retarding forces within an engine to slow down a vehicle, as opposed to using additional external braking mechanisms like friction brakes or magnetic brakes.

Flotation – Putting more of the tire's rubber in contact with the ground, enabling them to "float" atop loose terrains like sand, mud and loose clay.

Footprint – The portion of the tire's tread that touches the road's surface.

Fording – Crossing a river or stream at a shallow place.

Fording Depth – The maximum depth of water a vehicle can pass through at a given speed without ingesting water into the motor.

Four-Wheeling – Driving a four-wheel drive vehicle off-road and through extreme conditions.

Four-Wheel Drive – Putting your vehicle into four-wheel drive distributes torque and traction to all four wheels to help limit the chances of your vehicle getting stuck.

Full-Time 4WD – Also called permanent 4WD, full-time 4WD is a system that powers all four wheels at all times.

Gear – Transmits power from the crankshaft (the rotating axle that takes power from the engine) to the driveshaft running under the car that ultimately powers the wheels.

Gear Shift – Used to engage or disengage gears in a vehicle transmission.

Ground Anchor – Can be buried in the ground to serve as a winching anchor point.

Ground Clearance – Also called ride height, it's the distance between the lowest part of the vehicle and the ground or obstacle to be cleared.

Gully – A landform created by rushing water that sharply erodes the soil, typically on a hillside. Gullies resemble large ditches or small valleys, but are meters to tens of meters in depth and width.

Handling – The way your vehicle responds and reacts to driver input, as well as how it moves along a track or road.

Hi-Lift Jack – Designed for vehicles with lift kits, it offers higher clearance for repairs or recovery.

High-Flotation Tire – Flotation tires have a much wider footprint than LT-metric tires, putting more of the tire's rubber in contact with the ground to "float" atop loose terrains. Many all-terrain and mud-terrain tires have high-flotation sizes available.

Highway Use – The ability to drive an off-road vehicle on a paved road.

Idle – When the engine is running with no throttle input.

Independent Front Suspension – a vehicle suspension system where each wheel acts independently of one another.

Jack – A tool that allows you to lift a car off the ground in order to make repairs or change a tire.

Jacking Points – Areas where you can safely use a jack. Identified by your vehicle manufacturer.

Kinetic Energy – The energy created by being in motion.

Kinetic Recovery Rope – A recovery method that uses stretchy, high-tensity nylon rope to sling a bogged vehicle free – like a rubber band.

King of the Hammers – An off-road race that combines desert racing and rock crawling. Held in February on Means Dry Lake at Johnson Valley, California.

Left-Foot Braking – A technique that uses both feet to help control your speed over difficult obstacles.

Lift Kit – Lifts the suspension of the vehicle to allow for larger diameter tires. Provides more ground clearance to improve your vehicle's ability to overcome obstacles.

GLOSSARY

Lift Mates – Hook attachments to lift the wheel.

Limited-Slip Differential – Redirects torque to the tires with the most traction to help your vehicle move forward over difficult terrain.

Line Dampener – Placed over the winch cable to slow it down in case it snaps. Could be a blanket, coat or even a floor mat.

Load Range – The tire's ability to hold air pressure and carry weight. You'll find the load range listed on the tire sidewall represented by a letter. This letter code gives you a comparative idea of the tire's toughness; helping you understand how much air your tire can hold and how much weight it can carry, it's a relative measure of the tire's durability. Tires with higher load ranges carry heavier loads.

Locker – An axle mechanism for locking differentials.

Locking Differential – Allows wheels on a single axle to lock and spin at the same rate. Equal power is distributed to both wheels, regardless of traction.

LT Tires – If a tire size begins with LT, it signifies the tire is a light truck metric size designed for vehicles capable of carrying heavy cargo or towing large trailers.

Manual Transmission – Manual transmissions require a clutch and manual gear selection, allowing more individual control of the vehicle.

Momentum – The built up motion your vehicle needs to power through loose terrain.

Mud-Terrain Tires – Feature large tread blocks and voids to effectively evacuate mud and soft soil while maintaining traction on rocky and uneven trails.

No-Man's-Land – A place unoccupied due to fear or uncertainty.

Obstacles – Rocks, logs and other items obstructing your path.

Off-Road – The appropriate trails that are not paved, that you are allowed to take your vehicle on.

Off-Roading – Driving a vehicle on unsurfaced roads or trails made of sand, gravel, riverbeds, mud, snow, rocks, and other natural terrain. Types of off-roading range in intensity, from leisure drives with unmodified vehicles to competitions with customized vehicles and professional drivers.

Open Differential – Allows wheels on a single axle to move at different speeds. The torque flow in open differential will take the path of least resistance, so it will go to the wheel with the least amount of traction.

Original Equipment (OE) – Parts you get to match those that were on your vehicle when it left the manufacturer.

Overlanding – Self-reliant adventure travel to remote destinations where the journey is the primary goal.

P-Metric Tires – Tires designed for passenger vehicles and meant for highway use only. They are not suitable for off-road.

Pack It In, Pack It Out – Don't leave anything behind – ever. We only have one Earth, so you better treat it right.

Parking Brake – A brake used to hold a stationary vehicle in place.

Part-Time 4WD – Also called on-demand 4WD, part-time 4WD is a system that allows 4WD to be called upon when needed.

Prerun – Running the course before the start of the race.

Push-Start – Starting your engine by engaging the manual transmission while the vehicle is in motion. Used when other starting methods are unavailable.

Radial Tire – The sidewall and tread function as two independent features of the tire for better mileage and treadlife.

Recovery Boards – Lightweight ramps designed to help you regain traction in soft terrains like sand and mud.

Recovery Points – Tow points for off-road recovery.

Recovery Strap – A strap often made of flat nylon webbing with open loops that can be used to pull out a bogged vehicle.

Rim – The outer edge of a wheel that holds the tire.

Rock Crawling – Moving in a low gear at a slow speed to drive up, down and across obstacles.

Roll Bar – A metal bar running up the sides and across the top of a vehicle that strengthens its frame. This is imperative for your safety in the event that your soft-top vehicle flips.

Rollover Angle – The maximum angle a driver can drive a side hill without turning over.

Roof Rack – Provides additional storage for tools and gear needed for many types of off-road adventures.

Rut – A long deep track made by the repeated passage of the wheels of vehicles.

SCORE (Southern California Off Road Enthusiasts) –

An off-road racing sanctioning body in the sport of desert racing famous for the Baja 500, Baja 1000 and San Felipe 250.

Side Hill – Driving laterally across the face of a hill. This greatly increases your risk of rolling over.

Sidewall – The area of a tire between the tread shoulder and the rim bead. Thick sidewalls add toughness so you can take on all but the most extreme trails.

Single-Line Recovery – Also called self-recovery, a basic winching technique where a driver uses a large anchor to pull their vehicle free.

Sipe – A groove or channel in the tread of a tire improves its grip. More sipes increase the number of biting edges for more traction in winter conditions.

Snatch Block – A pulley used in conjunction with a winch in a recovery application that increases pull power over short distances. It also allows you to change the direction of your winch's cable when the anchor point is offset.

Soft-Top Vehicle – A vehicle with a roof made of fabric (rather than metal) that can be folded down or removed.

Solid Front Axle – A single, solid shaft that connects a set of wheels.

Spooling – Proper retraction of a recovery rope from a winch. Take time to inspect that the winch is spooling properly. Take periodic breaks to make sure that the motor of an electric winch won't overheat.

Spotter – Someone outside the vehicle who can you help find the proper line when it's difficult for you to see. A trusted spotter can save you from injuring yourself or committing costly damage to your vehicle.

Stall-Start Recovery – A technique for safely restarting a manual transmission vehicle on a steep hill.

Steering Column – The shaft that connects the steering wheel to the rest of the steering mechanism.

Straddling – Keeping your wheels on both sides of ruts or gullies as you drive.

Suspension – A system of springs and shock absorbers that cushion a vehicle from road conditions, including a system to smooth out bumps, keep tires touching the road and control vehicle stability.

SUV (Sport Utility Vehicle) – A vehicle with off-road features like raised ground clearance and ruggedness, and available four-wheel drive. Many SUVs are built on a light-truck chassis but operated as family vehicles, and though designed to be used on rougher surfaces, most often used on city streets or highways.

Synthetic Rope – While it's susceptible to chafe, this industry standard has a much higher breaking point and is safer than traditional steel cable.

Terrain – The physical features of a specific stretch of land.

Three-Point Turn – Turn a vehicle around in a tight space by moving forward, backward and forward again.

Throttle – A device controlling the flow of fuel or power to the engine.

Tire Pressure – The amount of air inside a tire. Affects the performance of your vehicle.

Torque – The rotating force created by the engine's crankshaft. An engine with higher torque is better suited for climbing and crawling over obstacles.

Tow Hitch – Device such as a tow ball attached to the chassis of a vehicle for towing.

Tow Strap – A piece of recovery gear used to pull loose a stuck vehicle.

Traction – The tire's ability to grip surfaces.

Traction Control – A system designed to prevent loss of traction by keeping the vehicle moving forward by alerting the computer to brake as necessary in order to keep the wheels from spinning and losing traction. It may have a simple on/off switch or come with multiple settings.

Trail – Unsurfaced roads or tracks other than paved roads and maintained dirt roads that can include sand, gravel, riverbeds, mud, snow, rocks, and other natural terrain.

Trail Ratings – To help drivers choose the right trail for their abilities, Jeep Jamboree USA labels many trails with a number and colored shape to distinguish how challenging they're likely to be.

Transfer Case – Transfers power from the driveshaft to the front and rear axles.

GLOSSARY

Transmission – Transfers power from the engine to the wheels. An automatic transmission changes gears without driver input. A manual transmission allows the driver to control shifting.

Transmission Wind-Up – The stress or torque created in the components of a vehicle when it is placed in four-wheel drive and driven around corners.

Tread – The part of the tire that makes contact with the road or ground to give you traction to move forward.

Tread Block – Independent areas of tread around the tire's circumference. Multiple side-by-side rows of tread blocks are typically molded across a tire's tread.

Tread Lightly – A U.S. nonprofit organization with the mission “to empower generations to enjoy the outdoors responsibly through stewardship to further the goals of responsible and ethical recreation.”

Treadwear – How quickly and evenly the tread on your tires wears out.

Tree Strap – An essential item in any winch recovery kit that allows you to winch from a wide variety of anchor points.

Undercarriage – The supporting frame under the body of a vehicle.

Void – The gaps between the raised tread blocks on your tire that allow the tire to flex slightly, improving traction and handling. These gaps direct water, mud and snow away from the tire, which helps prevent hydroplaning and keeps you gripping the road.

Wheel – A wheel is comprised of a tire, rim and hubcap.

Whip – A flag or a light that extends up past the roof of your vehicle to allow drivers on the other side of a dune or hill to know your location.

Winch/Winching – A winch is a heavy-duty cable attached to a powered rotating drum that can pull large vehicles. A vital tool for off-roaders.

