POWERTRAX® Extreme Traction Systems

LOCK-RIGHT® Performace Locker
Vehicle Owner's Manual

Part#: 1000701MOA

Introduction

Congratulations on your selection of the new **LOCK-RIGHT** automatic 100% full-locking differential! Just watch—soon it will be getting you and your vehicle into and out of many places that would have been difficult or impossible to reach without it. Better yet, a 4x4 with **LOCK-RIGHT**s in both ends will give you the most traction that you can get! Also note that a 4x2 with a **LOCK-RIGHT** in the rear axle will be about as effective as a 4x4 with standard open differentials, and in some situations even better. Because it will make such an amazing difference in how your vehicle performs, we're sure that you'll enjoy belonging to the growing family of **LOCK-RIGHT** owners. Welcome!

Important Information

Be sure to have any drivers of your vehicle carefully read and understand the sections in this manual beginning on page 7 that describe vehicle operation and on page 10 that describe driving precautions. The LOCK-RIGHT produces some minor but noticeable differences on-road while giving your vehicle major increases in traction off-road. **It is very important for the driver to read and understand these characteristics!** We suggest that you **store this manual in the glove compartment** for reference.

The LOCK-RIGHT®

-FUNCTION

The standard "open" differential always divides torque equally between the wheels. If one wheel slips and starts spinning with only a small amount of torque applied, the other wheel also receives only this same small amount—and your vehicle stops. To solve this problem, the **LOCK-RIGHT** automatically delivers up to 100% of the available engine torque to either wheel—so that the one with the most traction will help keep you moving.

-OPERATION

The **LOCK-RIGHT** (see: Figure 1) consists of two bi-directional over-running dog (toothed) clutches. Each one has a driving

member (the **driver**) and a driven member (the **coupler**, or in some models, the existing side gear). Both clutches are rotated by the pinion shaft(s) (or the spider). Each driver has special recesses cut in one face that receive the pinion shaft(s), and radial teeth cut in the opposite face. Each driver mates with its coupler to form a fully-locking combination. The coupler also receives the axle shaft to drive the wheels.

When your vehicle is moving straight ahead, both wheels are rotating at the same speed and both clutches are fully engaged (locked). When your vehicle begins to turn, the outside wheel starts to rotate faster than the inside wheel. The two clutches sense this difference in speed and allow the coupler (or side gear) of the outside clutch to unlock so that the wheel can rotate freely. It thus is "ground-driven" faster as the vehicle is turning; power continues to be applied to the slower (inside) wheel. As the vehicle straightens out the wheels again rotate at the same speed, and the outside clutch re-engages. This differentiating action occurs automatically for right and left turns and in both the forward and reverse directions.

-FEATURES

Its design is simple and rugged. It is an automatic 100% fully-locking differential that is "all-gears"—no belleville washers, clutch packs or cone clutches to break or wear out. The **LOCK-RIGHT** simply replaces many of the parts inside the standard differential case.

It uses your own stock differential case, bearings, spider (where applicable) and thrust washers (and also the side gears in some models) and in a few cases your pinion shaft(s) rather than parts that are all specially made and therefore more expensive.

It uses stainless steel springs for excellent resistance to high temperatures and fatigue.

The drivers and couplers are made from carbon steel aircraft alloy and are heat-treated for toughness and durability.

It uses standard gear oil rather than a special limited-slip differential lubricant.

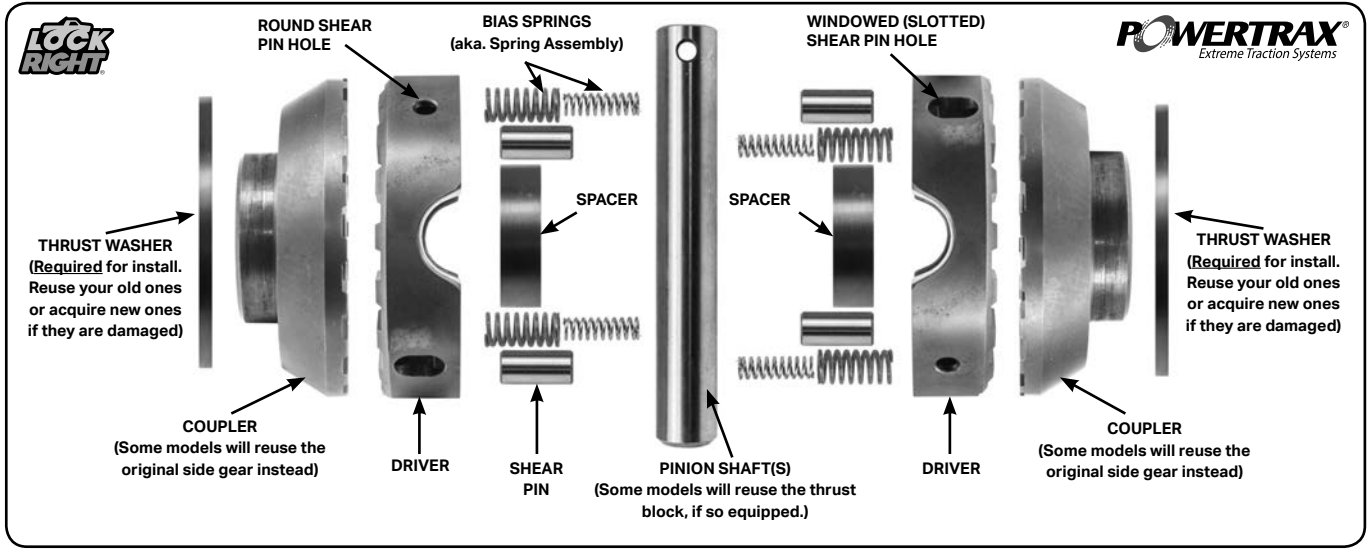

Figure 1: Typical Lock-Right exploded view

It can be easily installed by anyone familiar with general automotive work. With care, it can be installed without altering the drive pinion and ring gear settings—they do not need to be "set up" again.

It minimizes the tire wear that is associated with some other lockers and also with limited-slip clutch-pack differentials by allowing free rotation of the outside wheel during a turn.

It can increase gas mileage off-road in either a 4x4 or a 4x2 because of more efficiency due to increased traction, especially in sand.

It has been operated extensively off-road in some of the most rugged trucks in the world—military and civilian—and has been triple-checked for proper materials and design. We believe that it will last for as long as would your conventional open differential.

It provides you with the best off-road traction available. No other type of differential can match it in allowing up to 100% of the engine power to be applied to either wheel even when the other one is off the ground—the reason that the **LOCK-RIGHT** will allow your vehicle to reach its maximum potential.

-FRONT AXLE DISCONNECT OPERATION

All modern 4x4 vehicles have a way to save wear on the drive train and increase gas mileage by preventing the front differential from spinning in 2WD. Some late vehicles accomplish this feature by disconnecting only one axle shaft in the middle rather than by using free-wheeling front hubs. This design saves cost by eliminating the need for the additional hubs and full-floating axles. However, the differential gears continue to wear. The **LOCK-RIGHT** can be installed in these axles; however, the front ring and pinion gears will continue to rotate (the same characteristic as most early 4WD vehicles) because of the locking feature of the differential. **NOTE:** This spinning at high speed on-road can cause vibration if the drive shaft is unbalanced or if the vehicle has a lift and the U-joint angles are not matched. If

vibration occurs, carefully check the front end components.

Free-wheeling front hubs cannot be installed in some vehicles because of the axle assembly design. With a locker in the front end and the transfer case in the on-road 2WD position, the only change in vehicle performance will be a slight decrease in gas mileage and a shorter seal life for the drive pinion flange and transfer case front output. The life of the drive gears and the other bearings and seals will remain essentially unchanged.

If the vehicle is to be driven in cold weather, the drag produced by the thick gear oil will cause a slight pull on the steering wheel. A solution for this problem is to engage the disconnect mechanism so that both axle shafts are spinning, or use a lighter oil.

-VEHICLE PERFORMANCE

GENERAL: The first thing that you will notice about the **LOCK-RIGHT** installed in the rear axle is that it's hard to notice. Unlike some other designs, it is almost inaudible during cornering and operates with hardly any noise or jerking when driven properly. In two-wheel driving around town, your vehicle will behave quite similar to how it did before the **LOCK-RIGHT** was installed.

TRACTION: A **LOCK-RIGHT** installed in the rear axle of your vehicle will result in much more traction than ever before because it prevents any wheel spin at all unless both wheels spin. When either wheel begins to slip, the **LOCK-RIGHT** immediately transfers more torque to the other one to keep you moving instead of getting stuck. Thus, with a **LOCK-RIGHT**, the wheel with the most traction receives the most power. In a 4x4, this power-distributing characteristic is even more effective with another one in the front axle—giving your vehicle the ultimate in traction. It won't become stuck until all four wheels are spinning!

PAYLOAD: The **LOCK-RIGHT** increases the effective tractive ability of your vehicle but *does not increase its payload rating or its load-carrying capacity.*

STEERING: Any effect on steering produced by a

LOCK-RIGHT in the front axle is hardly noticeable in rugged off-road use or in 2WD on-road, even with the front locking hubs engaged. However, the vehicle may tend to understeer if it is in 4WD in a place where 4WD is not required, such as on a hard dirt road, for example. Even so, a vehicle with two **LOCK-RIGHT**s installed has the best of two worlds—maximum traction in 4WD and normal steering in 2WD.

BACKLASH: The **LOCK-RIGHT** needs about 25° of free drive shaft rotation to allow it to operate, producing a slight delay when getting on and off the throttle. This delay does not represent any problem with the assembly or with the drive gears. This built-in backlash characteristic is present in all automatic lockers and is completely normal.

-OFF-ROAD OPERATION

The places in which you will notice your new **LOCK-RIGHT** are off-road. Because your vehicle now will climb better than before, we suggest that you become familiar with its new capabilities slowly. Take it to an off-road area in which several types of terrain are present and try each one carefully to see how well your "new" vehicle performs. Only after becoming thoroughly familiar with its new capabilities should you put it through its paces with serious off-roading.

-VEHICLE OPERATION

APPLYING POWER: During normal driving, either rear wheel or both may be powered, depending on whether or not the vehicle is turning slightly or has just finished turning. Because of these constant small turning movements and minor differences in tire diameters, some of the time either one side or the other may be slightly unlocked. When you get on and off the gas quickly or shift gears, you may notice a momentary slight sway at the rear. This is because acceleration and deceleration will initially be applied at only one wheel rather than at both wheels until the torque equalizes. This effect is easy to become used to but is mentioned for your information.

CORNERING: When turning your vehicle, try to do so under slight positive throttle. If turning is done with a neutral throttle, it may tend to "buck" because of interaction between the free drive shaft rotation and the engine RPM change due to a varying load. During normal turning movements on the street, you will notice that your new **LOCK-RIGHT** operates easily.

If you are powering in a turn and then get off the gas, torque transfers from the inside (driving) wheel to the outside (decelerating) wheel. This transfer of torque may tend to change the vehicle direction; when turning on slippery surfaces, be sure to do so smoothly and avoid jerking.

If you are in a turn and accelerate suddenly, the vehicle will tend to straighten out because initially the inside wheel is the only one that is being powered (the outside wheel is free-wheeling during the turn). Be very careful in turns, especially on water or ice!

When a vehicle turns, each wheel follows a slightly different path. This means that each wheel turns at a slightly different rate than the others because of the individual turning radii. In a 4WD vehicle with all wheels engaged, the wheels try to slip a little as the vehicle is turning. On a dirt surface, this action occurs unnoticed. On a paved road, however, the wheels are "locked" to the pavement so that they are unable to slip. Since they are all connected together through the drive train and are turning at different rates, something must give. The result is that all members in the drive train, (drive shafts, U-joints, axles, gears, etc.,) become highly stressed and either something breaks or the parts bind up and the vehicle will not steer or move. This condition is known as "**driveline wind-up**" and is the reason that the manufacturers' manuals state that the vehicle should never be driven on hard-surfaced roads in 4WD. This especially is true of vehicles with locking differentials because wind-up occurs even more quickly than with standard differentials.

-TWO LOCK-RIGHTS

The LOCK-RIGHT in the rear axle produces about 70%

of the total difference in traction between two **LOCK-RIGHT**s and no **LOCK-RIGHT**s. Therefore, four-wheel drive will be needed less often than before because two-wheel drive now will get you farther. If you are in four wheel drive where it is not needed, the steering will tend to become stiffer than normal because of increased friction in the front axle universal joints and the vehicle also will tend to understeer. This effect is produced by **limited driveline wind-up** and continues until one of the wheels slips a little to relieve the tension. We therefore recommend that you use 4WD drive only when you need it.

-A WORD ABOUT NOISE

During the operation of your LOCK-RIGHT equipped vehicle, you may notice certain noises. They are as follows:

a) CLICK: The **LOCK-RIGHT** has released the outside wheel in a turn. This means that its coupler (or side gear) rotates faster than its driver so that the teeth passing by each other produce a uniform "click-click-click" that can sometimes be heard during turning. Cold weather and/or thicker oil will decrease the sound. This clicking is completely normal and lets you know that everything is functioning properly (also see the section about trouble-shooting on page 13).

b) CHIRP: During cornering, the faster outside wheel is free-wheeling; the slower inside wheel is under power but is having weight transferred off as the vehicle leans toward the outside. Under a lot of throttle on the street, it may "chirp" on the pavement as it momentarily loses traction and spins a little to catch up with the outside wheel. As soon as it is prevented from rotating any faster by the outside wheel it regains traction. This action may repeat several times in the course of a powered turn. This condition does not result from any tire scuffing or dragging as with some other lockers or limited slip differentials. Applying only a little throttle will eliminate the noise.

c) CLUNK: As mentioned on page 7, the **LOCK-RIGHT** has about 25° of free drive shaft rotation built into it so that it can operate properly. This backlash may produce a "clunk" in

the driveline when letting on and off the gas. This is perfectly normal. This noise is more prevalent with stick shift vehicles than with automatic transmission vehicles, but the operator should be aware that it exists. Also, be sure that the unit is installed properly before attributing any noise to the locker itself.

-DRIVING PRECAUTIONS

WARNING: Failure to observe the precautions in this manual may result in damage to your new **LOCK-RIGHT** and/or injury to personnel. The manufacturer, wholesalers and distributors who sell the **LOCK-RIGHT** do so with the express stipulation that the owner and/or operator is responsible for proper **LOCK-RIGHT** installation and safe vehicle operation (see the warranty for more details).

The following comment is contained in the warranty but also needs to be stated in this section: "Neither manufacturer nor seller will be liable for any injury, loss, damage or inconvenience arising directly or indirectly from the installation or use of these **[LOCK-RIGHT]** parts or the inability to install or use same." The **LOCK-RIGHT** gives your vehicle the ultimate in traction but also gives you more responsibility for its careful operation.

Traction-adding differentials, including clutch-pack types, can get you into trouble in three ways:

1. FIRST—by giving your vehicle different operating characteristics than before; you must take greater care during driving.

2. SECOND—by getting you farther up a hill before your vehicle stops; getting back down can be more difficult than before.

3. THIRD—by breaking an axle shaft. This way is more subtle but is potentially more dangerous. We will carefully analyze this situation with you now. (This analysis also holds true for many other types of traction-adding differentials, including clutch-pack limited slip units.)

a) APPLYING POWER: Because the **LOCK-RIGHT** can apply twice as much of the available engine torque (100%) to

either axle shaft when compared with the standard differential (50%), you must be more careful than before when getting your vehicle out of a rough situation. To avoid breakage, therefore, be sure to apply power smoothly and avoid jerking.

b) BREAKING AN AXLE: An axle shaft generally will break when it is under a lot of power. When this happens, the wheel on the opposite side will still be powered because of the torque-transferring capability of the differential—and the vehicle will tend to turn quickly toward the side on which the break occurred. When a front axle shaft breaks, the remaining powered wheel will also try to turn around the steering knuckle because its pulling is then no longer balanced through the tie bar by the pulling of the other wheel. Suddenly having only one front wheel powered can jerk the steering wheel right out of your hands. Remember, any traction-adding differential will give your vehicle more capability, but also must be used with more care than a standard differential.

FULL-FLOATING AXLES: If the broken axle shaft is a full-floating type and the vehicle continues to be driven, after about five minutes of operation check the temperature of the affected axle housing by feel and continue to do so occasionally. This precaution is because in the unlikely event that the axle has broken near the outer end, it can drop down onto the inside of the spindle or housing. Since the differential is of a traction-adding design the axle shaft will keep right on spinning. This rubbing may cause heat build-up that could eventually lead to damage.

FRONT WHEEL DRIVE: In some emergency situations it becomes necessary to drive a 4x4 vehicle in front-wheel drive only. If the vehicle has a traction-adding differential in the front, steering in a turn will become difficult because the inside wheel will continually try to straighten out. The vehicle can also be operated as a 4x1 if needed, however steering will become even more difficult because accelerating tends to turn the steering wheel in one direction and decelerating tends to turn it in the other direction. Even by holding the steering wheel tightly, the

vehicle still will steer from side to side by itself because of play in the drag link, tie rod and steering box. Therefore, be extremely careful if you must drive with only one front axle. Also, if one front axle should break when operating in front-end-only 2WD, the steering would be adversely affected as described above under "**Breaking an axle**". Again, remember to hold the steering wheel tightly when driving in difficult situations. *Also, driving the vehicle on ice in front-wheel drive is not recommended.*

CAUTION: Vehicle control will be affected by a broken axle shaft and further damage can occur. Replace it as soon as possible!

-DRIVING INFORMATION SUMMARIZED

OPERATION: Your vehicle essentially will **operate normally in 2WD** on- or off-road. A momentary slight sideways motion at the rear may occur when getting on or off the throttle.

FRONT AXLE: If you have a LOCK-RIGHT in the front axle, steering in 2WD will not be affected, even with the front hubs engaged (also see the next section).

HARD-SURFACED ROADS: Do not drive on hard-surfaced roads in 4WD because driveline wind-up occurs even more rapidly with a locking differential than with a standard differential. With a **LOCK-RIGHT** in the front axle, driving on hard dirt roads in 4WD also is not recommended because understeer will occur, and also because it is not needed.

POWER: Be very careful when applying a lot of power. If an axle shaft breaks, the vehicle may turn rapidly to one side and/or the steering will be affected. Also, be careful when driving in an emergency with only one axle shaft.

Your new **LOCK-RIGHT**-equipped vehicle now has much more traction than before. This means that it will climb farther and become stuck less, so be careful about where you are going and be sure that you can either turn around or back down. On slippery surfaces, especially on ice, accelerating during cornering can make the vehicle tend to straighten out, so drive carefully. When decelerating under slippery conditions, use the

engine rather than the brakes to slow down. When on a hill, don't get your vehicle sideways. When parking, be sure to use the emergency brake. Obey all safety precautions outlined in the manufacturer's manuals.

-LUBRICATION

The **LOCK-RIGHT** is designed to operate with any lubricant that is made for use with differential gears. For warmer climates we recommend a weight of 85-140 to provide adequate lubrication and to minimize the normal "clicking" sound around corners. For colder climates we recommend a light oil (such as 75-90) as recommended by the vehicle manufacturer.

-TEMPERATURE AND MOISTURE

TEMPERATURE: The LOCK-RIGHT will operate at any temperature that is likely to be encountered in the field. However, if your vehicle has been parked all night in the snow, for example, the gear oil can become as thick as honey and this can cause the parts to move more slowly than normal. We suggest that you drive the vehicle for a few miles on-road to warm up the oil before taking it off-road. If you are already off-road, drive easily for a while before doing difficult climbing.

MOISTURE: The following comments involve the whole power train and we offer them to help assure a long life for your vehicle in general and for your **LOCK-RIGHT** in particular.

Sustained driving will substantially increase the temperature of the axle housing, transmission, transfer case, etc. If these units are suddenly plunged into cold water, as when crossing a stream, for example, rapid cooling can produce a vacuum. If the housing remains submerged, water can be sucked in past the oil seals and into the gear oil. Until they mix, the water will settle to the bottom; it is important to carefully crack open the drain plug and remove the water as soon as possible to prevent rust and corrosion.

After the oil and water have emulsified (mixed on a microscopic level), high temperatures may not drive the water

out as readily as before mixing. Also, the oil-and-water mixture will not lubricate well and will cause corrosion, so replace it with fresh lubricant as soon as possible.

A similar high-temperature-then-vacuum situation can occur with U-joints. After submersion they should be greased as soon as possible to drive out any water.

-TROUBLESHOOTING

Your New **LOCK-RIGHT** is designed to operate trouble-free. If unusual noises or jerking begin to occur, the assembly should be removed and examined for anything either excessively worn or broken. Any bad parts should be replaced. Also see the note at the end of the warranty section about increases in horsepower and/or tire size.

The slight clicking sometimes heard during cornering can also aid in troubleshooting. If your vehicle is turning and no clicking sound is heard at all, even in a tight turn, an axle shaft may be broken and further checks should be made (see the installation manual for details). Briefly, block the vehicle, put it in gear (or in park) and release the emergency brake, jack up both tires, rotate and hold one and spin the other one in the opposite direction. Repeat for both tires in both directions.

-SERVICING

The **LOCK-RIGHT** does not require service other than that normally done on the differential as recommended by the vehicle manufacturer. Use the recommended lubricant and replace it at the proper intervals (also see the section in this manual about temperature and moisture on page 14).