

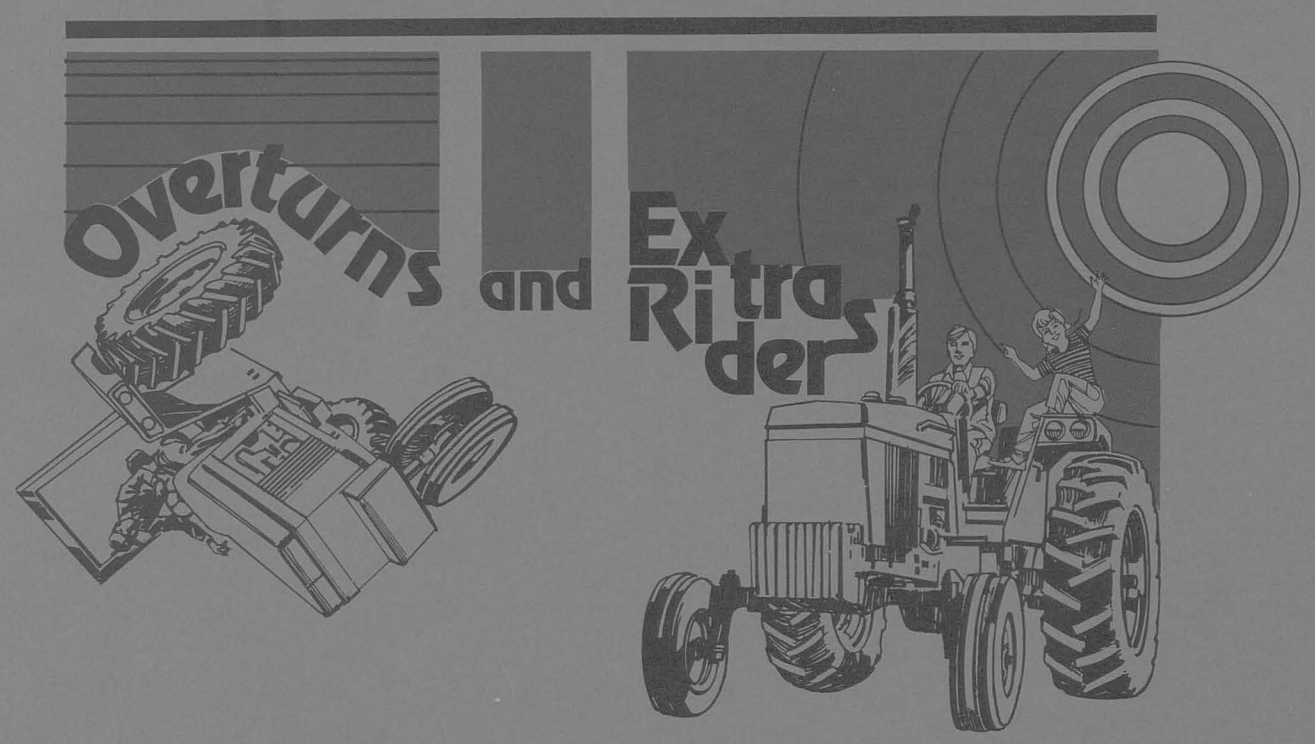
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# SAFE USE OF FARM TRACTORS



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# SAFE USE OF FARM TRACTORS- Overturns and Extra Riders

Each piece of machinery you have on your farm today has some chance of being involved in an accident. The tractor, because of its enormous power and frequent and varied use, is a major source of injuries and fatalities.

At least 450 lives are lost on farms each year because of tractor accidents, and many other people are seriously injured. Overturns result in more than half of all tractor-related fatalities. Extra riders falling from tractors are another frequent cause of fatalities, since nearly two-thirds of those who fall are run over.

## Overturns

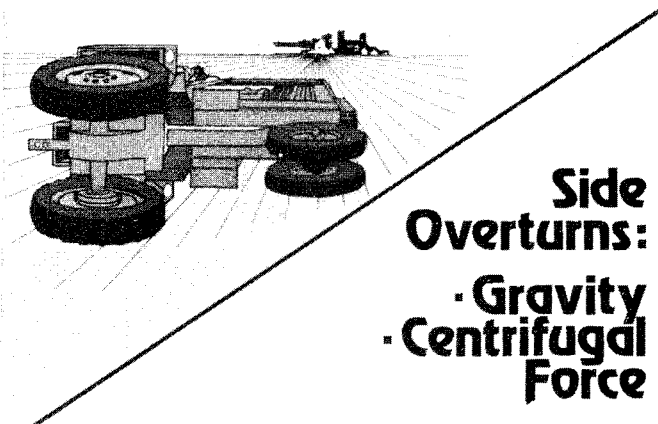
Side overturns account for approximately 80 percent of all tractor overturns. Rear overturns and, to a very small extent, forward overturns make up the remaining 20 percent.

### CAUSES OF OVERTURNS

Many variables involved in overturns are driver controlled, such as steering, braking, speed, and judgment. Also, a variety of physical forces including gravity, centrifugal force, rear axle torque, and drawbar leverage interact when a tractor is in motion and can cause an overturn if stability isn't maintained. Normally, overturns involve a combination of these forces. Understanding the role they play in tractor stability and how the driver can help can prevent an overturn.

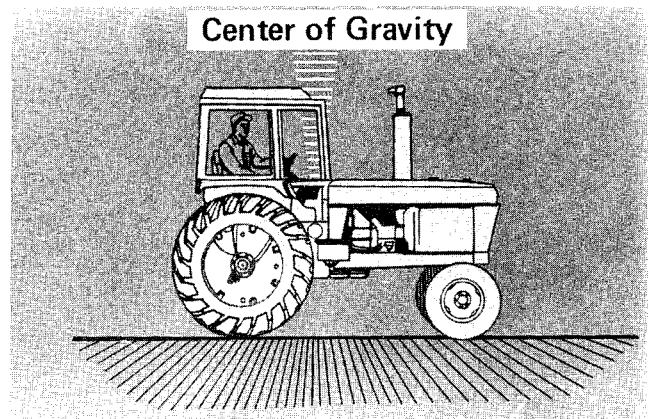
### SIDE OVERTURNS

Side overturns are the most common type of tractor overturn accident. Gravity and centrifugal force are the two primary forces involved in this type of overturn.



### Gravity

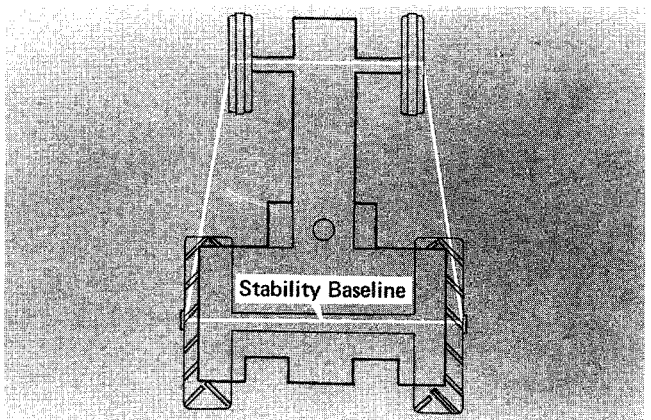
Gravity is the force the earth exerts on all objects on its surface. The strength of this pull is measured in ounces, pounds, or other units of weight. The center of gravity can be thought of as that single point or location on a tractor that causes it to act or react as if all of its weight were concentrated at that point. The center of gravity of a large two-wheel-drive tractor not under load is located about 40 inches above the ground surface and between one-fourth and one-third the distance of the wheelbase in



front of the rear axle. The normal center of gravity of a two-wheel-drive tractor can vary when using mounted equipment or even filling the fuel tank. Raising a front-end loader to a high position will raise the location of the center of gravity and make the tractor significantly more unstable because most of the weight is concentrated at the tractor's upper level.

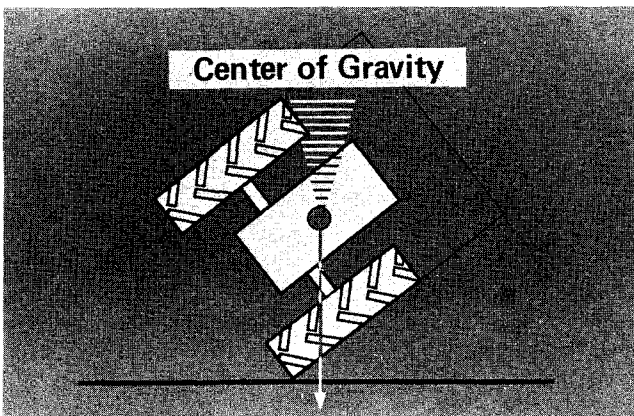
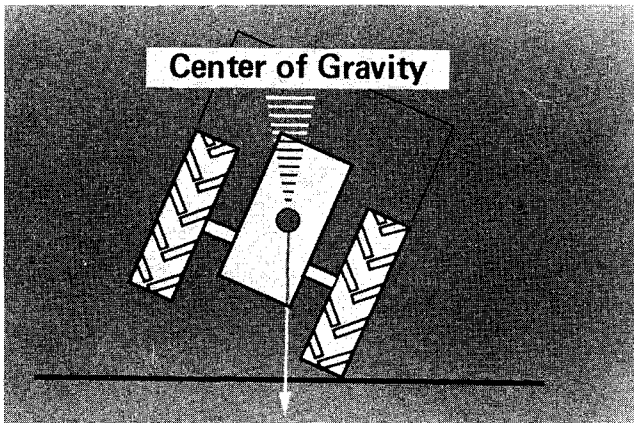
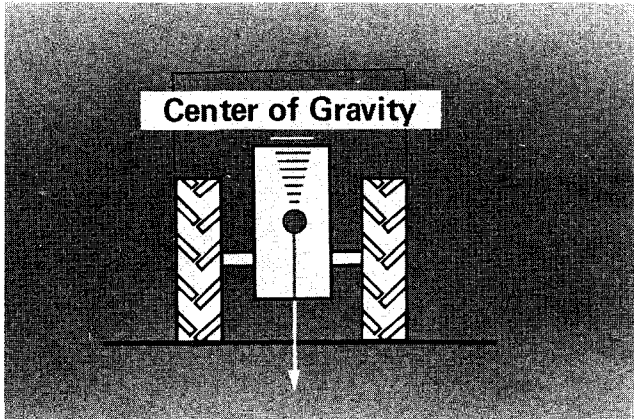
The big four-wheel-drive tractor with a 125-inch wheelbase is used today on many farms. When this tractor is not under load, the center of gravity will be located about 40 inches above the ground surface and approximately one-third of the distance of the wheelbase behind the front axle. This location will move to one-half the distance between the front and rear axle when the tractor is pulling a heavy load.

The stability of a tractor is determined, in part, by the spacing of the rear wheels. The outer edge of each wheel when connected by an imaginary line



makes up the stability baseline of a tractor. Generally, wide-front-end tractors are considered more stable than the tricycle type because they have a wide stability baseline.

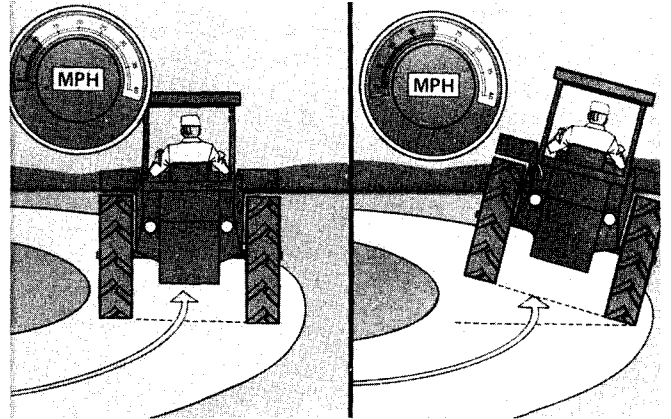
To understand the role that the center of gravity plays in tractor overturns, visualize hanging a string and plumb bob from an imaginary point of the center of gravity for most tractors. The plumb bob will hang directly below the center of gravity. If a force is exerted on the tractor, causing it to tilt sideways, the center of gravity will move outward toward the edge of the stability baseline. When the force is eliminated the tractor will return to its original position. If the tractor is tipped further, causing it to tilt to a point where the center of gravity moves outside the



stability baseline or outer edge of one of the rear wheels, the weight of the tractor will cause it to overturn.

### Centrifugal Force

The second force which is a major factor in tractor side overturns is centrifugal force. If you attempt to turn a corner, this force will push outward on the tractor, affecting stability. The centrifugal force against the tractor increases with the speed of the tractor and sharpness of the turn. If a tractor is traveling at a constant speed, a very sharp turn will produce a higher centrifugal force than will a gradual



turn. Also, doubling the speed of a tractor will increase the centrifugal force by four times; for example, if tractor speed is increased from 10 to 20 miles per hour, centrifugal force is increased four times.

### REAR OVERTURNS

Rear overturn accidents account for most remaining overturn accidents. The primary forces involved are rear axle torque and drawbar leverage.

A rear overturn victim has little chance of escape and generally is crushed between the seat and the ground unless the tractor is equipped with roll-over protection and the operator is wearing a seat belt. After the wheels have left the ground it takes about three-fourths of a second for the tractor to reach the point of no return.

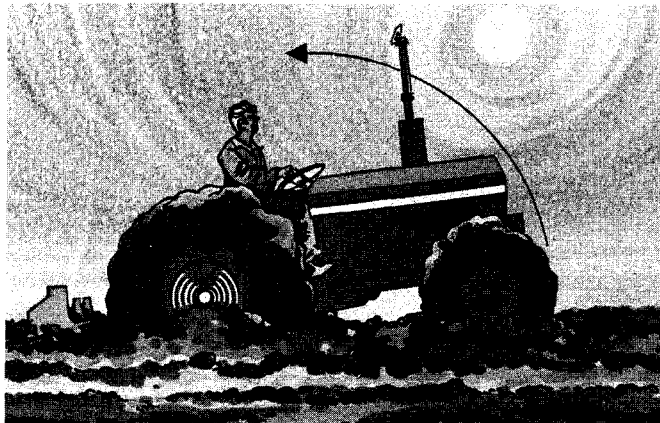
### Rear Overturns:

- Rear axle torque
- Drawbar leverage



## Rear Axle Torque

Rear axle torque occurs when the tractor is put into gear and power is applied to the rear axle. Normally, the tractor will move ahead; but if axle rotation is restrained in some way, for example if the



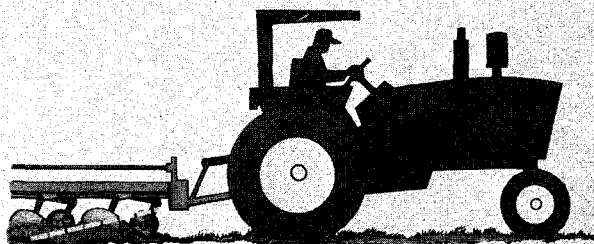
tractor is stuck, the power force to the axle will lift up the front wheels and rotate the tractor backward around the rear axle.

Experience has shown other examples that may cause rear overruns. Popping the clutch or starting suddenly when pulling a heavy load can raise the front wheels off the ground, making the tractor unstable. Driving up a steep hill or ditch can throw your tractor over backwards. The center of gravity will be higher and will move toward the rear of the tractor. If adequate front-end weights are not provided, rear axle torque can cause the front end to rise up and turn the tractor over backwards. Backing down a hill or into a ditch also can increase the chance of a rear overrun, if brakes are applied suddenly.

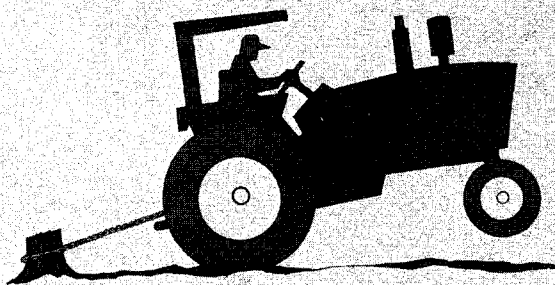
## Drawbar Leverage

Drawbar leverage is the force that pulls back and down on the drawbar when a load is applied. Improper hitching is the major reason this force becomes involved in rear overruns. If the hitch point is raised above the manufacturer's recommended height, the tractor's stability is reduced because the angle of leverage is increased. This can cause the

## Drawbar Leverage— correct hitching



## Drawbar Leverage— incorrect hitching



front wheels to be lifted off the ground and increase the probability of a rear overrun. An overrun also can result if a tractor is hitched to a two-point hitch or the lower links of a three-point hitch that is not braced to prevent the hitch from raising. All loads should be hitched to a fixed drawbar.

## HOW TO AVOID OVERTURNS

Accidents have taught farmers what to do next time, but experience is too costly a teacher. Knowing how to avoid tractor overrun accidents will allow you to reduce the accident risk.

### Be Physically and Mentally Fit

There are numerous human factors involved in fatal tractor-related accidents. Certain factors like carelessness, poor judgment, poor attitude, insufficient knowledge or training, fatigue, haste, stress, depression, intoxication, or showing off can cause a fatal tractor overrun accident.

Each operator should be physically and mentally fit when operating a tractor. An operator who is sleepy, tired, or not feeling well may not be able to react in time to avoid an accident. Your tractor does what you make it do.

### Train Operators

A worker who does not know how to operate a tractor safely in potentially hazardous situations can be injured or killed by exercising poor judgment. Make sure all persons permitted to operate tractors have been thoroughly trained. Educational resources are available through your county extension office, vocational-agricultural program, farm organization, and most machinery manufacturers.

### Check Tractor Before Operating

A pre-operational check of the tractor will assure you that it is in safe operating condition. Check the tires for proper inflation and defects, windows for visibility, seat position, seat belts, brakes for adjustment, steering response, rearview mirrors, slow-moving vehicle emblem, reflectors, and running lights for day or night time operation.

## Be Familiar With Operator's Manual

Read and follow procedures as outlined in the operator's manual. By being familiar with the operating features of a tractor, the operator will develop confidence when the tractor is driven under adverse conditions.

## Use Tractor for Intended Purposes

The tractor has many uses around the farm; however, improper use can result in an accident. For example, using the tractor to round up the cattle is dangerous because the operator may encounter rough, uneven ground and poor visibility, go too fast, and make sharp turns at high speeds, all of which can cause instability and increase the chance of an overturn. Use the tractor only for its intended purposes.

## Take Special Care With Large Four-Wheel-Drive Tractors With Articulated Steering

Operating large four-wheel-drive tractors with articulated steering requires skills in addition to those necessary for operating a two-wheel-drive tractor. The operator must be especially concerned about safety because of the increased power and large dimensions of the tractor, faster speeds, and different visual perspective.



Use engine braking going downhill with a heavy load.

## Use Engine Braking

Using the braking power of the engine when going downhill with a heavy load can prevent a runaway tractor and overturn. By stopping and shifting to a low gear before starting downhill you will maintain good control. A rule of thumb is to use the same gear to go down a hill that you would use to pull the load uphill. Also, use a tractor large enough and with adequate braking power to control the load being pulled.

## Use a Tractor With Roll-over Protective Structure

The most effective safety feature designed for tractors today is the roll-over protective structure (ROPS). Tractors equipped with a ROPS that meets



A roll-over protective structure (above) is the most effective tractor safety feature, but it must be used with a seatbelt (below).



the American Society of Agricultural Engineer's standard S383 will almost always prevent serious injury to an operator in a tractor overturn, particularly if a seat belt is worn. Rollover bars or cabs are designed to withstand one overturn, after which the structural soundness may be defective so the ROPS should be replaced. An operator wearing a seat belt on a tractor with ROPS has an excellent chance of surviving a side or rear overturn with little or no injury. The Occupational Safety and Health Act (OSHA) requires that a tractor manufactured since October 1976 must be provided with ROPS installed at the factory if the tractor is operated by an employee.

## Take Special Care With Front-End Loaders

Tractors that are mounted with front-end loaders have an increased chance of overturning if the loader is used improperly. When traveling with a loader, increase stability by reducing tractor speed and keeping the loader in the lowered position. This will provide good vision as well as maintain a low center of gravity on the tractor.

## Add Weights for Stability

Adding weights to a tractor can increase operating stability. Front-end weights will counterbalance rear-mounted equipment and heavy drawbar loads. Rear-wheel weights will counterbalance front-end-mounted equipment and

help maintain a low center of gravity on the tractor.

### Space Rear Wheels as Far Apart as Possible

Spacing the rear wheels of the tractor as far apart as practical is one of the most effective ways of increasing baseline stability and reducing side overturns.

### Take Special Care on Rough Terrain

Drive around ditches and steep slopes when possible. Forward movement up a steep slope can cause a rear overturn because the center of gravity of the tractor is higher and moves toward the rear of the tractor. Backing up a steep hill or out of a ditch helps maintain stability and can save you from an overturn.

Crossing slopes also can be dangerous. The operator should be alert for dips and raises that could trigger an overturn. If the tractor becomes unstable while operating on a slope, avoid an overturn and regain stability by turning down grade.

## Extra Riders

The practice of providing space for extra riders varies in different parts of the world. In Europe, some manufacturers commonly design a seat on the tractor for a second operator or passenger that provides protection to prevent injury in case of an accident. In the United States, manufacturers normally design tractors with one seat, for the operator only, and for that reason safety specialists recommend against extra riders.

Extra riders on a tractor create an unnecessary hazard. Most riders loosen their grip after only a few minutes because of distractions. Normally, only the operator's seat has shock absorption. If a tractor hits a bump or turns sharply, the shock is directly passed through the tractor to the rider, who can easily lose his or her balance and fall off. Statistics regarding falls from tractors indicate a majority of the victims are under 16 years of age, with one-third less than 6 years old. A tractor operator giving in to requests from children to ride or drive is one of the main reasons for extra riders.



Do not give in to requests from children to ride the tractor.

Many people think an extra rider is safe in the cab of a tractor, but in an accident the extra rider may be tossed around, hit the door, and be thrown out.

Make exceptions to the "no extra rider" rule only under these conditions: when a second seat is provided on the tractor or instructions are being given or received. There is potential danger for the instructor while training a new operator, but the training is essential. The danger can be minimized by driving at a slow speed and on level ground.

## Summary

Tractor overturn and extra rider accidents are a major source of injuries and fatalities on farms today. These accidents can be reduced by understanding and preventing factors that contribute to overturns and by not allowing extra riders.

Prevent injuries and fatalities from overturns by having ROPS on your tractor and using a seat belt. Be physically and mentally fit and ready to drive, to minimize human errors. Train all operators thoroughly, read the operator's manual, and perform pre-operational checks regularly. Hitch according to recommended procedures. Use the tractor for its intended purposes only.

Restrict extra riders. There is no safe place for them to sit or stand. Most riders loosen their grip after a few minutes and may lose their balance and fall off. You are gambling with the lives of children and other extra riders if you allow them to ride.

What would your life be like if you were seriously injured in a tractor accident? You can significantly reduce the possibility of that happening to you if you follow the practices and procedures recommended in this folder.

### REFERENCES

*Fundamentals of Machine Operation—Agricultural Machine Safety*; Deere and Company; Moline, Illinois.

Information from the Farm Department, National Safety Council; Chicago, Illinois.

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