THE UNIVERSITY OF TENNESSEE
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PREVENTING and SURVIVING TRACTOR OVERTURNS

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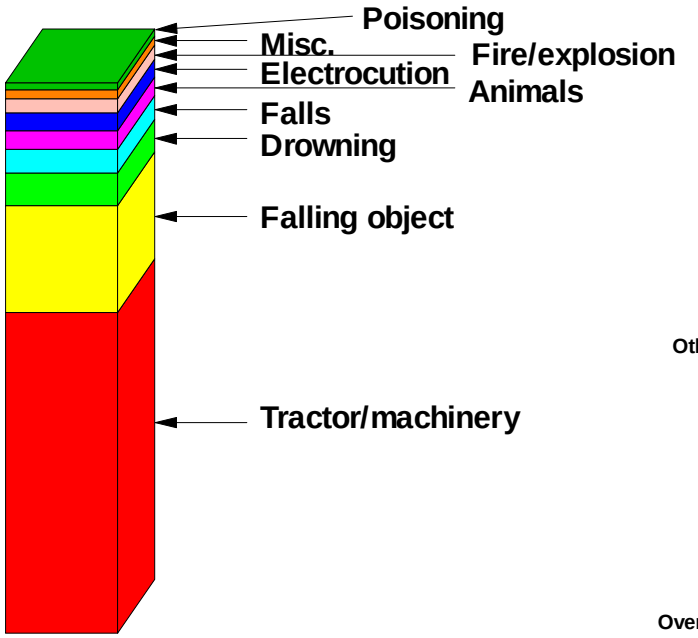
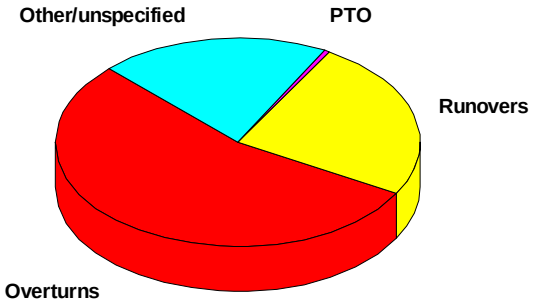
THE PROBLEM

There are up to 75 deaths and over 8,000 injuries related to farm activities each year in Tennessee. Financial losses can be staggering, and include medical expenses, lost production, replacement labor and property damage. Losses are estimated to be as high as $300,000,000 each year in Tennessee - over ten percent of the state's farm income.

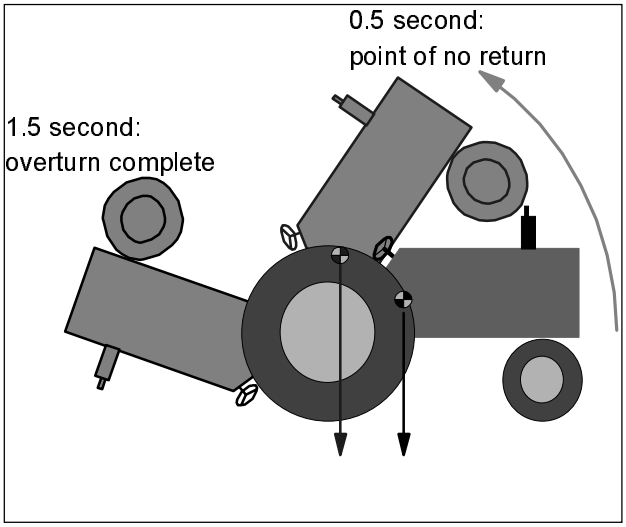




Tractor overturns are the leading cause of deaths related to farm work. About 25 Tennesseeans are killed and many others injured each year by tractor overturns.

Almost all overturns can be prevented by safe operating practices. The real tragedy is that virtually every tractor overturn is survivable if the tractor is equipped with a roll-over protective structure (ROPS) *and* the operator is wearing the seat belt.

Tractor overturns occur too fast for you to jump clear in most cases. An overturn can reach the "point of no return" in about $^{1}/_{2}$ to $^{3}/_{4}$ second and can flip completely in about $1^{1}/_{2}$ second.



It takes $^{1}/_{2}$ to $^{3}/_{4}$ second to realize you are in danger, then you must react. Your reaction time is at least $^{1}/_{2}$ to $^{3}/_{4}$ second - and that's when you are ready to act. Unless you are expecting the tractor to flip, your reaction time probably will be even longer (you have a problem if you *are* expecting it to flip). Your combined hazard recognition and reaction times will be 1 to $1^{1}/_{2}$ seconds *before you begin to move.* It will take you another second or two to clear the tractor after you react.

Test your reaction time. Have someone hold a crisp dollar bill by one end. Hold your thumb and forefinger about an inch apart at the face on the bill. The object is to catch the bill when it is released, but without chasing it downward. You have about 1/2 second to catch the bill before it reaches the floor.

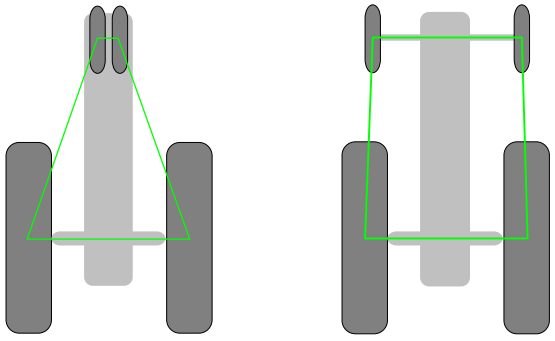
PREVENT OVERTURNS

Setting up the tractor

Install a certified ROPS and seat belt if your tractor does not already have them. The ROPS won't prevent an overturn, but it will let you survive one. A roll-over protective structure provides a crush-free zone of safety around the operator's station and the seat belt keeps you in the protected zone.

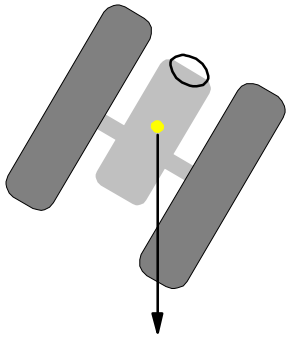
We are not aware of any deaths due to overturns where a ROPS and seat belt were in use. However, operators not wearing their seat belts have been thrown from tractors and crushed, some by the ROPS structures that were intended to save them.

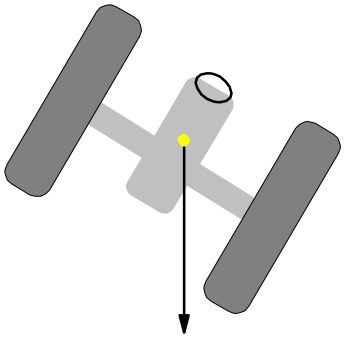
Wide front end tractors have more stability against side overturns than tricycle frame tractors. This benefit is greatest when the wheel spacing is at its widest practical setting.



Tractors with wide front wheel spacing have a larger base of stability than tractors with a tricycle frame. For increased stability, use the widest practical wheel spacing front and rear.

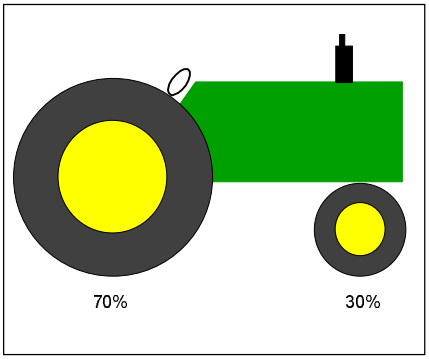
Use the widest practical wheel spacing for increased stability against side overturns. Wider wheel spacing provides a wider stability zone. It is much easier to keep the center of gravity inside the wider stability zone.





Using a wide wheel spacing provides greater stability on slopes. The center of gravity must remain above the space between the tires. The tractor to the left are tipped to the same angle. Notice that the tractor on the far left is about to tip over because the center of gravity is over the tire's contact point with the

Proper ballasting maintains proper balance for stability and control. The tractor's weight should be distributed evenly on each side, with about 70% of the weight on the rear wheels and 30% on the front wheels.



Additional front-end weights are needed when using heavy 3-point hitch mounted cultivators, mowers or other heavy implements and when moving round bales of hay. You are not in control of the tractor if the front wheels lift from the ground when engaging the clutch or starting up slopes or if the front wheels slide when attempting turns.

Extra rear weights are needed when using front-end loaders to maintain traction on the rear wheels. Rear ballast can be wheel weights, fluid in the tires or a heavy implement on the 3-point hitch. Losing traction on the rear wheels can be disastrous since movement and braking is accomplished by the rear wheels.

Safe operating practices

Be alert. Fatigue, stress and many medications can impair your ability to recognize hazards and slow your reactions, thus you cannot operate the tractor safely. And don't forget your hearing protection - noise is a significant cause of stress and fatigue. You can actually hear the equipment better with hearing protection because your ears won't be overwhelmed by the high noise levels.

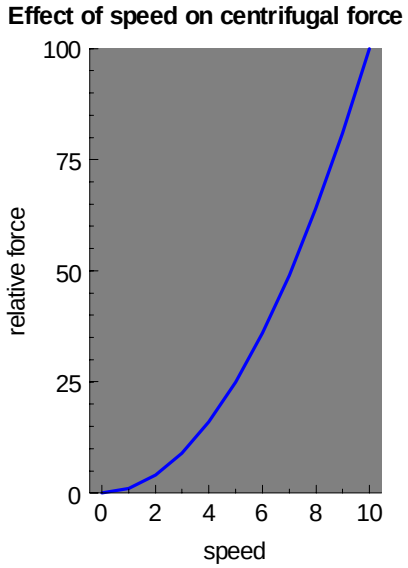
Fasten the seat belt if your tractor is equipped with ROPS. ROPS and seat belts virtually eliminate overturn related deaths. The seat belt can keep you from falling off if you doze off or run into rough terrain. Remember, you can't control the tractor if you're not on it!

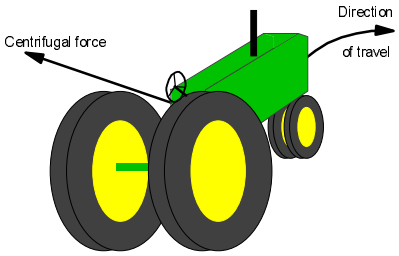
Don't gamble. A tractor cannot turn over by itself. It only does what you - the operator - command it to do. Many overturns are related to using bush hog mowers, because we tend to

place the tractor in precarious situations attempting to cut all offending vegetation. Tractors must obey the laws of physics. When you try to cheat on those laws, you lose!

Maintain a safe speed at all times. Many overturns occur on relatively flat ground, and speed is a factor in many of these mishaps. Increasing the speed increases centrifugal forces during turns. Increased speeds also mean you have less time to react and accomplish tasks such as braking, turning, etc. What is a safe speed? It depends on the tractor configuration, attached implements, towed load, terrain and other factors. If in doubt, slow down!

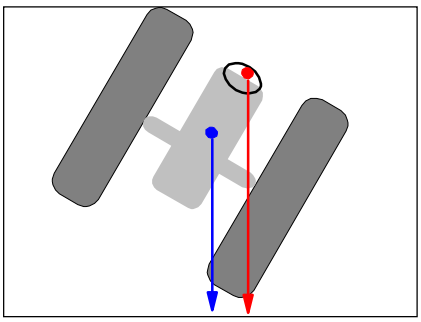
The effect of increased speeds is worse than most folks realize. The energy and forces increase exponentially as speed is increased.





Hitch and tow properly to prevent rear overturns. Never hitch a load to any point other than the drawbar. Hitching higher will *decrease* the tractor's pulling ability and will result in an overturn.

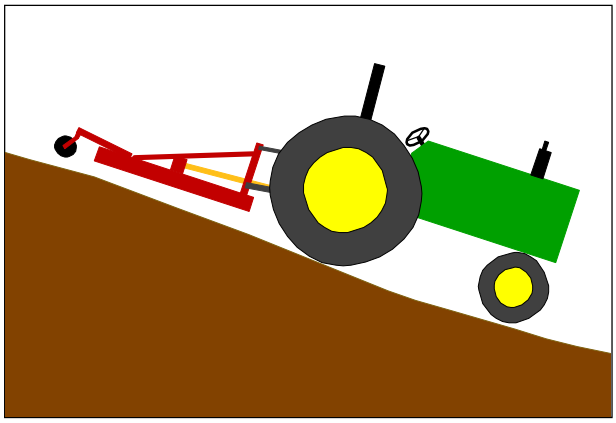
Keep the center of gravity low for increased lateral stability. The tendency to overturn increases in proportion to the height of the center of gravity. Add ballast low on the tractor and keep the front end loader and other mounted equipment as low as practical.



Proper hillside operation can prevent overturns. Wide wheel spacing and a low the center of gravity increase stability, but are no substitute for wise operation.

Back up slopes to prevent rear upsets. When you go up a hill forward, more of the tractor's weight is placed on the rear wheels, providing greater traction. If the hill is steep enough, the wheels will not turn, but the tractor will rotate around the axle.

The weight is shifted to the front wheels when backing up a slope, so traction is reduced and the tractor cannot climb as steep a slope. The real safety, however, is that the torque of the rear axle cannot flip the tractor over forward. A slope is too steep for safe operation if you can't back up it.



Watch for bumps and depressions that could lead to an upset. You may be on a relatively safe slope or even level ground, but a bump or hole could cause an upset. Scout ahead if you can't see the ground.

On side slopes, turn downhill when safe to do so. This causes centrifugal forces and gravity to work against each other, reducing risks of an overturn.

Always maintain a safe speed. Reducing speed reduces the effects of turns and bumps, reduces stopping distances and allows more time for you to control the tractor.

Watch for conditions with poor traction. Mud, loose soil or gravel, ice, snow, wet grass - they are all very slippery for your tractor. Pick safer routes and leave these places until the conditions improve.

Avoid ditches, banks and holes. The soil may not be able to support its own weight plus the weight of the tractor, so it can suddenly collapse and cause the tractor to tumble down the slope. **Rule of thumb -** stay back as far as the bank is high.

Operate smoothly, avoiding jerky starts, sudden turns and hard braking. Smooth operation is safer and can prevent costly breakdowns.

SURVIVE AN OVERTURN

Almost all overturns can be prevented by safe operating practices. However, the real tragedy is that virtually every tractor overturn is survivable if the tractor is equipped with a roll-over protective structure (ROPS) *and* the operator is wearing the seat belt. The ROPS and seat belt is the best life and health insurance policy you can have - it prevents serious injury or death. As an added benefit, the ROPS helps limit damage to the tractor in an upset.

Manufacturers have reduced the cost of ROPS retrofit kits. You can find a *certified* ROPS for all recent tractors and many vintage tractors as well, such as the Fordson, Ford Golden Jubilee, Ferguson 35, John Deere 40, etc. For information, contact your tractor dealer or UT Extension Agricultural Engineering.

Even if you refuse to wear the seat belt, you should try to stay in the seat during an overturn if the tractor has a ROPS. Hang on as tight as you can. As mentioned earlier, overturns are too fast for

you to react, so you won't be able to jump clear of the tractor. If you do jump, you may still be crushed by the tractor, possibly by the ROPS that is there to protect you.

OTHER TRACTOR HAZARDS

Runovers are the second highest cause of death related to tractors. Often the victim falls from the tractor and is crushed by the rear wheels, but a rotary mower is often involved.

Extra riders are especially vulnerable, particularly children. There is only one seat on a tractor - the operator's. ***NEVER, EVER*** allow extra riders.

Power takeoff (PTO) entanglement and other similar incidents claim few lives, but cause many serious injuries. Keep all guards and shields in place and in good condition. Always shut off the tractor and wait for all movement to stop before leaving the seat.

Noise-induced hearing loss is a gradual and permanent disability with no cure. Always wear hearing protection when operating tractors and other power equipment. Noise causes fatigue, irritability and stress in addition to hearing damage.

FOR MORE INFORMATION

This lesson provided some suggestions for increased tractor safety, and it was not intended to cover every possible situation. For more information on tractor safety, contact your tractor and machinery dealer, your tractor manufacturer, county Extension agent or state Extension farm safety specialist.

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