

# 2015 TRACTOR OPERATING CONTEST

## STUDY GUIDE

### HISTORY

John Froelich, the inventor of the first internal-combustion traction motor, or tractor, is born on this day in Girard, Iowa.

At the end of the 19th century, Froelich operated a grain elevator and mobile threshing service: Every year at harvest time, he dragged a crew of hired hands and a heavy steam-powered thresher through Iowa and the Dakotas, threshing farmers' crops for a fee. His machine was bulky, hard to transport and expensive to use, and it was also dangerous: One spark from the boiler on a windy day could set the whole prairie afire. So, in 1890, Froelich decided to try something new: Instead of that cumbersome, hazardous steam engine, he and his blacksmith mounted a one-cylinder gasoline engine on his steam engine's running gear and set off for a nearby field to see if it worked.

It did: Froelich's tractor chugged along safely at three miles per hour. But the real test came when Froelich and his team took their new machine out on their annual threshing tour, and it was a success there, too: Using just 26 gallons of gas, they threshed more than a thousand bushels of grain every day (72,000 bushels in all). What's more, they did it without starting a single fire.

In 1894, Froelich and eight investors formed the Waterloo Gasoline Traction Engine Company. They built four prototype tractors and sold two (though both were soon returned). To make money, the company branched out into stationary engines (its first one powered a printing press at the Waterloo Courier newspaper). Froelich was more interested in farming equipment than engines more generally, however, and he left the company in 1895.

Waterloo kept working on its tractor designs, but between 1896 and 1914 it sold just 20 tractors in all. In 1914, the company introduced its first Waterloo Boy Model "R" single-speed tractor, which sold very well: 118 in 1914 alone. The next year, its two-speed Model "N" was even more successful. In 1918, the John Deere plow-manufacturing company bought Waterloo for \$2,350,000

According to *Vintage Farm Tractors* by Ralph W. Sanders (ISBN1-55192-031-X) "Credit goes to the Charter Gasoline Engine Company of Sterling, Illinois, for first successfully using gasoline as fuel. Charter's creation of a gasoline fueled engine in 1887 soon led to early gasoline traction engines before the term "tractor" was coined by others. Charter adapted its engine to a Rumley steam-traction-engine chassis, and in 1889 produced six of the machines to become one of the first working gasoline traction engines."

### SAFETY

Agriculture in the United States is one of the most hazardous industries, only surpassed by mining and construction. No other farm machine is so identified with the **hazards** of production agriculture as the tractor.<sup>[25]</sup> Tractor-related injuries account for approximately 32% of the fatalities and 6% of the nonfatal injuries in agriculture. Over 50% is attributed to tractor overturns.<sup>[26]</sup>

The **roll-over protection structure** (ROPS) and seat belt, when worn, are the most important safety devices to protect operators from death during tractor **overturns**.<sup>[27][28]</sup>

Modern tractors have a ROPS to prevent an operator from being crushed if the tractor turns over. The ROPS does not prevent tractor overturns; rather, it prevents the operator from being crushed during an overturn. This is especially important in open-air tractors, where the ROPS is a steel beam that extends above the operator's seat. For tractors with operator cabs, the ROPS is part of the [frame](#) of the cab. A ROPS with enclosed cab further reduces the likelihood of serious injury because the operator is protected by the sides and windows of the cab.

These structures were first required by legislation in Sweden in 1959. Before they were required, some farmers died when their tractors rolled on top of them. Row-crop tractors, before ROPS, were particularly dangerous because of their 'tricycle' design with the two front wheels spaced close together and angled inward toward the ground. Some [farmers](#) were killed by rollovers while operating tractors along [steep slopes](#). Others have been killed while attempting to tow or pull an excessive load from above axle height, or when cold weather caused the tires to freeze to the ground, in both cases causing the tractor to pivot around the rear axle.<sup>[citation needed]</sup> ROPS were first required in the United States in 1986, but this requirement did not retroactively apply to tractors produced before this year; therefore, adoption of ROPS has been incomplete in the farming community. To combat this problem, CROPS (cost-effective roll-over protection structures) have been developed to encourage farmers to retrofit older tractors.<sup>[28]</sup>

For the ROPS to work as designed, the operator must stay within its protective frame. This means the operator must wear the seat belt; not wearing it may defeat the primary purpose of the ROPS.

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## **Safety with Farm Tractors**

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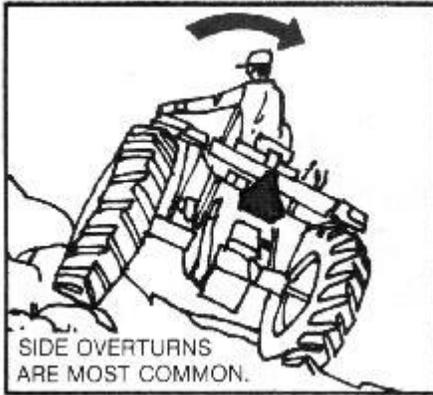
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Farm tractor accidents are the major cause of farm work-related deaths. More than 200 Indiana farm family members died as the result of tractor accidents during the 70's. Nationally, it is estimated that between 500 and 600 persons are killed each year in tractor accidents; and, for every person killed, at least 40 others are injured.

Tractor upsets or overturns account for more than half of all tractor-related deaths. Falls are also a major cause of tractor accidents. Falls involve both tractor operators and extra riders who are often children. Another source of tractor-related injuries and death is entanglement in rotating power-takeoff components.



Examples of some typical fatal tractor accidents are:

- \* An 18-year-old was killed when he tried to drive his tractor back onto the road. The tractor upset on him, crushing his chest and fracturing his skull.
- \* A 64-year-old man fell from his tractor and was run over by the right rear wheel as the tractor rolled down an embankment.
- \* An 11-year-old boy jumped from the tractor scoop and was run over by the tractor.
- \* A 3-year-old boy was killed when he fell beneath a chicken house being hauled by a tractor.
- \* A 49-year-old man was killed when his tractor hit a stump and overturned.
- \* A 61-year-old man caught his clothing in the power-takeoff.
- \* A 34-year-old man died from a crushed skull when his tractor overturned while towing a car.

These are only a few examples of the tragedies caused by unsafe use of farm tractors. Most tractor accidents happen during peak cropping months, from April through October. Most tractor accidents happen to persons aged 25-64; but operators under 15 and over 64 have 7 to 10 times more accidents per hour of machine use than operators in the 25-64 age group.(National Safety council. Accident Facts, 1978)

### **Know How to Operate the Tractor Safely**

More than 85 percent of all tractor accidents involve members of the farm family. Of course, in many situations, members of the family do most of the tractor work. However, few tractor operators, family or otherwise, have had training for the job of tractor operation.

A vitally important tractor safety rule is to be sure that each person who operates a tractor is trained, physically fit, and qualified to do the job.

The new tractor operator should first practice, without equipment attached, in a level field or a large, level yard. A skilled operator should be the trainer. The trainer should start the tractor, demonstrating the procedure for the new operator. The trainer should drive the tractor around the yard, showing the student how each of the controls operate. Then, the new operator can take the seat and operate the tractor, while the trainer stands on the drawbar to give assistance if needed.

If your tractor is equipped with a cab, the trainer will need to ride in the cab to give needed instruction. Normally, extra riders should not be allowed anywhere on the tractor. The hazard is not so great during the training, since the tractor is operating on level ground at slow speed without attached equipment.

After the new operator has learned to operate the tractor alone in a level area, the next step is to attach and operate the equipment. The trainer should now stay off the tractor. The new operator should gradually work into the more complex jobs of tractor operation.



### **Preventive Maintenance**

Many factors affect the reliability and safety of your tractor. Safe operation begins with making a pre-operational check before each tractor use. Keeping the tractor in good repair is an important part of safety.

Before starting the tractor, check:

- \* Tire condition and inflation level
- \* Fuel, oil, and hydraulic fluid levels
- \* Condition of fuel and hydraulic lines--no leaks
  - \* Shields in place
- \* Platform and steps clean, free of debris, chains, and tools
  - \* Clear visibility from within cab, mirrors clean

- \* Brakes operational
- \* Steering operating correctly
- \* Air cleaner and coolant
- \* All lights working
- \* SMV emblem in place and clean
- \* Neutral-start safety switches operating correctly

Your tractor operator's manual is an important safety manual. Read it, know and understand the information in it. Follow all operating precautions and the recommendations outlined in the manual.

Before starting the tractor, make one more check-of your clothing. Loose, torn, or bulky clothing can catch on moving parts, pedals, or levers. Clothing should fit well and be in good repair. Your shoes or boots should be in good condition and have slip-resistant soles. Laces should be tightly tied and not extend out beyond the shoe. Long hair should be tied back or kept under a hat.



### **Safe Refueling**

Prevent fires and explosions when refueling. The greatest danger occurs when handling gasoline, gasohol, or LP-gas, because these fuels vaporize easily to form explosive mixtures.

Never refuel your tractor while the engine is running or is hot. Static electricity, a spark from the ignition system, or a hot exhaust could cause the fuel to ignite. Grounding out the tractor by use of a ground wire or by dropping mounted equipment so it touches the ground can reduce static electricity.

Always refuel your tractor outside. Locate large storage tanks at least 40 feet from any building. Keep the storage area free from weeds and other easily ignited materials.

Label your fuel containers so that they can be identified quickly and accurately. Carry gasoline and diesel fuel in approved safety cans. Approved cans bear Underwriters Laboratories or Factory Mutual labels. Never smoke while refueling.

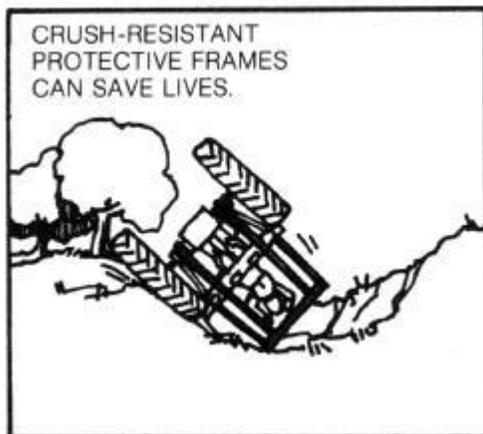
Carry a first aid kit and an approved ABC-type dry chemical extinguisher. Every tractor should have at least one 5-pound extinguisher.



#### **A Cab and ROPS Can Save Lives**

More and more farmers are recognizing the safety, comfort and utility of a cab. A cab built around a crush-resistant protective frame will give protection from overturns, dust, weather, and will reduce fatigue. It should also be designed to keep noise at a safe level. A roll-over protective structure (HOPS) and seat belts can save your life.

A pressurized air-filtering and air-conditioning system is another comfort factor. However, cabs do not protect against chemical fumes such as those from pesticides, unless very specialized equipment is installed.



### **Keep Power-Takeoff Stub Shaft Guarded**

An unshielded or partially-shielded stub shaft can be deadly to the careless or unsuspecting operator. It can catch clothing or a loose shoestring and wrap a person around it in a fraction of a second. Keep the stub shaft guarded when not in use to provide power to other implements. There are two types of PTO stub shaft shields commonly in use.

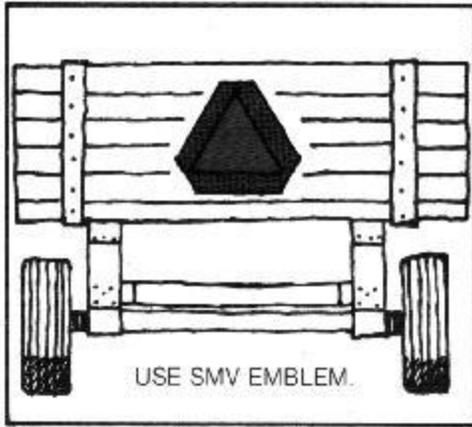
- \* master shield which provides a zone of protection around the stub shaft
- \* PTO stub shaft guard which completely covers the stub shaft.

If you must remove the PTO master shield for installation of mounted implements, the stub shaft guard should always be in place. Use older tractors that lacked adequate PTO stub shaft protection with extra caution. If a shield becomes damaged or lost, replace it as soon as possible. Shields are cheap insurance against injury.



### **Safety on Public Roads**

Use all required and available safety devices and driving skills when operating tractors on public roads. The risk is high! Roll-over protection, safety hitch, SMV emblem (Slow Moving Vehicle), rear-view mirrors, signal lights, hand signals, clearance lights and/or reflectors are all aids to safety on the highway. Make sure all loads are properly secured. Allow traffic to pass. Be considerate of others, and pull over to the shoulder when necessary. Keep your tractor and implements in your lane. If your equipment is wider than the traffic lane, keep it over on the shoulder. Avoid excessive speed, and drive defensively. Consult local or state officials for regulations on moving extra wide equipment on public roads.



### Some Basic Safety Practices

#### \* No extra riders

Don't allow extra riders, and don't ask to be an extra rider. Make this a firm rule, and avoid a major cause of tractor accidents. Tractors are designed only for the drivers. Even in cabs, riders have only limited protection, and they may interfere with the tractor's operation. The warning "hold tight" is practically useless after the first minute or two.

#### \* Get on and off safely

Don't mount or dismount when tractor is moving. Keep the mounting steps, handholds, and operator platform clean and dry. Do not jump from the tractor. Set brakes if there is the slightest chance of rolling.

#### \* Stuck in hole

When stuck in a hole or soft spot, a tractor can easily upset backwards when the clutch is engaged. If power is applied and wheels stick, the chassis may revolve around the axle. When you can't back out, get help!

#### \* Hitch to the drawbar only

Never hitch to the axle or seat bracket-you're inviting a backward upset. Engage the clutch smoothly, and avoid sudden acceleration.

#### \* Use tractors only for jobs intended

Tractors are meant to be implement carriers, transport units and remote power sources. Tractors are not designed for recreation, nor for use as a tow truck or to run errands, herd cattle, etc.

#### \* Stay clear of ditches and embankments

Keep tractors and implements away from ditch and embankment edges. Edges may be

undercut or weakened and not be able to support the weight of the equipment. Implements that slip over the edge will tend to pull the tractor with them.

\* Loader accidents are common

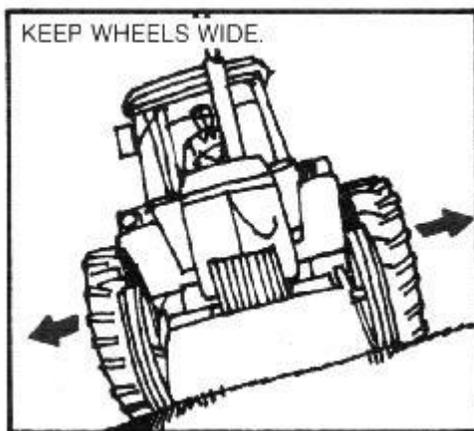
Move and turn tractor at low speeds. Keep load low while moving. Add rear weight, and keep wheels wide. Lower loader to the ground when parking or servicing.

\* Drive at a safe speed

When speed is doubled, the chance of a side upset is four times as great. Adjust speed to conditions.

\* Operating on slopes and hillsides

Keep wheels spread as wide as possible for the job—even when on level ground. A tractor will overturn sideways much more easily if the wheels are close together. Watch for rocks, humps, or holes which may cause the tractor to tip. Make uphill turns with caution, particularly with tricycle-type tractors. Turn downhill if stability becomes uncertain. Backward upsets are apt to happen when climbing hills, going forward out of a ditch, or overloading the drawbar. If you have to go up a steep slope, back the tractor up the slope. Use a lower gear when going downhill.



\* Sharp turns cause upsets

High speed, rough ground, and narrow, high-speed wheels greatly increase the chance of upset, especially when turning. Slow down before turning, and avoid sharp turns if possible.

\* Sharp turns and short hitches

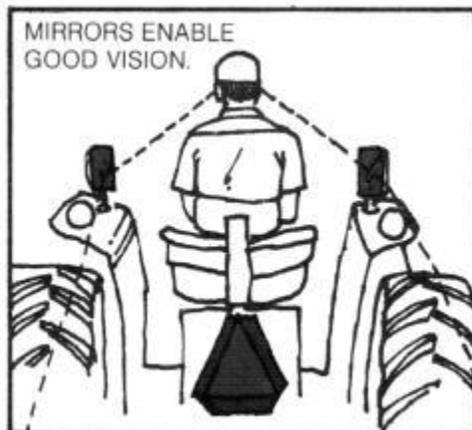
Equipment can "ride" up on tractor tires and cause a serious accident or damage. Allow plenty of turning room, especially when using duals or extended wheels.

## The Human Safety Factor

Knowing what to do and how to do it goes a long way to ensure safe tractor operation. Another vital factor is you, the operator. It is important to be in good physical and emotional condition when you are operating a tractor. If you are ill, tired, angry, emotionally upset, or if your mind is on something else, you could make a fatal mistake.

It is important, too, that you are comfortable enough while operating the tractor so that you can function well. If you are too cold or too hot, or the tractor noise level is too high, or the seat adjustment is incorrect, you will not operate the tractor as well as you would if you were comfortable. Discomfort is distracting, and it contributes to fatigue.

Short, frequent breaks will rest you better and faster than longer, less frequent ones. And, if you are exhausted, stop. You could save your life by doing so.



### **If You Are Under 16..**

... a federal labor law affects you. Except when working for your parent or guardian on a farm owned or operated by that person, you are not permitted to operate a tractor over 20 pto-hp and certain other farm machinery (although these jobs can be started at age 14 with special 4-H or vo-ag training).

Persons under 14 may be employed to do any job that is not classified as particularly hazardous IF they have the written consent of their parents or guardians. There is one exception: those under 12 are not permitted to work on farms that used 500 or more man-days of farm labor during any quarter of the preceding calendar year.

Check with your county Extension office for up-to-date information