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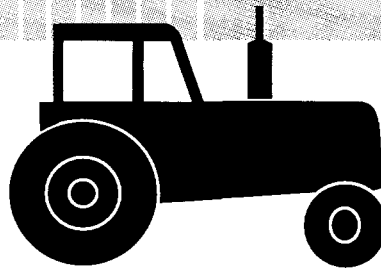
Tractor Safety

Stay on Top of It!

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The farm tractor is often considered the farmer's best friend. But, all too often, the tractor is the agent of injury and death. Tractor injury incidents account for nearly 16 percent of the agricultural machinery-involved injuries in North Dakota from 1991 through 1994. Only the combine was involved in more injuries. In the same time span, tractors were involved in nearly 25 percent of the agricultural-related fatalities in North Dakota.

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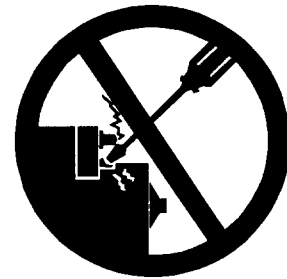
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Types of Tractor Injury-Incidents

There are several types of tractor mishaps that result in injury. Common mishaps are:

- by-pass starting
- front-end loader incidents
- rearward tractor rollovers
- sideways tractor rollovers
- falls from tractors
- tractor runovers
- caught-between crushing
- PTO stub shaft entanglements



By-Pass Starting

Starting a tractor while standing on the ground beside the machine is not a safe procedure. To do this, the operator must either make certain electrical connections on the starter motor, or reach up and over to turn the ignition key. An operator standing on the ground cannot be sure if the transmission is in neutral or in park.

If a manual transmission is in gear when the engine is by-pass started, the tractor probably will run over the operator. The tractor will start moving as soon as the

engine starts to turn over. There may be a slight delay if the tractor has either a hydrostatic transmission or power-shift type transmission, but the delay will not be sufficient for the operator to get out of the way.

New tractors are sold with a shield covering the starter motor to prevent by-pass starting. Many older tractors did not have this shield. Now, a retro-fit shield that covers the by-pass contacts and prevents by-pass starting is available. This shield should not be removed from the starter motor except for servicing the starter motor, then replaced immediately.



Front-End Loader Incidents

Front-end loaders are used for many jobs in agriculture, essentially lifting and moving objects and materials. These versatile implements are often misused by stretching their lifting capacity, inappropriate use, and lack of safety equipment.

Heavy objects such as big round bales, mini-bulk containers, farm machinery parts, and other items are often lifted with front-end loaders. There is a limit to how much a loader can safely lift. The limit may be affected by condition of hydraulic lines and hoses, pressure capacity of the hydraulic pump, proper ballasting of the tractor, strength of front axle assembly, and condition of front tires. The owner/operator of a loader-equipped tractor is usually knowledgeable about its condition and capacity, but caution and good judgement must always be applied.

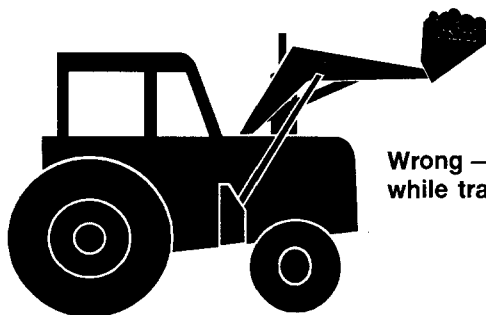
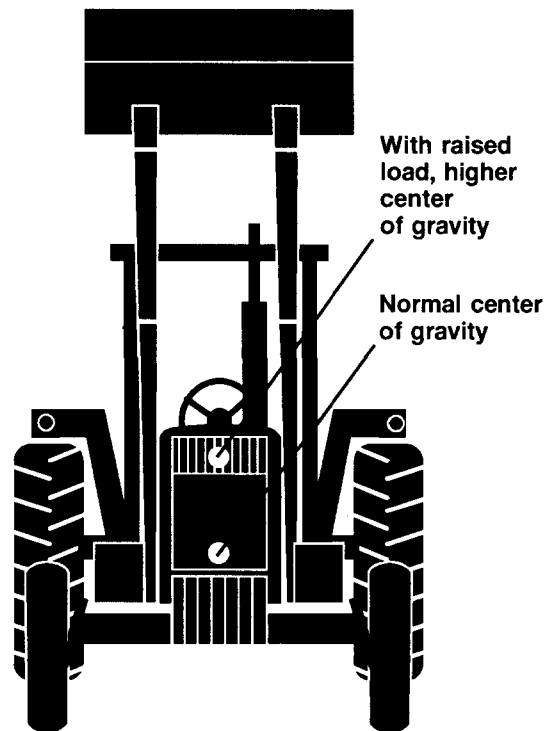
Adequate ballasting of the loader-equipped tractor is essential for safe lifting. If the rear of the tractor is somewhat light and bouncy as the loader starts to lift the load, additional ballasting is needed. At this point, the safe operator will not proceed with lifting, but will lower the load and safely add ballast to the rear of the machine.

Agricultural workers have been fatally crushed as a result of attempting to move big round bales with a front-end loader not equipped with grapple forks. The grapple forks grasp the big round bale and prevent it from rolling rearward, out of the bucket and down the arms of the loader toward the operator. The safe worker always selects a grapple

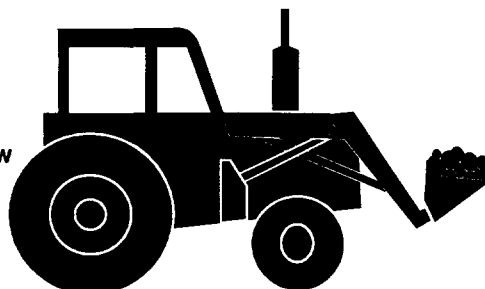
fork-equipped front-end loader to move big round bales and lifts the load high only when it needs to be. Another choice would be a spear type bale mover, mounted on either the front or rear of the tractor.

Speed — working too fast for existing conditions — is often a factor in front-end loader injury-incidents. An elevated front-end loader raises the center of gravity of the unit, making it easier to tip due to momentum and/or centrifugal force. Always keep the load and the speed low when using the front-end loader.

The front-end loader is not intended or designed for lifting people for any type of work. There are no safety features to provide support for people while in the bucket. System controls are not designed for safe movement of a loader bucket with a person in it.

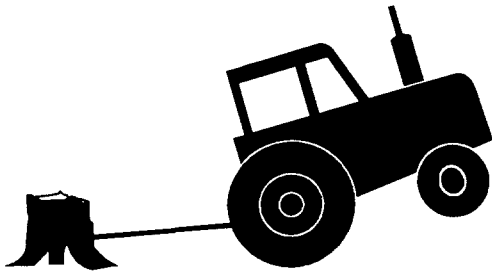


Wrong — Bucket high while transporting

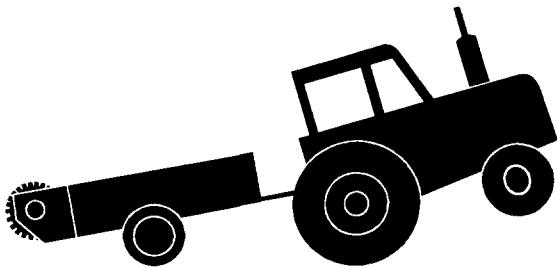


Right — Bucket low while transporting

Rearward Tractor Rollovers



Rear axle torque will upset the tractor if rear wheels can't spin or move forward.



Hitching above normal drawbar height may tip a tractor backward.

Tractor rollovers happen when the center of gravity moves past a baseline of stability, either to the side or the rear of the machine. The center of gravity must be kept within the baseline of stability to keep the tractor right side up.

Agricultural tractors will easily tip to the rear when the rear wheels cannot rotate enough to move the machine forward. As the front of a tractor rises and rotates opposite to the rear axle, momentum and engine power work together to keep the tractor body rotating and lifting. The process of a rearward tractor rollover can take as little as three fourths of a second, less than the reaction time of the average worker.

Five situations where this can happen are when:

- the tractor is stuck in mud or snow, preventing the rear wheels from rotating.
- the rear wheels cannot turn because chains, boards, or other materials are used to improve traction and actually prevent the wheels from rotating.
- the tractor is climbing a hill that is too steep. The steeper the hill, the more the risk.
- the clutch is released too quickly with the transmission in a lower gear and the engine running at a high speed.
- a load is hitched above the drawbar of the tractor.

Improper Hitching

Many agricultural workers are injured or killed as a result of improper hitching of a tractor to a load. Loads for pulling should be hitched only to the drawbar or the three-point hitch. There is no place on the rear of a tractor that

is safer, or more effective for pulling, than the drawbar.

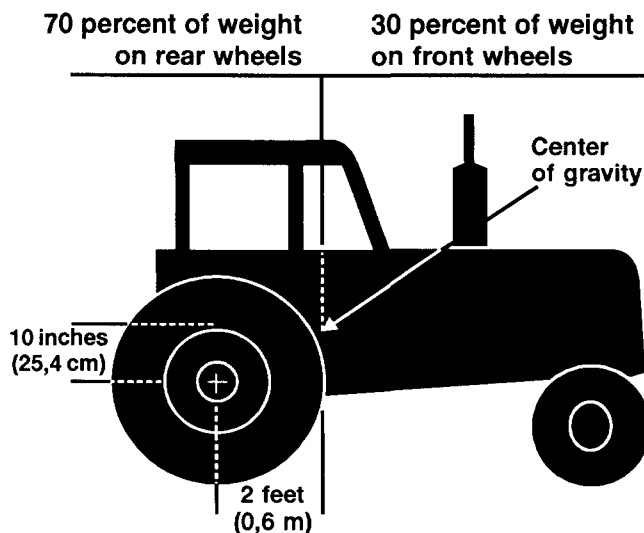
Loads that are attached by looping a chain around the axle housing, seat base, or upper link of the three-point hitch reduce the pulling capacity of the tractor

and increase the possibility of a rearward tractor rollover.

The drawbar mounted on a three-point hitch system can be moved up and down to fit many situations, but the safest situation is when the drawbar is at the height recommended in the operator's manual. Raising this drawbar decreases safety and pulling effectiveness of the tractor. Stay braces should be installed where possible to maintain a safe drawbar height.

Rearward tractor rollovers can be prevented by:

- releasing the clutch only when the rear wheels CAN rotate forward.
- using a reverse gear to break tractor tires from frozen conditions.



Sideways Tractor Rollovers

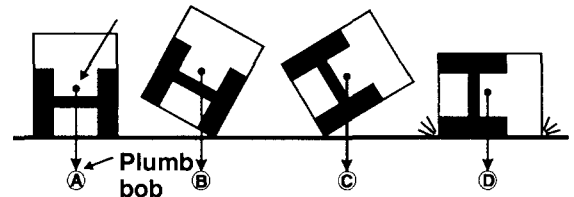
Similar to rearward tractor rollovers, sideways rollovers happen when the center of gravity of the machine passes over one of the baselines of stability. Three situations most common for sideways rollovers are:

- when the tractor is driven on a hillside that is too steep
- when the front-end loader is elevated too high for a given load on a hillside that is too steep or in a turn at excessive speed
- when the tractor is driven too close to the edge of a roadside ditch or other steep slope.

The wider the tractor (from outside edge to outside edge of the rear wheels) the more stable the machine is for any given angle of tilt to the side. Also, as the center of gravity is more centrally located within the baseline of stability, the more stable it is. Proper ballasting of the tractor will help to keep the center of gravity low and safely centered.

The operator is responsible for keeping the tractor's center of gravity within its baseline of stability. To do this, he/she must decide and react accordingly; when is a side hill tilt too steep for the tractor, and when is an elevated load too high for a given speed? The safe operator is always aware of the operating

Center of gravity

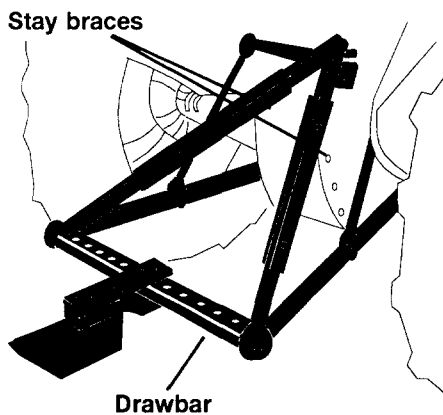


environment and safely alters his/her driving to match those ever-changing conditions.

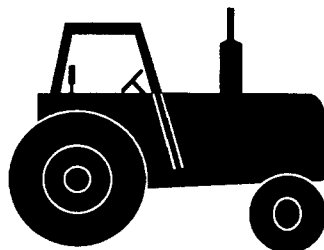
ROPS — Roll Over Protective Structures

It is nearly impossible to buy a new tractor without a ROPS already installed, along with seat-belts. Much of the used-tractor market is filled with ROPS-equipped tractors. But many farms and ranches have a ready supply of older tractors without ROPS. Many of them can be equipped with a retrofit ROPS, but the value of the tractor isn't considered enough to warrant the expense. A more important question is, does the life of the operator who drives that tractor warrant the expense of the ROPS?

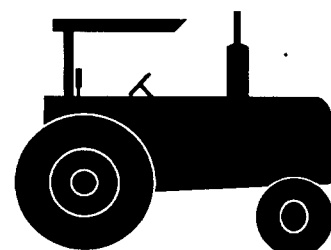
An important part of the ROPS is the seat belt that keeps the operator within the safety envelope. Wearing the seat belt, even when working fields as flat as a tabletop, will help prevent poor posture in the seat and ease back strain. The seat belt works, but only if it is worn.



- choosing NOT to climb steep hills in a forward direction with a tractor.
- using a reverse gear to back the tractor up a steep hill where it is feasible.
- using only enough engine speed to start the tractor moving and using the clutch smoothly.
- changing tractor speed gradually by applying power smoothly.
- ballasting the tractor properly for the work to be done.
- appropriate use of tire chains, boards and other materials to improve traction of wheels that are slipping.
- hitching loads properly to the drawbar.



Four-post protective frame



Two-post protective frame with weather canopy

Some tractors are used in situations where the full height of a ROPS would be an inconvenience to the work being done. Foldable ROPS are now available on most new tractors. They should be folded only when needed to enter or clear an overhead obstruction.

When the ROPS is in the folded position the seatbelt should not be worn since the ROPS is not effective in that position. Always secure the ROPS in the upright position as soon as possible after the close clearance work is done.

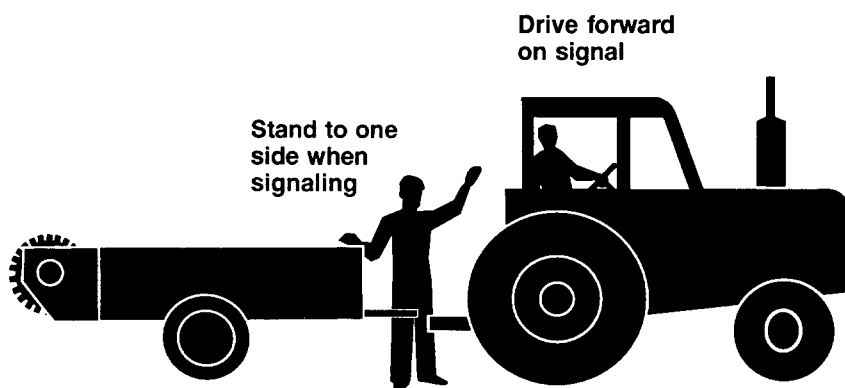
Falls From Tractors

Many agricultural workers have suffered wrist, arm, hip, leg, and ankle injuries as a result of falling from their tractors. Most of these falls are due to unsafe, improper mounting and dismounting the steps of the tractor. The steps on the tractor should be used the same as the steps of a ladder; either two hands and one foot or one hand and two feet should be in contact with the steps at all times. Climbing the steps with no hands holding on or taking two steps at a time is inviting an injury-incident.

The operator should always face the tractor when going up or down the steps - the handholds will then always be in position to be used; otherwise they are in back of the worker and out of reach. Many pants cuffs or boot loops have caught on the clutch pedal as the operator moves forward off the platform, pitching him/her forward, off the tractor. This can be prevented simply by facing the tractor when going up or down the steps and using the handholds.

Extra Riders

Extra riders are never safe on a tractor. There is no place for them to stand or sit safely. There is no seatbelt to keep the rider in an envelope of safety if the tractor should tip over. Many children have fallen from tractors as an extra rider, even from cabs with supposedly locked cab doors. Many falls from a tractor result in injury or death; the rear wheel is right there, ready to fatally crush the fallen extra rider.



Tractor Runovers

Tractor runovers often happen due to:

- the driver's inability to see small children and other people in the line of travel.
- extra riders falling from the steps, cab, or drawbar.
- backing the tractor toward machinery to be attached.
- by-pass starting.

These injury-incidents happen and are preventable.

A child or unseen adult in the vicinity of the tractor is at risk of being run over. The operator must be sure the area is clear before moving the tractor.

Children should not be permitted to play in the area where tractors and other machinery are operating. Children should be restricted to a safely fenced play area.

Tractors should be driven responsibly at all times, but especially when near populated areas such as the farm buildings. The operator should always drive the tractor and machinery at a safe speed for the given situation. Also, keep the brake pedals locked together for simultaneous braking of the rear wheels in these areas.

The time saved by operating the tractor at a higher rate of speed in potentially populated areas (the farmstead) is simply too little to justify risking human life. Reduce the speed, and be cautious when people are present.

Caught-Between Crushing

Backing up to attach machinery

Agricultural workers can easily become crushed between a tractor and the machinery being attached. The worker is standing between the tractor and the machine as the operator is backing up the tractor. There is either a breakdown of communication or control of the tractor is lost; the worker on the ground is in the wrong spot, the tractor moves rearward too much, or the tractor operator cannot see the worker, who is then crushed between the machines.

The safe solution to this situation is, the worker should not enter the area between the tractor and the machine until the tractor has been stopped, shifted into neutral, and the brakes applied. The worker should step out of the area between if adjustments have to be made between the tractor and the machine, particularly if the tractor has to be closer to the machine.

Tractor Operator Responsibilities

The farm tractor is not a machine that can be operated safely without responsibility on the part of the driver. There are eight primary responsibilities the safe tractor operator must meet whenever the tractor is used. They are:

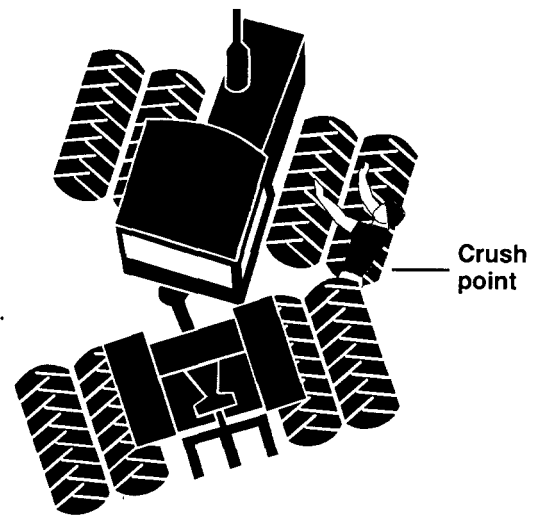
- conducts proper maintenance
- conducts pre-operation checks
- avoids injury-incident situations
- maintains safety features
- uses tractor as intended
- refuels safely
- starts and stops safely
- adjusts the tractor for safety

The safe worker will recognize dangerous situations and make changes to remove the hazard. He/she will not proceed with work until it is safe to do so, knowing and believing that no job is so important that injury or human life should be at risk.

Articulated four wheel drive tractors

The area between the front and rear wheels on either side of an articulated four wheel drive tractor is a very dangerous place. Slight movement of the steering wheel will cause the tractor to move or articulate in the middle, bringing the front and rear wheels of one side or the other closer together with more than enough power to crush a human.

If the steering wheel of some tractors is moved, even with the engine not running, the tractor will articulate later when the engine is started. Not all four wheel drive tractors are so closely coupled between front and rear sections that a crush will happen, but it is an area to stay out of as much as possible, especially when the engine is started or running.



PTO Stub Shaft Entanglement

Most tractors, new or old, have a PTO stub shaft protruding from the rear. All newer and most older tractors were equipped with a PTO master shield to cover the stub shaft. Most of these shields are difficult to remove, but some have been. This leaves the stub shaft exposed and puts the operator at risk of entanglement with it.

Many tractors are equipped with stub shaft shields that cover the entire stub shaft when not in use. These shields usually screw into place and are often misplaced soon after being removed. Tractors are often found with this shield missing. If this shield is missing, it is to the operator's advantage to replace it and restore another safety feature of the tractor. Refer to NDSU Extension Service Circular AE-1070, Straight Facts About PTO Shafts and Shields, which discusses the dangers of exposed PTO shafts.

Master shields for PTO stub shafts should never be removed from the tractor except for maintenance work, and then should be replaced immediately after. Stub shaft shields should never be taken off except when the PTO stub shaft is to be used and replaced immediately after PTO use.

Maintaining the Safety Features

The safety-oriented owner/operator of a farm tractor maintains all of the safety features on it. Not all tractors have the same or equivalent safety features when new. The safe owner/operator will add safety updates to machinery as they become available.

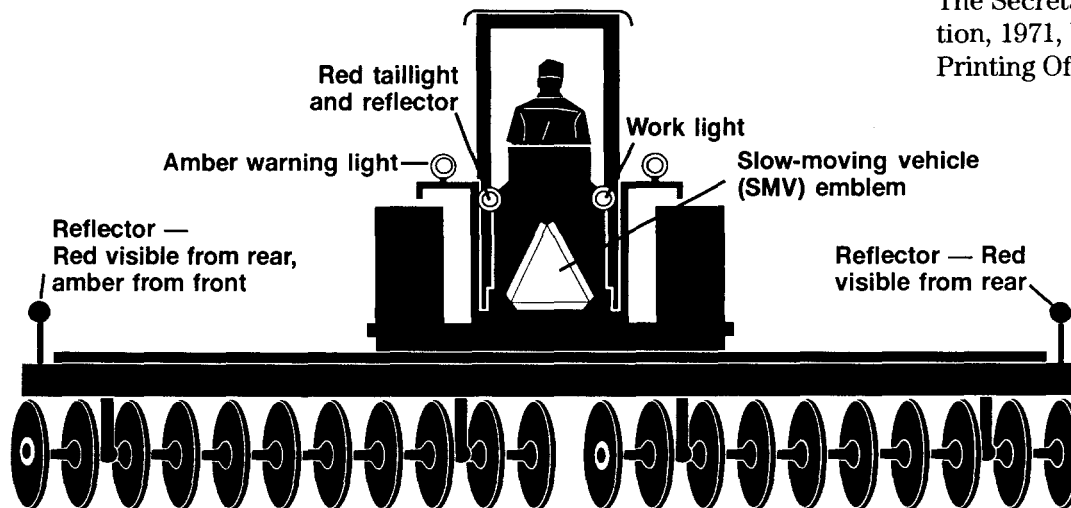
Safety features to be maintained on agricultural tractors relate to the following:

- tractor stability
- tractor visibility and recognition
- safety decals
- operator comfort and control
- protection from hazards

Safety features include ROPS (rollover protective structure) with seatbelt, posture-designed seat, lighting for highway and field, SMV (slow moving vehicle) sign, flashing amber hazard lights, turn signals, fenders, engine shrouding, PTO master shield, PTO stub shaft shield, manual over-ride power steering, neutral start interlocking switch, steps with handholds, hazard warning decals, and breakaway hydraulic couplers.

Tractor operators need to know these features and how they work, as well as how to use them and maintain them. Safety features that have been allowed to deteriorate and become ineffective are a hazard. The operator assumes the protection is there, depends on it and is at greater risk if it is missing.

Owners and operators of tractors need to know that it is their responsibility to maintain safety decals in good condition. Owners are responsible for providing safe equipment for their employees. The decals are there to provide important safety information about the tractor and its safety features. The decals can't do their job if they cannot be read; replace them as they wear out due to weather and use.



Note— If implement obstructs view of SMV emblem on tractor, emblem must be mounted on implement

Prevention of Injury-Incidents

Of the many tractor injury-incidents that happen, few are caused by machinery or equipment failure. Most are caused, directly or indirectly, by carelessness and unnecessary hurry. Use safe procedures, pay attention to what is being done and how it is being done, and THINK about what you are doing — then tractor safety isn't too difficult or time-consuming.

Additional Information

Safe Operation of Agricultural Equipment, 2nd Revision, 1990, Hobar Publications, St. Paul, MN

FMO Agricultural Safety, Third Edition, 1996, Deere & Company, Moline, Illinois

Agricultural Tractor Safety on Public Roads and Farms, A Report To The Congress from The Secretary of Transportation, 1971, U.S. Government Printing Office, Wash. D.C.



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