TRACTOR SAFETY

SAFELY WORKING WITH AND AROUND TRACTORS

Risk Management and Safety
Camp Auburn Road Safety Annex
971 Camp Auburn Road
Auburn University, Alabama

PRESENTATION WILL COVER

Tractor Operation Basics

- Common Tractor Hazards
- Accident Prevention
- Rollover Protection Structures (ROPS)

TRACTORS: FRIEND AND FOE

- Tractors are often considered a farmer's best friend. Yet, tractors continue to cause serious injury and death among users and ground workers.
- Even though tractor hazards have been identified for years, the same injuries/accidents continue to occur, even though there are known engineering controls and standard procedures to deal with these hazards.
- Few of the recorded tractor injury accidents have been caused by equipment failure.

AGE OF THE TRACTOR

- Newer tractors have many safety controls that automatically protect the user.
- Our state-wide tractor fleet contains many older tractors.
- Knowledge gap exists for younger workforce and new hires of any age on how to operate tractors safely (esp. older models).

TRACTOR OPERATOR MANUALS

- Tractor and tractor implement operator's manuals are the "oracle" on proper tractor operation and maintenance.
- As many tractors are older, manuals are sometimes lost.

<u>If manuals are not on-site, find a copy:</u>

- Contact manufacturer
- Internet search

POSTED INSTRUCTIONS AND LABELS

EMPLOYER RESPONSIBILITIES

- Provide employees with a properly maintained tractor.
- Provide safety features for the tractor.
- Provide operator training.
- Supervise and enforce responsible operation of equipment.

PRE-QUALIFICATIONS

Equipment operators **MUST**

- be **18** and have a valid drivers license.
- be trained on the specific tractor and implements they will be using prior to operating equipment.

TRACTOR OPERATOR RESPONSIBILITIES

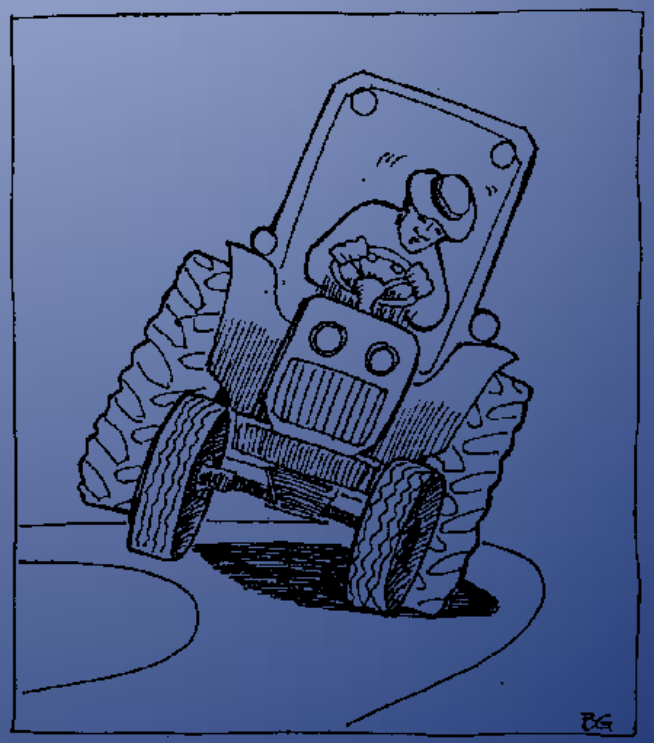
- ☑ Stay alert and avoid potential hazards.
- ☑ Preview your route for obstacles, holes, slopes, ditches, terrain, etc. and remove debris.
- ☑ Maintain and use the tractor's safety features (such as, ROPS, seat belt, and PTO shields).
- ☑ Conduct tractor pre-operation checks.
- ☑ Operate the tractor and implements safely and according to manufacturer's directions.
- ☑ Use the right tractor and implement for the job.
- ☑ Know equipment blind spots.

SECURELY FASTEN YOUR SEAT BELT IF THE TRACTOR HAS ROPS

- Don't rely on the tractor's Rollover Protection System (ROPS) alone for your protection - use your seat belt.
- Studies show that tractor drivers can still be thrown from an upset tractor and be seriously injured or crushed.
- The seat belt will help keep you inside the ROPS in the event of a rollover.

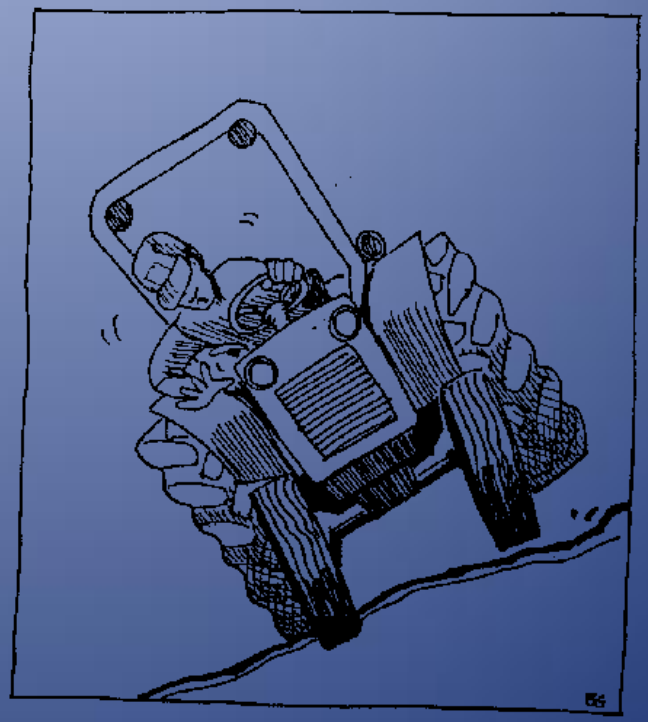
REDUCE SPEED WHEN TURNING

- When operating a tractor, avoid sharp turns and high speeds.
- High speeds, coupled with rough ground and narrow wheel settings increases the chance for a rollover.
- Make turns slowly and at wide angles.



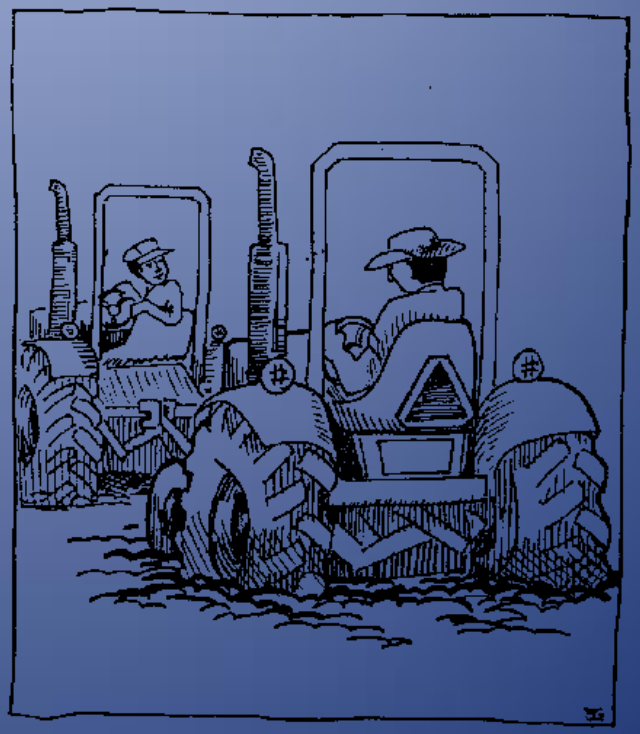
AVOID OPERATING TRACTORS NEAR DITCHES, EMBANKMENTS AND HOLES

- Keep tractors and implements away from irrigation ditches and embankment edges to avoid tractor upsets. Edges may be weak and break from the weight of the equipment.
- When you are traveling downhill, use low gears. When you must go up a slope, back up to increase your stability.
- Approaching a steep slope in the forward position will cause the tractor to upset and possibly injure or kill you.
- Look ahead at your path. Keep your eyes open for large holes, rocks or any slopes and avoid them.



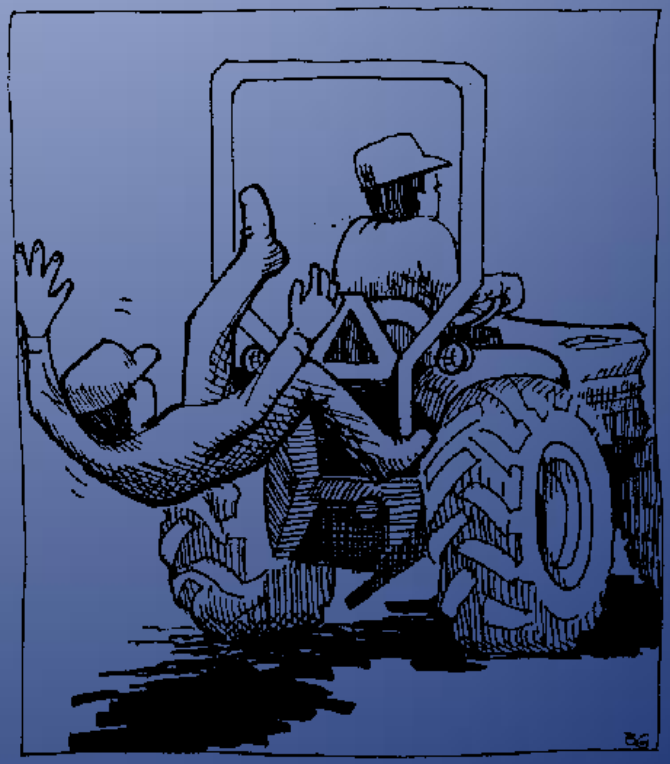
IF YOU GET STUCK, GET HELP FROM ANOTHER TRACTOR

- If you get stuck, do not tie a fence post or any other object to the tire for traction as it may tip the tractor over as it tries to overcome the hump, or the post may be thrown up behind the tractor hitting the driver.
- The best solution is to have another tractor pull you out.



DO NOT PERMIT OTHERS TO RIDE

- Many unnecessary injuries occur due to riders falling unintentionally from the tractor.
- An unexpected jolt or stop can cause a rider to lose balance and fall beneath the trailing equipment or tractor tires.
- Unless a seat is specifically designed for an additional person, never permit anyone to ride.



HITCH ONLY TO THE DRAWBAR AND HITCH POINTS

- Tractors are designed to tow loads from the rear hitch only. Never hitch a load to the axle or seat as this will cause the tractor to upset backwards.
- Always match your load to the tractor. Tractors that are too small for the load will have problems stopping once the load has begun to move.
- If the tractor needs extra weight for balance, add front weights as necessary.
- Balance the weight of the load on the trailing implement in order to minimize the stress at the hitch point.

STUNT DRIVING AND HORSEPLAY IS PROHIBITED

- Tractors are not designed for high speeds or for quick maneuvers.
- Due to the location of the tractor's center of gravity, the tractor can very easily tip to the side if not handled properly.
- Horseplay and stunts are unsafe acts that promote injuries and death and will not be tolerated.

SET THE BRAKES SECURELY WHEN THE TRACTOR IS STOPPED

- When you need to make adjustments to the tractor or to the trailing equipment, put the tractor into neutral, set the brakes, turn off the engine and remove the key.
- Be sure to disengage the PTO before working on any trailing equipment.
- Always replace the PTO shield and other shields after your adjustments.

INSPECT YOUR TRACTOR REGULARLY

- Since tractors can be taken on public roads as well as in the field, it is important that tail lights, signals and safety chains are maintained in good condition.
- Inspect the brake fluid and engine fluid, and notify your supervisor if any adjustments/repairs need to be made.
- Make sure your tractor has a Slow Moving Vehicle emblem at the rear if it is to be driven on public roads.

ARTICULATED-FRAME TRACTORS REQUIRE SPECIAL CAUTION

- Because articulated-frame tractors bend in the middle, it is especially important that you exercise caution when others are nearby.
- Before starting articulated-frame tractors, make sure bystanders are not nearby.
- Understand that steering is more difficult with these tractors and any load being pulled will swing wider side to side, so drive slowly.
- When making turns, stop first and then begin your turn slowly.

USE COMMON SENSE WHEN OPERATING TRACTORS

- To prevent unnecessary injuries, don't jump from the tractor but use the provided hand railing and steps.
- Use safety hand signals to co-workers to maintain communication.
- Ask your supervisor for a copy of the hand signals used at your workplace.

FINAL OPERATION THOUGHTS

- Fuel tractor when engine is off and cool.
- Use tractor responsibly in enclosed spaces to avoid carbon monoxide poisoning.
- Never leave a tractor running unattended.
- Before dismounting switch off the engine and wait for the tractor and PTO implements to come to a complete stop.
- **Take the tractor key with you!**

TRAINING AN OPERATOR

Training should include classroom and field lessons on:

- Tractor hazards and operational basics.
- Familiarization with equipment operator manuals and manual location.
- The importance of not operating equipment with mechanical problems or missing shields and other safety devices.
- Familiarization of terrain hazards where the tractor will be used including holes, obstacles, slopes, embankments, stumps, ditches, etc.

TRAINING AN OPERATOR

- Hands-on operational instruction on tractor(s) and implement(s) to be used.
- Competency test drive for tractor and for implement attachment operation.
- Written training documentation.

TRACTOR SAFETY FEATURES

- PTO shield and other machine guards
- ROPS
- Seat belt
- Rear view mirrors
- Head/Tail/Turn/Warning Lights
- Back-up alarm
- Slow Vehicle Warning Triangle
- Fire extinguisher
- First Aid Kit

COMMON MISHAPS

- Rollovers: rear and side
- Front-end loader incidents
- Falls from tractor
- Tractor run-over's
- Caught-between crushing
- PTO shaft entanglement
- By-pass starting

TRACTOR ROLLOVERS

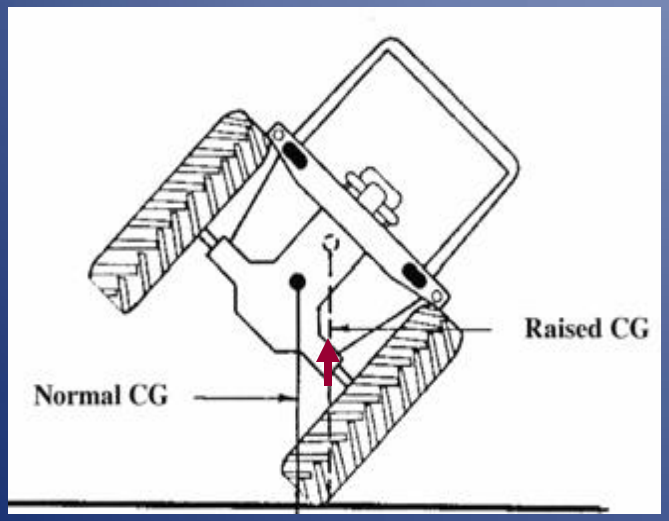
- Tractor rollovers happen when the center of gravity moves past a baseline of stability, either to the side or rear of the machine.
- Many rollovers happen at speeds <8 mph and on slopes less than 5°. Avoid sudden motions.
- Contributing factors to rollovers are:
  - Various sizes, shapes and weights of implements
  - Speed!!!
  - Terrain
  - Human error

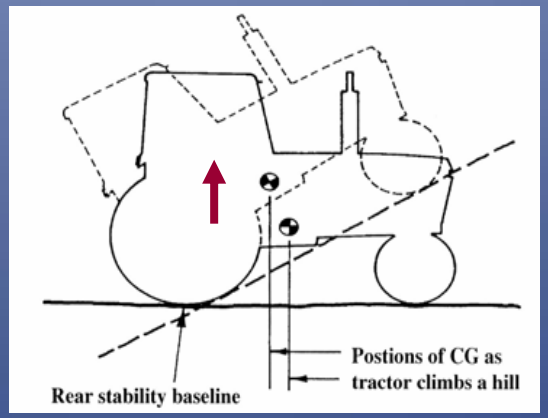
Know the safe working load of each tractor and never exceed it!

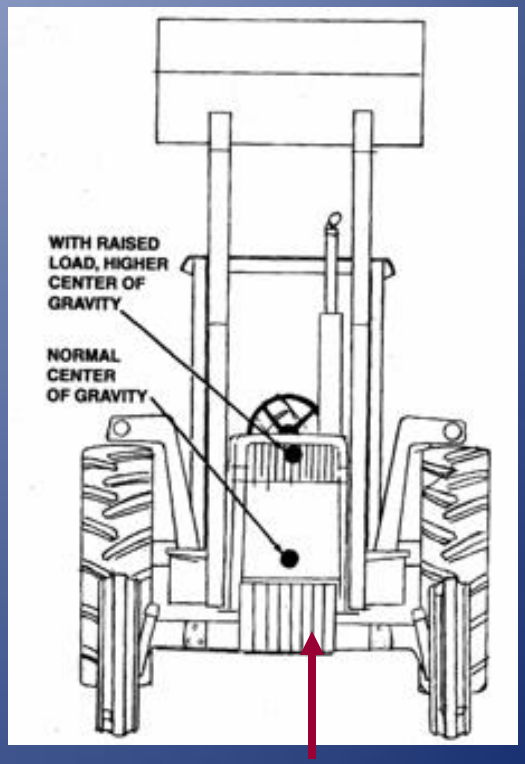
CENTER OF GRAVITY

Center of gravity is affected by slopes, loads, turns and terrains.

Stay Centered!





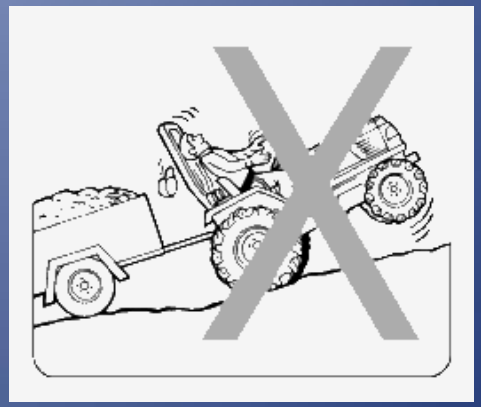


When the center of gravity is raised the risk of rollover increases

REARWARD ROLLOVERS

Common causes for rear-ward rollovers:

- Tractor is stuck in mud or snow preventing rear wheels from rotating.
- Rear wheels can't turn because of chains, boards, or other materials used to improve traction.
- Climbing a hill that is too steep.
- Clutch is released too quickly w/ transmission in a lower gear and engine at high speed.



- Load is too heavy and/or hitched above the drawbar of the tractor.

REARWARD ROLLOVERS

- Usually caused by rear axle torque and/or drawbar leverage as tractors easily tip to the rear when the rear wheels can't rotate enough to move the machine forward.

Tractor can tip in as little as ¾ of a second

PREVENTING REARWARD ROLLOVERS

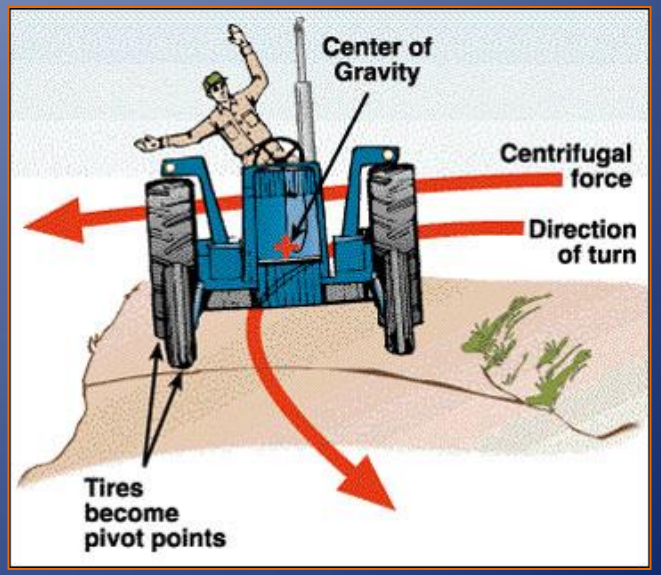
- Release clutch only when rear wheels can rotate forward.
- Do not climb steep hills in a forward direction. Instead, use a reverse gear to back the tractor up the hill.
- Use only enough engine speed to start tractor moving while engaging the clutch smoothly.
- Change speed gradually by applying power smoothly.
- Ballast (counter-balance) the tractor properly for the job.
- Hitch loads properly to drawbar.
- Use reverse gear to break tractor tires free from frozen conditions.

It is preferred to use another tractor to pull out a tractor from a ditch or muck. To avoid injury take care in using tire chains, boards, and other traction materials to improve tire traction.

SIDEWAYS ROLLOVERS

Common causes for sideways rollovers are tractor:

- Driven on hillside that is too steep.
- Driven too close to the edge of a roadside ditch or embankment.
- Cornering too sharply or too fast (centrifugal force pivots tractor on outside wheels).
- The tractor's front-end loader is elevated too high on a hillside or in a turn at excessive speed.



ROLLOVER PROTECTIVE STRUCTURES

R-O-P-S

Stationary

or

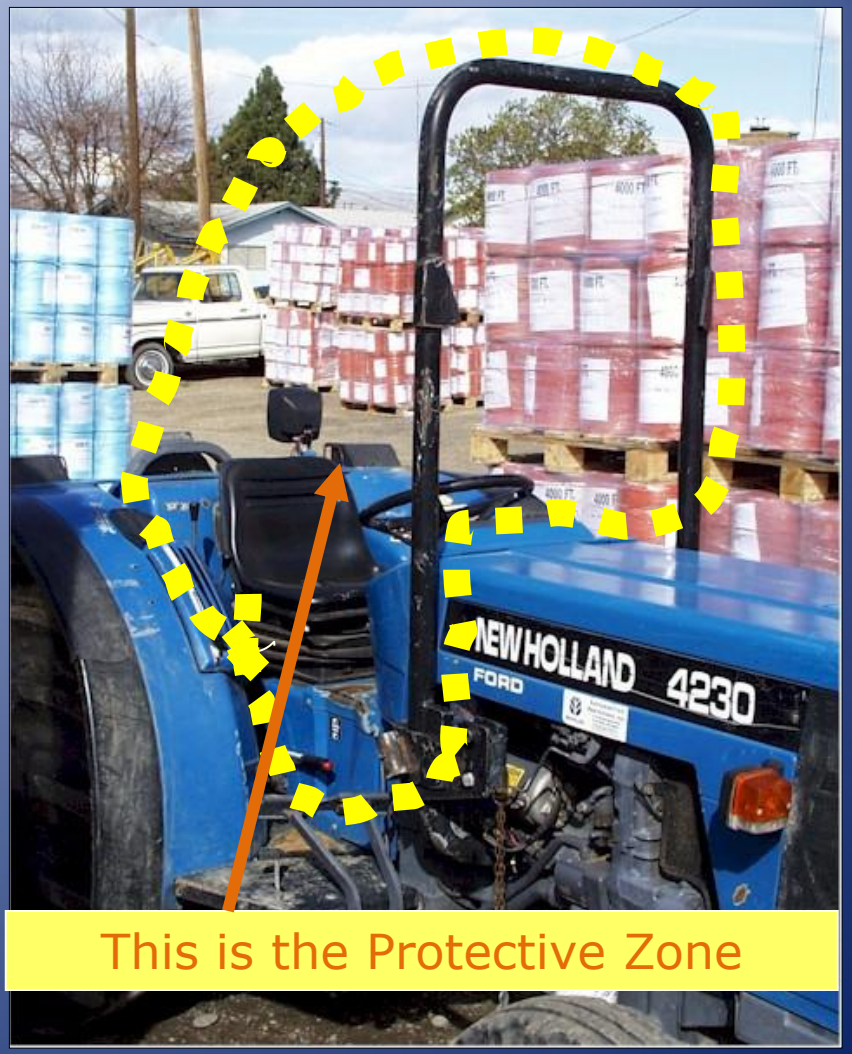
Foldable

ROLLOVER PROTECTIVE STRUCTURES (ROPS)

- ROPS work by **limiting a rollover to 90°** and preventing the operator from being crushed under the weight of the tractor.
- ROPS work only if the operator is **wearing a seatbelt** to keep them in the operator station as the tractor is rolling.

What is a Protective Zone?

- An imaginary space surrounding an operator's body.
- **ROPS and a seatbelt** keep the operator within this safe space in the event of a rollover.



ROPS save lives!

*No ROPS-cause for the majority tractor-related fatalities (~130/yr)!

*Runovers are second (fatalities ~ 60/yr)!

ROPS AND SIDEWAYS ROLLOVER DEMO

TWO HILLSIDE DEPRESSIONS

TRACTOR HITS DEPRESSION AND TIPS

PAST POINT OF NO RETURN

ROPS AND SEATBELT PROTECT OPERATOR

ROPS AND REARWARD ROLLOVER

With ROPS and a seatbelt, operator has an excellent chance of being contained in the protective zone and surviving a rear rollover.

WHEN ARE ROPS REQUIRED

WHEN:

- Engine greater than 20 horsepower.
- Vehicle is 2-wheel, 4-wheel or track driven (crawler-type) and designed to pull, propel, or carry implements designed for agricultural use (disk, tiller, plow, etc.).
- Manufactured after October 25, 1976.
- The manufacturer made a retrofit ROPS option available or it was available at the time tractor manufactured (*no matter what year tractor manufactured).*

ROLLOVER PROTECTIVE STRUCTURES (ROPS)

- ROPS must come from the manufacturer and must not be made “on-the-job” or “home-made”.

- One **limited** exception to ROPS requirement is low profile tractors used under certain conditions (see following slides).

LOW PROFILE TRACTOR ROPS AND INTENDED USE EXEMPTION

Low profile tractors do not require ROPS when used in:

- Orchards, vineyards, hop yards where ROPS would interfere with normal operations or related work.
- Farm buildings or greenhouse where vertical clearances are insufficient to allow ROPS.
- When tractor has mounted equipment that is incompatible with ROPS.

THESE USES ARE THE ONLY EXCEPTIONS- LOW PROFILE TRACTORS ARE NOT TO BE USED FOR ANY OTHER PURPOSES

WHAT IS A LOW PROFILE TRACTOR?

Low-profile tractors:

- Are wheeled.
- Have equal spacing between wheel centerlines of the two front and rear tires.
- Have clearance of 18” or less from bottom of tractor chassis to ground.
- Hood’s highest point is 60” or less from ground.
- Are designed so operator straddles the transmission when seated.

ROLLOVER PROTECTION
FOLDABLE ROPS

- Foldable ROPS are available for some tractors.
- Fold down in low vertical clearance areas.
- Return ROPS to upright position as soon as possible after close clearance work is done.
- It is recommended to install foldable ROPS on low profile when available.

ROLLOVER PREVENTION OPERATING ON SLOPES

- Avoid working on steep slopes.
- Follow operator manual instructions on operating equipment on slopes.
- **Set wheels wide.**
- Drive slowly.
- Make wide **slow** turns.
- Know the terrain: small holes, depressions, or stump can cause tip over.
- Stay back from embankment edges as they are often soft.
- Go down slope in low gear.
- Follow operator manual instructions on side mount implement placement (up or down hill).

ROLLOVER PREVENTION OPERATING ON SLOPES

Harper-Deweze All Terrain Mower

Remote Control-Kubota

ROLLOVER PREVENTION IMPROPER HITCHING

- Hitch loads for pulling to the drawbar or the three-point hitch only.

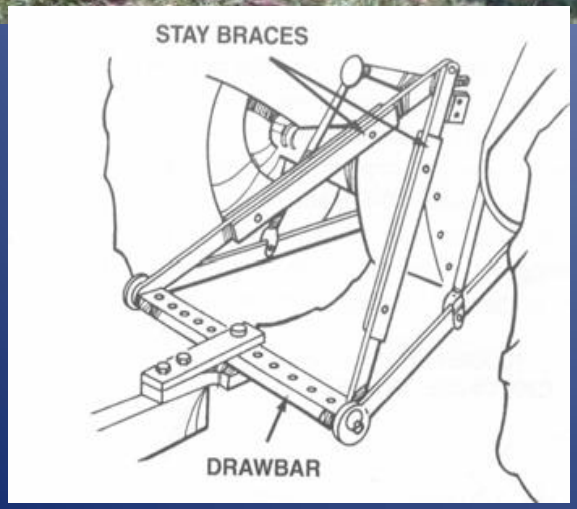
  Loads that are attached by looping a chain around the axle housing, seat base, or upper link of the 3-point hitch reduce the pulling capacity and increase the possibility of rear-ward rollover.

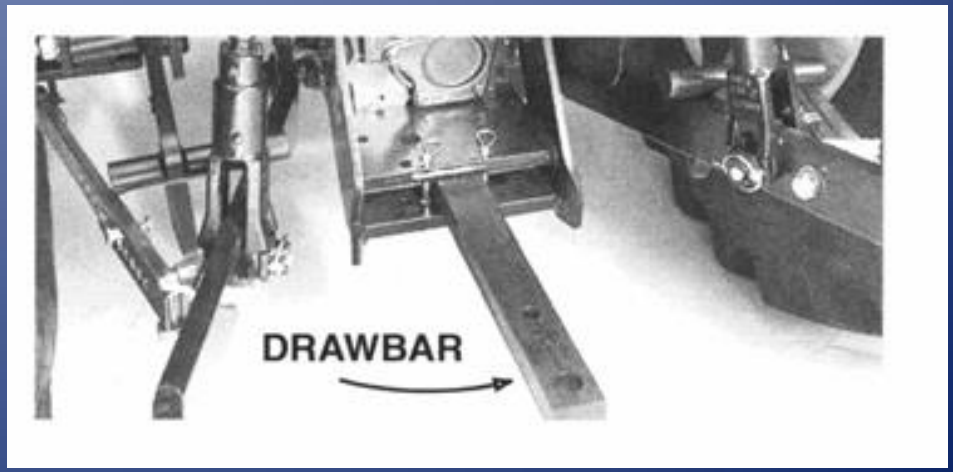
- Use draw bar at height recommended in operator's manual. Don't alter or raise height of the drawbar. Raising the drawbar decreases safety and pulling effectiveness.
- Install stay braces where feasible to maintain a safe drawbar height.

HITCHES

3-point hitch is desired

Always hitch to the drawbar

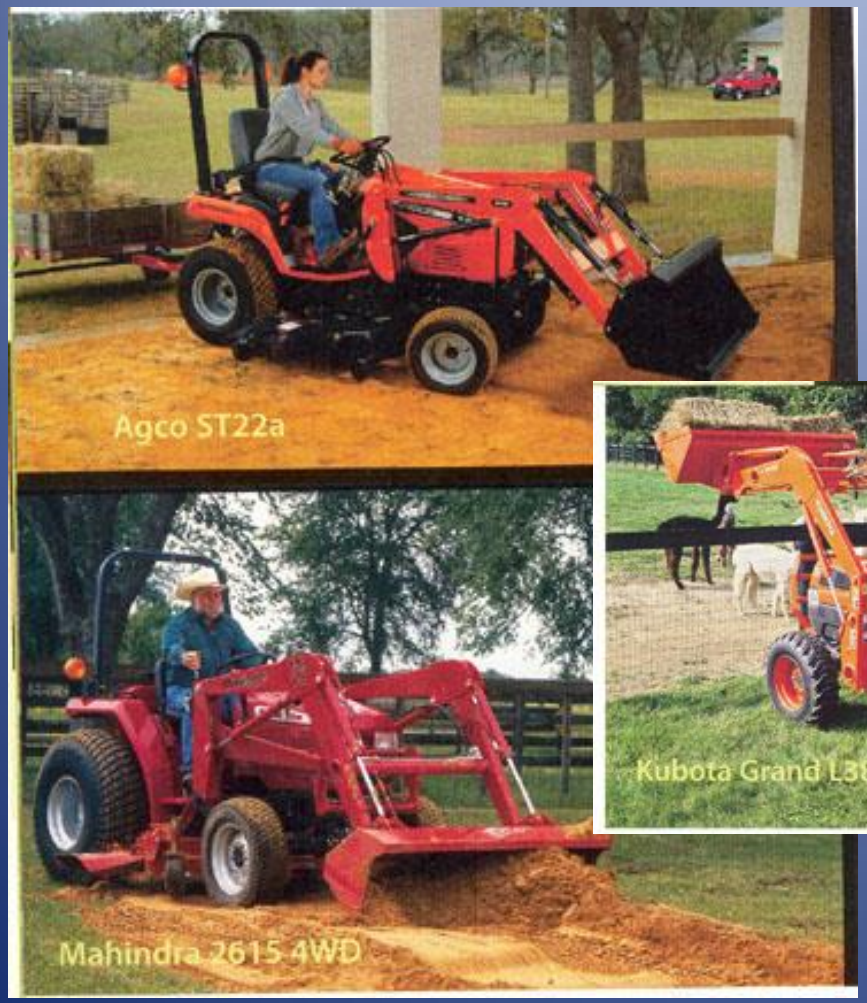




FRONT-END LOADER INCIDENTS

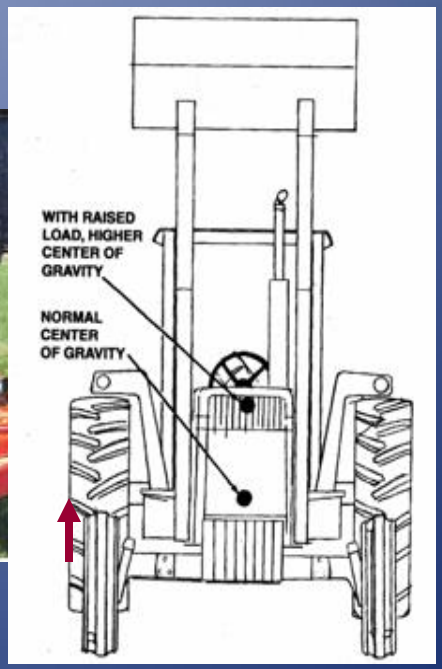
- Front-end loaders are used for lifting and moving materials.
- Mishaps are caused by exceeding lifting capacity, lack of safety equipment, or inappropriate use including:
  - Front-loader attachment not intended for lifting people.
  - Speed: working too fast for existing conditions.
  - Rear of tractor may not have proper counter balance for the load.
  - Weight of load: Exceeding front loader lift capacity.

TRACTOR FRONT LOADER INCIDENTS



KEEP LOADS LOW!

Lifting loads too high can cause instability, rollover, and injury



Remember center of gravity changes as bucket rises

FRONT LOADER INCIDENTS

- Shape of load can cause instability.
- Use proper tools to lift odd shapes.
- Many injuries happen while hauling hay-this bale type can crush a driver or ground worker.

FALLS FROM TRACTORS

- Most falls are due to improper mounting or dismounting of the tractor (Injuries to wrist, arm, hip, leg, ankle and runovers can result).
- Don’t “jump” down from tractor (Injuries to knees, ankles and feet).

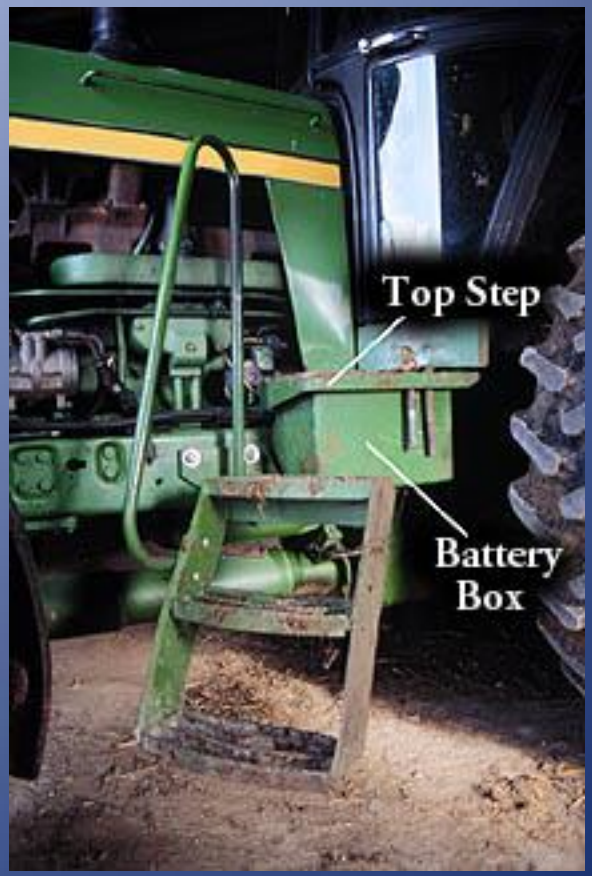
FALLS FROM TRACTORS

Use a **3-point mount** *(either 2 hand and one foot or 2 feet and one hand in contact with steps at all times).*

Face the tractor when going up and down the steps and use handholds. There is less chance of catching pant's cuffs or boot loops on clutch pedal, etc. which can pitch a person off the tractor.

FALLS FROM TRACTORS

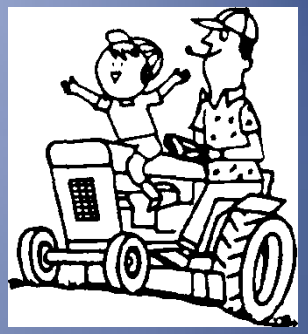
Beware slippery, wet, and muddy surfaces.



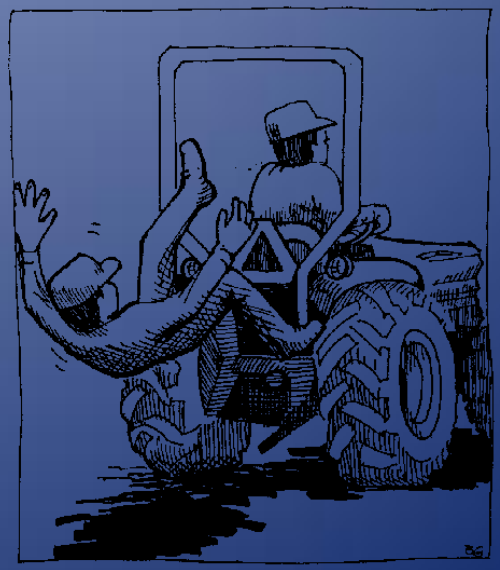
Accident photo:

A person slipped on these muddy stairs and was run over and killed by this tractor.

FALLS FROM TRACTOR



- Most tractors are not designed to carry passengers.
- Maintain a no rider policy.
- Injury occurs to passengers by falling from tractor and being run over once they have fallen.



RUNOVER INCIDENTS

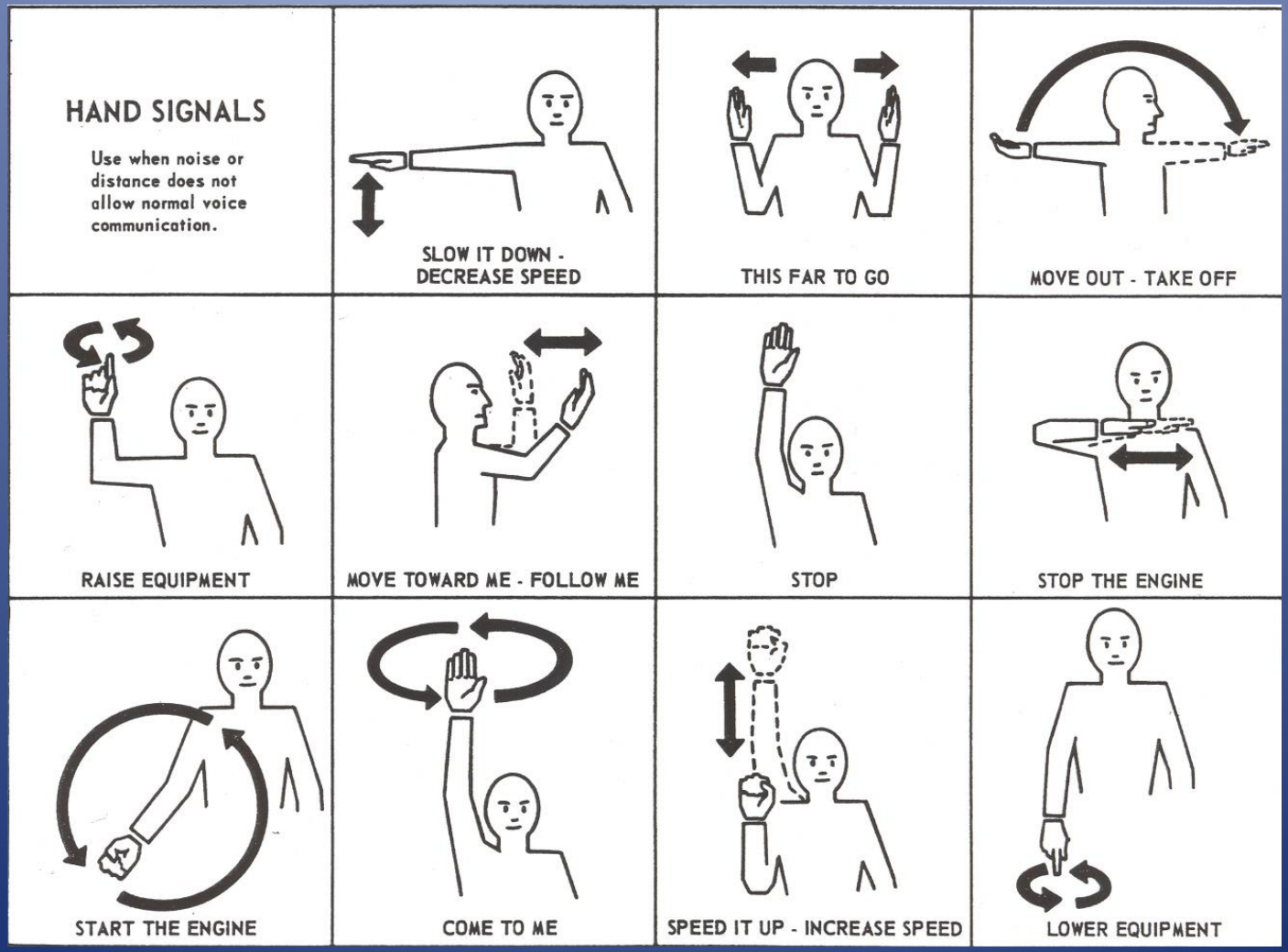
Usually happens due to:

- Inability to see small children or others in the line of travel.
- Extra riders falling off from steps, cab, or drawbar.
- Backing the tractor toward machinery to be attached.
- By-pass starting.

Avoid runovers by:

- Keeping speed down.
- Keeping others esp. children out of the area where a tractor is operating.
- Not allowing ground workers to enter area between tractor and implement until the tractor has been stopped, shifted into neutral and the brakes applied.
- Having ground workers step out of the area when adjustments have to be made between the tractor and implement.
- Clear communication methods between operator and ground workers.

COMMUNICATION!
HAND SIGNALS FOR SAFETY



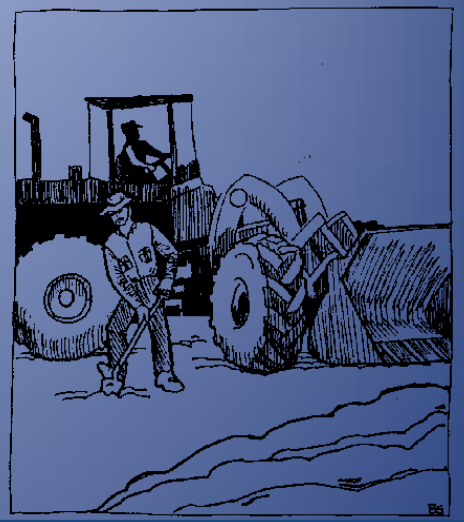
CAUGHT-BETWEEN INCIDENTS

- "Caught between" means a ground worker is crushed between the tractor and an implement.
- This often occurs when the tractor is backing up to an implement to hook up.
- Common causes of caught-between accidents:
  - Break down of communication between operator and person on the ground.
  - Loss of control of the tractor.
  - Worker in wrong spot.
  - Operator can't see worker.
  - Operator misjudges and tractor moves rearward too far.
  - To avoid caught-between incidents refer to run over prevention procedures.

To avoid caught-between incidents refer to run over prevention procedures

CAUGHT BETWEEN ARTICULATING TRACTOR INCIDENTS

There is potential to crush a person on either side of the tractor in the area between the front and rear wheels.



Stay out of this danger area as much as possible.

Slight movement of steering wheel causes tractor to articulate in the middle bringing the front and rear wheels of one side or the other closer together.

If steering wheel is moved, even with engine not running, the tractor may articulate upon start-up.

BY-PASS STARTING CAUSES RUNOVER ACCIDENTS

- By-pass starting is an unsafe practice of starting a tractor while standing on the ground and can result in the person being run over by the tractor.
- Starting the tractor from the ground is accomplished by rigging unsafe electrical connections or reaching up and over the tractor from the ground to turn ignition key (on older tractors).
- New tractors are sold with shield covering the starter. Retro-fits can be gotten for some older tractors.
- Dead man's seat switch is also a built-in safety factor. No one on seat, the tractor shuts off or won't start.

THE PTO (POWER TAKE-OFF)

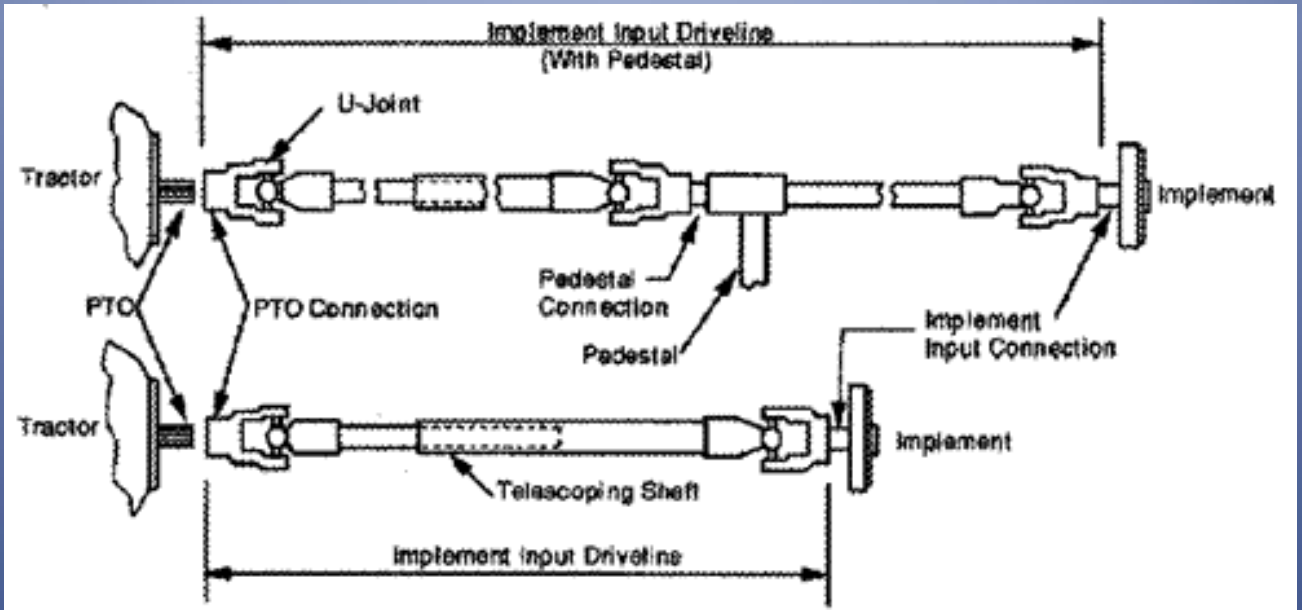


Figure 1. The major components of PTO systems

PTO produces a rotating torque and directly transfers it to another machine or tool. For a mower implement the rotating torque is used to turn the mower blades.

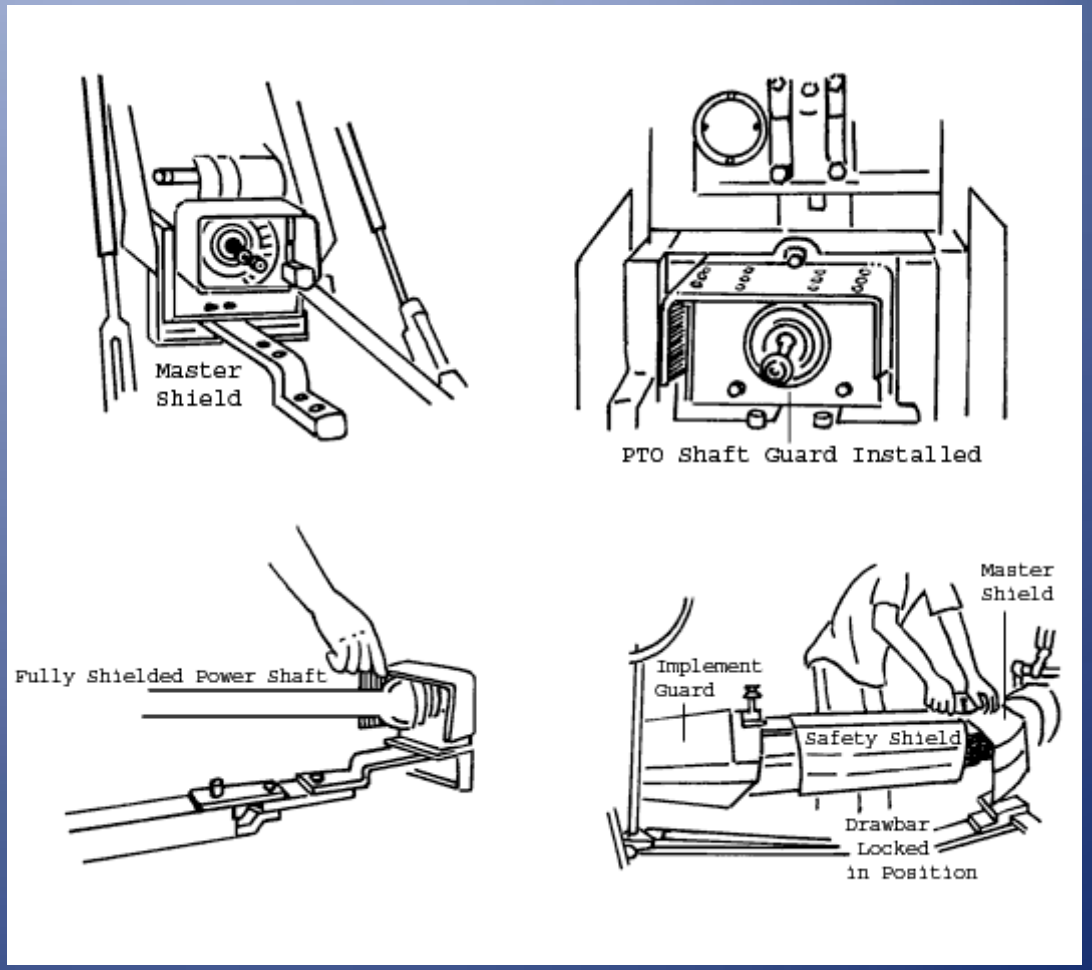
PTO ENTANGLEMENT INCIDENTS

The most gruesome of injuries resulting in severe injury, dismemberment, or death by the human body becoming entangled in (literally wrapped around) equipment.

- A PTO operating at 1000 rpm will pull in clothing at a rate of 8’ per second.
- PTO powered implements operating at 540 rpm can entangle a shirt sleeve or pant leg around the drive shaft 9 times in 1 second dragging your arm or leg with it.

Happens in a blink of an eye!

PTO GUARDS HELP PREVENT INJURY



PTO ENTANGLEMENT

- Proven accident prevention is to **keep PTO shaft shields in place**, and never remove them except for maintenance work.

- While the tractor is **off,** always inspect shaft, driveline and universal joint to ensure guarding prior to use.

- Spin driveline guard to ensure it is not stuck to the shaft.

SIX COMMON MACHINE HAZARDS

1. **Wrap points** (hay baler, PTO shaft, auger)
2. **Hydraulic systems** (high pressure 1000-3000psi. Hot! Hoses can whip around; equipment fails and can crush)
3. **Pinch points** (gears, sprockets, moving parts of belt or pulley drives/chains)
4. **Shear and cutting points** (sickle bars, rotary blades, grain augers)
5. **Crush points** (between two machinery parts or machines)
6. **Thrown objects** (ejected or propelled objects, stones, sticks, chaff, etc.)

SAFETY PRECAUTIONS AROUND MACHINERY

- Prior to use assure all covers, shields and guards are in place.
- Never step across rotating mechanical parts.
- Keep extremities clear of operating parts. Work at least 12’ away when PTO is engaged *(rule of thumb: 2x your height).*
- Never walk or stand behind operating farm machinery.
- Always de-energize equipment and wait for it to stop moving before performing adjustments, unclogging or service.

SAFETY PRECAUTIONS AROUND MACHINERY

- Field work is tiring

and

- tired people make mistakes:

- Beware of carelessness, impatience and fatigue

SAFE OPERATION OF TRACTORS ON THE HIGHWAY

- Attach a slow moving vehicle emblem.
- Use headlights, flashing lights, safety clearance flags.
- Use an escort vehicle when feasible.
- Secure attachments in the transport position. Never operate attachments in transit.
- Keep PTO level in neutral.
- Don’t travel on the shoulder-soft spots.
- Take it slow and pull over when feasible to let normal traffic pass.
- Take special care at intersections, turns, and curves.
- Always leave room to stop safely.
- Independent brakes must be locked together to avoid uneven braking in panic stop situations.
- Watch for blind spots.
- Have a cell phone with you.
- Carry instructions to your site.
  - (contact info)

PPE (Personal Protective Equipment)

Depending on the situation, wear some or all of the following:

- ☑ Hearing protection for prolonged noise exposure (plugs or muffs).
- ☑ Gloves that fit and are the right type for the job can help guard against cuts, abrasions, skin irritants and chemicals.
- ☑ Long pants protect against flying debris, skin irritants, and burns from exhaust.
- ☑ Respirators prevent inhalation of dust and other particulates, and most pesticide vapors.
- ☑ Eye protection impact-resistant and UV.
- ☑ Sturdy work shoes (steel toes preferred).

RECAP

Use the right tractor and implement for the job

Conduct pre-operation checks

Maintain tractor safety features (esp. ROPS, seat belt, and PTO shields)

Operate the tractor and implements safely (consult operator's manual)

Know equipment blind spots

Stay alert and avoid potential hazards-preview or know your route, obstacles, and terrain

Fuel when engine is cool; and never when engine is running

RECAP


Use the tractor as intended No passengers!


No horseplay!

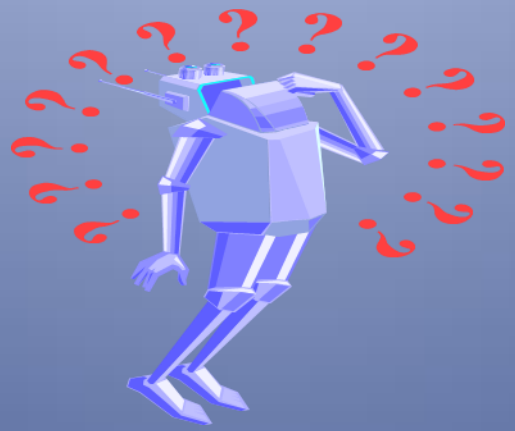

Slow down! Speed kills


Never leave a tractor running unattended!


Before dismounting switch off the engine and wait for the tractor and PTO implements to come to a complete stop.


Take the tractor key with you!

Questions?



If you have questions please call:
Risk Management and Safety,
Occupational Safety and Health Program
334-844-4805

References

- spokane.wsu.edu/.../Safety_Security/Tractor%20 Safety%20EHSS4.pptx
- http://danrrec.ucdavis.edu/ehs
- http://www.aces.edu/farmsafety/documents/Tractor_Machinery.pdf