

Farm Tractors

- Nationally, 75% of all farm-related fatalities involve tractors and machinery.
- Fatality rate for agricultural workers is estimated to be 6 times higher than average for all industries. 22.5/100,000 vs 3.8/100,000
- Little data to estimate economic losses due to workplace illnesses.

Four primary functions:

1. Move loads (high lift)
2. Remote power source (PTO)
3. Implement carrier (3 pt hitch)
4. Transport Unit – Drawbar

Types

Narrow Front End – Tricycle = haven't been manufactured since the 1960s

2- wheel and 4-wheel drive are common options.

There are also articulated tractors that usually are over 250 horsepower (hp).

Common hazards associated with tractors:

1. Overturns
 - a. Approximately 50% of tractor-related fatalities are from overturns
 - b. Sideways (too close to edge or berm or a bank, packing tractors on horizontal silos) or backwards (carrying loads, trying to pull out a fixed object like a tree stump or tree branch)
 - c. Common Examples
 - Driving too fast on rough roads and lanes and running or bouncing off the road or lane
 - Hitching somewhere other than the drawbar when pulling or towing objects
 - Driving a tractor straight up a slope that is too steep
 - Turning a tractor sharply with a front-end loader raised high



Rollover Protective Structures (ROPS) were an added safety feature beginning in 1966. ROPS should support the maximum weight of tractor without collapsing or breaking. Maybe a 2-or 4 -post ROPs on an open frame or integrated into the cab. Tractors equipped with a ROPS must have a seat with a seatbelt.

In 2014, 62% of tractors used on farms in the US were equipped with ROPS. If ROPS were placed on all tractors used on US farms manufactured since the mid-1960's, the prevalence of ROPS-equipped tractors could be increased to over 80%. (<https://www.cdc.gov/niosh/topics/aginjury/default.html>)

ROPS limit the tractor in overturns to 90 degrees. ROPS also provide a protective zone for operator in case of an overturn. Reduces crushing injuries. High speed forces such as a collision with another vehicle or structure may cause ROPS to collapse. Operator must be wearing seatbelt.



2. Runovers

- a. Extra riders
- b. Standing on the drawbar, axle housing, on operator platform, etc.
- c. Operator falling off tractor – knocked out of seat (mostly on tractors without ROPS) or mounting/dismounting a moving tractor
- d. On ground near the tractor – bypass starting, helping to hitch up an implement, not visible to operator (especially young children)

3. Power Take-off entanglements (part of machinery section)

4. Older tractors lack safety features including ROPS and seats with backs and arms. Often used as a power source for stationary equipment like silo blowers or augers. Or tasks requiring less horsepower like raking hay, pulling wagons, etc.

Tractor Controls

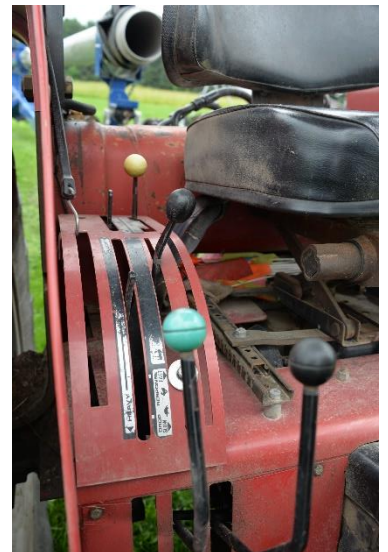
RED – top engine (Important to know in rescue situations to get power shut-off). Engine stop control with a push/pull lever, lever pulled out to stop engine. Keys turn counterclockwise to stop engine. Diesel engines may be different but newer diesels are stopped by turning key counterclockwise to stop engine.

ORANGE – Ground motion including engine speed, transmission)

YELLOW – Power engagement like PTO or accessories, such as mowers

BLACK- Positioning and adjusting, turning on lights, engine choke, hydraulic, lamps and signal lights,

FOOT BRAKES – independent for each tire.



2017 Tractor Incidents

- Wood County – Man killed **runover**
- Green County – Woman injured **pinned** between metal arm and tractor’s bucket
- Burnett County – Man pulling down a dead tree with tractor and **limb fell on** him.
- Marathon County - Tractor **overturn** in ditch
- Richland County - Tractor **rollover** in a deep ditch
- Marathon – **Incident involving** tractor at a residence

Farm Tractors	DR. ABERNETHY	DR WUBBEN
Mechanism of Injury	RESULTS	TYPICAL INJURY
Tractor overturn – open operator platform without ROPS	Major crush injuries	<p>Chest Injuries – mechanical asphyxia, flail chest, pneumothorax, hemothoax, subcutaneous/mediastinal emphysema</p> <p>Abdominal injuries – laceration of liver and spleen, rupture of hollow organs, penetrating wounds</p> <p>Spinal injuries – fractures and dislocations</p> <p>Pelvic injuries – fracture with associated internal bleeding, ruptured bladder, lacerated rectum</p> <p>Head injuries – fractured skull, usually depressed, severe concussion, decreased level of consciousness.</p> <p>Minor cuts and bruises from broken glass and loose objects in cab</p>
Tractor overturn – closed cab without ROPS	Lacerations and shearing from torn metal in addition to crush injuries	
Tractor overturn – ROPS equipped cab	Major trauma if operator is ejected; deceleration injuries if operator is not wearing seatbelt	
Fluid burns or Acid burns from hot engine coolant, hot transmission oil, hydraulic fluids, battery acids, calcium chloride solution used to ballast tractor tires	A variety of fluids in a tractor may cause burns	Burns or chemical exposure to face, eyes, skin.

Rescue Considerations:

1. Tractor incidents often result in serious injuries and fatalities. Fire, rescue and emergency medical services should respond to the scene.
2. Set up scene safety first. Be prepared for a fire threat with a tractor overturn due to spilled fuels or other fluids.
3. Shut off engine.
4. The rescue may take a long time as lifting a tractor may be a slow process. Location of the tractor overturn, part of victim under the tractor, soil conditions, weight of tractors will be factors to address in the rescue.
5. Family members or friends may have lifted off or tried to lift off the tractor prior to rescue arriving shifting tractor or causing additional injury to the victim.
6. Large tractors or articulated tractors will require additional stabilization. It is hard to stabilize an articulated tractor due to the 2 sections moving independently.

Large Equipment

Agricultural equipment may be self-propelled or pulled by, attached to or powered by a tractor, portable engine or electric motor.

In a cropping season, numerous pieces of equipment may be used. Crops like cranberries and potatoes have very specialized machinery and some machines locally built or modified from another machine.

The WI dairy industry means that machinery may be used year round and within farm building (e.g. skid steer loaders, feed carts)

Farm machinery may also be within a farmstead structure. Some examples are:

- Augers inside grain bins
- Silo unloaders in upright silos
- Manure handling equipment with in barns or under barns
- Push gates to ease cows forward into milking parlor from holding pens

Truck mounted equipment has increasingly been used. For example, self-unloading forage boxes, TMR units mounted on trucks. Or the use of truck-tractors with semi-truck tankers for hauling larger loads and further distances.

Power Take-Off is a common component to transfer power from a tractor to a trailered, towed, mounted on or stationary equipment. Example equipment are:

- Balers
- Grain augers
- Self-unloading forage wagons
- Brush mowers
- Forage choppers

PTO operate or revolve at 2 common speeds. A PTO with a 6 spline shaft at 540 revolutions per minute (rpm) or a 21 spline shaft is common on newer, larger equipment and rotates at 1000 rpms.

When standing behind a tractor, looking at the tractor, PTO shafts rotate clockwise. Some tractors may have both 6 and 21 spline shafts.



Skid Steer

Hazards:

- a. Crushed between machine parts (e.g. trying to operate from outside the operator platform and crushed between protective frame and hydraulic arm)
- b. Runover (e.g. operator doesn't see a ground worker, carrying person in bucket or on an attachment and person falls off and is runover)
- c. Caught in an attachment (hooking and unhooking attachment and crushed fingers, hands)
- d. Trapped by loads in operator station (e.g. large bales)
- e. Pinned by rollover or submerged loader (e.g. skid steer push off into a manure storage and operator drowned as he was pinned in the operator platform)
- f. Forward tipping over with heavy load or attachment raised to high.
- g. Falls mounting and dismounting
- h. High pressure hydraulic leaks cause injection into person. Hydraulics system pressure exceeding 2000 pounds psi.
- i. Buried under material – pile or embankment higher than the operator's station (e.g. horizontal silo or silage pile faces collapsing onto skid steer)

2017 Incidents

- Marathon County - Man found dead near tractor and piece of farm equipment. **Entangled in PTO.**
- Monroe County – Man **trapped** in farm machinery (skid steer)
- Trempealau County - Man found dead **entangled** between tractor and a brush hog mower.
- Columbia County
 - o 4 yr old killed when he **fell off ATV and ran over** by a sprayer tank trailer.
 - o Man killed when **ATV overturned** in pasture while he rounded up cows.
- Clark County -
 - o 3 yr old killed when ran over by **skid steer.**
 - o Man killed by **valve cover** off a liquid manure pump striking
- Dane – Man injured caught in **cornpicker.**
- Waupaca County – 6 yr old caught in **skid steer** seriously injuring leg

LARGE EQUIPMENT	Result	Dr. Abernthy and Dr. Wubben
MECHANISM OF INURY		Typical injuries
Entanglement in Power Take-Off or PTO	Clothing entanglement produces extensive soft tissue and severe deceleration injuries Strangulation, hand fractures; avulsion of fingers and soft tissues; degloving of extremities; hair entanglement may result in scalping	Head injuries – closed and open skull fractures
Entanglement in secondary drive		<p>Spinal injuries – severe fractures and dislocations</p> <p>Chest injuries – flail chest, sucking chest wounds, pneumothorax, hemothorax, tension pneumothorax, pulmonary contusion, myocardial contusion</p> <p>Abdominal injuries – blunt trauma internal bleeding, possible extensive evisceration</p> <p>Pelvic injuries – fractures with internal bleeding, ruptured bladder, ruptured rectum, degloving,</p>



GRAIN BINS		DR. GAVER
MECHANISM OF INJURY	RESULTS	TYPICAL INJURY
Entanglement in portable augers	Amputation or deep lacerations from auger flighting; electrical burns if auger contacts overhead power lines; crush or shear injuries if auger collapses	Head injuries – concussion and/or fracture if auger collapses Spinal injuries Chest injuries Abdominal injuries – evisceration if victim is mall and auger is large Pelvic injuries – if victim is mall Extremity injuries 0 amputation of fingers, toes, feet arms, legs, hands; spaced, spiral fractures; localized crush injuries Electrical injuries

GRAIN BIN		DR. GAVER
MECHANISM OF INJURY	RESULTS	TYPICAL INJURY
Falls into tub grinder or TMR	Massive blunt force trauma to body	High incidence of fatality
Entanglement in ensilage cutter	Amputation of extremities	Traumatic amputation; open fractures
Entanglement in potato digger (harvester)	Shear injuries	Traumatic amputation Open fractures
Entanglement in drive belts and chains of any equipment	Local compression injuries	Traumatic amputation; fractures; degloving injuries

Definition of a confined space:

- limited or restricted entry or exit
- large enough for a person
- not designed for continuous occupancy
- potential for a significant hazard to be present

Is it a permit required confined space?

- Is there a hazardous atmosphere?
 - Lack of oxygen or toxic gases?
- Is there a potential engulfment hazard?
 - Grains, feed, manure slurry
- Is there a configuration hazard?
 - Sloped floors, converging surfaces
- Any other recognized serious hazard?
- If yes to any of these, then it is a permit required confined space.

What about for your rescue team?

Common Agriculture Confined Spaces

- Grain and **feed storage facilities – steel bins, silos**
- **Upright silos – forage storage**
- Sumps, tunnels, and pump pits
- Dump pits
- **Manure storage and handling systems**
- Transport vehicles – manure, grain, milk, chemical, commodity
- Fermentation vessels
- Environmentally controlled fruit and vegetable storage
- Bulk liquid tanks
- **Wells, cisterns, dry wells, septic tanks**
- Grain dryer
- Fuel storage tanks



Photo courtesy of OSHA

Figure 1: The hole cut into the side of the whey tank was used for the rescue operation.

August 2016 Non Enclosed Manure Storage



- ▶ 29 year old beef producer and 16 beef cattle died
- ▶ Confirmed by blood test “hydrogen sulfide exposure” - thiosulfate
- ▶ Storage
 - ▶ Concrete lined storage 150 ft wide X 400 ft length X 14 ft deep
 - ▶ Beef feedlot with manure scraped into the storage
 - ▶ Agitator had nozzle towards producer and pen where animals located.
- ▶ Weather factors
 - ▶ Air inversion - Still air conditions
 - ▶ Warm temperatures week prior
 - ▶ Increased sulfur content

Conditions Which Increase Gas Production and/Or Risk

- Increased temps increase microbial activity – increase gas production
- Decrease in dispersion (vertical or horizontal) increase risk
 - Still conditions and inversions
 - Covers (natural crust, permeable, and impermeable covers)
- Distance from source
- Increased H₂S levels
 - Excess sulfur – gypsum bedding, distiller by-products, high sulfur water

Rescue

- Assume that there is an atmospheric hazard if someone down in a confined space or during agitation period.
- If machinery is involved, check that all power is locked out including any backup generators.
- It is a dirty environment and manure may have pathogens.
- Pre-planning should include a pump truck or sewer pumping company.

OPEN MANURE PIT/CONFINED SPACES		DR. KIM
MECHANISM OF INJURY	RESULTS	TYPICAL INJURIES
Fall or entrapment in confined space	Suffocation and or trauma from fall	<p>Anoxia or hypoxia – due to low oxygen levels and or high concentration of toxic gases</p> <p>Fall injuries depend on distance fallen</p> <p>Chest injuries – broken ribs, possible flail chest</p> <p>Spinal injuries – usually cervical spine, injuries to lumbar and thoracic spine also possible</p> <p>Open or closed fractures</p>
<p>Entrapment in flowing grain</p> <ul style="list-style-type: none"> - Maybe in a transport wagon, grain bin or feed storage structure 	Suffocation; possible trauma; possible hypothermia	<p>Mechanical suffocation due to inability to expand chest/diaphragm</p> <p>Airway obstruction by grain</p> <p>Toxic atmosphere</p> <p>Hypothermia</p>

Animal Handling

- Avoid quick movements or loud noises. Cattle have close to 360-degree panoramic vision. A quick movement behind cattle may “spook” them.
- Poor depth perception and will be slow to adjust to shadows.
- They also have sensitive hearing and can detect sounds that human ears cannot hear.
- Be patient; never prod an animal when it has nowhere to go.
- Move slowly and deliberately around livestock; gently touch animals rather than shoving or bumping them. Don’t shout.
- Move in a group. Harder to move a lone animal.
- Always have an escape route when working with animals in close quarters. Alleys and chutes should be wide enough to allow animals to pass, but not wide enough to let them turn around.
- Most animals tend to be aggressive when protecting their young; be extra careful around cows with newborn calves.
- Bulls of breeding age are very dangerous. Use special facilities for them and practice extreme caution when handling them. Never trust them or assume they are tame.
- Keep young children away from animal handling areas.

Animal handling incidents

Person crushed between gate and a barn structure as animal pushes against gate.

Animal gets the person down on ground – trample or uses head to butt the person. A mature bull may have the head force of almost 2000 pounds or 1 ton.

An large animal stepping on a person, especially younger children.

Cattle and horses kicking with their rear legs.

A cow with a newborn calf will protect her young. If in a pen, will use head to get person down or pinned against a structure.

Animals may be on pasture so incident could be out in a field. Incident may also involve an overturn of a tractor or ATV and responders have to address animals in the pasture – especially bulls.

Animal Housing

Animal housing has changed significantly since the old red dairy barns were common throughout Wisconsin. Many older barns may still be in use for animal housing but no longer a milking facility.

Haymows (above the animal housing area) have floor openings for pushing hay, straw, fodder to the lower level for feed or bedding.

Gates (wooden or metal) have been used to create pens for animals and have fallen over on younger children or when they climb the gate.

Newer designed barns handle animals in larger open pens. More movement of a person amongst animals that are not restrained.

2017 Incident

Dodge County – Woman injured when **trampled by** cow with calf

ANIMAL HANDLING	DR. CATHERS	
MECHANISM OF INJURY	RESULTS	TYPICAL INJURY
Animal incidents – kicked or stepped on by animal Fall from animal Animal falls on person Gores and bites	Extremity fractures; concussion; crush injuries; blunt trauma; penetrating trauma; abrasions and contusions	Head injuries – basal skull fracture, depressed skull fracture, severe concussion, possible maxillofacial injuries Abdominal injuries Fractures Soft tissue injuries Blunt trauma

<i>CHEMICAL EXPOSURE</i>	<i>Dr Griffin</i>	
<i>MECHANISM OF INJURY</i>	<i>RESULTS</i>	<i>TYPICAL INJURY</i>
Exposure to anhydrous ammonia	Freezes exposed tissue; chemical burns	Clothing frozen to skin; Severe chemical burns to all exposed parts of the body; Severe injury to lung tissue
Exposure to high pressure liquids/fuels	Burns, if liquid is hot; subcutaneous or intravenous injection due to force of pressure- hydraulic fluid in machinery Exposure to animal vaccinations through accidental injection	Thermal or chemical burns, both internal and external; embolic phenomena