Entanglement Hazards
Guarding and Lockout

DANGER
MOVING PARTS

DANGER
ENTANGLEMENT IN PTO SHAFT CAN SERIOUSLY INJURE OR KILL YOU.

WARNING
YOU CAN BECOME CAUGHT IN THE EQUIPMENT'S MOVING PARTS.
Entanglement Hazards

- A Fairmount man who was caught waist-deep in a grain auger has died... became entangled in the equipment after he was crawling over it.

- Zaloudek Grain Co., where Bryce Gannon and Tyler Zander, both 17 years old, each lost a leg after they were caught in an auger.

- A 53-year-old farm worker was killed when he became entangled in a grain bin auger...

- A 28-year-old man was working on a farm and suffered injury when he stepped over a power take-off (PTO) shaft from which the safety guard had been removed. He caught his coat in the PTO shaft and was pulled into the machinery, resulting in the degloving of his genital and perineal regions.

- A farm owner/operator died of suffocation when his clothing became entangled in the machinery he was attempting to adjust. The PTO continued to turn strangulating him.
Entanglement Hazards

- You do NOT have time to react!

- Takes about ½ to ¾ second for us to react to an unexpected event.
- 540 RPM pulls a person’s body over 5.25 ft in ¾ second.
Presentation Objectives

This presentation will:

- Identify common sources of entanglement hazards found around grain handling environments.
- Explain the types and characteristics of hazards posed by PTOs and how to prevent them.
Presentation Objectives

- Recognize & explain machinery hazards that create entanglement risks and.....
- Provide the best preventive and correction methods specifically:
  - Machine Guarding
  - Lockout/Tagout
Sources of Entanglement Hazards
Entanglement Hazard Sources

- Common Machine Hazard Types
- Hazards of Specific Machinery/Equipment
Common Machine Hazards

- Pinch Points (Nip Points)
- Wrap Points
- Pull-in Points
- Shear/Cutting Points
Pinch Points/Nip Points

Examples:

- Elevator leg drive
- Motor
- Elevator leg belt
- Auger drive motors
- Sliding doors for bins
- Pulleys
- Belts
- Gears
Unguarded/Guarded Pinch Points

Belt turns clockwise

Belt is no longer exposed

Fan is exposed

Fan is no longer exposed
Wrap Points

Examples:

- PTO – prime example
- Augers
- Motor drive shafts
- Pulley attachments

Wraps in direction shaft is turning
Wrap Hazard
Pull-in Points

Examples:

- Forage Harvester
- Crop Harvesters
- Combine Headers
- Windrow pickups
- Grinders

Operating point - catches object & drags it in.
Pull-in Points

You do not have time to react!

Takes only 3/10 second to react when stalk begins to pull through.

Stalk & hand will travel 3.6 feet before he can react.
Shear/Cutting Points

- **Cutting points**
  - Single object
  - Cuts from force or speed
  - Sickles, Mower blades, Windrower cutter bar

- **Shear points**
  - Two edges
  - Cuts soft material
  - Augers, Harvesters
Hazards Specific to Equipment

- PTOs
- Conveyors
- Elevator Legs
- Sweep Augers

NEVER reach over or around rotating parts!
Power Takeoff (PTO) Hazards

PTO (shafts) are among the oldest and most common machinery hazards.

Ensure PTO drivelines are fully shielded.
Reduce PTO Injuries & Deaths

NEVER attempt to step over rotating PTO drivelines.

NEVER operate tractor controls from the rear.

Stay well clear of rotating PTO drives.

KEEP long hair pulled back.

NEVER wear loose, baggy clothes around PTOs.

Bind, tuck, cut -laces, cords, ties, flaps, loose threads.

Avoid jewelry – bind, tuck, hide.
Conveyors

Types

- Tractor Mounted
  - Belt
  - Auger
- Screw
- Drag
- Belt

Primary mechanism to move grain
Tractor Mounted Conveyor-Belt

Uses a PTO and has multiple types of hazards.
Tractor Mounted Auger Conveyor

- Protruding auger
- Unguarded horizontal auger
- No master shield on tractor
- PTO without proper shield
U-trough Screw Conveyor

- “Flighting” - rotating helical screw blade.
- Enclosed in tube or U-shape trough (cover across top of U).
- Moves liquid or granular material.
- Stationary.
- Auger (screw) much larger than portable ones.
Drag Conveyor

- Continuous loop of chain.
- Rotates on two or more sprockets.
- “Paddles” on chain at 90 degree angles.
- Paddles hold material in place.
- Chain “drags” material being moved.
Drag Conveyor

- Opening should have a shield.
- Pinch Point
- Pull in Point
- Shear Points
- Pull in Point
- Pinch Point
Belt Conveyor

- Material on the belt
- Belt moves material
  - Can be high speed
Belt Conveyor

- Guards
- Shear Point
- Wrap Point
- Pull In Point
- Pinch Point
Grain Leg
Grain Leg

Schematics - Courtesy of Florida Center for Instructional Technology at University of South Florida [http://etc.usf.edu/clipart/](http://etc.usf.edu/clipart/)
Operating Sweep Auger With Bin Stop Device

- Helps move grain to center sump for removal.
- Moves at differing rates of speed.
- Stop prevents sweep from more than one rotation.
Sweep Auger Guarding

Exposed drive mechanism

Inadequate guard

Free hanging power cord

No guard
Bin Discharge Screw Auger

- Full length sweep auger guard
- Unguarded drive mechanism
- Guarded reclaim or sump hole
Incident Example

- Employee – sweeping grain to reclaim hole.
- Stepped over sump.
- Turned around.
- Stepped directly into the reclaim hole.
- Reclaim hole had no guard.
- LOST leg from mid-calf.
Incident Example

Actual sump hole

Actual boot found in bin.
NEVER found person’s foot!
Guarded Reclaim Hole
Removable Guard

Guarded Reclaim Hole
Fixed Guard
Entanglement Hazards

- Guard ALL exposed moving parts including augers.
- Use LOTO.

Unguarded parts

Guarded Part
Entanglement Hazards

Operating Equipment

- Wear tight fitting clothing.
- Guards & shields **ALWAYS** in place.
- Never step over operating PTO.
- Keep children away from operating equipment.
Guards and Lockout/Tagout
Guarding and Lockout/Tagout

Proper Guarding and strict adherence to Lockout/Tagout procedures will prevent the majority of Entanglement hazards!
What is a Guard?

A physical barrier that prevents exposure to an identified hazard.
Machine Guarding Basics

- Point of operation
- Power transmission apparatus
- Moving parts

If it moves and could cause injury it must be guarded! Best Practice for all.
Point of Operation

- Where the work actually takes place.
- Where a person comes in contact with the machine.

Pile of corn? Or human foot?

The machine
- Doesn’t know
- Doesn’t care

It just keeps on working.

Unguarded Auger
Power Transmission Apparatus

- Carries power from its originating source (motor)

- Through mechanisms (belts, gears) to

- The point of operation.
Power Transmission Apparatus

Unguarded belts and pulley
Moving Parts

Unguarded Conveyor

Guarded Conveyor
Guarded Augers

Must not be able to reach moving parts – with body or tool.

No exposure to moving parts.
Injury Example

- Corn hung-up & not flowing to dryer from wet holding tank.
- Rod added to top of U-trough conveyor.
- Employee stood on conveyor operating rod.
- Inspection lid was off.
- Employee stepped back into the running screw auger.
- No one around to help.
- Lost inner half of foot.
Injury Example

Removing this guard allows exposure to moving parts
Guard Requirements

Guards should follow the “AUTO” Principle.

A round
U under
T through
O ver

Note open area in guard. It does not follow the AUTO Principle.
Guard Requirements

A Machine Guard should:

- Prevent contact
- Secured to machine
- Protect from falling objects
- Not create new hazards
- Not interfere with job performance
- Not have to be removed to lubricate machine
- Easy access for maintenance
Fixed Guards

- Permanent fixture attached to machine with bolts or screws.
- Requires a tool to remove.
  - No wing nuts
  - Clips
  - Bunge type straps
  - These allow for guard to be removed by hand
- First Choice/Best Choice.

Guard completely encloses belt and pulley
6-Sided Guard

- Top
- Bottom
- Front
- Back
- Right Side
- Left Side
Interlocked Guard

Shuts off or disengages power (to machine) when it is opened or pushed out of position.

Interlock mechanism that senses the absence or presence of the guard.
Lockout/Tagout

- OSHA Standard 1910.147
- Protects Employers
- Protects Employees
- Protects Family Members
- Requires Written Procedures

Lockout is a Best Safety Practice for everyone even Farmers who are not covered by OSHA!
Lockout/Tagout

Protects all persons.....

- From injury.
- From unexpected startup.
- During service & maintenance work.
- Working near exposed electrical conductors & parts of electrical equipment.

Keeps others from turning machines on without your knowledge!
General Lockout Procedures

1. Prepare for shutdown.
   - Notify all persons of LOTO.
2. Shut down machine.
3. Disconnect or isolate ALL energy sources.
   - Electrical
   - Air
   - Hydraulic (May have to chain raised tractor or skid steer buckets in place)
   - Gas
   - Mechanical
   - Other
General Lockout Procedures

4. Install locks and tags on machine energy sources.
5. Release stored energy.
6. **Tryout/verify LOTO** by attempting to start. This is a critical step….*don’t forget it!!*
7. Begin maintenance/service work.
8. Finish - check machine & clean up area of tools.
General Lockout Procedures

7. Ensure people are safe distance.
8. Notify persons of intended start-up.
9. Remove locks, tags and lockout devices.
10. Start-up & verify working normally.
Lockout/Tagout Requirements

- ONLY authorized employees perform LOTO.
- ALL Employees must be trained.
- Assign a specific type of lock for equipment lockout and do not use those locks for anything else but lockout.
  - This ensures locks will be available when needed
  - Each lock must be individually keyed
  - Protects the person as they are only one with a key(s) that will open the lock
Lockout/Tagout Requirements

- Each person working on the equipment must have a lock and tag on each energy source.
  - Persons are not allowed to work under someone else’s lock
  - This will require the use of multiple locks and tags
- Written LOTO procedures.
- Follow LOTO every time.
- Review procedures annually.
# XYZ GRAIN MACHINE SPECIFIC LOCKOUT PROCEDURES

**MACHINE:** Bin #10 Unload  
**LOCATION:** Grain

## PRIMARY ENERGY SOURCES
- Electrical: X Voltage Type 240 Volts
- Air: N/A, Chemical: N/A, Hydraulic: N/A
- Steam: N/A, Gas: N/A, Water: N/A

## STORED ENERGY SOURCES
- Water: N/A, Air: N/A, Gas: N/A
- Hydraulic: N/A, Electrical: N/A
- Gravity: N/A, Thermal: N/A, Springs: N/A
- Other: N/A

## REQUIRED LOCKOUT EQUIPMENT
- Multiple Lockout Hasp
- Quick Disconnect Lockout
- 110 Volt Plug Lockout
- 220 Volt Plug Lockout
- Universal Circuit Breaker Lockouts
- Locks 1
- Tags 1
- Chains 1

## LOCKOUT PROCEDURES
1. Notify employees of equipment shutdown/lockout.
2. Go to the Control Panel located on the North wall in the Scale House and press the RED STOP button labeled “Unload 10.” (See Picture #1)
3. Then go to the electrical disconnect switch at the auger motor and place the disconnect switch labeled “10U” to the “OFF” position by standing off to the side so you are not directly in front of the panel. (See Picture #2) Attach a lockout hasp to the disconnect switch, put a tag on lock and place lock on lockout hasp.
4. Attempt to start Bin 10 Unload by pressing the GREEN START button. (See Picture #1) If Unload does not start it is successfully locked out. Important: Press the RED STOP button again before starting work.
5. If the Unload does start, contact the Program Administrator before proceeding.

### Picture #1
![Unload 10 Control Panel](image1.png)

### Picture #2
![Electrical Disconnect Switch](image2.png)

## START UP PROCEDURES
1. Remove all tools and materials and replace all covers and machine guards.
2. Reverse above procedures, remove locks, tags, lockout devices and restore energy to the machine.
3. Notify employees that lockout has been completed, restart machine and verify proper operation.

## DOCUMENTATION

Written By:  
Approved By:

Title:  
Title:
Lockout/Tagout Example

1. Out of Service Tag
2. Isolation point
3. Safety hasp
4. Safety lock
5. Danger tag
Lockout Equipment

- Padlock
- Circuit Breaker Lockouts
- Plug Lockouts
- Valve Lockouts
- Lockout Hasps
Why LOTO for Farms

- Father & son discussed need to check a cross auger on top of a bin.
- No responsibility assigned.
- Dad checked auger; did not like what he heard.
- Dad got on top of bin & stuck his arm in the auger.
- Son did not know Dad was already working on the auger and decided to check the auger by turning it on.
- Father lost his forearm.
Why LOTO for Farms

If they had a system in place — dad would still have his arm and son wouldn’t have his GUILT.

LOTO is a Best Practice and should be followed at ALL times without exception!
QUESTIONS??

OSHA
Occupational Safety and Health Administration

WISCONSIN AGRI-BUSINESS ASSOCIATION
WABA