



AG HEALTH 101

TRACTOR SAFETY

UNIT 10

Chapter DISCUSSION QUESTIONS

CHAPTER 1. INTRODUCTION TO TRACTOR SAFETY

Almost everyone who lives in rural communities has a story about a tractor mishap. Think about a case you have heard - from friends, family, or the news - and identify if one of the hazards we discussed above was a major factor of that case (e.g., roll over, striking a pedestrian, striking other vehicles, striking other bodies, attached equipment, unstable loads). If you are with friends/co-workers when listening, share stories and discuss what you want to know more about to protect farmers/communities from such hazards.

CHAPTER 2. ROLL OVER PROTECTIVE STRUCTURES (ROPS)

ROPS come in a variety of designs - from two post to four post, an enclosed cab or a fold-down bar. Discuss examples that you have seen out in rural environments, in tractor shows, or on TV. Think about what you are asking the driver to do during a roll-over by staying inside the tractor and wearing a seatbelt. What is the ideal outcome by using ROPS, staying inside the tractor, and wearing a seatbelt? Think about how you would communicate the value of ROPS to farmworkers.

CHAPTER 3. COLLISION PREVENTION

If you live in the Midwest, chances are you have been stuck on the road following a tractor. Now that you know the risk factors associated with trying to pass the tractor to get back up to speed, describe practices that you want to adopt on the roadway for the next time this happens.

CHAPTER 4. POWERED TAKE OFFS (PTOS)

Reflect on how you would talk to farmworkers about PTO shaft safety. Come up with a plan to discuss how often a farmworker's job requires them to work with or around a PTO shaft. How would you ask about engineering controls, guards, and administrative controls that would minimize working around rotating shafts.

CHAPTER 5. FINAL TRACTOR SAFETY TIPS

We have provided many recommendations for tractor safety in this chapter. How would you communicate tractor safety to a farmworker? What tools would help in sharing this information?

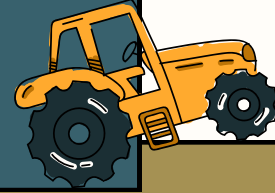


Chapter 1

INTRODUCTION TO TRACTOR SAFETY

Roll-Over

- A tractor's center of gravity changes when implements are added & moved.
- When the center of gravity moves outside of the area in which the tires are supporting the tractor, the vehicle can tip over.
- **Roll-overs cause about 33% of fatal injuries to farmworkers.**
- **Roll-overs play a role in 25% of non-fatal injuries.**



Striking Pedestrians

- If the tractor driver does not see someone who is around the tractor or its implements, there is a huge chance that the pedestrian may be hit.
- A common practice, which should be adopted by anyone on the farm, including visitors, is to presume you cannot be seen by a tractor driver and to stay away until you can visually communicate with the driver.

Striking/Struck by Other Vehicles

- Since tractors & other agricultural vehicles are large & slow-moving, visibility around tractors is limited, there are dangerous driving behaviors (of both the community and farmers) that lead to crashes.
- **About 70% of collisions occur in clear weather.**
- **About 50% of crashes are side swipes, often with a tractor turning into a passing vehicle.**

Striking Other Bodies

(buildings, trees, power lines)

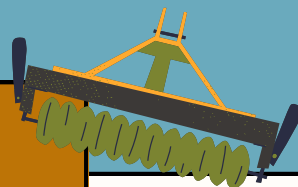
- Injuries, including fatal ones, have occurred when tractors strike immovable objects such as buildings, trees, and power lines.
- While counted in "striking pedestrians" above, a person not on the tractor could also be injured if caught between the tractor and an immovable object.



Attached Equipment

(wagons, manure spreaders, corn head, baler)

- Tractor implements that are attached & powered by the tractor's engine can cause tractor instability (leading to roll-overs), generate risks of crushing during connection & disconnection of the implements.
- Entanglement from machinery hazards that are not guarded is another major risk.
- Implements also have their own hazards, including **high pressure hydraulic lines**, **moving parts** that may require blocking for safe work on them, & **unstable or falling loads**.



Unstable/Falling Loads

- If loads are lifted above the height of the tractor's cab, the risk of materials falling onto the driver are high.
- Best practices are to recommended to ensure the load is stable & as low as possible to clear hazards on the ground to minimize this risk.



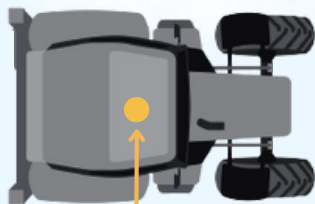
Chapter 2

ROLL-OVER PROTECTIVE STRUCTURES

These figures illustrate the Center of Gravity discussed in the audio for Chapter 2.

FIGURE 1

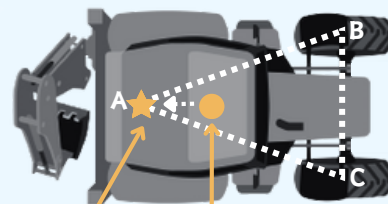
Unloaded Tractor



Tractor's
Center of
Gravity

FIGURE 2

Tractor with Back Counterweight

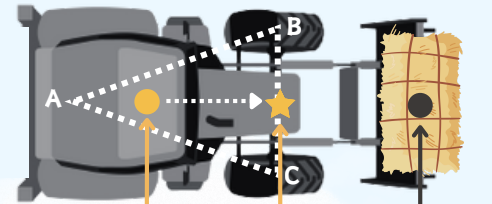


Center of
Gravity
(CG)

Tractor's
Center of
Gravity

FIGURE 3

Tractor with Front Load



Tractor's
Center of
Gravity

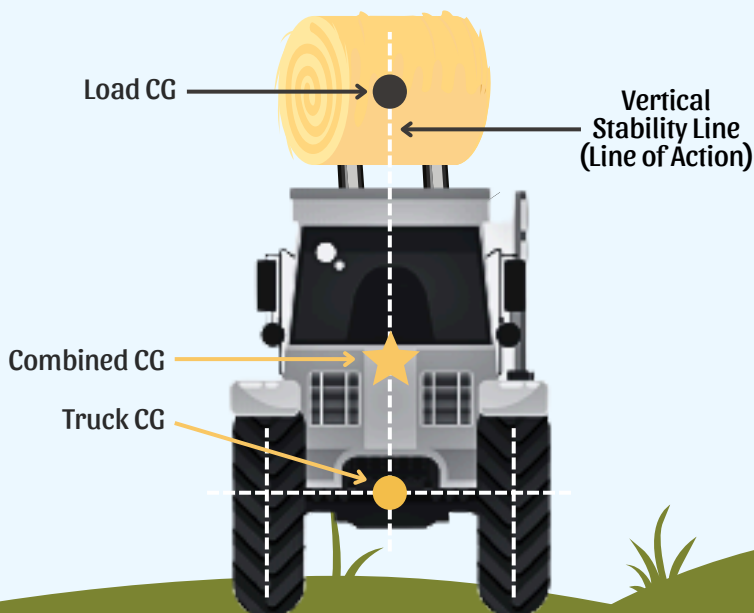
Combined
Center of
Gravity
(CG)

Load's
Center of
Gravity

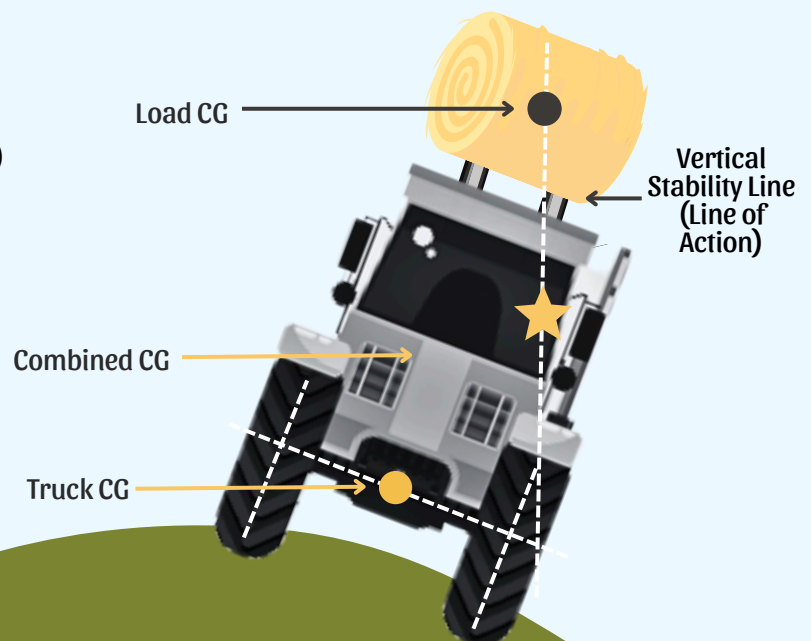
When the tractor is unloaded (**figure 1**), the tractor's CG is located between the front axel and the back axel, meaning the tractor is stable.

Additional counterweight (on the back) will cause the tractor's center of gravity (CG) to shift toward point A and result in a tractor that is less stable laterally (**figure 2**).

When the tractor (or vehicle) has a load in the front, the combined CG shifts toward the front axels (**figure 3**). In practice, the combined CG should NEVER be in front of the front axel (B-C line).



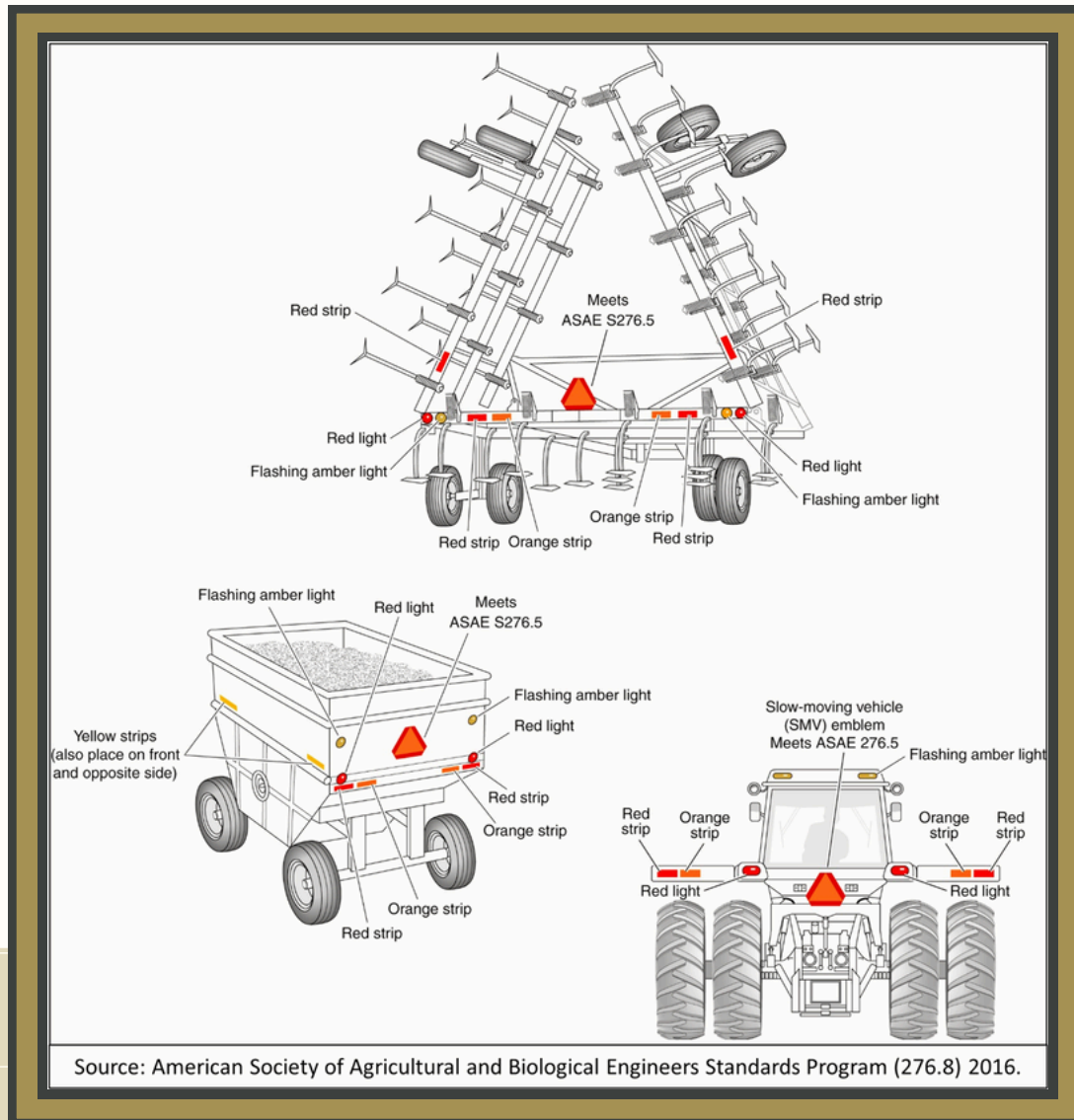
The vehicle is **stable**:
Combined CG is **within** the
wheelbase.



The vehicle is **unstable** and will
continue to tip over:
Combined CG is **outside**
wheelbase.

Chapter 3

COLLISION PREVENTION



ASABE LIGHTING AND MARKING STANDARDS

- Red Tail Lights** - Symmetrically mounted on both sides, to indicate stopping & turning
- Amber Hazard Flashes** - As widely apart as possible on front & rear
- Turn Indicators** - Both amber & red should flash to indicate a turn direction
- Retroreflective Strips** - On the rear, should be horizontal and in line with each other to signal the maximum width of the vehicle, red on outer edges and 6" away orange, just to the inside of the red. On the front of the tractor, these strips should be yellow. These tapes reflect light back to the source and are 10 times brighter than previous materials.
- Headlamps** - Tractors should also have two headlamps on the front to illuminate its path and increase visibility from the front.

Chapter 4

POWER TAKE-OFFS (PTOs)

A power take-off shield can wrap your arm or leg around the PTO shaft

9 times or 16 times

in 1 second at **540 PTO rpm**

in 1 second at **1000 PTO rpm**

PTO entanglements are one of the **top**

3

causes of FATAL INJURIES in the United States

21%

of PTO entanglements occur **among children**

Amputations occur **28-43%** of the time in **PTO ENTANGLEMENTS**

PTO shields are **missing on 1/3-1/2** of all PTO drivelines

Prevention Tips

① Minimize entanglement by NOT wearing gloves.

② Minimize entanglement by managing loose hair.

③ Minimize loose clothing (tuck in shirt and turn up cuffs).

④ Always operate PTO-driven equipment with a PTO shield/guard in place.

⑤ The PTO shield/guard should cover the shaft at both ends.

⑥ PTO shaft should NEVER be operable any time someone is working on it.

⑦ **Engine off, keys in pocket** when PTO shaft is being connected/disconnected.

Chapter 5

FINAL TRACTOR SAFETY TIPS

CHECKLIST FOR TRACTOR OPERATORS

Operating Rules, per OSHA's Standard: 1928.57(a)(6)

- ☐ Initial and annual training of safe operating practices
- ☐ Keep all guards in place when machine is in operation
- ☐ ***Permit no riders***
- ☐ Stop engine, disconnect power, wait for machine motion to stop...
- ☐ Everyone is clear of machines prior to starting machine
- ☐ Lock out electrical power before performing maintenance

To Reduce Rollover Risk:

- ☐ Understand the risk
- ☐ Increase width between wheels, if possible
- ☐ Avoid steep slopes
- ☐ Drive slowly and avoid quick uphill turns
- ☐ Reduce speed, particularly when
 - Turning, crossing slopes, on rough, slick or muddy surfaces
- ☐ With front-end loader: Drive with load as LOW as possible
- ☐ Avoid sharp turns and reduce speed when turning
- ☐ Avoid driving on steep embankments, near ditches, around holes

Understand the Following Recommendations:

- ☐ Watch where you are going at all times
- ☐ Watch for pedestrians before moving
- ☐ Engage the clutch slowly and evenly
- ☐ Apply break at slow speed... and do so before entering the turn, not in it
- ☐ Do not allow riders on the tractor; If there is no seatbelt for someone on a vehicle with ROPS, they should not be on the tractor
- ☐ When moving loads:
 - Hitch the load as LOW as possible
 - Use a safety hitch pin to keep the load attached
 - Apply power slowly
- ☐ When stopped, apply the break securely or, if none, set transmission to park
- ☐ When parked, lower the load, remove the key
 - DO NOT assume that all moving parts have stopped motion as soon as the key is removed



View these links for more information & additional resources on the content presented in this unit.

TRACTOR SAFETY

Resources

Chapter 1. Introduction

- Tractor Safety: https://web.nicc.edu/Marketing/NECAS/pdfs/Falls_from_tractors_and_trailing_equipment_updated.pdf
- Online Modules: <https://gpcah.public-health.uiowa.edu/core-course-online-modules/>, see Transportation Hazards in Ag

Chapter 2. Roll-Over Protective Structures (ROPS)

- Video on Preventing Roll-Over: <https://youtu.be/ReVlzcHLi4M?si=rxJxR5ll-rlZs-7lQ>
- Video on the Center of Gravity: <https://youtu.be/yWWbAr9iLZg?si=dR0lgBb8vkVSUWV3>
- Discussions on the Center of Gravity: <https://extension.psu.edu/tractor-stability-and-instability>

Chapter 3. Collision Prevention

- Traffic Safety: <https://gpcah.public-health.uiowa.edu/wp-content/uploads/2017/02/Traffic-Safety.jpg>

Chapter 4. Powered Take Offs (PTOs)

- How the PTO Works: <https://youtu.be/tTcVvB675k8>
- Case Studies: <https://extension.psu.edu/power-take-off-ptto-safety>

Chapter 5. Final Tractor Safety Tips

- Video on General Tractor Safety Tips: <https://www.youtube.com/watch?v=7jJChB9IfKE>

