**SKID STEERS**

**HOSTA Task Sheet 6.1**

**NATIONAL SAFE TRACTOR AND MACHINERY OPERATION PROGRAM**

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**Introduction**

Skid steer loaders are versatile machines. They fit into small spaces, can turn within a tight radius, and are easy to operate. Young farm workers can enjoy much work success with the skid steer loader.

This task sheet discusses the safe use of a skid steer loader. Skid steer loaders are safe to use if the operator works within the machine’s limitations. As in all machinery use, the operator must know the machine’s proper use, as well as its limitations.

**Skid Steer Loader Basics**

*Hydraulic Power*

A skid steer loader is a hydraulic workhorse. A hydrostatic transmission controls forward and reverse direction. Hydrostatic valves control the flow of hydraulic oil to steer the machine by “skidding” it sharply around corners. Hydraulic cylinders raise and lower lift arms and tilt the load bucket. Task Sheet 5.5 serves as a review of hydraulic power.

Hydraulic power is positive power. The machine moves the instant you move the hydraulic control levers or pedals. The skid steer will move forward, reverse, or “skid” steer. The load bucket will lift, roll or tilt. Bumping the control levers can cause the machine to move unintentionally.

**Weight and Stability**

A skid steer can move heavy loads. Operators of a skid steer may attempt to lift or move more weight than the skid steer is designed to handle. The skid steer’s center of gravity is low and between the wheels. A load carried too high raises the center of gravity and increases the risk of a turnover. See Task Sheet 4.12, Tractor Stability, and Task Sheet 4.13, Using the Tractor Safely, as a review of center of gravity.

**Machine Hazards**

Skid steer loaders function to push, scrape, scoop, lift, and dump materials. Lift arms raise and lower a load bucket near the operator’s cab. The load bucket is mounted in front of the operator and can be rolled forward or tilted back within inches of the operator.

Control levers, pedals, and a parking brake are arranged compactly within the operator’s space. It is easy to bump these controls. Workers have been crushed between lift arms and the skid steer. Load buckets have dropped onto workers and killed them. Load buckets have rolled back and crushed a worker’s legs.

Pinch points, shear points, and crush points exist within close reach of the operator’s space. See Task Sheet 3.1, Mechanical Hazards, to review pinch point, shear point, and crush point hazards.

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**Learning Goals**

- To safely use a skid steer loader

**Related Task Sheets:**

- Hazard Warning Signs 2.8
- Hand Signals 2.9
- Mechanical Hazards 3.1
- Noise Hazards and Hearing Protection 3.2
- Tractor Hazards 4.2
- Preventative Maintenance and Pre-Operation Checks 4.6
- Starting and Stopping Diesel and Gasoline Engines 4.7
- Tractor Stability 4.12
- Using the Tractor Safely 4.13
- Using Implements With Hydraulic Components 5.5

Over 50% of skid loader fatalities are due to crushing by lift arms and load buckets.
bars (hand holds) and the tread plates mounted on the load bucket. A three-point hold provides the safest footing. The load bucket and machine surfaces can be slippery when wet or muddy. Exit from the machine in the same manner.

When seated, lower the restraint bar and/or fasten the seat belt immediately.

**Controls**

Before using the skid steer, become familiar with the controls. A qualified person should demonstrate how to start and stop the engine, how to move the machine forward and reverse, how to steer the skid steer, and how to raise, lower, and tilt the bucket attachment. It is a good idea to know how to safely change attachments. If an attachment to the skid steer uses hydraulic power, ask for a demonstration of how to engage the remote hydraulic unit.

Skid steer loaders are controlled by hand levers and foot pedals. The beginning operator should understand the following points:

- **Movement controls**: Grasp the right and left hand control levers; push both levers forward to move forward, or pull the levers rearward to move in reverse. Let go of the levers to stop the movement.
- **Steering controls**: To control the steering direction, push one hand lever forward while pulling the other lever back. Pushing the left lever forward while pulling the right lever back will make the skid steer travel to the right.
- **Lift controls**: Foot pedals control the lift arms and load bucket. The left pedal raises and lowers the lift arms, while the right foot pedal tilts the bucket to dump or rolls the bucket back. See Figure 7.1.b. and page 3 for more details.

Joystick controls are also used to control the functions of the skid steer. Get advice on there use.
Using the Lift Arm and Load Bucket Pedals

Foot pedals on the skid steer are used to control the high lift (boom) work of the skid steer. Toe and heel movements are needed to activate these controls. See Figure 7.1.b. Note: Some models use the hand controls to make these movements.

**Raising the lift arms (left pedal):**

The left pedal raises or lowers the lift arm (boom). Use the left heel to push on the back of the pedal to raise the lift arms and bucket. Use the left toes to push on the front of the pedal to lower the bucket. These movements must be done smoothly. Hard-soled shoes give better feel for the pressure needed on the pedal.

**Tilting the bucket (right pedal):**

The right pedal controls the load bucket. Use the right heel to push on the back of the pedal to roll the bucket back while loading. Use the right toes to push on the front of the pedal to dump the bucket while unloading.

### Skid Steam Safety

Skid steer loaders can work in small areas, but they have similar limitations as does a tractor. Follow these skid steer safety recommendations:

- One seat and one seat belt means one operator. No passengers are permitted on the bucket.
- Lower the safety restraint bar and/or fasten the seat belt every time you enter the machine.
- Be sure area around skid steer is clear of children, bystanders, pets, and farm animals
- Do not work near overhead utility lines.
- Lower the load bucket for travel.
- Use slower speeds over rough ground
- Do not overload the bucket. Skid steers have a Rated Operating Capacity. Exceeding that capacity with a lifted load will result in forward or sideways tipping of the machine. See Figure 7.1.c.
- When moving up a slope, keep the heaviest weight up the hill. With an empty bucket, back up the hill. With a full bucket, drive forward up the hill. See Figure 7.1.d.
- Avoid crossing steep slopes.
- Avoid ditches and stream banks to prevent overturns.
- Lower the boom and bucket, stop the engine, and set the park brake before dismounting the machine. Do this every time.
- Never stand or lean where lift arms or load bucket movements could crush you.
- Use the lift arm locks (boom locks) to prevent lift arms from dropping downward if repairs must be made to the machine.
- Prevent load rollback by securing loads in the bucket and filling the bucket only to rated levels.
- Do not reach outside of the cab while the skid loader is running. All adjustments and connections of attachments should be made with the engine stopped.

Safe skid steer loader work requires attention to the machine, the surroundings, and the work being done.
Safety Activities

1. Use the Internet to visit manufacturers’ websites (John Deere, New Holland, Bobcat, etc). Assemble a picture chart of as many skid steer loader attachments as you can find.

2. Set up a skid steer loader course to practice moving the skid steer around and through obstacles. Be sure that one part of the obstacle course involves using the load bucket.

3. With adult supervision and a blind fold (skid steer parked and brakes locked), raise and lower the lift (boom) arms and tilt and roll the bucket as the supervisor commands you. You must be able to use the proper controls to operate the skid steer without errors.

4. Matching. Match the skid steer control position with the resulting action to be expected.

<table>
<thead>
<tr>
<th>Skid steer control position</th>
<th>Resulting action to be expected</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Left foot pedal pushed forward with toes</td>
<td>1. Skid steer spins in circles to the left</td>
</tr>
<tr>
<td>B. Left foot pedal pushed downward with heel</td>
<td>2. Lift arm raises</td>
</tr>
<tr>
<td>C. Right foot pedal pushed forward with toes</td>
<td>3. Bucket tilts forward to unload</td>
</tr>
<tr>
<td>D. Right foot pedal pushed downward with heel</td>
<td>4. Bucket rolls back to load</td>
</tr>
<tr>
<td>E. Right hand control lever pushed fully forward, left hand control lever pulled fully back</td>
<td>5. Lift arm lowers</td>
</tr>
<tr>
<td>F. Right hand control lever pulled backward, left hand control lever pulled back</td>
<td>6. Skid steer moves forward</td>
</tr>
<tr>
<td></td>
<td>7. Skid steer moves in reverse</td>
</tr>
</tbody>
</table>

5. Determine how the joystick controlled skid steer performs the functions in Question 4.

References
2. www.cdc.gov/niosh/nasd/Click on search by topic/Scroll to Skid Steer.
3. www.cdc.gov/niosh/At search box, type Preventing Injuries and Deaths from Skid Steer Loaders.
Starting and Stopping a Skid Steer

Learning Goals

- To be able to safely start and stop the skid steer

Start Procedure

Use the bucket or attachment steps, grab handles and safety treads to get on and off the skid steer. Always maintain 3 points of contact as you climb on the skid steer and face the machine as you do this.

Follow these steps to start:

1. Adjust seat position.
2. Fasten seat belt snugly or lower seat bar if so equipped.
3. Check that foot pedals and hand controls are in a neutral position.
4. Set engine speed control to a 1/2 speed position.
5. Turn key to start. If equipped with a cold temperature start (pre-heat) follow manufacturer’s recommendations.
6. Allow the engine and transmission oil to warm for 5 minutes in cold weather.

Interlock Control System

Skid steers are equipped with an interlock system meaning the skid steer cannot be started unless the operator is physically in position to operate the machine. The machine cannot be started and operated except from the seat and with the seat belt fastened.

The seat belt and the operator restraint allow the lift, tilt, and traction functions of the skid steer to be activated. All of these functions are electronically interlocked with the start function. A lighted display on the instrument panel will indicate if these systems are functional (Figure 6.1.1.a.).

You should see the lighted display for:

- Seat occupied/seat belt fastened/operator restraint bar
- Valve for lift and tilt functions
- Traction function (forward/reverse)
- Power to input controller supplied (the input controller provides power to all output functions electronically).

The owner or the operator should not attempt to disable the interlock system.

Introduction

Don’t be surprised if you can’t just jump on the skid steer, turn the key and be gone. Skid steer manufacturer’s safety decals warn that operators must have instruction before running the machine. Ask questions; get training; read the Operator’s Manual; don’t just tell the supervisor you know what to do. Untrained operators can cause injury, fatality, and property damage.

This task sheet will help you to understand how to safely start and stop a skid steer.

Become familiar with all parts of the instrument panel.

Related Task Sheets:

- Starting and Stopping Diesel and Gasoline Engines 4.7
- Skid Steers 6.1
**Stopping the Skid Steer**

Stopping the engine may not be as simple as turning off the ignition key. Some manufacturers may instruct the user to let the machine idle for a few minutes to cool the engine, hydraulics, and hydrostatic transmission fluid. Become familiar with what each machine requires for shut down. Your supervisor should have this information readily available.

To stop the skid steer:
1. Idle back the engine speed to 1/2 throttle.
2. Set the parking brake.
3. Return lift arms and attachments to ground level.

**Safety Activities**

1. If you have never operated a skid steer, visit an equipment dealership and ask to sit in the skid steer cab to observe what controls are available and where they are located. This may be done with your employer’s guidance as well.

2. Use the operator’s manual for the skid steer you will operate to study the controls and instrument gauges as you sit in the operator’s position.

3. Practice starting and shutting off the skid steer and using the lift and traction controls while sitting in the machine with the parking brake set.

4. Learn where the lift arm locking pins are located on the skid steer.

5. Ask a classmate to describe the conditions that must be met for an operator to exit the skid steer cab.

See Figure 2

4. If attachments with hydraulic hoses are to be changed, relieve the pressure in the auxiliary hydraulic system either by turning the ignition key past stop for a few seconds until the engine is stopped, or by moving the hydraulic control lever back and forth several times after the engine is stopped. This will make the use of the Quick Couplers® easier to disconnect and connect.

5. Turn the ignition key to off if not already completed.

6. Remove key if required.

7. Raise seat bar or remove seat belt, and dismount the machine using the grab handles while facing the machine. Maintain 3-points of contact as you exit the machine.

**References**

1. Various Skid Steer Manufacturer’s Operation and Maintenance Manuals
2. Website, www.agsafety.psu.edu. Scroll to Publications, E47 Skid-Steer Safety for Farm and Landscape, Dennis J. Murphy and William Harshman

**Contact Information**

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**Credits**

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Introduction
Just as the name implies the skid steer (regardless of manufacturer) is steered by skidding the inside tires or rubber track while the outside drive wheels or track moves the machine in the direction of the skid. On soft soil or a manure packed barn area this happens easily. On a hard surface like a roadway the machine may grab the hard surface and bounce roughly.

This task sheet discusses safe and efficient ground movement of a skid steer. This includes moving it without damage to the machine, bystanders or property.

Forward, back, turn
Control levers are the steering “wheel” and ground movement control of a skid steer. Some skid steers use two levers (Figure 6.1.2.a.), while others may use a “joystick” type of control. Use the Operator’s Manual and become familiar with the controls that you will be using.

To use control levers to move the skid steer forward or reverse:
- Push forward on both levers to go forward
- Pull both levers toward you to go in reverse
- Push on the left lever and pull back on the right lever to turn to the right
- Push on the right lever and pull back on the left lever to turn to the left.

Note: Maintain full load engine speed above 2900 rpm for efficient operation. Attempting to move the skid steer with low engine speed will often stall the engine.

Newer models of skid steers are equipped with “joystick” controls. Joysticks can control movement, steering, and the hydraulic functions of raising and lowering the bucket or tilting the bucket forward and back. Joysticks have internationally accepted symbols to indicate their function (Figure 6.1.2.b). In some cases there may be dual functions for the joy stick depending upon the mode of use selected.

Study the operation symbols or ask your supervisor to explain how the joystick or any other component you do not understand is used.

By letting go of the skid steer control levers they will return to a neutral position and you will stop moving.

Learning Goals
- To safely steer the skid steer in the direction you must travel

Related Task Sheets:
Skid Steers 6.1
**Safety considerations**

Once in the cab of the skid steer operator vision is reduced to the side and to the rear of the machine. While no bystanders, children, pets or livestock should be in the work zone, the operator must be aware of what is happening in the work area. Barn walls, supporting posts and beams and other machinery can be damaged by careless skid steer use.

Be especially careful when backing the skid steer. Not all skid steers have mirrors that let you see behind you.

Skid steers are not made for rough terrain work. When operated on sloping ground:

- Drive slowly.
- Keep the bucket as low to the ground as possible.
- Load the bucket evenly.

If you must move the skid steer over a sloped area follow these safe practices:

- Avoid crossing steep slopes.
- Keep the heaviest weight up the hill whether traveling up or down the hill. For example: with an empty bucket back up the hill. With a full bucket, drive forward up the hill (see Figure 6.1.2.c).
- Stay away from ditches, stream banks and silage pile edges to prevent an overturn.

**Safety Activities**

1. Set up a skid steer loader course to practice moving the skid steer around and through obstacles. Do this in forward and in reverse. Include using the loaded bucket as part of the course.

2. Inspect the work area you are assigned to for: hidden obstacles, building parts that are close to the work area, overhead utility lines, ditches, and any other potential problem that might interfere with your moving the skid steer as you work.

3. Have an operator sit in the skid steer facing forward; approach the skid steer from different angles asking the operator to signal when they can see you coming. Mark these positions and discuss the restricted field of vision around the machine. Repeat the exercise, but use a caution (traffic) cone and see how the field of vision changes. What could be the results if a small child, pet, or by-stander entered that area as you operated the skid steer?

**References**

2. [www.cdc.gov/niosh/nasd/Click op search by topic/ Scroll to Skid Steer.](www.cdc.gov/niosh/nasd/Click op search by topic/ Scroll to Skid Steer.)

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Version 3/2013

This material is based upon work supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, under Agreement No. 2010-41521-20839. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.
SKID STEER—ATTACHING ACCESSORIES

HOSTA Task Sheet 6.1.3
NATIONAL SAFE TRACTOR AND MACHINERY OPERATION PROGRAM

Introduction
Skid steers can be used for a variety of tasks. Commonly the skid steer is equipped with a scoop bucket to move soil, gravel, feed, and more. Attachments like pallet forks, post hole augers, soil preparation tools, and powered brooms will mean that you will change one of these accessories for another.

This task sheet will discuss the skid steer quick attachment procedures and how to do this important job safely.

Know the parts
Boom mounted attachments can be changed quickly. The parts of the system include:

A. Pivoting mounting plate attached to the boom lift arms
B. Latch handles to lock the attachment to the pivoting mounting plate
C. Attachment saddle (part of the attachment)

How to do it
To mount an attachment, the latching handles must be in the fully “up” position. If not the lock pins will not be retracted.

Align the skid steer mounting plate with the attachment’s saddle by moving the skid steer while hydraulically raising or lowering the top of the mounting plate under the attachment saddle. Raise the mounting plate using the foot or hand lever controls until the back surface of the attachment rests against the mounting plate. The attachment can then be lowered with the bucket rolled forward (bucket does not touch the ground). It is ready to be locked into place.

To be safe, turn off the engine, set the parking brake, and exit the skid steer. Push the locking levers down firmly to engage the lock pins into the retaining tabs.

Note: Some Skid Steers may be equipped with a push-button attachment locking system electrically activating hydraulic pins from the operator’s seat.

Reverse the process to remove the attachment. When attachment is free, lower the boom slightly and slowly back away from the attachment. Be sure the attachment is setting in a stable position.

Learning Goals

- To safely attach skid steer attachments.

Related Task Sheets:

- Implements With Hydraulic Components 5.5
- Skid Steers 6.1

Do not attempt to lock the manual lock pins from inside the operator’s cab. Keep all body parts inside the cab.
Removing a hydraulic powered attachment

To remove an attachment that is hydraulically powered involves not only the mechanical connection, but the hydraulic hoses as well.

Follow these steps to disconnect the hydraulic hoses.

- Make sure the attachment is in a stable position before disconnecting the mechanical linkage and hydraulic connect-
ors.
- With the lift boom arms lowered move the hydraulic control levers back and forth a few times to release the static (load) pressure.
- Push back on the lock ring.

- Remove the hydraulic hoses from the couplings.
- Replace the dust caps on each connector.
- Hang the hoses on the equipment.
- Keep the hoses off the ground.

If you are not sure of these steps, seek assistance to prevent damage to the machine or injury to yourself.

Safety Activities

1. Ask your supervisor to demonstrate how the bucket attachment is removed and replaced on the skid steer.
2. Practice removing and re-attaching the skid steer load bucket or other attachment being used. Pay special attention to the lower bucket tabs where the lock pins hold the bucket/attachment in place. The lock pins must fit into the lower bucket or attachment tabs to be secure. Do not raise the attachment if these lock pins are not engaged in the attachments lower tabs.

References

1. Skid Steer manufacturer’s Operator’s Manuals.

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Version 3/2013

This material is based upon work supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, under Agreement No. 2010-41521-20839. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.
Learning Goals

• To safely and correctly connect and use the skid steer hydraulically operated machine attachments.

Related Task Sheets:

Using Implements with Hydraulic Components 5.5
Skid Steers 6.1
Skid Steer-Attaching Accessories 6.1.3

Introduction

The skid steer is a hydraulic machine powered by an engine. Everything that happens when you start the engine is a hydraulic action for ground movement, steering, lift arm control, bucket position, or attachment operation.

This task sheet will help you to understand and properly care for and use the skid steer and the hydraulically operated attachments you may encounter.

Hydraulic Power

The term “hydraulic” refers to fluids under pressure. Any liquid can be placed under pressure, but not all liquids are used for hydraulic work. An un-drained garden hose left lying in the sun serves as an example. When we turn the nozzle on, solar-heated water erupts from the hose with great force. Water, however, becomes steam at 212 degrees Fahrenheit and could not be used as a working hydraulic fluid.

Oil is the common hydraulic fluid used with farm equipment. Hydraulic oil system components are briefly shown on page 2, Figure 6.1.4.b. Turn to Figure 6.1.4.b. before reading further.

Hydraulic fluids work through systems with very small openings and are under great pressure.

Precautions When Using Hydraulics

To safely and correctly operate hydraulic systems, understand these three points:

• Oil needs to be clean
• Heat is generated by use
• Oil leaks under pressure

Be sure you understand each point. If necessary, discuss these points with a knowledgeable supervisor or hydraulic technician.

Clean Oil Needs:

Hydraulic pumps and control valves operate with minute clearances and close tolerances. Grit, grime, and dirt pushed through these openings can eventually wear the surfaces and damage the system. Clean hydraulic oil must be used. The fill area and connections must be kept clean as well. Dirt is the greatest source of hydraulic system damage.
Hydraulic Use Precautions (continued)

**High Pressure Oil Leaks:**
Pressure within the hydraulic system can exceed 2000 pounds per square inch (psi). Reinforced hoses can develop pin hole leaks and hydraulic connections can vibrate loose allowing oil to leak from the system.

**Heat Generated by Use Hazards:**
As hydraulic fluid moves through the closed system, the fluid meets resistance from the load to be lifted or moved. Pressure increases and heat in the lines and hydraulic controls builds. Under extreme load conditions, the reinforced hoses can become hot, however, metal connections, fittings, and piping can become super-heated. Place the back of your hand near the connection to sense for heat before touching the connection. If hot, allow the hydraulic system to cool down before touching the heated connections.

**Hydraulic system pressure may exceed 2000 psi. Pin hole leaks can develop.**

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Figure 6.1.4.a. Hydraulic systems are closed systems which move and control fluid (hydraulic oil) for the purpose of operating cylinders and/or motors. This drawing gives a general look at hydraulic components. Much more detail is involved in these systems than this drawing shows. Filters, pressure relief valves, accumulators, etc. are included as well. Consult a machinery owner’s manual to see drawings of more complex hydraulic systems.

Figure 6.1.4.b. Hydraulic systems are closed systems which move and control fluid (hydraulic oil) for the purpose of operating cylinders and/or motors. This drawing gives a general look at hydraulic components. Much more detail is involved in these systems than this drawing shows. Filters, pressure relief valves, accumulators, etc. are included as well. Consult a machinery owner’s manual to see drawings of more complex hydraulic systems.

Figure 6.1.4.c. Hydraulic hoses may be reinforced, but damage to the outer covering plus pin holes from high pressure can cause serious injury (e.g. amputation) and machinery down time.

Figure 6.1.4.d. Hydraulic hoses and fittings can become hot during use. Place your hand near them to check for heating. Do not just grab them!

Figure 6.1.4.e. Use a mirror or piece of cardboard to check for high pressure hydraulic leaks. Do not use your hand! Pin hole leaks are often invisible.

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Fittings and Connections

Connecting Hydraulic Hoses to Couplers

Hydraulic couplers make the connections quick and simple. Follow these steps.

1. Use gloves or a wipe cloth to remove dirt and grit from the couplers.
2. Remove the dust covers from the couplers.
3. Push the couplers together until the lock ring snaps the two parts securely. Older style lock levers and manual pull lock rings may be also found. Ask for a demonstration of these connectors.

If you cannot easily make the connection, try the following:

a. While seated on the tractor where no hydraulic lift arms or other moving parts can crush you, move the hydraulic control levers back and forth to release any static pressure. The previous operator may have failed to do this.

b. Move the locking ring of the female coupler back and forth to be sure that dirt has not blocked its movement.

In some circumstances, the hoses leading to the hydraulic cylinders may have become reversed. The system will still operate. However, using the system with hoses reversed will result in the control valves/levers causing the opposite action of what is expected. This can lead to hazardous situations where operators must react quickly and adjust their knowledge and skills to the new condition.

To correct the reversal problem, disconnect the hydraulic hoses and switch them to the opposite female coupler.

If hydraulic repairs have changed the standard coupling set-up, you may find that you must ask for help in determining which hose goes to which coupler.

Hydraulic systems can produce pressure in excess of 2000 psi. Oil trapped in a hydraulic component may still be under enough pressure to cause mechanical problems or hazardous situations to develop. Someone’s faulty repairs may have created several problems that the beginning operator cannot solve.

Disconnecting Hydraulic Hoses

To disconnect hydraulic hoses:

- relieve the static pressure by moving the control lever
- push back on the lock ring
- remove the hydraulic hose
- replace the dust caps on each connector
- hang the hoses on the implement
- keep hoses off the ground
Safety Activities

1. Identify all the hydraulic system components that are external to the skid steer. You may wish to name the parts and their purpose to a friend or mentor or supervisor.

2. Check the hydraulic fluid level of a skid steer. Could you find where to check the fluid level? If not use the Operator’s Manual to find the location of the hydraulic fluid fill and/or check point.

3. Practice connecting the hydraulic hoses to the skid steer coupler until you can do this easily.

4. Use the skid steer hydraulic system for practice:
   a. raising and lowering the lift arms
   b. tipping the bucket forward and rolling it back

5. Answer these questions:

   A. What is the greatest source of damage to a hydraulic system?
      1. Water    2. Dirt    3. Air    4. None of these

   B. The term hydraulic refers to:
      1. Fluid under pressure    2. Air under pressure    3. Gas under pressure

   C. Hydraulic pressures on skid steers and attachments may exceed ___________ psi
      1. 2000 psi    2. 4000 psi    3. 10,000 psi

   D. The safe way to check for pin hole leaks in the hydraulic system is to:
      1. Rub your hand over the hose.
      2. Hold a match near where you suspect the leak.
      3. Hold a piece of metal or cardboard near where you suspect the leak.

References


3. Operator’s Manuals for various skid steer models.
Learning Goals
• To safely use ATVs and utility vehicles for work and recreational purposes

Related Task Sheets:
Injuries Involving Youth 2.1
Age-Appropriate Tasks 2.4
Mechanical Hazards 3.1
Tractor Hazards 4.2
Tractor Stability 4.12
Using the Tractor Safely 4.13
Skid Steers 7.1

Introduction
They look like fun. They can go fast. They can travel in the woods. They can kill and injure. What are they? They are ATVs and utility vehicles.

In a recent year, 90,000 injuries and 120 deaths were reported due to use of these fun vehicles. The U.S. Consumer Product Safety Commission reports that 4 of every 10 people treated in hospital emergency rooms are younger than age 16. Why would this be the case?

This task sheet discusses safe use of ATVs and utility vehicles as they are used for work and recreational purposes.

All-Terrain Vehicles
As the name implies, all-terrain vehicles (ATVs) can travel almost anywhere. Rough terrain, steep slopes, rutted mountain roads, and muddy conditions make ATV use appealing. Sportsmen, leisure time enthusiasts, and workers use ATVs. ATVs have become a valuable tool for farm and ranch tasks.

ATVs are designed for work. Other task sheets discuss tractor and skid steer stability. Review Task Sheets 4.12, 4.13, and 7.1. Then consider these ATV design features.
• stability
• suspension
• drive lines
• power and speed

Stability: A four-wheel ATV is more stable than a three-wheel ATV. Heavy loads, steep slopes, and “popping the clutch” can cause the ATV to roll or flip backward. Overturns occur with operator actions that change the center of gravity.

Note: Three-wheeler sales have been banned for several years.

Suspension: ATV suspension systems vary with the machine. Less expensive models may use only balloon tires for suspension. These ATVs can bounce and pitch sideways at high speeds. More expensive models use coil springs and shock absorbers to improve traction and steering control.

Drive lines: ATV drive mechanisms vary greatly. Several combinations of clutches, driveshafts, and differential locks are used. Higher speeds and sharp turns can increase the risk of side overturns if the drive wheels are locked together for traction.

Power and Speed: ATV engines vary in size from 100 cc to 700 cc or greater. Transmission gear ratios vary also. Some ATVs can travel over 50 mph. High-speed operation of the ATV increases the risk of loss of control and rollovers.

Remember, ATVs are not toys. They are powerful machines.
ATV Operation and Safety

Safety training for ATV use is the first step in being a qualified ATV operator. Local ATV dealers, ATV clubs, and safety professionals from Cooperative Extension, state Departments of Conservation and Natural Resources and farm organizations may offer safe ATV operation programs. The Specialty Vehicle Institute of America (SVIA) provides training as well. Visit them on the Internet at www.svia.org. At a minimum, use the operator’s manual and the safety signs on the ATV to help educate yourself before using the machine.

Here are some guidelines for safe ATV use:

- Manufacturers recommend that ATVs with engine sizes greater than 70cc be sold only for children 12 and older and that ATVs with engines greater than 90cc be sold only for individuals 16 and older. The child’s strength, skills, and maturity determine readiness to operate an ATV.
- Carrying passengers increases the risk of overturn injury and death. A second person changes the center of gravity of the machine and the machine’s steering ability.
- Know the machine’s limitations. Operating on steep terrain, pulling heavy loads, excessive speed, and “wheelie” type starts can result in ATV turnover.
- Wear a full-face shield helmet. The helmet should fit snugly and securely. It should be labeled with the American National Standards Institute (ANSI) Z90.1 label.
- Over-the-ankle shoes with sturdy heels and soles are necessary.
- Gloves and long sleeves are needed for specific jobs.
- Use lights, reflectors, and highly visible flags to increase the ATV’s visibility.
- Avoid public roads. Paved and unpaved roads are designed for truck and automotive traffic. ATVs are designed for off-road use. Increased risk for rollovers of ATVs on road surfaces has been shown.
- Check your state’s vehicle code for use of the ATV as an agricultural machine. Use of the ATV for agricultural purposes and only incidental road travel may be permitted in your state.
Utility Vehicles

Utility vehicles are similar to golf carts except they are fitted with cargo boxes to carry work material. The utility vehicle can have four, five, or six wheels depending upon its use. The UV weighs about 1,000 pounds and can carry several hundred pounds of cargo. The machine can be diesel, gasoline, electric, or hydrogen fuel cell powered.

Like other farm machines, the utility vehicle is made for work purposes. Hauling feed, mulch materials, and supplies makes it a convenient transport for small jobs. Like an ATV, the utility vehicle is a tool and not a toy.

Safe operation of the utility vehicle requires the same safe work habits as used with tractors, skid steer loaders, and ATVs.

Safe Utility Vehicle Use

Use the operator’s manual and safety signs/decals found on the machine to learn how the utility vehicle operates and what safety practices to observe. A successful operator becomes familiar with a machine before attempting to use it. Ask a qualified operator to show you what to do if no training materials can be found.

The following safety practices should be followed in operating a utility vehicle:

- Some manufacturer’s specifications suggest that no operator younger than age 16 should be permitted to operate a utility vehicle.
- With increased amounts of cargo, the utility vehicle’s center of gravity is raised. Risk of an overturn increases. Drive slowly and turn smoothly.
- To prevent over turns, secure the load from shifting sideways.
- Avoid driving on steep slopes. It is safer to drive uphill or downhill rather than across a slope. Avoid sharp turns to prevent over turns. Drive to the top or bottom of a slope to make a turn. When approaching a downhill slope, reduce speed before you reach the slope. This will help reduce wear on the brakes.
- Reduce speed over rough terrain to prevent the utility vehicle from bouncing. Operator and riders have been thrown from utility vehicles.
- A second rider should occupy the passenger seat. Do not permit extra riders to ride in the cargo box. Use the handholds. If the utility vehicle has a rollbar, buckle the seat belt.
- Do not drive near ditches or embankments. Remember if the ditch is 6 feet deep, stay back from the edge by at least 6 feet.
- Use your tractor, skid steer loader, and ATV knowledge to safely operate a utility vehicle.

As with all machinery, use the device as it was designed. Utility vehicles are tools, not toys.
Safety Activities

1. Use the Internet website www.atvsafety.org to solve crossword puzzles or to play word search games related to all-terrain vehicle (ATV) safety.


3. Collect newspaper, magazine, or Internet news articles about ATV and utility vehicle injuries and deaths. Create a poster presentation to display at a local ATV or utility vehicle dealership.

4. What does the designation “100cc engine” represent? Using the math formula for volume of a cylinder (ask your teacher), calculate the diameter and height of the cylinder that would represent a 100cc engine cylinder. Use a sheet of paper to construct the cylinder. Answer the same question for a 500cc engine cylinder.

References

1. Safety Management for Landscapers, Grounds-Care Businesses, and Golf Courses, John Deere Publishing, 2001. Illustrations reproduced by permission. All rights reserved.

2. www.cdc.gov/nasd/ Search the National Ag Safety Database site by topic for ATV information.

3. www.atvsafety.org/Search site for interactive quizzes, word searches, and puzzles.


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Credits


This material is based upon work supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, under Agreement Nos. 2001-41521-01263 and 2010-41521-20839. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.
Learning Goals

- To understand how a telehandler operation
- To understand the concepts of machine and load stability in operating a telehandler

Related Task Sheets:
- Hand Signals 2.9
- Mechanical Hazards 3.1
- Tractor Hazards 4.1
- Tractor Stability 4.12
- Skid Steers 6.1

**Introduction**

Large volumes of agricultural crops and inputs stored in large facilities have created the need for equipment that can reach higher and farther. Telehandlers can lift up to 10,000 lbs. and their booms can extend outwards 30-40 feet. Since they could be mistakenly overloaded or operated on sloped ground, a thorough understanding of telehandler use is a must. Understanding the safe operation of the telehandler is the focus of this task sheet.

**What is a telehandler?**

Telehandlers are becoming more common on farms. These powerful units go by many names such as material handlers, telehandlers, and many localized versions. Technically, telehandlers are rough terrain variable reach forklifts and are considered a class 7 powered industrial truck. They operate entirely different however than a forklift.

**The Boom** - The telescopic (variable reach) boom can extend/retract to 30-40 feet and elevate to an angle of 70 degrees from the horizontal. Capacity may reach 10,000 lbs. Booms are marked in increments to alert the operator how far the boom is extended. (Figure 6.3.c. and 6.3.d.).

**Frame Tilt** - When operated on sloping ground the telehandler frame can be altered relative to the ground by 10 to 15 degrees in either direction to keep the boom vertical in position. A frame tilt/level indicator is mounted in the cab to assist the operator in keeping the frame level relative to the slope.

**Steering** - Most telehandlers have three steering options for various work locations. These include:

a. Front wheel steering where the front wheels turn as with our automobiles
b. Circle steering allows the front and rear wheels to react in opposite directions to permit a tight turning radius
c. Crab steering which creates the ability to move diagonally over the ground as all four wheels react in the same direction as the steering wheel is turned.

Continued on page 2.
**What is a telehandler?**

(continued)

**The Carriage** - This is the lifting attachment or attachments which can tilt further forward and back than a forklift and can also rotate slightly to tilt a load into an unusual space (Figure 6.3.a.).

**Outriggers** – Larger telehandlers may be equipped with outriggers for heavy load stability when loaders are operated stationary (Figure 6.3.e).

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**Know how to interpret the load capacity charts found in the operator’s cab.**

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**Load Capacity**

Telehandler load capacity depends upon many variables. Lifting large loads to high storage areas may exceed the capacity of a machine. The operator must understand that each load and each position to which the load is lifted or moved has the opportunity to change the center of gravity and stability of the telehandler.

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*Figure 6.3.b.* The telehandler load capacity chart must be used to determine if the weight of the round bales and the distance the boom must be extended to store them remains within the capacity range of the machine. Exceeding the weight and reach capacity of the telehandler could cause it to tip forward.

*Figure 6.3.c.* As the boom is extended a letter (circled) or number markings are revealed that are referenced in the operator’s cab to give restrictions on how much weight can be lifted safely. A boom angle indicator is included. *Insert photo courtesy of JLG, Inc.*

*Figure 6.3.d.* A close-up of the boom angle indicator.

*Figure 6.3.e.* If the telehandler is equipped with outriggers use them to stabilize the machine during use. *Photo courtesy of JLG, Inc.*

*Figure 6.3.f.* A typical boom angle indicator is visible to the operator from the cab seat. A similar indicator is found on the instrument panel to show frame angle (frame relative to ground slope).
Each of the following items, if handled incorrectly, can lead to a mishap.

- Boom angle and extension. See Figure 6.3.c and 6.3.d for boom markings and Figure 6.3.e for the boom angle indicator
- Load weight
- Use of outriggers, if equipped
- Rubber tires vs. rigid tires
- Grade, or slope
- Wind
- Lifting attachment

The operator’s station has several charts to reference load capacity versus boom extension, boom angle, and frame angle. Use these charts to determine maximum machine angles and settings before lifting a load.

### Start-up procedure

Following your training period on the telehandler, use this reminder on how to start the machine.

1. Complete a pre-inspection of the machine.
2. Fasten your safety belt.
3. Observe that all controls are in the neutral position.
4. Turn ignition switch to pre-heat position if so equipped; start the engine when signaled.
5. Warm up the engine at 1/2 throttle.
6. Close the cab door.
7. Check lights, back-up alarm, and horn.

### Moving/Using the Telehandler

Before moving the telehandler:

- Check the steering and braking controls.
- Be sure the boom extension and leveling controls are operational, but test these on level ground.
- Lower the outriggers before lifting.
- Practice using the lift and leveling controls before moving a load.
- Check that other personnel and machines are not in the area.
- Plan your travel for best visibility.
- Keep the boom retracted and as close to the ground as possible.

If the telehandler has outriggers, be sure they are lowered during lifting (for stability) and then raised for travel.

- Start, stop, turn and brake smoothly.
- Slow down for turns and uneven surfaces before reaching those hazards.
- Avoid overhead utility lines to prevent electrocution.
- Raise the outriggers before moving the machine.

(Continued from page 2)
Shut-down procedure

When the work is completed park in a safe location on level ground away from other equipment and traffic.

Follow these steps:
1. Apply the park brake.
2. Shift transmission to neutral
3. Retract boom and lower boom and attachments (see Figure 4).
4. Let engine idle for 3-5 minutes to cool.
5. Shut off engine and remove key as directed by the employer/supervisor.
6. Remove seat belt.
7. Use grab handles and exit the machine safely.
8. Block wheels if parking on a slope is unavoidable.
9. Some models may have a master electrical switch to disconnect the battery from service.
   Disconnect if so.

Safety Activities

1. If you have never operated a telehandler, visit an equipment dealership and ask to sit in telehandler’s cab to observe what controls are available and where they are located. This may be done with your employer’s guidance as well.
2. Use the operator’s manual for the telehandler you will operate to study the controls and instrument gauges as you sit in the operator’s position.
3. Practice starting and stopping the telehandler, raising and extending/retracting the boom, leveling the frame of the telehandler while sitting with the parking brake set, and/or lowering and raising the outriggers.
4. Practice driving the telehandler with no load. Use the 2-wheel, 4-wheel, and crab drive functions.
5. Practice picking up and lifting a load, extending the loaded boom, and lowering the load.

References
1. Websites for various telehandler manufacturers Operator’s Manual
Introduction
A front-end loader (high-lift with bucket or other accessories) mounted on a tractor is a valuable tool for lifting, moving, dragging, and pushing items such as soil, gravel, large round bales, equipment parts, and road repair materials. Using the front-end loader requires an understanding of machine capacity limitations, center of gravity, and an awareness of work surroundings.

This task sheet discusses safely using a front-end loader mounted on a farm tractor. (Similar task sheets dealing with skid steer and material handlers also discuss these safety ideas.)

Front-end loader components
Oftentimes the front-end loader is used on a tractor dedicated to that attachment. In other cases the front-end loader is parked on its support legs and must be attached to the tractor’s frame and hydraulic system for use. The tractor will have mounting points from which to attach the front-end loader.

Loader components include (Figure 6.4.a.):
A. Tower columns, that are the back of the loader and attach to the tractor’s mid-frame and may serve as the support legs. Some loaders will have support legs which support the front end loader frame when it has been removed from the tractor if different than the tower columns.
B. Bar and Saddle, found behind the bucket and which mounts the loader to the front of the tractor’s frame
C. Lift arms and frame
D. Hydraulic system components (hoses and control valves)

Manufacturer’s have made the attachment of the front-end loader to the tractor relatively simple. Use the Operator’s Manual to identify the loader components before attempting to attach it to the tractor.

Check that all components are secure before operating the front-end loader.

Learning Goals
- To safely use a tractor-mounted, front-end loader.
- To understand how the center of gravity of a farm tractor changes as the front-end loader is used.

Related Task Sheets:
- Tractor Hazards 4.2
- Tractor Stability 4.12
- Using the Tractor Safely 4.13
Center of gravity

Review the following task sheet(s), Tractor Hazards- 4.2, Tractor Stability- 4.12 and Using the Tractor Safely-4.13.

The tractor’s center of gravity is engineered to maintain a stable “footprint” with the ground. Anything that moves the center of gravity outside of the stability baseline can lead to a tractor overturn. Raising the front-end loader bucket with or without a load raises the center of gravity. See Figure 6.4. With the center of gravity raised, while operating on uneven surfaces, or on rough roadways, an overturn can occur more easily. Always travel with the bucket as low to the ground as possible. If working on a hill with a loaded bucket, travel uphill in forward and downhill in reverse.

Load capacity

Agricultural inputs of feed, fertilizer, chemical bulk packs, and large package hay bales have all become heavier and bulkier. All loads, whether heavy or light, when lifted with a front-end loader changes the center of gravity of any tractor. The tractor can be more easily tipped as a result. Loads can also roll back onto the operator. To reduce risk of overturn or load rollback:

- Use a wide front-end tractor for loader work rather than a narrow front wheel tractor to improve stability.
- Understand that some loads are going to be too heavy for the tractor to lift. Know your machines capacity.
- Make sure the load must not be bigger in size than the bucket. Load rollback can result.
- Use several trips to complete the work rather than trying to move too much material in one load.
- Keep loads close to the ground during transport (maintain a low center of gravity).
- Avoid slopes or rough terrain when transporting a load with a front-end loader.
- Move slowly if loads must be carried high and avoid jerky movements.
- Consider if the tractor needs more ballast (weight) added to the rear before you continue to use it. If the tractor feels like it is tipping during loading, reduce the load or add ballast to the rear end of the tractor.
**Pinch and crush points**

Front end loader lift arms move closely to the tractor frame and mounting points. Other close fitting parts include the connections between the bucket or attachments and the lift frame as these parts are rolled back during loading. **These are places where a person can be pinched or crushed.** To avoid pinching and crushing injuries:

- Be sure that bystanders or helpers move away from the front end loader during use.
- Before making needed repairs, lower the front-end loader, shut off the engine, and relieve the hydraulic pressure by moving the hydraulic control lever back and forth a few times.

**Work surroundings**

Farm equipment operators must be aware of their surroundings as they go about the work to be done. Before operating the front-end loader check these points:

- Location of fellow workers
- Location of children and pets
- Location of livestock and livestock equipment
- Location of building corners and overhangs
- Location of utility lines

Equipment operators can become so focused on their work they can overlook where other persons or animals have moved in the work zone. Farms have children, bystanders, and pets that may not understand what you are doing or anticipate your movements. Be alert to these situations.

Buildings have received damage from equipment operation. Be sure that you understand the width and height of the front-end loader and any cargo you are carrying in it. Avoid working too near buildings if possible.

Most importantly know the location of overhead power utility lines. Maintaining a safe distance from the utility lines. Contacting power lines with front-end loaders or the cargo can result in electrocution.

To avoid electrocution do not use the front-end loader bucket to dig into the ground unless you know where underground utilities are buried.

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**Number 1 rule:**

*Keep it low; drive slow.*

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Safety Activities

1. Answer these questions.

   A. What happens to a tractor’s center of gravity when you raise the front-end loader?

   B. Why should the front-end loader be lowered to the ground before you leave the operator’s seat?

   C. Describe a situation where load rollback can occur.

2. Become familiar with front-end loader controls by practicing the raising and lowering of the front-end loader and then rolling the bucket or attachment forward and back. Do this until you are not confused what each control movement does as you use it. Request that a supervisor observe your initial efforts.

3. Using a pile of sand or sawdust or mulch, practice scooping up while observing how you approach the pile of material. Pay attention to how much you scoop into the bucket, and how heavy it is to lift. Slowly move the loaded material to another nearby location and dump it. Request that a supervisor observe your initial efforts.

4. When you have mastered safety activity 2 and 3 above, repeat the activity, but place the load into a dump truck or other container by approaching the dump truck or container slowly, raising the bucket fully, adjusting the final approach and then dumping the load carefully without damage to the truck or container.

References


2. Operator’s Manuals from various manufacturers.

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Version 3/2013

This material is based upon work supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, under Agreement No. 2010-41521-20839. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.
Introduction

Farm producers have increasingly turned to the use of dump trucks and trailers to quickly and efficiently move the inputs and products of the farm. Serious property damage, crippling injury, and even death can result when these trucks overturn or the dump bed falls onto a worker during repairs or use.

This task sheet identifies risks associated with using dump trucks and trailers and how to avoid common hazards. This task sheet refers only to farm use of dump trucks and trailers and does not discuss road use of these vehicles.

In-experienced or untrained operators should not be assigned to operate dump truck and trailers. Age restrictions in CDL licensing requirements may further remove younger employees from being considered for this duty.

Types and Uses

Dump trucks and dump trailers are used for many farm chores including hauling grain, silage, firewood, sawdust, wood chips, soil, gravel, sand, debris, and other pulverized or loose items.

Among the types of large trucks and trailers found on farms are semi-trailer end-dump trucks (Figure 6.5.a), pup trailers (Figure 6.5.b), and regular and long-bed straight dump trucks (Figure 6.5.c). Hereafter, these units will be referred to as farm dump trucks and trailers.

Farm dump trucks and trailers use hydraulic hoists to raise the bed during unloading (Figure 6.5.d). Raising the bed allows the contents of the load to slide out of the bed for unloading by gravity.

The remainder of this task sheet discusses the variable conditions, types of load and unloading surfaces and mechanical issues that can create hazards in using farm dump trucks and trailers.

Learning Goals

- To understand the concept of center of gravity of farm dump trucks and its potential to cause overturns.
- To safely use farm dump trucks and trailers during on-farm use.

Related Task Sheets:

- Hazard Warning Signs
- Mechanical Hazards
- Electrical Hazards
- Tractor Hazards
Dump truck hazards

Three situations present the most potential for a fatal injury involving on-farm use of large farm dump trucks and trailers.

One situation involves trucks and/or trailers tipping over while emptying loads. These rollovers happen for a variety of reasons and will be discussed in the Instability Hazard section.

The second situation occurs when a person works under a raised dump truck or trailer bed. Usually the person has not physically blocked the dump bed from coming down unexpectedly. The crushing injury from the dump bed or loaded bed is usually fatal.

The third scenario occurs when the dump truck or trailer bed comes into contact with overhead electrical lines where the driver or a ground located helper is electrocuted. This usually happens when the driver pulls away after unloading the load without lowering the bed.

In all three cases, a person can be crushed or electrocuted within seconds. There have been at least eight incidents in Pennsylvania involving farm dump trucks in the past few years. Many incidents go unreported if a fatality is not involved therefore the number of incidents may be much higher.

Instability Hazard

A dump truck or trailer becomes less stable as its bed is raised, especially when the ground is not level or not firm (Figure 6.5.e.). The greater the length and height of the bed, and the greater the degree of slope, the greater is the hazard for tipping over. As the bed is raised, it is important the load center of gravity stay between the frame rails of the bed, preferably right in the center. Even when the ground is relatively flat, a slight slope can be created by one set of tires settling into a hole or deep set of ruts, low tire pressure on one side, or a depression created on one side as an off-center load is unloaded on soft ground. Driving or unloading to close to a ditch, road bank, or material pile edge can cause the rig to tip over as well. It is often a combination of these conditions that result in instability and a tip over.

Off-center and shifting loads often contribute to overturns. These can occur for a variety of reasons including the load not distributed properly when loaded, (e.g., top-heavy or too much on one side) and material not flowing evenly out of the bed (e.g., wet or frozen material stuck to the sides or floor). Materials such as silage, high moisture corn, and damp sand can hang up causing uneven loads.

To reduce risk of overturns:

- unload on a firm level surface
- keep the rig in a straight line; not jack-knifed
- avoid unloading in high winds
- consider a dump bed equipped with two hydraulic cylinders to reduce the chance of overturns
Use the manufacturer’s mechanical block device to prevent the bed from coming down during repairs and maintenance.

Figure 6.5.f. A wooden plank is not a suitable blocking device to secure a dump bed.

Figure 6.5.g. Avoid contact with overhead power lines.

Crushing Hazard

Workers have been crushed to death when dump beds come down unexpectedly. Checking an unfamiliar noise or malfunction, performing routine maintenance (e.g. greasing) or repair may mean the operator enters the space between the dump bed and truck frame. In this work position the risk of a crushing fatality can occur if the bed is lowered inadvertently by a worker or co-worker tripping a hydraulic control lever, or by a mechanical or hydraulic component failure.

To reduce the risk of dump bed crushing injury or fatality:

1. Completely understand the dump bed controls and how the system works.
2. Use the manufacturer’s locking device to secure the dump bed when working between the dump bed and truck frame (Figure 6.5.f).
3. If a problem exists for which you are not trained, immediately call upon a knowledgeable operator to help correct the malfunction.

Electrocution Hazard

Overhead power lines are a hazard. The possibility of electrocution exists with raised dump trucks or trailer beds contacting power lines. This may happen because of forgetfulness, haste or impatience when the driver doesn’t want to wait for the bed to completely lower before pulling away (Figure 6.5.g). If contact with power lines occurs, the driver is normally protected from electrocution because they are insulated from the electrical charge by the truck tires. If the driver leaves the cab and is in contact with the ground and the truck they could be electrocuted. Some drivers, either from panic or lack of knowledge, attempt to leave the cab and are electrocuted. A person touching any part of the truck or trailer in contact with an overhead power line may also be electrocuted.

To avoid electrocution risks:

- Know the location of overhead power lines in relation to dump locations
- Have a helper to observe for potential power line contact and to signal you for safe clearances.
- Always move the unit with the bed down.

Figure 6.5.e. Raising the dump bed on sloped ground increases the risk of rollover. Longer trailers, windy conditions, and uneven loads add to the risk. Never attempt to unload a rig that is parked in a jack-knifed position.
Safety Activities

1. Conduct a farm community survey to determine the extent of dump trucks, semi-trailer, end-dump truck and pup trailer use in your community.

2. Conduct a survey of local farmers to find out how they received training in safe dump truck and trailer use.

3. Copy and mail this Task Sheet to local farmers as a community service of your 4-H and/or FFA club.

4. Visit your local Driver Test Station to locate information on weight restrictions and CDL licensing requirements for off-farm or road use of the dump truck and trailer.

5. Build a table top demonstration to show how dump trucks and trailers can tip over on a sloped surface. Use the following plan. Locate a model dump truck or semi-truck end dump trailer to place on the tilting deck. Raise the tilting deck, use a protractor to measure the angle where the truck overturns with the bed down, with the bed raised and with the bed raised with some load involved. The load may be any items you may find to place in a small cloth bag. Damp sand in a plastic baggy could be used for an example. Material that shifts in the raised bed as the angle increases can be demonstrated. For comparison secure a model dump truck with a round bed to compare the results.

References

1. Website, www.agsafety.psu.edu. Scroll to Publications, E44 Farm Dump Truck and Trailer Safety, Dennis J. Murphy and William C. Harshman

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This material is based upon work supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, under Agreement No. 2010-41521-20839. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.
Learning Goals

- How to conduct a pre-use safety inspection
- How to load and secure a load on a trailer
- How to test electric trailer brakes before entering a public roadway

Related Task Sheets:
- Tractor Stability: 4.12
- Operating the Tractor on Public Roads: 4.14

Introduction
As farms become larger and more spread out, a farmer may own or lease farm land several miles from the home farm. A new employee may be asked to tow equipment from one farm to another.

Safe towing or transporting of equipment on trailers is the subject of this task sheet.

Towing involves...

The trailer must be safe to take on the road. This means that the load or cargo on the trailer cannot weigh more than the trailer can handle. Nor can the combined weight of the trailer and the load on it be more than the towing vehicle can handle. The hitch on the towing vehicle must be of the correct size, and safety chains and locking clips, lights, and trailer brakes, if applicable, must be in good condition and used properly. Inspecting and testing equipment before you get on the road is important. All of these items are discussed in the following sections.

The operator also must use safe driving habits while towing a load.

Pre-use inspection

Pre-inspection should be done in three phases. These include:

Phase 1. Walk around the trailer to inspect tires, damage to light fixtures, missing tail gate pins or other loose or damaged parts.

Phase 2. After hitching the trailer to the towing vehicle, turn on the vehicle lights and be sure that trailer marking lights, turn signals, brake lights and emergency flashers are functional. Replace any lamps or fuses that are burned out before taking the trailer onto the highway.

Phase 3. Inspect tie-down straps or chains and chain binders. Frayed tie-down straps or deeply nicked chains have reduced strength and may not be strong enough to secure the load. Replace damaged straps or chains immediately.

Figure 6.6.a. This heavy duty trailer can safely handle hauling this tractor. The towing vehicle must have a hitch rated for the load, be able to pull the load, and have sufficient braking capacity to stop the load as well.
LOADING AND TOWING EQUIPMENT ON A TRAILER

What is GVW and GCVW?

The towing vehicle must be capable of pulling and stopping the trailer and its load. Steering and braking are greatly affected when cargo weight is heavier than the towing vehicle can handle.

Manufacturer’s have established a Gross Combined Vehicle Weight (GCVW) rating for the tow vehicle’s weight plus the loaded trailer weight. This GCVW is found in the vehicle’s serial number or in the Operator’s manual for that vehicle. Remember this weight includes fuel, passengers, and the cargo. Trying to pull too heavy of a load can end in disaster.

Hitch point

Not all receiver and ball hitches are the same. Ball diameter is just one factor. The hitch, receiver/ball mount and ball must be heavy enough for the load to be towed. Each component has a rating tag or load rate stamped in the metal. The lowest rating of the three parts is the safest load that can be pulled.

Regulation safety chains

Safety chains are required while towing a load. These chains provide some security should the hitch be damaged or come loose. Fasten chains in a criss-cross manner to form a cradle beneath the tongue should the hitch fail. The operator can slow the load and move from the highway until repairs can be made. Older style safety chains have an open end, but new regulations require a closed chain hook (see Figure 6.6.b.).

Testing electric trailer brakes

Before entering the roadway with a loaded trailer it is advisable to check the electric tow brakes on the trailer. If you do not know how to use trailer brakes ask your employer to show you. If no one is available check the operator’s manual for your specific brake setup.

To test the electric brakes:

1. Shift the tow vehicle transmission to neutral; next use the slide lever on the brake controller to bring the load to a stop using the trailer brakes.

2. The trailer should stop the load. If the trailer brakes jerk the truck to a stop you have too great a trailer brake adjustment. Adjust the trailer brakes until the load stops smoothly. If the trailer cannot stop the load, adjust the controller to a higher number and repeat the test.

Some trailers may have no brakes or may be equipped with surge brakes (see figure 6.6.c. for an explanation of surge brakes).
Note: Unbalanced weight distribution of equipment can cause it to tip during loading (see figure 5) due to the slope of the loading ramp and the machine’s center of gravity.

**Safe Loading/Unloading**

Follow these steps to load equipment on the trailer.

- Place trailer hitched to tow vehicle on a firm, level surface.
- Use outriggers and chock blocks (see figure 6.6.d).
- When loading equipment such as a skid steer or 2-wheel drive tractor remember that 60% of the weight is at the rear end and 40% is at the front, therefore back the heavy end of the equipment onto the trailer first (see figure 6.6.e.).
- Drive or load the equipment onto the trailer keeping the load balanced. The heaviest part of the load should be centered over the axle(s). Placing the load too far forward places too much weight on the tongue of the trailer. Too far back lifts the trailer tongue and reduces traction of the tow vehicle.

**Securing the Load**

Secure the equipment with tie-down straps or chains and chain binders. Check the tie-down straps for wear. Do not use them if they are worn or frayed. Chains and chain hooks should be inspected for deep nicks and/or weak links. Use a chain rated for the load (5/16” chain is rated for 4700 lbs. of strength, 3/8” chain is rated for 6600 lbs of strength, and a 1/2 “ chain is rated for 11,300 lbs of strength).

Secure the front and rear of the machine tying the straps or chains downward and outward. This prevents the machine from shifting forward or rearward during transport.

85-90% of the load weight should be carried over the axles; only 10-15% of the weight carried on the tongue.
Safety Note: Towing/Trailering of engine driven equipment equipped with a turbocharger may require blocking of the airflow into the turbocharger through the exhaust. While it is rare, expensive turbochargers have been damaged by transporting tractors with the exhaust pipe facing the direction of travel. Damage occurs should an exhaust valve in the open position allow air to flow through the turbocharger, freely rotating the turbocharger blades. Since the turbocharger is not being operated by engine power, turbocharger bearings can burn due to no lubrication being pumped to those turning parts.

Safety Activities

1. Ask a trained individual to demonstrate how to drive a tractor or skid steer onto a trailer for you. Then perform this task under their supervision. Observe the position of the load as it is placed over the axle(s) of the trailer. Remember that 85-90% of the weight must be over the axle(s).

2. Ask the same individual in Activity 1 to demonstrate the correct way to secure a load on a trailer using tie-down straps or chain and chain binders. Repeat this task with their supervision.

3. What is the GVW of the tow vehicle you will use? What is the GVW of the trailer you will be using? Add the two GVW weights together for the GCVW. Check the GCVW weight you have calculated and compare with the information found on the tow vehicle serial number plate (usually found inside the door frame). Is the total weight within the limits shown on the serial number plate?

4. Federal regulations include Commercial Drivers License (CDL) requirements for trucks and trailers over a certain CGVW. Some exemptions may apply to agriculture. Use an Internet search engine to find if your State has other requirements or exemptions.

5. What is the weight of the load you are about to tow? If only 10-15% of that weight can be on the tongue of the trailer how much weight can be on the tongue? If a heavy enough set of wheel-type scales (scale beneath each wheel) are available, load the equipment on the trailer, chock the wheels, place one scale beneath the jack, disconnect from the tow vehicle and raise the tongue until the loaded trailer is setting on the scales. What is the weight you have on the tongue of the trailer?

References

2. Internet search for trailer safety, www.howstuffworks.com

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This material is based upon work supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, under Agreement No.2010-41521-20839. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.
Introduction
Talk to an older farmer and they will tell you about shoveling corn into the corn crib or feed grinder. Those days are over. Augers and elevators quickly and efficiently move grain, processed feeds, and forages to improve our farm productivity. These devices have moving parts with pinch points and wrap points that must be guarded. After years of use, guards may be damaged or missing and homemade elevators exist that have never been guarded. The risk of being pulled into and entangled in the moving parts of unguarded machines is high.

This task sheet provides facts that may help you avoid an injury or fatality due to auger and elevator hazards. Review Task Sheet 3.1, Mechanical Hazards.

How an auger works
The auger is a shaft with a metal or hard plastic, screw-thread fluting attached. The end of the auger can be placed into a grain pile, bin, or wagon and begin to move material very quickly. The turning part (auger) and the auger tube move close enough together to be able to snag loose clothing, feet or hands. Entanglement, amputation or both can occur. Elevator belts and pulleys or chains and sprockets can entangle the operator if guards are not in place.

Safely guarding augers
Engineering Standards by the American Society of Agricultural and Biological Engineers –ASABE) call for exposed auger flights to be guarded as follows:

- Guards are to cover the top 180° of the inlet area and extend a minimum of 2.5 inches above and below the exposed auger flights.
- Openings in the guard for the free flow of material shall be no larger than 4.75 inches for the largest dimension opening and the area of the opening shall be no larger than 10 square inches.
- The guard should be no closer than 2.5 inches to the rotating auger flights and able to support a 270 lb. person.
- Drag-type augers and grating type guards are to have these standard dimensions as well.

In addition, safety signs should be in place to inform the operator of the rotating parts hazards and to warn against modification or removal of guards.

With years of use auger guards can become damaged. Damaged auger guards increase the risk that an injury or fatality can occur. If auger guards are damaged or missing report it to the employer or supervisor.

Augers must be guarded. Keep guards in safe condition.

Learning Goals
- To learn how an auger and elevator operates
- To identify auger and elevator hazards and how to avoid an entanglement or electrocution.

<table>
<thead>
<tr>
<th>Reaction Time</th>
<th>Mechanical Hazards</th>
<th>Grain Bins</th>
<th>Electrical Hazards</th>
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<tbody>
<tr>
<td>2.3</td>
<td>3.1</td>
<td>3.10</td>
<td>3.6</td>
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</table>
**Elevators**

Elevators carry hay and straw bales or other agricultural materials using a chain with webbing or flights, or sometimes with an endless belt. The mechanism may be powered by an electric motor, gas engine or tractor PTO.

Commercial elevators may be purchased without a power source which the end-user supplies. The end-user may not have installed a guard around the belt and pulley or chain and sprocket drive system. The risk of entanglement increases when moving parts are unguarded.

*Guarding by location*

A hazard is guarded by location when it is guarded by other parts or components of the machine that are not themselves guards, or when the hazard is beyond the safety distance. The high sides of the mixer wagon form a “barrier” to prevent the hazardous area from being reached inadvertently.

Figure 6.8.b. Missing auger guards and shields increase the risk for injury or fatality. Replace these shields before using the auger. Report missing guards and shields to your employer. Your employer must provide a safe workplace. Because no guard is in place this is an unsafe auger to use.

Figure 6.8.c. A Total Mix Ration (TMR) Mixing Wagon loads from the top by high-lift bucket. This is not a normal work position and because of the distance away from the operator is considered to be guarded by location*. DO NOT ENTER this mixing space that has three augers moving close together.

Figure 6.8.d. An example of an elevator for moving hay. Note the turning parts (motor pulley, belt, and drive pulley) as well as the open frame structure. Homemade elevators may be made with solid wooden sides and bottom. Because of the unguarded pulleys and belt this is an unsafe drive mechanism.

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Cooperation provided by The Ohio State University and National Safety Council.
Other considerations

Augers and elevators move large quantities of material. The weight of the material may not be evenly distributed in the auger or on the elevator. They can up-end (tip forward) easily if not secured by an anchor at the intake end or by supports at the discharge end.

Don’t forget that when the job is done and the auger or elevator is to be moved to a different site, the auger tube may still have grain or feed in it, and the elevator can be top-heavy. Be sure to empty the auger tube before transporting the auger to prevent up-ending. Lower the elevator or auger to reduce the center of gravity and prevent tipping forward or sideways.

Augers and elevators must be lowered to transport position to avoid contact with power lines around the farmstead. Electrocution can result if contact is made with the wires.

Safety practices for augers and elevators

1. Read and understand the operator’s manual before using the auger or elevator.
2. Have the owner show you how to use the auger or elevator and then observe you successfully doing the job for which you are assigned.
3. Keep all safety shields and devices in place.
4. Make sure the area is clear of by-standers before operating the auger or elevator.
5. Keep hands, feet, and clothing away from moving parts.
6. Shut off power to adjust, service, or clean the auger or elevator.
7. To prevent a fire clear crop debris and dust from accumulating around a motor or engine. Dust can catch fire or even explode.
8. Do not ride an elevator to the top of the barn or bin as a personnel transport. Falls and entanglement can occur.
9. Consider that a small internal combustion engine used as the power source can be a source of heat or sparks that may ignite hay, straw or grain dust that accumulates around the engine.
10. Keep a 10 lb. ABC fire extinguisher available for emergency use.

Observe the location of overhead power lines before moving augers and elevators.
Safety Activities

1. Using an Internet search engine of your choice, search for agricultural injuries and/or fatalities involving an auger or elevator. Analyze 3 of these incidents to find if the incidents had anything in common. Compare the age of victim, machine condition, time of year, and any other factor in your analysis. A good source of information is found at www.agsafety.psu.edu. Look for the annual farm fatality reports in this website hosted by the Penn State University, Department of Agricultural and Biological Engineering, Agricultural Safety and Health Program.

2. Conduct a safety check on the augers and elevators on your farm, a relative’s farm, or a neighbor’s farm (with their permission and supervision if possible). Using the ASABE Standards (page 1) and the safety recommendations (page 2) information given develop a report with pictures that could be given to the owner or presented to your agriculture class or 4-H club members.

3. Solve this problem. If a 10 inch auger can move 65 bushels of grain per minute, how many bushels of grain will a 7.5 inch auger move in one minute. Show your work in this ratio, or proportion-type calculation.

References

2. American Society of Agricultural and Biological Engineers (ASABE), ASAE S361.3 (Revised 2005) Safety for Portable Agricultural Auger Conveying Equipment.
3. www.nasdonline.org. Type in Search Box to locate auger and elevator safety information.
4. American Society of Agricultural and Biological Engineers (ASABE), ANSI/ASAE S493.1(Revised 2008) Guarding for Agricultural Equipment.
Introducing

Census data shows that American agriculture is growing in scope. Expanding livestock feeding operations require the handling of ever larger quantities of forage and silage. Silage storage in trenches, bunkers, and drive-over piles is now a common sight. Trenches, bunkers and piles can contain thousands of tons of silage often packed to depths of 20 feet or more.

With these mountains of compacted silage comes the need for equipment to remove it for feeding. This task sheet addresses the safe use of silage defacers.

The work of a silage defacer

Silage defacers have been designed to loosen silage from tightly compacted trenches, bunkers, and piles. Hydraulic powered versions and toothed, non-rotating defacers are available. The defacer, when placed on an extendable boom can reach to the top of the pile.

The typical farm’s feeding equipment may be too small to reach the top of a massive silage face. Continual removal at the bottom of the face causes undercutting, leading to a dangerous collapse of the silage. Several deaths have been reported across the US due to silage face collapse and suffocation of the victim. One death involved a youth caught in the blades of a silage defacer.

Understanding the purpose of these machines involves two major considerations:

1. The maintaining of a consistent supply of high quality silage to the herd means removal of enough silage to stay ahead of spoilage without excessive disruption of the tight pack of the silage.
2. The prevention of a silage pile collapse due to a continuous undercutting of the bottom of the silage feed-out face.

Learning Goals

- To understand silage removal procedures
- To safely use silage defacing equipment

Related Task Sheets:

- Mechanical Hazards 3.1
- Silos 3.9
- Horizontal Silo Safety 3.9.1
- Packing Forage in a Horizontal Silo 3.9.1.1
Using the silage defacer safely

Follow these suggestions to safely use the silage defacer.

- Understand how the defacer works by studying the operator’s manual.
- Clear the work area of all bystanders.
- Operate the defacer only from the operator’s station.
- Position the defacer at the top of the silage feed-out face before engaging the defacer motor to prevent undercutting which can lead to silage collapse.
- When the defacer has reached full speed, lower the unit slowly while cutting through to the correct depth, usually 1-3 inches on each pass.
- Keep the defacer level while lowering to maintain an even cut.
- Do not force the defacer down through the silage.
- Avoid contact with bunker walls and concrete or asphalt floor.
- Do not leave the operator’s station until the unit has been lowered and the tines have stopped moving.
- Service the unit only when it is completely stopped and the keys have been removed from the ignition switch.

Safety Activities

1. Visit YouTube on the internet and search for silage defacer equipment. Watch the film clips to see how the equipment is operated. After watching the film clips make a list of the hazards that you can identify.

2. After listing the hazards involved in using a silage defacer, develop drawings of safety symbols that could help a person understand the hazards involved in using a silage defacer.

3. Conduct a class or club discussion to identify how many farms or ranches in your community have horizontal silage trenches, bunkers, or drive-over piles and how many tons of silage are estimated to be in storage.

References

1. Horizontal Silo Safety, Fact Sheet E49, College of Agricultural Sciences, Department of Agricultural and Biological Engineering, Dennis J. Murphy and William C. Harshman
2. Internet search. Using any search engine type in silage defacer safety. Access manufacturer’s information, operator’s manuals, etc.

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This material is based upon work supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, under Agreement No. 2016-61521-26039. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.
Introduction
Forage crops are often stored in large plastic bags or wrapped in plastic rather than placed in silos, barns or sheds. Crop harvest efficiency and lowering the costs of storage has been the driving force in the use of this equipment. These machines are designed to store large quantities of forage rapidly. Since PTO and hydraulic systems provide the power to operate this equipment, the operator must understand the hazards that can occur during use of the silage bagger or bale wrapper.

This task sheet discusses the safe operation of silage bagging and bale wrapping equipment.

The silage bagger
Silo bags are filled using a machine that appears to be a sled with a large plastic bag attached to one end. The silage bagger is driven from the PTO of the bagging tractor which has been left in neutral and is therefore gradually pushed forward as the silage bag is filled. Bags are filled in a straight line as the tractor’s steering is held straight. There may not be a person sitting on the bagging tractor during the bagging operation. (Figure 6.10.a)

The bagging tractor’s PTO is in operation for the entire fill period. Operators and bystanders are at risk in the area close to the turning PTO.

The plastic silage bag is loaded in a similar manner to any other silo, but in this case the forage wagon being unloaded is being moved progressively forward with the bag loader as the plastic bag is fed from the bagging machine. A table-like attachment with spiral-shaped teeth moves the crop from the dump platform into the throat of the bagger equipment.

To pack the bag tightly, cables with springs are attached to the back of the bag being filled and packing is controlled by a large brake shoe-type pressure regulator. (Figure 6.10.b). Once filled this pressure is released and the rear gate mechanism falls to the ground. Bystanders must be kept away from the filling operation.

Learning Goals
• To safely use forage bagging and bale wrapping equipment

Related Task Sheets:
- Hand Signals 2.9
- Mechanical Hazards 3.1
- Noise Hazards and Hearing Protection 3.2
- Using a Front-End Loader 6.4
Safe Practices around forage bagging equipment

While silage bagging operations have reduced the potential of falls from an upright silo, other safety hazards exist when using silage bagging equipment.

Unloading equipment is powered by tractors which are stationed next to each other. Limited access to this area should be expected. Observation and operation of the unloading equipment should be done from outside this high hazard zone.

All safety practices involved with agricultural equipment relate to silage bagging equipment as well. Review Task Sheet 3.1, Mechanical Hazards.

Heed these points:

- Ask your supervisor to demonstrate how the machine is operated and what can go wrong.
- Remember to avoid loose or torn clothing, which easily becomes entangled.
- Keep shields in place.
- Do not step over turning PTO shafts.
- Stop the machine to unplug any jamming that may occur from too rapid feeding of the unloading table or from plastic wrap that may have become entangled.
- Know where the other workers are located and communicate equipment movement with them.
- Never leave the bagger or bagger–tractor running unattended.
- Keep children and other bystanders away from the work area.
- Understand that silo gases can accumulate near bag openings if the fill process will occur over several days.
- Remember that when unloading silage from the bag the front-end loader must be carried low to the ground to prevent tractor rollover.

Consider the space between the wagon or truck being unloaded and the bag being filled as a “hazard zone”.

Figure. 6.10.b. From the rear of the bagging equipment, the endgate and cable braking system are shown. Large industrial disc brake(s) (see inset) and a simple brake hand pump and brake pressure gauge control the rate of cable release. Silage bags may have convenient “stretch gauges” marked continually along the bag to insure packing consistency. Tension may be pre-set with experience or manually controlled during fill. Tension on the cable is released from the endgate when the “bag” is filled. The endgate can drop heavily to the ground. The close quarters between the wagon or truck being unloaded raise the potential for injury. Turning parts can snag loose clothes very quickly, and the tractor operator’s visibility of someone in this space is reduced.

Figure. 6.10.c. As silage is removed from the storage bag, tractor front-end loader safety practices are used. Travel with the front-end loader as low to the ground as possible. A heavy bucket of silage moves the tractor’s center of gravity forward and raises it as the loaded bucket is lifted which can lead to a tractor rollover.
The bale wrapper

Round hay bales may be wrapped in the baling machine itself, but often bales are dropped in the field and wrapped later. The bale wrapper shown in Figure 6.10.d utilizes a hydraulic lift arm to lift the bale from the field and place it on the wrap table. Plastic film is applied as the bale is rolled and rotated on a support table. Controls may be manual, hydraulic, or joystick activated from the operator’s seat.

When wrapped, the plastic is sheared and the bale dropped from the support table and the process repeated. Dozens of bales per hour can be wrapped.

The operator of the bale wrapper is physically removed from close proximity to the machine’s turning parts, but hazards still exist. Read this section to learn about potential hazards.

Working safely with bale wrapping equipment

Engineering design keeps the operator of the bale wrapping machine at a safe distance from the turning wrap table and drop point of the wrapped bale. Yet hazards exist and injuries occur while using a bale wrapper.

Hydraulic power removes many turning parts, but may expose the operator to hydraulic related hazards. In addition to hot hydraulic fluid, hoses can develop pin-hole size leaks under pressure. Handling or inspecting hoses for leaks must be done with a piece of cardboard, a mirror, or a small piece of glass. Never use your fingers or hands to check for hydraulic leaks. Hydraulic oil injected into the body must be treated as a medical emergency immediately.

The lift arm device and support table are moving parts that pose pinch point or shear point hazards. Understand that these areas can cause injury or fatality.

Round bales are heavy. Once wrapped they are dropped to the ground by machine power and gravity. Crushing incidents are possible and round bales can roll.

It is important to keep children and bystanders away from the bale wrapper during its operation. When moving wrapped hay bales remember that heavy loads change the center of gravity of the tractor or skid steer being used to move the bale and rollovers can occur.
Safety Activities

1. Attend an agricultural exposition in your state and watch a field demonstration of how the bale wrapping equipment operates.

2. Measure the length and diameter of a silage bag. Calculate the volume of this “tube” in cubic feet. If a cubic foot of corn silage would weigh 35 lbs., how many tons of silage are being stored?

   Use the formula: Volume = 3.14 x radius² x length
   Remember to use radius not diameter, follow the order of operations in math, and that there are 2000 lbs/ton.

3. Calculate the cost per bale to wrap hay. You will need to find out the cost of a roll of plastic film, how much is used per bale and then calculate the cost per bale.

4. Research how agricultural plastic is recycled. Can it be recycled? What are some of the problems with recycling agricultural plastics? Make this a current event presentation to your class or group.

5. Use the Internet to locate equipment that is used to move and feed out plastic wrapped hay bales. What kinds of equipment are available?

References

1. Website, www.nasdonline.org. Type in Search Box to locate large bale handling safety information.
2. Websites for various silage bagging and bale wrapping equipment manufacturers
3. Operator’s Manual for silage bagging and/or bale wrapping equipment
4. Visit to a agricultural equipment dealership

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