
PennState Extension

Tractor & Machinery Operations: Putting Safety in Motion

PennState Extension

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Outline

- Hazards and Risk
- Pre-operation Checks
- Tractor Operations

Hazards and Risk Assessment

- Hazard
  - Any existing or potential condition which, by itself or by interaction with other variables, can result in injury, illness, death or other loss.
- Risk
  - A measure of the combined probability and severity of possible harm;
  - mathematically risk is the product of: probability x severity

Tools

- Risk Assessment forms
  - SaferFarm
- Job Safety Analysis
- Preventive Maintenance checklist

saferfarm.org (A.K.A FARM-HAT)

PENNSTATE

Tractors
ROPS

Most Protection

1. ROPS cab with all glass in place and a door that shuts properly.
2. ROPS cab with missing or improperly shutting door or missing window glass; a 4-post ROPS.
3. Two-post ROPS.
4. A modified or homemade ROPS.
5. No ROPS installed on the tractor or tractor with weather cab only.

Least Protection

(over)

Reminders

Effective roll-over protection consists of ROPS with seatbelt.

Seatbelts are to be buckled and worn in ROPS equipped tractors.

Replace a ROPS if it becomes damaged.

ASAE-certified 2-post ROPS are available for many tractors from dealers for less than $1000.

Personal Protective Equipment

Pre-operation Inspections

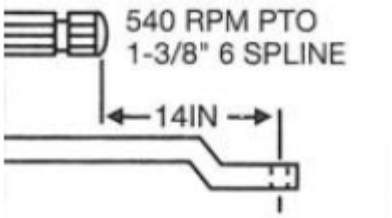
- Review
  - ground conditions, terrain, obstacles
- Complete visual inspection of equipment
  - Lights
  - Brakes
  - Steering
  - Tires
  - Fluids

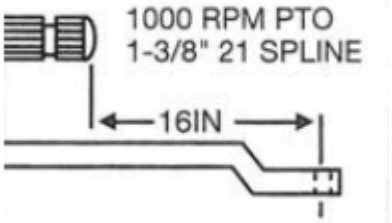
Drawbar

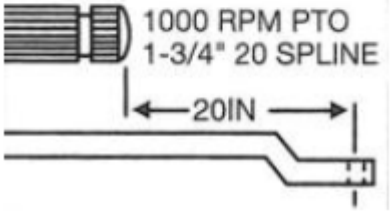
- Categories
  - 0-5; increase in size
  - Increase in loads
- Adjustable or Fixed
- Single attachment point
  - Engineered and placed low to minimize rear rollover

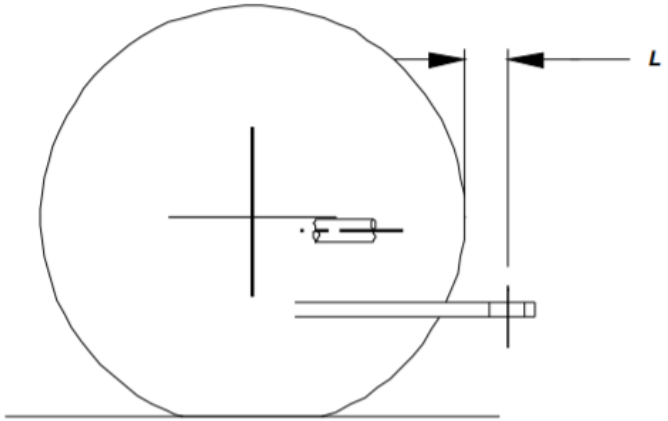
Drawbar

- Avoid
  - “homemade” bars or modifications
- Pre-operation Checks
  - Distance from PTO Stub end to hitch pin hole
  - Distance from OD of rear tire to pin hole (1”)
  - Cracks/gouges
  - Bolt torque
  - Tongue and Clevis
  - Pins & Keepers









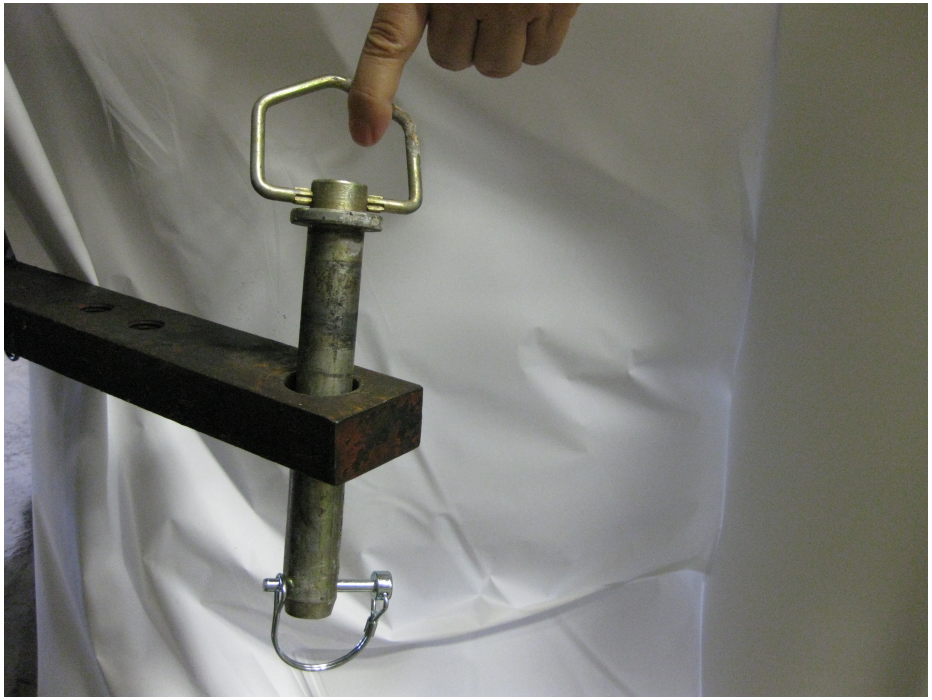
Drawbar Hazard Identification

- Crush
- Run-over
- Stored energy
  - Hitch jack
- Load detachment

Drawbar Hazard Control

- Secure parking brake
  - Chock wheels of implement
- Use a helper
  - Keep clear during backing of equipment
  - Maintain visual contact and use hand signals
- Use a one-person drawbar hitching system
  - Examples:
    - http://www.bergmanmfg.com/index.html
    - https://youtu.be/93EPQ5S8fMA
- Use slow speeds and lower gear when backing

Hitch Pins



Hitch pin selection

Diameter

Grade (shear strength)

Length

Safety Chain

Length

Safety Chain Size

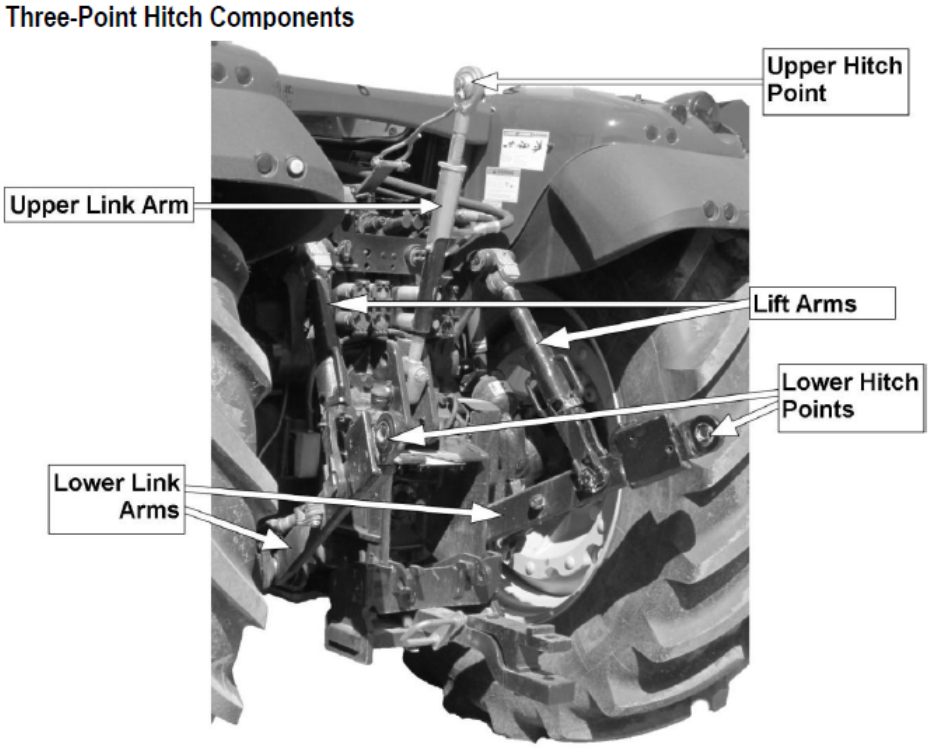
- Minimum strength equal to the gross weight of the implement being towed, for implements up to 80,000 lb (36,300 kg).
- Rated at 80,000 lb (356 kN) for implements weighing over 80,000 lb (36,300 kg).
- The rating of safety chains will be marked on a metal tag and should not be detached from the chain.

Grade

Intermediate support

Three-point Hitch

- Raise and lower implement
  - Hydraulic cylinder
- Top link to adjust set of the implement level
- Pre-op checks
  - Ensure controls are in depth position
  - Restrict side movement of draft links
  - Check drawbar position
  - Check ballast requirements
  - Check hitch pins and alignment



Three-point Hitch Hazard Identification

- Pinch point
- Run-over
- Crush
- Roll-over or tipping
- Load detachment

Three-point Hazard Control

- Proper ballasting of tires
- Use helper
  - Hand signals and visual contact
- Support stands to align implement
- Use one-person in-cab three point hitching system
- Slow speeds and lower gear during backing.

Power Take Off Shaft

- Power transmission to implement
- 540 rpm or 1000 rpm
  - Size of shaft diameter changes
- Pre-op checks
  - Guards
  - Alignment of drawbar and three-point

PTO Hazard Identification

- Entanglement
- Pinch point
- Run-over

PTO Connections

Types of PTO Retainers

PTO Hazard Control

- Replace worn or damaged driveline components
- Use guarding in good condition

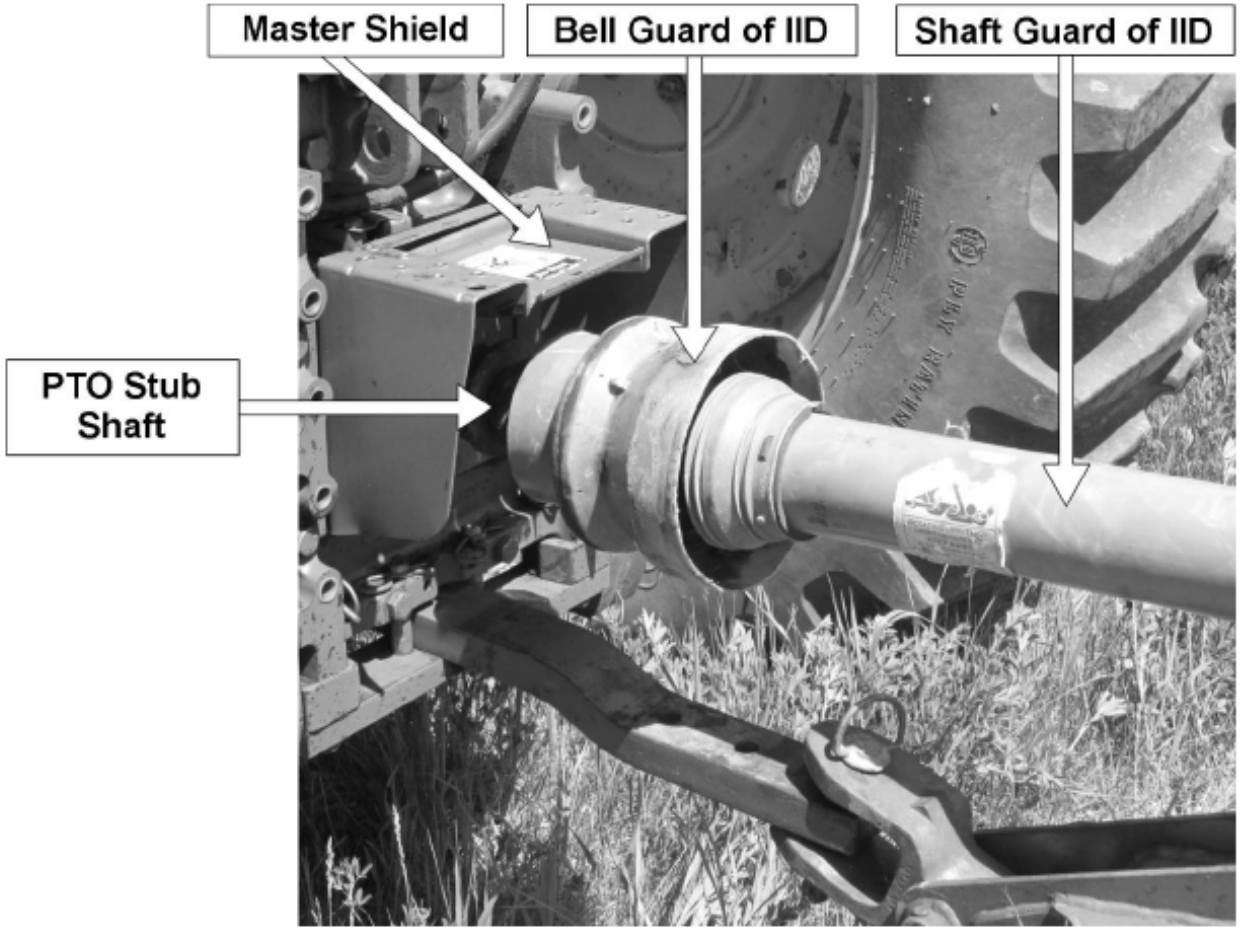
PTO Guarding

Stub cover

Master Shield

Bell Guard

Shaft Guard



Hydraulic Connections

- Operate a high pressure
  - 2,100-3,000 psi
- Allows raising or lowering of implement
- Rotational power
- Engaging mechanisms

Hydraulic Remote Operation

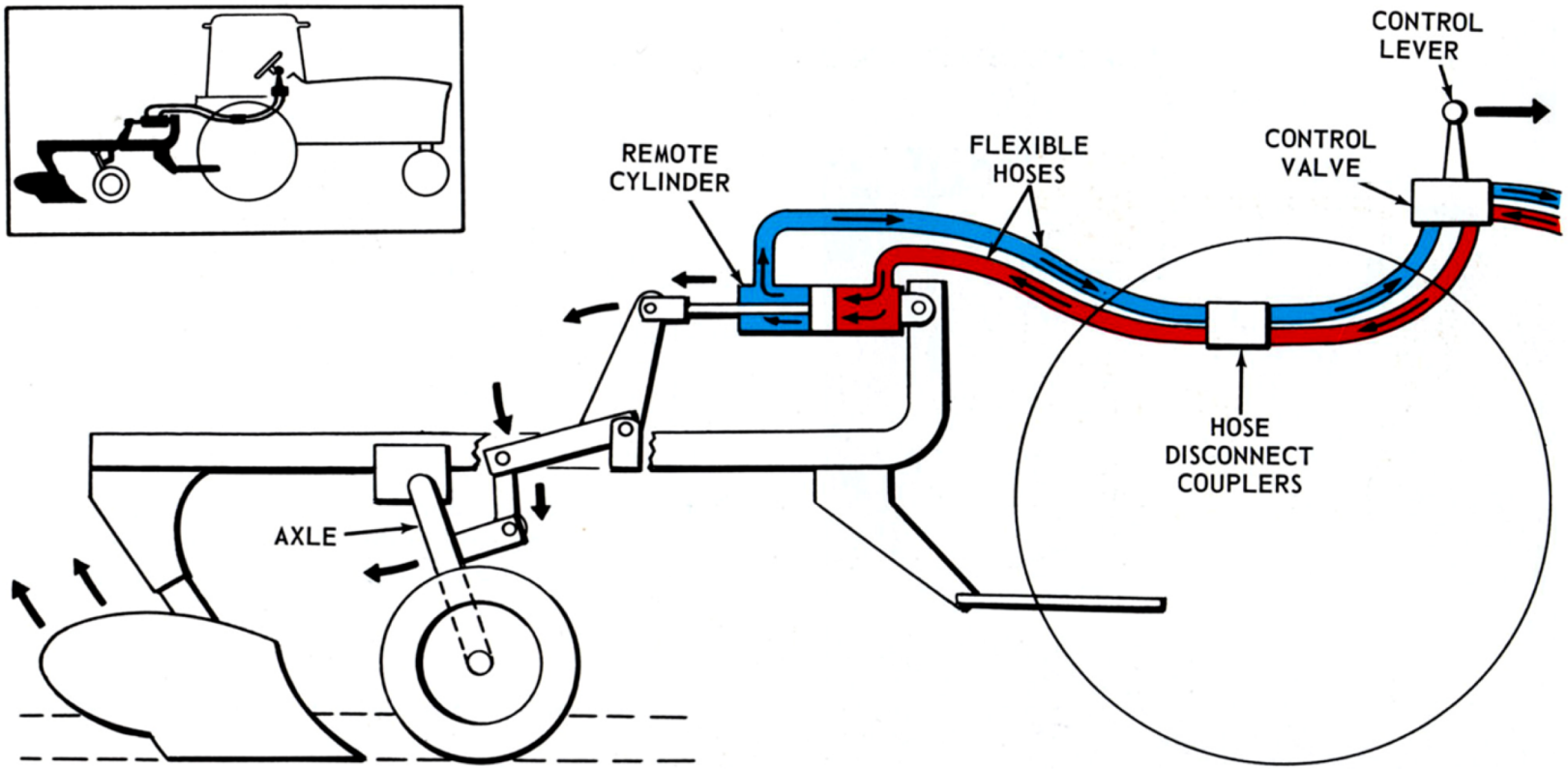


Fig. 7—Raising A Pull-Type Plow Using Remote Cylinder Hydraulics

Hydraulic Hazard

- Fluid injection
- Run-over
- Crushing
- Pinch
- Burn

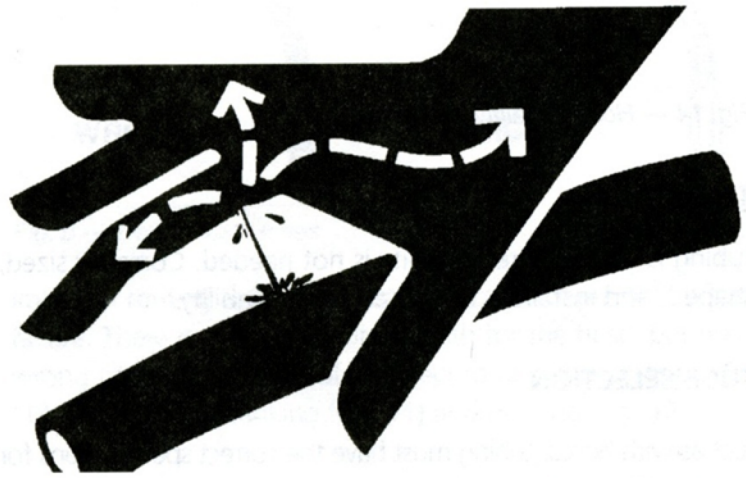


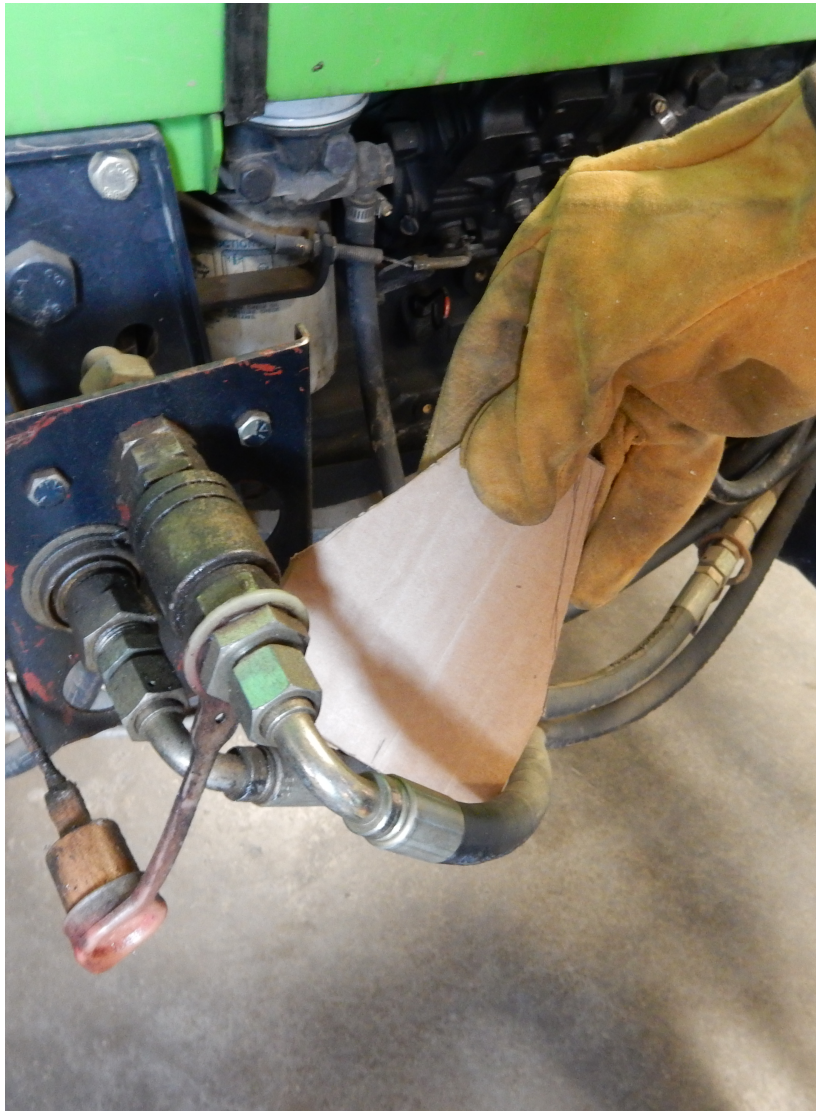
Fig. 16 — Be Careful with Hydraulics

Hydraulic Hazard Control

- PPE
- Use cardboard
- Relieve pressure in circuit
- Repair damaged equipment
- Maintain connections
- Use cylinder locks

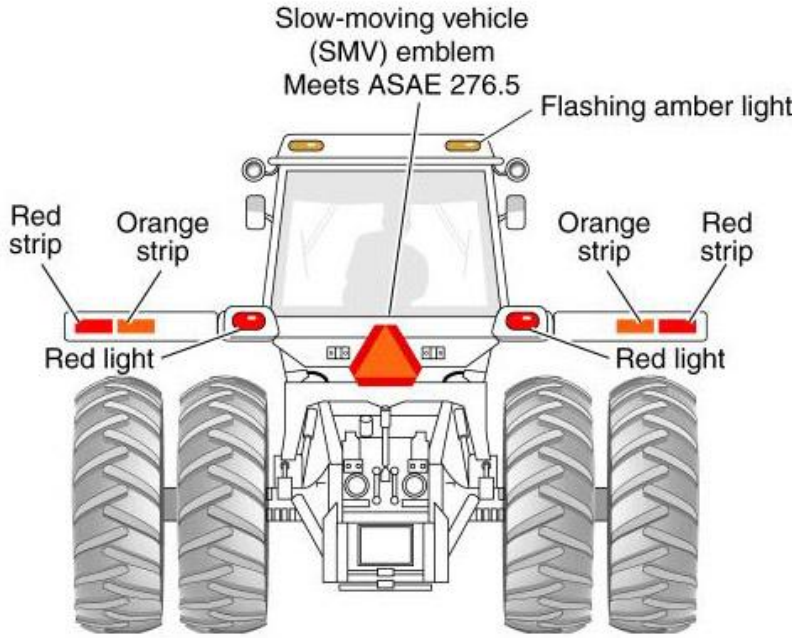
Hydraulics

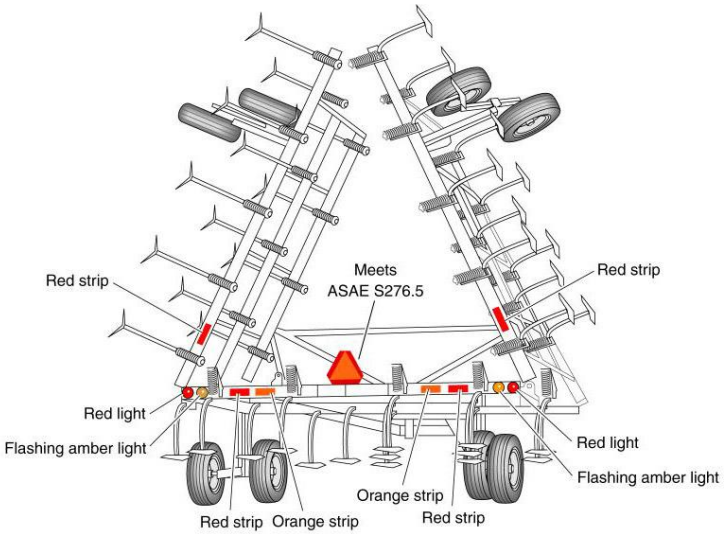
- Pre-op checks
  - Leaks
  - Remove dirt and debris before connections
  - Check hoses for wear
  - Ensure pressure has been released from the system
  - Ensure hoses are protected
  - Check fluid level
  - Transport locks



Electrical

- Operation of safety lighting
- Wiring and terminals
  - Clean and Inspect
    - Check for:
      - Corrosion
      - Wear
  - Maintain support(s) for wiring
  - Ensure functions with controls in the cab.





Maintenance

- Brakes
  - Stopping
  - Hard turning
- Types
  - Band brakes (external contacting)
  - Shoe brakes (internal contacting)
  - Disk brakes
- Actuators
  - Mechanical
  - Hydraulic

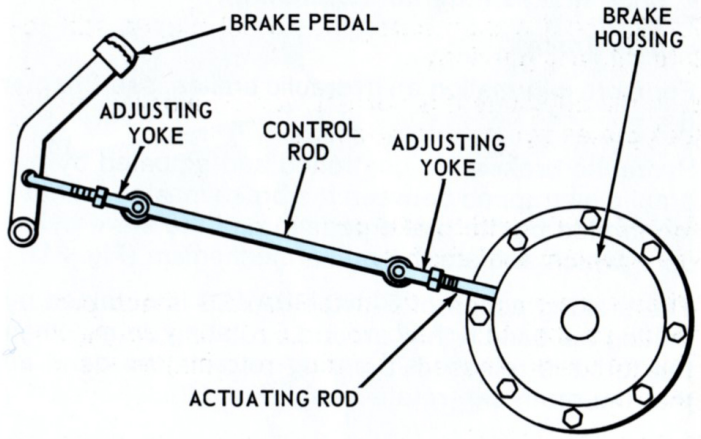
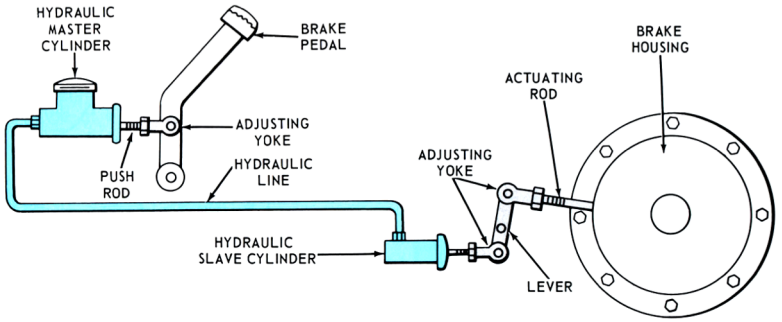


Fig. 30—Mechanical Brakes

Fig. 31—Hydraulic Brakes



Servicing Brakes

- Check for too much pedal free travel
- Poor or uneven braking action
- Look for leaks and loose fittings
- Check fluid reservoir

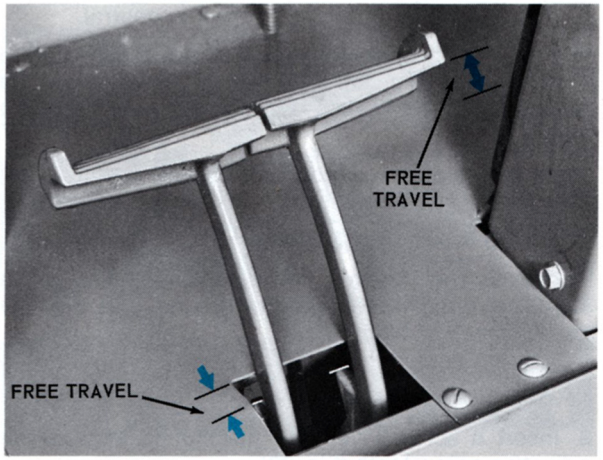
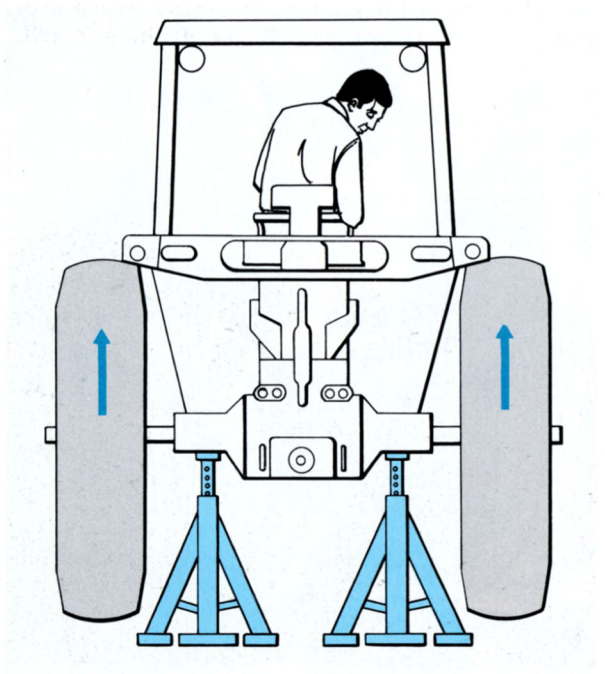


Fig. 36—Two Methods Of Measuring Pedal Free Travel

Fig. 38—Checking For Equal Braking Action



Maintenance

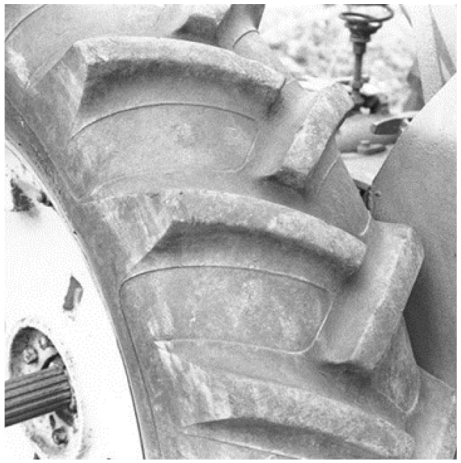
- Tires
  - https://youtu.be/OPcxzoDkdAE
  1. Use the proper tire for the application.
  2. Always inflate to recommended pressure.
  3. Do not overload.
  4. Never exceed the tire speed rating.

When inflating, use a safety cage or long hose attachment to keep the mechanic away from the tire and rim

Tire Damage

- Improper tire inflation
- Objects
- Spinning
- Stubble damage - spacing

Tire Visual Inspection



#1

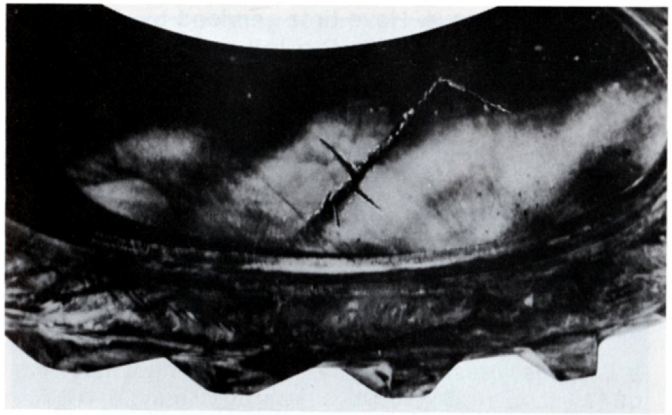
no gouging or other tread or sidewall damage and is probably rated with at least 90% tread wear.

#3

some damage between the lugs and is at or below 50% remaining tread wear.

#5

The cracking in the tread area has damaged the tire and the tread wear remaining is in the 10-20% range



IMPACT BREAK

SPINNING WEAR

STUBBLE WEAR

EMBEDDED STONE

Fig. 50—Damage Caused By Tire Abuse

Tire Inflation

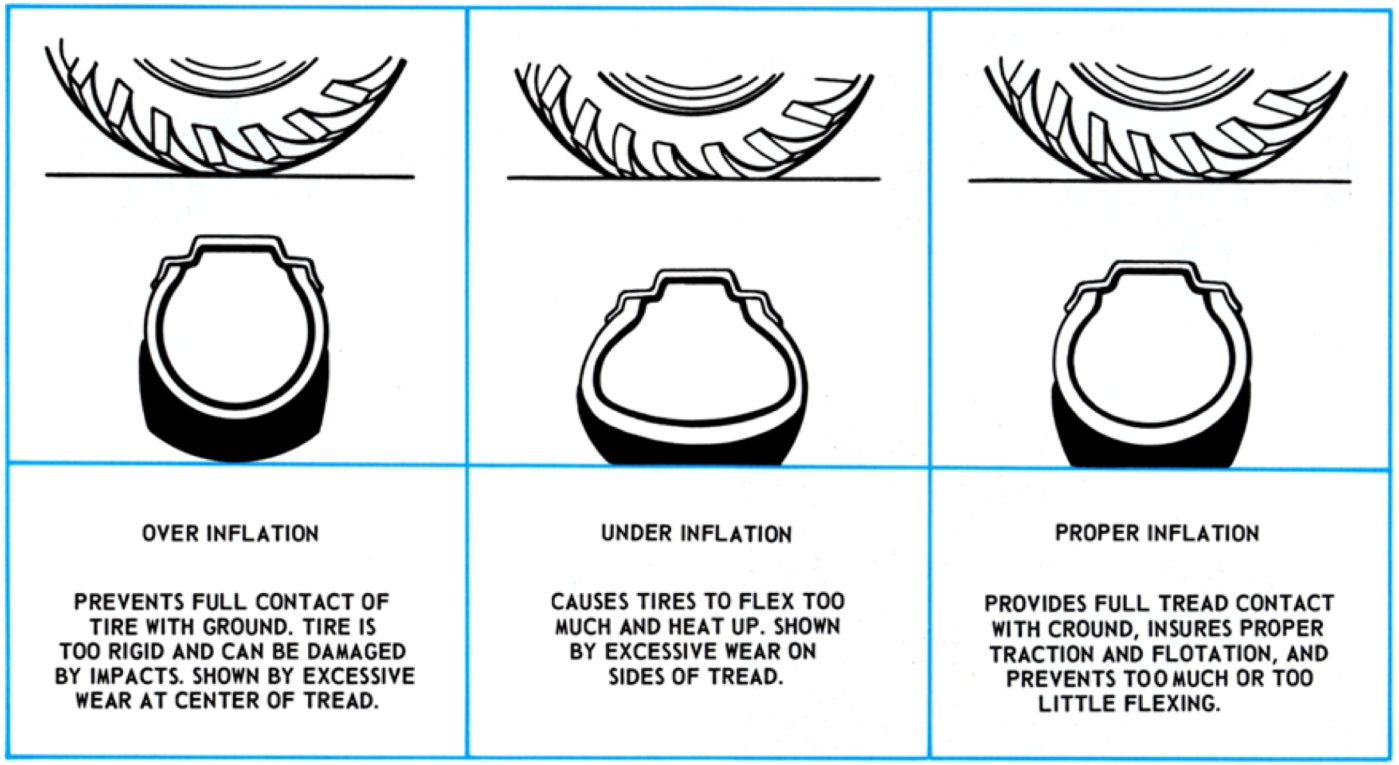


Fig. 45—Tire Inflation

Operating the Tractor

- Roll-overs hazard
  - Side
  - Rear
- Run-overs hazard
  - Bystanders
- Falls
- Noise
- Eye Injury
- Entanglement

Safe Operations

Always face the tractor for mounting and dismounting. Use three points of contact. Never jump from the tractor.

Fasten Seat Belt
(ROPS equipped tractor)

Avoid ditches, embankments, and holes

Reduce speed when turning, crossing slopes, and on rough, slick, or muddy ground

Stay off slopes too steep for safe operation

Safe Operation

Watch where you are going

No riders

Avoid jerky turns, starts, and stops

Hitch properly (Drawbar and three-point)

Set brakes securely when stopped (parking brake)

Communicating with hand signals

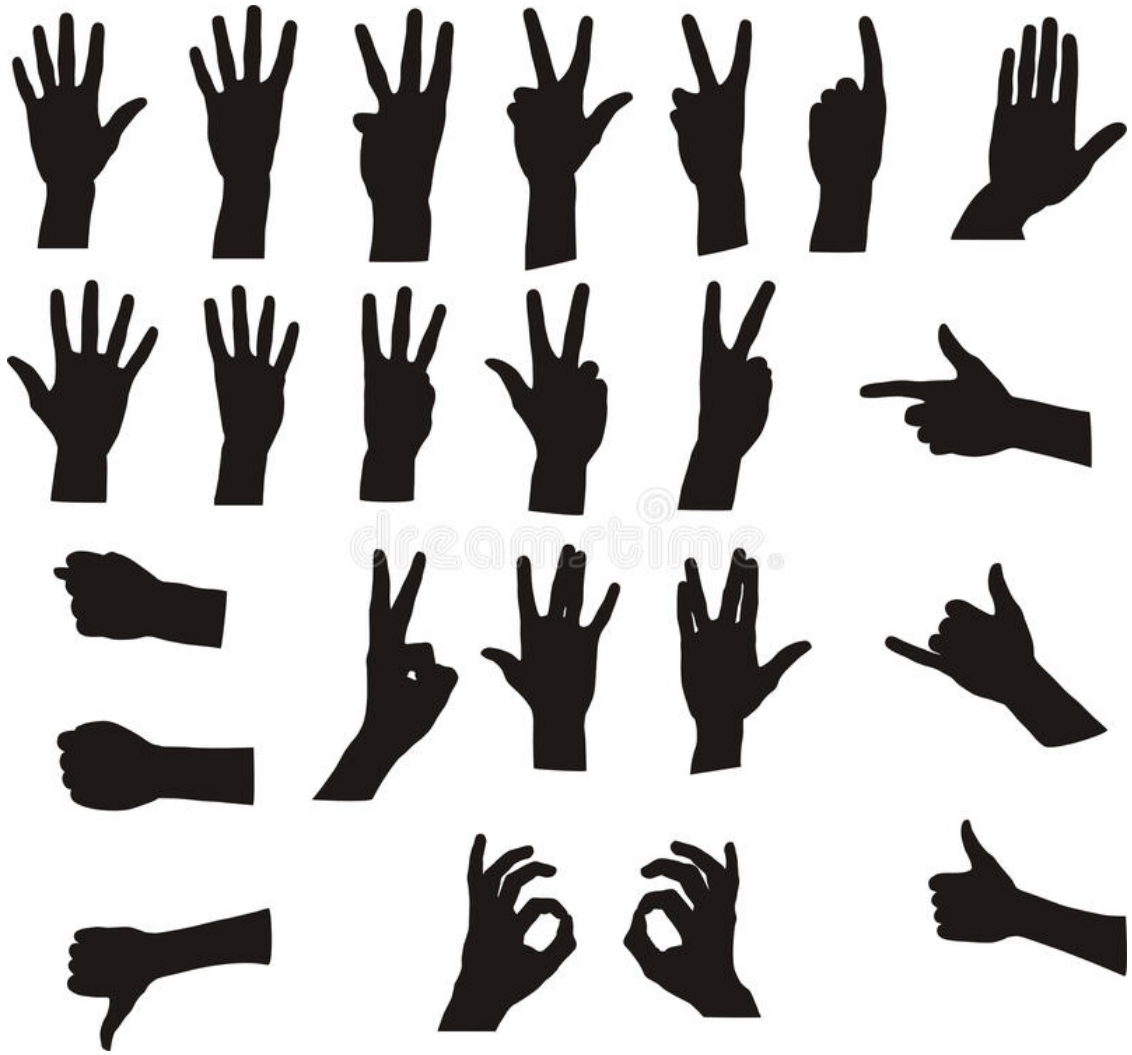


Figure 8 – START THE ENGINE — Simulate cranking of vehicles by moving arm in a circular motion at waist level.

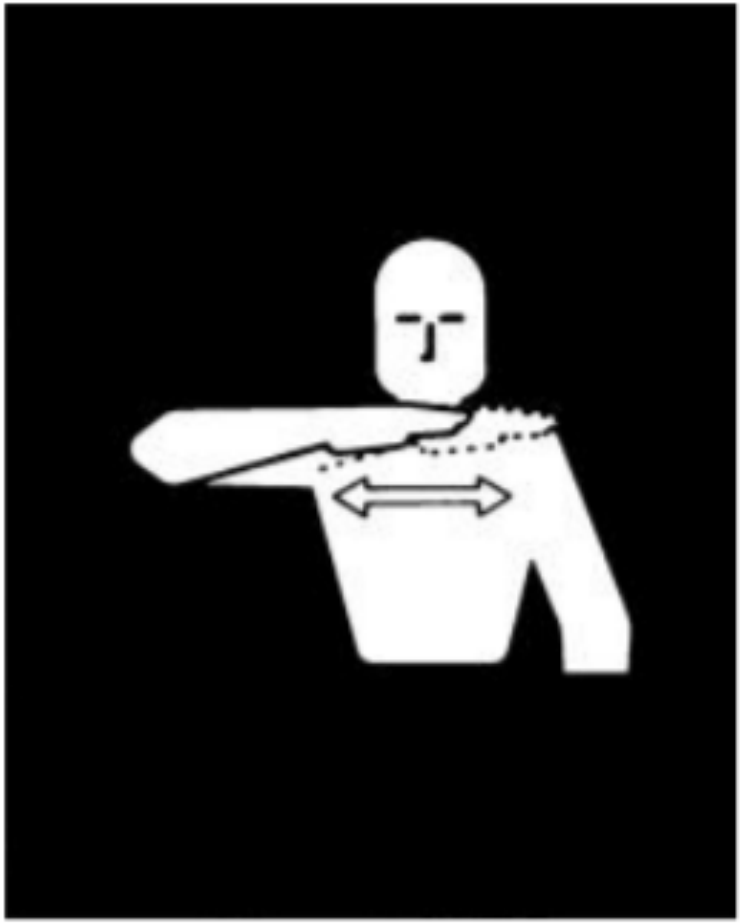


Figure 9 – STOP THE ENGINE — Draw right hand, palm down, across the neck in a “throat cutting” motion from left to right.

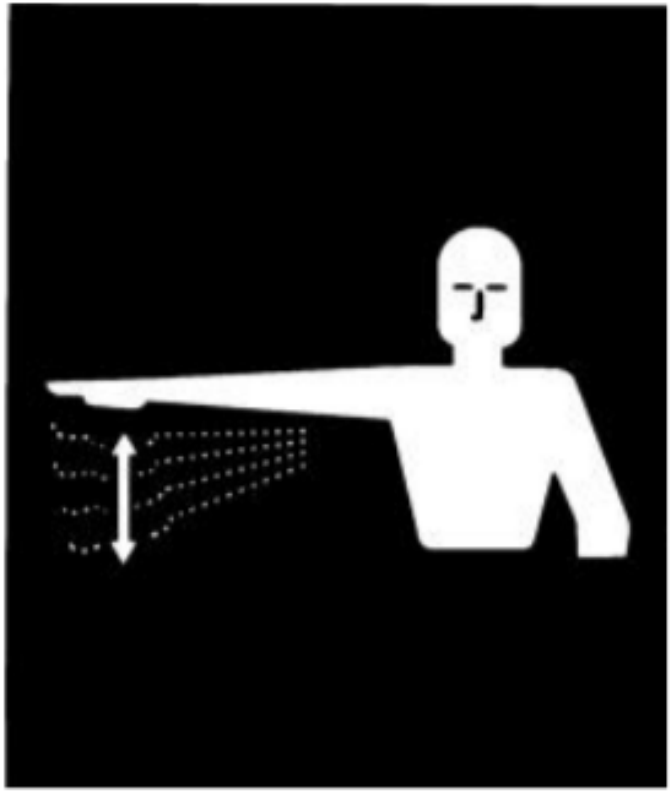


Figure 7 – SLOW IT DOWN — DECREASE SPEED — Extend the arm horizontally sideward, palm down, and wave arm downward 45 degree minimum several times, keeping the arm straight. Do not move arm above horizontal.

Figure 1 – THIS FAR TO GO — Place palms at ear level facing head and move laterally inward to indicate remaining distance to go.

Figure 5 – STOP — Raise hand upward to the full extent of the arm, palm to the front. Hold that position until the signal is understood.

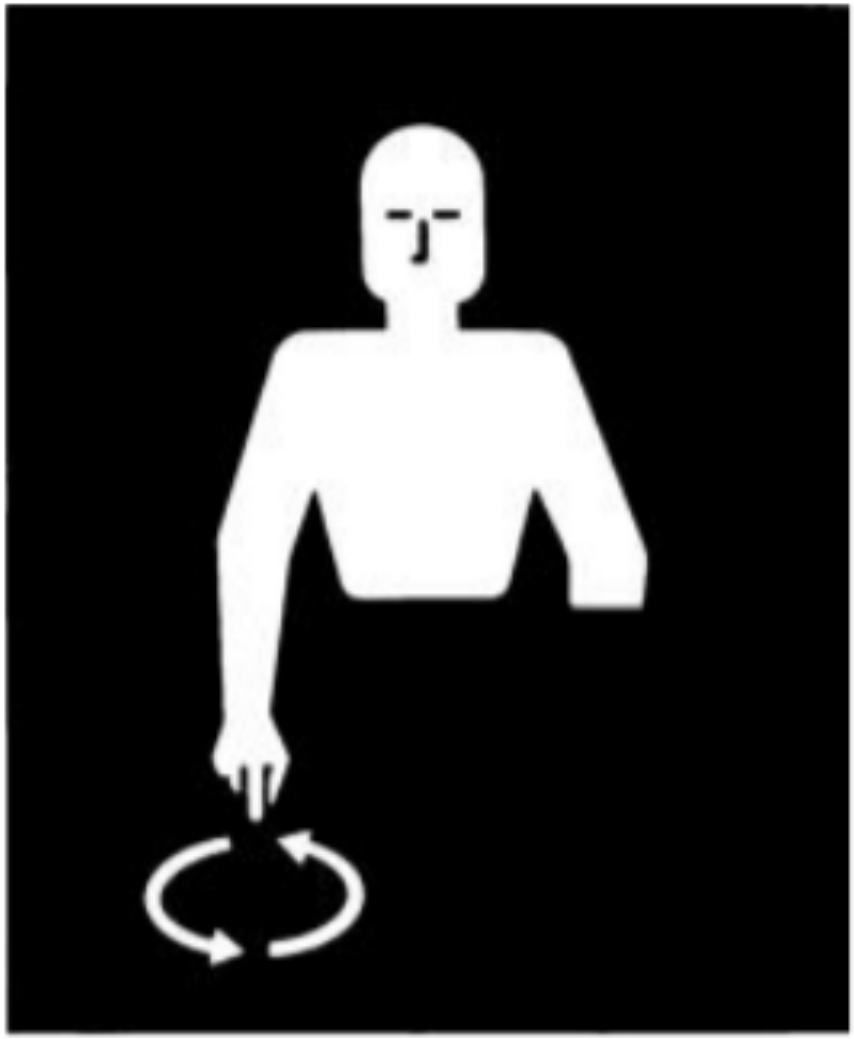


Figure 10 – LOWER EQUIPMENT — Make circular motion with either hand pointing to the ground.

Figure 11 – RAISE EQUIPMENT — Make circular motion with either hand at head level.