1974

Hazardous Occupations in Agriculture for Boys and Girls 14-16 Years of Age

Cooperative Extension, South Dakota State University

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Hazardous Occupations in Agriculture

For Boys and Girls 14-16 Years of Age*

*As referred to in the Department of Labor Standard's exclusion features to Hazardous Occupations in Agriculture in order to become eligible for employment OFF the home farm.
# 5927585

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This publication has been compiled from safety sections of Manuals 1, 2, 3 and 4 of the 4-H Tractor Program - to familiarize youth (including non-4-H members) who are 14 but not yet 16 with tractor safety. Satisfactory completion of this 10-hour course, passing a written examination and demonstrating the ability to safely operate a tractor on a 4-H tractor operator's contest course would qualify the participants for exemption from order no. 5 of Interim Determinations by the Department of Labor.
LEARNING HOW TO BE SAFE

Did you know that just one hundred years ago a 1-year-old child had only a fifty-fifty chance of reaching adulthood? Scarlet fever, diphtheria, smallpox and other diseases took the lives of many children. Thanks to modern medicine these diseases can now be controlled by vaccinations and "miracle drugs." Nowadays a 1-year-old child has an excellent chance of growing up—if he does not have a bad accident. In fact, accidents cause more deaths to persons between the ages of 15 and 24 than all other causes added together.

You cannot be vaccinated against an accident, but you can greatly reduce your chances of having an accident by developing some good safety habits. One of the main purposes of the 4-H Tractor Program is to help you form good safety habits, and thus reduce the number of accidents with farm tractors and machinery.

AGE OF TRACTOR ACCIDENT VICTIMS

Tractor accidents cause more than 1,200 deaths each year in the United States. Figure 2 shows how these are divided among the different age groups. One-third of these victims are under 20 years old. This is a good reason for you to be careful as you "grow up" with your tractor. Listen to your leader and your parents when they tell you how to be a safe operator.

Even after you think you have learned how to operate a tractor safely you can't relax for a minute—an accident has no respect for age or experience. Look at Fig. 2 again. Notice that a number of accidents happened to all age groups.

One more thing. Did you see how many accidents happened to children under 10 years old? How do you suppose these happened to children who were too young to operate a tractor? The National Safety Council tells us that most of these were "extra" riders on the tractor or on the implement the tractor was pulling. This points to the need for you to follow one very important rule. Keep young children off tractors and away from areas where machinery is working.

Operating a tractor is serious business and a full-time job. Make up your mind that you are going to be a safe tractor operator. Start right now. Here are some important safety rules that must always be followed.
LEARNING HOW TO BE SAFE

THE OPERATOR MUST BE THE ONLY PERSON ON THE TRACTOR

The safest place to ride on a tractor is in the operator's seat. Since there is just one seat on a tractor, there must be only one rider—the operator. No matter where the extra person rides he may lose his balance and be thrown off if the operator has to stop suddenly or make a quick turn to avoid a hazard.

This rule also applies to riding on equipment that is hitched to the tractor. One of the most dangerous practices is to give children a ride on mounted equipment such as a front-end loader. Remember the study by the National Safety Council, which was summarized in Fig. 2. Many of the fatalities to children under 10 years old were caused when a front-end loader tripped and the children were run over by the tractor.

The operator must be the only person on the tractor and there must be no riders on the equipment hitched to the tractor. The operator has a full-time job keeping the tractor under control. He has no time to look out for the safety of "extra" riders.

ALWAYS OPERATE THE TRACTOR AT A SAFE SPEED

Unsafe speeds may cause a tractor to upset. Since a tractor can turn over in half a second or less, the operator cannot possibly get off the tractor in time to avoid the chance of getting injured or killed. (Ask your leader to demonstrate how long it takes to make a simple reaction.)

Safe speeds vary with the situation, but you must be extra careful when going back and forth to the fields. Records show that one-third of the tractor accidents happen under these conditions. You can upset a tractor going in a straight line at even 8 miles an hour, if the wheels hit an object or drop into a hole. Eight miles an hour is about twice as fast as you can walk. The same thing could happen at 6 miles an hour or less while the tractor is turning. When speed is doubled, the chance of upsetting is four times as great.

SHUT OFF THE ENGINE BEFORE REFUELING

Fuel vapor, which is invisible, can collect around the tractor engine and may cause a fire. This is most likely to happen when you refill the tractor fuel tank, even though liquid fuel is not spilled. Fuel vapor is three times heavier than air, and will flow downward and collect around the engine. Refueling when the engine is hot or while it is running may cause the vapor to ignite from a hot manifold or a "loose" spark. To avoid starting a fire, shut off the engine and wait until it has cooled before refueling.

Check the fuel system for leaks as they can cause fires, too. You can't be too careful in making sure your tractor is safe.
LEARNING HOW TO BE SAFE

OPEN THE SHED DOOR BEFORE STARTING THE TRACTOR

Exhaust gases from an engine contain carbon monoxide. When breathed in sufficient quantity it is a deadly poison. You can’t see it or smell it so you have no way of knowing when this deadly gas is present. To be safe, always fasten the shed door open before starting the tractor. This allows the fresh air to mix with the carbon monoxide and carry it away.

As an added precaution keep an approved fire extinguisher in the shed and another one on the tractor. Carbon tetrachloride is no longer approved for fire extinguishers. Use the newer ones which contain special chemicals.

HITCH ONLY TO THE DRAWBAR WHEN PULLING A LOAD

The drawbar hitch is the safest place on the tractor for pulling a load. Hitching to the axle or seat bracket, for example, can cause the tractor to upset backwards. The higher a load is hitched to the tractor, the easier it is for the tractor to be pulled over backwards. (Ask your leader to demonstrate some of the causes of upsets by using a model tractor.)

A tractor has enough speed and power to upset backwards in a half-second or less. This means the operator has no chance to escape from being crushed, since it would take him two or three seconds to get clear of the tractor once it starts to upset.

For safe hitching, the drawbar should be from 13 to 17 inches above the ground. On tractors that have an adjustable drawbar, the drawbar should be kept low when pulling a load. Raising the drawbar to get better traction is a dangerous practice that can cause the tractor to upset backwards.

Here’s another important thing to remember. Loose chains dangling from the drawbar are a hidden hazard because they might catch on a stump or rock and give the tractor a sudden jolt, causing it to upset.

To be safe always use the drawbar when pulling a load, and keep it low.

KEEP POWER-TAKE-OFF SHAFTS PROPERLY SHIELDED

A rotating power-take-off (PTO) shaft can be a deadly killer unless protected by shields. Modern tractors have PTO shafts that run at either 540 or 1,000 revolutions per minute. At either of these speeds an unguarded shaft will quickly grab your clothes should you brush against it. Your clothes can be wrapped around the turning shaft at the rate of 8 feet a second. Once you are caught you are no match for the speed and power of the turning shaft, since a ‘1y’s tractors are 500 times more powerful than the average man.

All rotating shafts should be protected. To help prevent PTO accidents, tractors have three different types of guards, or shields: (1) A shield that covers the PTO stub when it is not in use. (2) A master PTO shield, which should remain on the tractor at all times. (3) A shield that covers the rotating shaft when the tractor is connected to an implement. All of the shielding must be used properly to give protection from the rotating shaft. Manufacturers have made this shielding so that it can be used with all combinations of tractors and equipment.
USE CAUTION WHEN MOUNTING OR DISMOUNTING FROM THE TRACTOR

A safe tractor operator doesn’t jump on or off a tractor. Use the steps and handholds that are provided and watch your step. Being in a hurry always increases your chance for an accident. Remember, too, a clean tractor is safer than one that is cluttered with dirt and grease. Don’t use your tractor platform for storing tools. They belong in the toolbox.

Before getting off the tractor make certain that it is left in a safe condition. This means shutting off the engine, setting the brakes, disengaging the PTO shaft, and leaving the tractor in low or reverse gear. On some tractors the gearshift should be placed in the “park” position instead of being left in gear.

REDUCE SPEED BEFORE MAKING A TURN OR APPLYING BRAKES

Tractor brakes are provided for the main purpose of helping to make short turns at slow speeds. They can also be used for making quick stops in case of an emergency. Such might be the case when traveling in high gear on the highway. In this case the brakes should be locked together and adjusted to equal pressure. The brakes may need frequent checking since brakes tend to wear unevenly.

To help prevent upsets, leave the tractor in gear and slow the engine down with the throttle. Then the inside brake can be applied to help make the turn.

KEEP YOUR TRACTOR UNDER CONTROL AT ALL TIMES

The best way for you to prevent an accident is to always keep your tractor under control. A tractor is a completely inhuman machine and, as such, is not responsible for anything it does. The way a tractor acts depends on the operator—his attitude, and his skill of operation.

THINK AND PRACTICE SAFETY

Always remember that a tractor is faster and more powerful than you are and that an accident can only happen under one or both of two conditions: When you do an unsafe act, or when you allow an unsafe condition to exist. You can be the master over the power and speed of a tractor with your ability to think. Learn to correct unsafe conditions and safeguard yourself and your family against potential hazards. Think ahead and avoid accident situations.

Practice being a safe tractor operator at all times. Remember that safety cannot be acquired by rules alone. And you can’t be vaccinated by a doctor to keep you from having an accident. You must develop safety as a habit and always be alert to prevent accidents.

Fig. 14 Use steps and handholds provided.

Fig. 15 A clean tractor is a safe tractor.

Fig. 16

Fig. 17 Safety is a family affair. Sign your safety pledge now. (See the worksheet.)
1. By now you have read and discussed some rules for operating a tractor safely. If you believe that these rules will help prevent accidents, sign your name here as a pledge that you will always do your best to follow them and to be a safe tractor operator.

Signed ___________________________ Member

Show the rules to your parents. Have them sign their names below, both as a pledge to help you become a safe operator, and to always practice safety themselves.

Signed ___________________________ Parent

Signed ___________________________ Parent

2. Look through your Operator’s Manual carefully and see how many additional safety rules you can find. If you can think of some that aren’t given, add those to the list too.

a. _______________________________________

b. _______________________________________

c. _______________________________________

d. _______________________________________

e. _______________________________________

f. _______________________________________

g. _______________________________________

h. _______________________________________

i. _______________________________________

j. _______________________________________

k. _______________________________________

l. _______________________________________

m. _______________________________________

n. _______________________________________

o. _______________________________________

p. _______________________________________

q. _______________________________________

(Over)
3. Check the drawbar.  
   Height from drawbar to ground. _______ inches. What should it be: _______ inches.  
   Is it a safe drawbar? _______. Does the tractor have a brace for locking the drawbar in position  
   when pulling a load? _______.  

4. Are all shields in the proper place? _______. If not, which shields are missing? _______.  
   Don't wait, replace shields immediately.  

5. Can you tell by looking at the power-take-off lever if it is engaged? _______.  
   How? _______________________________________.  

6. How many adjustments does the seat have? _______.  
   What are they? _____________________________.  
   Is the seat loose? _______. If so, tighten all bolts and make proper repairs.  
   See if you can adjust the seat so you can reach all of the controls on the tractor from a comfortable  
   sitting position. If not, you may be too young to operate the tractor safely. Check with your leader  
   to see what he thinks.  

7. Give the tractor a complete safety check. List below anything you can find that you think is unsafe.  
   For example, have trash or tools been left on the platform? Is there a leak in the fuel system? How  
   about the tires and wheels? Correct any items that are unsafe. Your Dad will be glad to give you some  
   help. Tell what you did to correct any items that were unsafe.  
   a.  
   b.  
   c.  
   d.  
   e.  
   f.  
   g.  
   h.  
   i.  
   j.  

Note: Fill out this work unit using your own tractor at home. Be ready to discuss  
your experiences with the other 4-H members at your next meeting.
MEMBERS' CHECK-UP

FIRST YEAR UNIT 1

LEARNING HOW TO BE SAFE

Draw a line under the right word or words and place the letter for the correct answer at right of page.

1. Diseases kill (A-more) (B-fewer) farm children than accidents.

2. Extra riders are (A-always) (B-sometimes) (C-never) permitted on a tractor.

3. Exhaust gases are deadly poison because they contain (A-carbon monoxide) (B-carbon dioxide).

4. When you apply the brake to only one wheel when the tractor is traveling at a high rate of speed you are likely to (A-upset) (B-find the brake has no effect).

5. When speed is doubled, the chance of an upset is (A-doubled) (B-three times as great) (C-four times as great).

6. Before dismounting from a tractor you should: (List the correct answers below)
   a. ________________________________
   b. ________________________________
   c. ________________________________
   d. ________________________________

7. It's safe to hitch to your tractor (A-anywhere on the back end) (B-to the tractor hitch only).

8. Exhaust gases (A-are) (B-are not) a fire hazard.

9. It takes half a second for a tractor accident to happen. In an emergency it may take you (A-1/10 second) (B-1 second or more) to make the proper reaction to avoid the accident.

10. Being a safe operator is mostly a matter of (A-pure chance) (B-thinking ahead and avoiding accident situations).

Note: This Check-Up Sheet is intended to test what you have learned and to stimulate discussion with the other 4-H members. The more you discuss these questions with your leader and the other members the more you learn.
THE INSTRUMENT PANEL

Pilots of space capsules and jet airplanes use an instrument panel to tell them if all of the systems are working properly. Your tractor has an instrument panel for the same reason. The dials and gauges on the instrument panel will warn you of trouble in any of the different parts of the tractor engine. Study the instrument panel carefully so that you will understand what each of the dials or gauges tells you. The Operator's Manual for your tractor will give the correct readings for these instruments. It will also tell you what to do if trouble is indicated.

OIL PRESSURE INDICATOR

An oil pressure gauge is used on some tractors to show the amount of pressure in the engine lubrication system when the engine is running. Instead of a gauge, other tractors have a red light that comes on or flashes to indicate a low oil pressure.

This gauge or light tells you if the oil pump in the crankcase is working. It does not always mean that oil is circulating properly through the engine. If, for example, an oil line is plugged, the proper pressure will still be shown by the gauge, but some part of the engine may not be getting enough oil.

When a tractor engine is first started it takes a while for the circulating pump to build up the oil pressure. This explains why low pressure may be indicated every time you start the tractor. If the correct pressure is not indicated within a few seconds after starting, shut off the tractor and see if you can locate the trouble. Start with the gauge. It may not be working properly. Check the oil level in the crankcase. It may be too low for the pump to work properly. If the oil level is correct, then too much oil is escaping in the system, which usually means the engine needs to be repaired.

Some tractors have a similar light or gauge for the transmission oil.

CHARGE INDICATOR

This gauge is sometimes called an "ammeter" and will let you know whether the generator is charging the battery properly.

There are two common types of ammeters used on tractors. One of these will actually indicate the rate at which the battery is being charged, or discharged. The other is a red light that comes on or flashes when the generator is not properly charging. When the amount of electrical energy supplied to the battery from the generator exceeds the amount supplied by the battery to the electrical system, a charge will be indicated. Discharge will be shown when the energy supplied by the battery is greater than the amount received from the generator.

Both types of indicators are connected to the switch and will normally show discharge after the switch is turned on and before the engine is started. Discharge may also show when the engine is running at a slow idle speed.

You should shut off the engine at once when trouble is indicated by this gauge. There may be a short in the electrical system. A loose or broken connection may be the cause of the trouble, or there may be a faulty generator.
THE INSTRUMENT PANEL

COOLING SYSTEM GAUGE
This gauge shows the temperature of the engine cooling system. With the engine warmed up properly the gauge will indicate "normal" or "run," or give you the actual temperature of the liquid in the cooling system. For gasoline and LPG (Liquified Petroleum Gas) engines the operating temperature should be from 165°-185° F. For diesel tractors the normal operating temperature is usually 180° F. and higher.

If the temperature is too low the engine is not developing all of its power and there will be rapid wear of the moving parts. A faulty thermostat is usually the cause of low operating temperatures. A thermostat keeps the engine at the proper temperature in the same way that it controls the temperature in your house.

When the engine is running too hot there are several possible causes. Shut off the engine and locate the trouble. It may be nothing more than a clogged radiator, or perhaps the fan belt is loose or broken. If you cannot find the trouble right away, call your local dealer.

ENGINE SPEED INDICATOR
On some tractors there is an instrument that tells you how fast the engine is running. It may also show the speed in miles per hour. This will be quite helpful for operations such as spraying, where proper speed is important.

The dial is marked in revolutions per minute and tells you how fast the crankshaft of the engine is turning. A special mark on the dial indicates the standard PTO speeds of 540 and 1,000 revolutions-per minute.

The number of hours the engine has been used is also given by another dial. This can be used to help remind you when the tractor needs servicing.

FUEL GAUGE
Most modern tractors have a gauge that shows how much fuel is in the tank. A good tractor operator never lets the tank run dry. This is particularly important if the tractor burns diesel fuel or LPG. Every time a diesel tractor runs out of fuel, it takes time to vent the fuel system and re-start the engine after refueling. If you run out of fuel with an LPG tractor, you may be a long way from the fuel storage tank. Since LPG has to be stored under high pressure you need special equipment for refueling.

Keeping the fuel clean is a problem with diesels. Some diesel tractors have a fuel pressure gauge to show when the fuel filters are plugged.
1. Draw a diagram of the instrument panel on your tractor. Show the location of (a) oil pressure indicator (b) charge indicator (c) water temperature gauge (d) engine indicator (e) fuel gauge. Draw a small circle in the proper location to indicate each of these dials. Inside the circles place the letters a, b, c, d, and e to indicate which gauge properly matches those listed. Hint: Your Owner's Manual may help you identify these gauges.

2. What does the oil pressure gauge indicate? _______________________

Draw a picture of this gauge and show the proper location of the needle when the engine is running.

If your tractor has a light instead of a dial, check here _____________

3. Tell what you should do if the oil pressure gauge does not show the proper amount of pressure with the engine running. _____________________________________________

4. What does the charge indicator or ammeter tell you? _______________________

(Over)
Draw a picture of the charge indicator and show the proper location of the needle when the engine is running.

If your tractor has a light instead of a dial, check here. 

5. Tell what should be done if the charge indicator does not indicate the proper rate.

6. Where is the water temperature gauge located? 

What is the normal operating temperature for your tractor? 

What type of fuel does your tractor burn? gasoline _________________
diesel fuel _________________ LPG _________________ other (list) _________________

What should you do if the tractor engine runs too hot? 

What would cause a tractor engine to run too cold? 

7. Look at the engine speed indicator. What is the rated engine speed? _________________ rpm. What is the rated power-take-off speed? _________________ rpm.

Does the indicator tell you how many hours the tractor has been run? _________________

Does this dial tell you how fast you would be going in the various gears? _________________

8. There may be other gauges or dials on your tractor. Look over your tractor carefully and list them below.

Also indicate the normal reading. 

Note: Fill out this work unit using your own tractor at home. Be ready to discuss your experiences with the other 4-H members at your next meeting.
MEMBERS’ CHECK-UP

FIRST YEAR UNIT 4

THE INSTRUMENT PANEL

Draw a line under the right word or words and put the letter for the correct answer at right of page.

1. The oil pressure gauge (A - will) (B - will not) tell you when you need to add a quart of oil.     ________

2. Operating a tractor engine with a low radiator temperature will result in (A - more power) (B - less power) than when the temperature is normal.    ________

3. A charge indicator is sometimes called an (A - ammeter) (B - thermostat).    ________

4. Low operating temperature of a tractor engine is usually the result of (A - full throttle operation which causes the fan to over-cool the engine) (B - a faulty thermostat).    ________

5. A tractor speed indicator tells you (A - the number of revolutions per minute the engine is turning) (B - the number of feet per second the tractor is traveling).    ________

6. If a diesel engine runs out of fuel (A - the fuel system has to be vented) (B - the engine can be restarted immediately).    ________

7. The same fuel gauge (A - can) (B - cannot) be used for both a gasoline and LPG tractor.    ________

8. If you are plowing and the red light comes on, indicating low oil pressure, you should (A - leave the tractor engine running and go for help) (B - increase the throttle setting to see if the light will go out) (C - shut the engine off at once).    ________

9. The ammeter or charge indicator light will show a discharge of the battery if (A - the generator is not charging properly) (B - there is a broken spark plug wire) (C - the engine is running very slowly).    ________

10. Most tractors (A - do) (B - do not) have a warning light to tell you when to change oil. ________

Note: This Check-Up Sheet is intended to test what you have learned and to stimulate discussion with the other 4-H members. The more you discuss these questions with your leader and the other members the more you learn.
CONTROLS FOR YOUR TRACTOR

The controls on your tractor make it possible for you to "tell" the tractor what to do. In order for you to become a safe and skilled tractor operator it will first be necessary for you to learn the function of each control. You will also need to be able to find and use these controls quickly to stop the tractor, when it is necessary to do so to avoid an accident.

SEAT ADJUSTMENT

Let's start with the seat on your tractor. It should be adjusted to the position that permits you to reach all of the controls from a comfortable sitting position. Most tractors have seats that can be raised or lowered, as well as adjusted to the weight of the operator. If, after the seat is adjusted, you can't reach the controls easily from a comfortable sitting position, you may be too young to start operating a tractor. If you are not sure, ask your leader to help you determine whether you can reach all of the controls safely.

CONTROLS FOR STARTING THE TRACTOR

The controls for starting the engine vary somewhat from one make of tractor to the next. The most common controls are: (1) A key to turn on the ignition and starting systems. On some tractors the key also operates a switch to open and close a fuel supply valve. (2) A starter button that completes the connection of the cable from the battery to the starter motor. Sometimes the key also serves as a starter. In both cases electrical energy is supplied to a solenoid (a kind of electromagnet), which engages the starter gear first, and then closes a switch to operate the starter motor. Some tractors will not start unless the gearshift lever is in "neutral" or "park" position. This is a safety feature to keep you from starting the tractor in gear and possibly causing an accident.

CLUTCHES

A clutch is a device for disengaging or disconnecting a rotating shaft. Several different types of clutches may be found on tractors. The main clutch is called an engine clutch and is used to disconnect power to the transmission when you want to stop or change gears. When this clutch is disengaged, power to the transmission is stopped and the gearshift lever can be moved to the desired position. When the clutch is engaged the tractor will start moving. *To be safe, always engage a clutch gradually.* It means less wear and tear on the tractor, too.

This same type of clutching mechanism is also used to control power to such places as the PTO shaft or belt pulley. Sometimes these clutches can be used when the tractor is moving. With some tractors, the engine must be running before the PTO can be engaged. Always check the Operator's Manual to be sure.

ENGINE SPEED CONTROL

The engine speed control is often called a "throttle." Actually it is a governor control on most tractors. On gasoline or propane tractors the throttle lever regulates the governor spring pressure, and a rod leading from the governor controls a throttle plate in the carburetor throat. The throttle plate controls the amount of fuel and air mixture entering the cylinders. The speed of an engine is determined by the amount of fuel and air mixture that is burned during the power stroke.
CONTROLS FOR YOUR TRACTOR

The purpose of the governor is to help maintain a constant engine speed for a given "throttle" setting.

Diesel tractors also use an engine speed control lever and governor for controlling engine speed. But on a diesel engine the governor controls speed by changing the amount of fuel injected into the cylinders.

With the engine speed control lever, the desired engine speed can be selected for the load you are pulling. Many times when pulling a light load you can save fuel by using a higher gear and a lower engine speed.

BRAKES FOR TURNING AND SAFETY

Brakes are used on a tractor for three reasons: (1) to assist in making short turns in field operations; (2) for emergency stops; and (3) for parking.

Your tractor is equipped with two brake pedals. Each pedal controls the brake on one side of the tractor. When the brake pedal is engaged, pressure is applied to the brake drum on one side of the tractor. This slows down or stops movement of the rear wheel on that side. This causes the tractor to try to turn in a circle, and explains why braking the rear wheel on the side towards the turn will actually make it easier to turn shorter. If you hit only one brake hard with the tractor going at a high rate of speed, the tractor may upset. For traveling in "road gear," both brakes must be locked together in case an emergency situation makes it necessary to come to a sudden stop. Always keep both brakes adjusted equally. Some of the modern tractors have power or hydraulic brakes. Less pressure is needed to operate these brakes, so you need to be very careful in using them until you are thoroughly familiar with their operation.

STEERING

A steering wheel is used to transmit turning effort to the front tractor wheels. The turning effort may be transmitted by shafts, linkage, and gears, or it may be transmitted by oil under pressure. Tractors with narrow front wheels are called "tricycle" tractors and are capable of making very short turns. Tractors with wide front wheels are called "general purpose" or "standard" tractors. They can't turn as short as the tricycle tractors but they are quite useful for general operation.

Most new tractors are equipped with power steering. Less effort is required to turn the steering wheel, which helps to make it less tiring to operate the tractor on rough ground or for extended periods.

TRANSMISSIONS

Your tractor is equipped with a gearshift and transmission. This is a device for changing tractor speeds to match the operation you are performing. On some tractors speed can be changed with the tractor in motion. On others the tractor must be stopped and the clutch disengaged before the gears can be changed. Tractors formerly had only one reverse and three forward speeds. Modern tractors have two or three times as many speeds to select from as the older models.
CONTROLS FOR YOUR TRACTOR

1. Try the seat on your tractor. How many adjustments does it have? ____________________________

What are they? ________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

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2. Sit in an operating position with your hands on the steering wheel. Can you reach and operate all of the hand and foot controls? ________________ If not, which ones can’t you reach? ____________________________

______________________________________________________________________________

______________________________________________________________________________

3. Draw a diagram of the gearshift pattern on your tractor. Use the numbers to show the various gearshift positions.

______________________________________________________________________________

______________________________________________________________________________

4. Does your tractor have a hand clutch? ____ foot clutch? ____ Can you shift gears without using the clutch? ______ (Read the Owner’s Manual carefully to find the answer.) If your answer to the last question was yes, tell which gears can be shifted without a clutch. ______________________________________

5. Does your tractor have an additional clutch to vary the forward speed of your tractor “on the go”? ______ What is it called? ____________________________________________
6. Take a look at the engine speed control lever on your tractor. With the tractor not running, have another member move this lever back and forth. See if you can tell how it controls speed. Draw a diagram of the speed control lever, showing the direction of movement of the various parts as speed is increased.

7. Where are the brakes located?

Can they be locked together? How do you set the brakes so the tractor will not roll away when you leave it on a slope?

Are the brakes mechanically operated? Hydraulically operated?

8. Does the tractor have power steering? If so, does the power steering work when the engine is not running? Why?

9. Make a complete list of all of the controls on your tractor. Tell what each one does.

<table>
<thead>
<tr>
<th>Control</th>
<th>What It Does</th>
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Note: Fill out this work unit using your own tractor at home. Be ready to discuss your experiences with the other 4-H members at your next meeting.
MEMBERS’ CHECK-UP

FIRST YEAR UNIT 5

CONTROLS FOR YOUR TRACTOR

Draw a line under the right word or words and put the letter for the correct answer at right of page.

1. (A - All) (B - Some) tractors can be shifted from one gear to another without using the clutch.    
2. Diesel tractors vary engine speed by regulating (A - the amount of air taken in during each intake stroke) (B - the time of fuel injection) (C - the amount of fuel injection).  
3. If you apply only one brake while traveling at a high rate of speed you will probably (A - kill the engine) (B - upset the tractor).    
4. When you push down on a foot-pedal clutch, the transmission is (A - engaged) (B - disengaged).  
5. Tractors having power steering (A - do) (B - do not) have a shorter turning radius than those without power steering.    
6. (A - One) (B - Both) of the brakes should be used to make an emergency stop.  
7. (A - All) (B - Most modern) tractors cannot be started unless the transmission is in neutral or park.  
8. Operation of a modern tractor requires use of (A - both hands and both feet) (B - both hands and the left foot) (C - both hands, both feet, and your head).  
9. The throttle on a gasoline tractor is actually a (A - governor control) (B - control attached to the carburetor) (C - device for increasing the fuel as it mixes with air).  
10. It is important from a safety standpoint to have both brake pedals (A - adjusted for different pressures) (B - adjusted so pressure is applied evenly when the pedals are locked together).  

Note: This Check-Up Sheet is intended to test what you have learned and to stimulate discussion with the other 4-H members. The more you discuss these questions with your leader and the other members the more you learn.
DAILY MAINTENANCE AND SAFETY CHECK

In order for scientists to launch a space vehicle a careful count-down must be made to insure the proper function of all the various parts. While a tractor is not nearly as complicated as a space rocket, it still must be mechanically fit and safe for the day’s work. In this unit you will learn how to develop your own “count-down” so your tractor will operate properly once it is started for the day’s work.

THE AIR CLEANER ASSEMBLY

Every gallon of fuel burned in an engine requires from 6,000 to 9,000 gallons of clean air. The air cleaner must remove dirt and dust from the incoming air so it will not get into the engine where it could cause rapid wear and extensive damage. Without an air cleaner, an engine can be completely ruined in one day’s time. The air cleaner cup should be checked every day for dirt content and proper oil level. On some of the newer model tractors a dry type of air cleaner is used. To be sure that you service the air cleaner properly, check the instructions in your Operator’s Manual.

COOLING SYSTEM

The cooling system is really a “heat control” to keep the engine at the proper temperature. When the fuel-air mixture burns inside the cylinder a great amount of heat is created. Temperatures often reach 3,000 to 4,000°F. Part of this heat must be carried away by the cooling system. It is also possible to keep the engine too cool. A cold engine uses more fuel, wears faster, and will not develop full power. To maintain proper engine temperature, a control called a thermostat is used in the cooling passage between the engine and radiator. This device opens when hot and closes when cold. It maintains proper engine temperature by controlling the amount of liquid that passes through the radiator for cooling.

The cooling system should be checked every day to see if the liquid level in the radiator is high enough to let it circulate properly. Don’t try to keep the radiator full. Some space must be left for the liquid to expand when the engine gets hot. Watch the heat gauge, because it will tell you whether the cooling system is running at the proper temperature. The fan belt and pressure valves in the radiator cap should also be checked. Before removing a radiator cap always allow the engine to cool. Remove the cap slowly for sudden release of hot water under pressure may cause serious burns.

OIL IN THE CRANKCASE

The oil in the crankcase helps keep the engine clean, reduces friction of moving parts and carries away some of the heat produced in the cylinder. It also acts as a cushion between moving parts to reduce shock and to form a seal between the piston and cylinder wall. If an engine does not have enough oil in the crankcase it will soon overheat, causing extensive damage.

Tractor engines are equipped with a dip-stick or plug level check to show the amount of oil in the crankcase. The level of the oil should be checked daily. Add oil if the dip-stick shows too low a level. If the dip-stick shows increase in oil level, check for dilution from the fuel or cooling systems.
DAILY MAINTENANCE AND SAFETY CHECK

THE FUEL SYSTEM
Make it a habit to check the fuel supply each time before starting an engine. Include the sediment bowl, fuel line, and carburetor in your inspection. Keep the fuel supply clean, and avoid contamination by water. This is particularly necessary with diesel tractors. They have close-fitting parts that can be quickly ruined with even a minute particle of dirt. Use a trap or filter on your diesel storage tank and keep the traps and filters on the tractor clean.

LPG fuel is stored under high pressure and can’t be checked by looking in the tank. Most LPG tractors have either a direct reading sight gauge or a rotary tube that indicates the fuel level. Caution—direct contact of LPG fuel with fingers, face or any part of the body can cause a severe “frostbite.” Be careful when checking fuel level, or transferring fuel.

LEVEL OF LIQUID IN THE BATTERY
The battery provides electrical energy for starting the tractor and for operating the lights and other accessories. The life of a battery depends on (1) keeping the battery fully charged at all times, (2) keeping the liquid level above the plates, and (3) keeping the battery clean. Permitting the plates to remain exposed to air for any length of time will cause deposits to form on the plates in the battery and shorten its life.

If the liquid level is too low, refill with distilled water or with rainwater caught in a non-metal container. It is better to use clean tap water even though it may contain harmful minerals, than to let the battery run dry. Be careful not to contact the battery with your hands or clothes. The sulfuric acid solution from the battery will quickly burn or eat holes in cloth.

When you check the battery for liquid level look at the clamps on the posts. Tighten them if they are loose, being careful not to ground the “hot” terminal. Grounding the “hot” terminal could cause sparks that might explode the vapor on top of the liquid in the cells. The vapor is an explosive mixture of hydrogen and oxygen.

GREASE THE TRACTOR
There are some fittings on your tractor that need daily service. Check your Operator’s Manual to see where they are located. Also check to see what kind of grease should be used, and how much is needed. Be sure to wipe each fitting with a cloth before greasing. Leave a little grease on the fittings when you finish. This will help to keep the dirt out. As you grease these fittings every day, check for broken fittings or fittings that do not take grease. Replace these fittings immediately.

MAKE SAFETY A DAILY HABIT
Safety must become a daily habit. Each time a tractor is used it should be looked over carefully for any unsafe condition that might cause an accident. This inspection can be made at the same time you make the daily maintenance check. There is almost no limit to the number of items that should be checked. The steering mechanism must be properly adjusted. Check the tires. A damaged or low tire can cause an accident. Keep tires properly inflated.

Other items you should check include the fan belt, brakes, clutch, seat, and shields. Make sure there are no leaks in the fuel system. Keep the tractor clean. Keep tools in the tool box where they belong and not on the platform.

This is only a partial list. Space for a safety check of your tractor is included in the work unit.
In the white sheets we learned about some of the more important daily maintenance needs of a tractor. Take a look at your Operator's Manual and see if you can find more that should be added. How about the hydraulic system? Or the fuel sediment bowl? Perhaps the pre-cleaner on the air cleaner stack should be included too. In checking your Manual, the Daily Maintenance check may be listed under the heading of "10-hour service."

O.K. let's go! Use your Operator's Manual and make up a complete list of daily maintenance items. Better yet, follow the items listed in your Manual and check them out on your tractor. Then, after you are familiar with all of these items, list them below. List them in the same order you want to follow in making the daily maintenance check.

Here's a final suggestion: When you make up your list, start at the seat and platform and move clockwise around the tractor. This will result in a better organized check list that will be easier for you to remember.

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(Over)
Use the blanks below and make up a check list for a Safety Inspection of your tractor. Then ask Dad to help you give it a trial. If you find anything that isn't safe, correct it right away. Report what was done to correct the unsafe item in the right-hand column below.

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<thead>
<tr>
<th>Daily Safety Check Points</th>
<th>Unsafe Items Corrected</th>
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Note: Fill out this work unit using your own tractor at home. Be ready to discuss your experiences with the other 4-H members at your next meeting.
MEMBERS’ CHECK-UP

FIRST YEAR UNIT 6
DAILY MAINTENANCE AND SAFETY CHECK

Draw a line under the right word or words and put the letter for the correct answer at right of page.

1. It (A - is) (B - is not) normal for a tractor engine to use some crankcase oil.

2. Pressure caps are used on cooling systems for (A - keeping the radiator from overflowing when the tractor is not running) (B - more efficient cooling).

3. Every gallon of fuel burned in a tractor engine requires nearly (A - 800 gallons of air) (B - 9,000 gallons of air) (C - 1,000 gallons of air).

4. (A - LPG) (B - Diesel) (C - Gasoline) tractors use a pressurized fuel tank.

5. The liquid in a battery is a solution of water and (A - hydrochloric acid) (B - sulfuric acid) and (A - will) (B - will not) be dangerous if spilled accidentally.

6. It (A - is) (B - is not) possible to overlubricate the clutch on your tractor.

7. Removing the radiator cap suddenly from a pressure cooling system (A - is) (B - is not) dangerous.

8. A loose or broken sparkplug wire (A - can) (B - cannot) cause a fire.

9. On tractors with a battery ignition system the strength of the spark for starting (A - does) (B - does not) depend on how well the battery is charged.

10. A good way to prevent a tractor accident is (A - take your chances) (B - make sure your tractor is safe at all times).

Note: This Check-Up Sheet is intended to test what you have learned and to stimulate discussion with the other 4-H members. The more you discuss these questions with your leader and the other members the more you learn.
STARTING AND STOPPING YOUR TRACTOR

Learning the proper way to start and stop a tractor is an important first step toward becoming a safe, skilled tractor operator. The best place to start is—you guessed it—by reading your Operator’s Manual. Study the Manual carefully to learn the exact procedures for your tractor.

STARTING PROCEDURE

Not all tractors use the same starting procedure. This is particularly true for diesels or LPG tractors. Here are some rules that should be included in the procedure for starting any tractor safely: (1) Make a Daily Maintenance and Safety Check as outlined in the previous unit. (2) Take your position in the operator’s seat. Adjust the seat so you can reach and operate all of the controls. (3) Place the gearshift in neutral or park. This is necessary on some tractors to make the starter work. (4) Make sure the power-take-off and hydraulic lift levers are in the neutral position. (5) Look out for the safety of others by checking carefully to make sure any persons who may be in the vicinity are well out of the way of the tractor and any equipment that may be attached. (6) Put your foot on the clutch. This reduces the load on the starter and is a good safety precaution in case the tractor is in gear. On some tractors, a safety solenoid switch is provided so the tractor cannot be started unless the clutch pedal is depressed. (7) Turn on the switch and start the tractor. (8) After the engine starts, let it warm up for a while before applying a load.

STARTING A GASOLINE ENGINE

In order for a gasoline engine to start and run, the mixture of fuel and air delivered to the cylinders must be in the proper ratio. It takes about $13\frac{3}{4}$ pounds of air to provide enough oxygen to burn 1 pound of fuel for full-load operation. However, an engine with the carburetor adjusted properly for full-load operation may not start without “choking.”

The choke is a valve in the carburetor that cuts air intake for starting a cold engine. When the choke valve cuts off the air, more fuel and less air is pulled into the engine. When the intake manifold begins to heat up, more of the fuel is vaporized and the choke can be shut off. Excessive choking causes many troubles. Raw gasoline washes the oil from the pistons and cylinder walls. Fuel dilutes the oil in the crankcase. When the engine puffs black smoke from the exhaust it is telling you that the mixture is too rich.

STARTING A DIESEL ENGINE

Diesel tractors do not use a spark for ignition. Instead, the incoming air is heated by the compression stroke to a temperature high enough to cause the fuel to start burning as soon as it is injected. Due to the cold temperature of (continued next page)
the cylinder and the surrounding parts, diesels need some kind of help in starting, particularly in cold weather. Sometimes a glow plug is used to heat the air in the pre-combustion chamber. Other models have a special device for injecting a small quantity of ether with the first few turns of the engine by the starter. All of these devices are used to help heat the engine block so the compressed air in the cylinders will be hot enough to start the engine and keep it running. Diesels do not have a true choke. In cold weather, excess fuel is supplied by adjusting the throttle or with an excess fuel button.

**STARTING AN LPG TRACTOR**

LPG tractors are started in almost the same way as a gasoline tractor. A special fuel tank is required on the LPG tractor since the fuel will completely vaporize at ordinary temperatures if exposed to atmospheric pressure. Most LPG tractors are designed to start the engine on vapor, while the fuel is stored as a liquid under high pressure.

Normally the vapor valve is opened for starting, and the liquid valve is left closed. The vapor valve should be opened slowly, permitting vapor from the top of the fuel tank to become available for starting. If this valve is opened too quickly the sudden rush of gas will cause another valve, called the excess gas valve, to close. You will then have to wait a few minutes for the excess gas valve to open again. The purpose of the excess vapor gas valve is to provide an instant shut-off in case a leak develops in the fuel line from the tank.

Once the LPG engine has started and warmed up to the proper operating temperature, the liquid withdrawal valve should be opened and the vapor valve closed.

**IF THE ENGINE DOESN'T START**

If the engine, whatever its type, fails to start on the first try, wait until the engine stops rotating before trying again. If the starter is engaged while the engine is turning there is a chance of causing damage to the starter or to the ring gear on the engine. In trying to start any tractor don't engage the starter for periods longer than 15 seconds, to prevent the battery from overheating and running down. Don't keep grinding on the starter, because failure to start may be due to something seriously wrong with the tractor.

When the engine fails to start, you have to become a “trouble shooter.” Perhaps you forgot to turn on the fuel. Or there might be a loose or broken ignition wire. Then too, the engine may be flooded by excessive choking, or perhaps you did not have the choke out at all. If you cannot find the trouble right away, then you had better check with Dad.

**STOPPING A TRACTOR**

Just as it is important to know how to start an engine, there are some rules that must be followed when the engine is shut off. The following procedure is suggested. Other suggestions may be listed in your Operator's Manual.

1. Reduce engine speed with the throttle and let the engine idle for a few minutes. This cools the engine down and may prevent warped valves. It also will help keep the engine from backfiring.
2. Shut off the engine. This is done with a switch on a gasoline or LPG tractor. On diesels there is a fuel shut-off valve, either separate or included on the throttle.
3. When the engine is completely stopped, put the gearshift lever in park or low gear. Putting the transmission in gear or park will prevent the tractor from rolling away if it is parked on a slope.
4. Set the brakes. This will also help to make sure the tractor will not accidentally roll downhill.
1. Read your Operator's Manual to find out how your tractor should be started. 
   List, in proper order, the steps given in your Manual.
   a. 
   b. 
   c. 
   d. 
   e. 
   f. 
   g. 
   h. 
   i. 
   j. 

2. Does your tractor have any special attachments for cold-weather starting? 
   What are they?

3. What should you do if the engine fails to start immediately?

4. Make a list of some common causes of hard starting.
   a. 
   b. 
   c. 
   d. 
   e. 
   f. 
   g. 
   h. 

(Over)
5. List, in proper order, the steps you would take in stopping a moving tractor and shutting it off for the night.

a. 

b. 

c. 

d. 

e. 

f. 

g. 

h. 

i. 

j. 

6. How would you stop a tractor engine if the ignition key fails?

____________________________________________________________________________________

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Note: Fill out this work unit using your own tractor at home. Be ready to discuss your experiences with the other 4-H members at your next meeting.
MEMBERS' CHECK-UP

FIRST YEAR UNIT 7

STARTING AND STOPPING A TRACTOR

Draw a line under the correct word or words, and put the letter for the correct answer at right of page.

1. In choking a tractor engine for cold-weather starting you (A - make the air-fuel mixture richer) (B - lean the air-fuel mixture).

2. (A - Diesel) (B - Propane) tractors require heated air in the cylinders for quick starting in cold weather.

3. In cold weather a tractor engine should not be placed under a load until (A - it will run smoothly without being choked) (B - the heat gauge is in the normal operating position).

4. Propane is a fuel that (A - vaporizes) (B - liquifies) at ordinary temperatures.

5. Diesel engines (A - do not) (B - do) require a warm-up period before being loaded.

6. Shutting off an engine before letting it idle for a few minutes (A - makes it hard to start the next time) (B - may cause warped valves due to uneven cooling).

7. When driving a tractor downhill make certain the clutch is always (A - engaged) (B - disengaged).

8. It is a good idea always to (A - leave the ignition key in the tractor) (B - remove and place the ignition key where it is not available to children too young to operate the tractor).

9. The first step in starting any tractor is (A - turn on the ignition) (B - check the gearshift lever) (C - make certain the area is clear of other people).

10. If a tractor fails to start immediately (A - give up and do something else) (B - see if you can locate the trouble) (C - keep trying, because all tractors start if you crank them long enough).

Note: This Check-Up Sheet is intended to test what you have learned and to stimulate discussion with the other 4-H members. The more you discuss these questions with your leader and the other members the more you learn.
The tractor is involved in more fatal and non-fatal accidents than any other farm machine. In fact, an Ohio study tells us that 4 out of every 10 operators will have a serious accident with a tractor during the time they are actively engaged in farming. As a member of the 4-H Tractor Program you should do your part to help reduce tractor accidents.

**PLAN AHEAD—AVOID ACCIDENTS**

"I was in a hurry." "I just got careless." "I thought I could get out of the way in time." How many times have you heard these excuses from persons who have had an accident? We all know that carelessness and being in a hurry can cause accidents. But why do we hurry or get careless? The answer is simply that we are trying to do more in a given amount of time than can be done safely. Or we continue to work after we get tired. When we get behind with our work, we take too many chances, and that results in accidents.

You have the ability to think. That's something a machine doesn't have. That's also why it is better for you to plan your work so that you don't need to hurry or take chances. By thinking ahead you can learn to eliminate hazards before they cause an accident.

You can be a safe tractor operator by forming two important safety habits: (1) Be sure the equipment you operate is safe, and (2) Be sure you have the proper attitude—one that lets you think ahead so you can avoid getting into an accident situation.

**REACTION TIME**

Do you know how long it takes to make a simple reaction, such as putting your foot on both brakes to make a sudden stop? Or turning off the ignition? The minimum time needed to make these reactions is one-half of a second. It may take two or three times that long if you panic or make the wrong move first. A lot can happen in the fraction of a second it takes for you to make a simple move. The tractor could upset on you or you could be caught in the PTO shaft.

Your natural reaction in an accident situation is either to freeze and do nothing at all, or to make the wrong move. Here's an easy way to demonstrate this fact: You hold one end of a broomhandle and ask another 4-H'er to grip the other end tightly with one hand and pull. Tell him to let go when he feels you jerk on the broom. After a second or two give a quick jerk on the broom. Chances are, your friend only tightened his hold and could not let go. Your natural reaction is to tighten your grip and hold on. This is why people get caught when they try to unclog a machine while it is running. The machine suddenly unclogs itself and the operator can't let go, so his hand goes into the machine.

The simplest and easiest way to avoid accidents is to think ahead and avoid accident situations. When you are having trouble with a tractor or machine, always shut off the motor before leaving the seat to work on it.
TRACTOR SAFETY ON THE FARM

START WITH SAFE EQUIPMENT

Every time you get ready to start your tractor, make sure it is mechanically safe to operate. That goes for all other machines too.

With a little practice, you can give your tractor a complete daily maintenance and safety check in less than five minutes. Use a method that lets you start at one place on the tractor, and move completely around it so that you don't miss anything. Include the seat, steering, brakes, clutch, platform, wheels, tires, hitch, and PTO in your check. You can add several other items to the list for your tractor.

SEAT

Seats on modern tractors have several adjustments. Adjust the seat to your size and weight. You need to be able to reach and operate all controls from a comfortable sitting position. Check all of the bolts and screws. If any are loose or missing, make repairs immediately.

BRAKES

Good brakes are important too. Keep them evenly adjusted whether they are the kind that can be locked together, or are both operated with one foot. Newer tractors having power or hydraulic brakes need special care. Check your Owner's Manual. If you usually turn in one direction more often than the other, brakes will not wear evenly. For this reason they must be checked frequently. Form the habit of stopping your tractor by slowing down the engine. Don't jam on the brakes to make a stop unless it is necessary to avoid an accident.

HITCHES

Any time you pull a load with your tractor, the load is trying to pull the tractor over backwards. The tractor tries to pivot around the point where the rear wheels touch the ground. You may have noticed how the front end of your tractor seems to be lighter when you are hitched to a very heavy load. The hitch on your tractor is designed to let you pull very heavy loads without fear that the tractor will upset backwards, provided you use the hitch properly. So always hitch to the drawbar, and keep the hitch low. When the point of hitch on the tractor is raised, the chance for a backward upset is greatly increased.

Always use a safety-hitch pin for fastening a pulled implement to the drawbar of a tractor. This pin will not bounce out and cause the implement to get loose and possibly cause an accident.

LOAD

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Fig. 6 Start each day with a safety check of your tractor.

Fig. 7 Adjust the seat to your height and weight.

Fig. 8 Tractors can pull several times more weight than they can safely stop in an emergency. Slow down before applying brakes.

Fig. 9 Is your hitch the proper height?

Fig. 10 The load tries to raise the front end of the tractor.
TRACTOR SAFETY ON THE FARM

TRACTOR TIPPING

A tractor has the power to rotate around the rear axles should the rear wheels be held fast. In this situation, if the tractor is in a forward gear, the front end will come up, resulting in a backward upset. Such might be the case if you got stuck in a ditch and fastened a plank or something else to the wheels to get traction. Always back out, if you get stuck. Or get someone to pull you out with another tractor.

A tractor can tip over sideways at a speed of 8 miles an hour if the wheels drop into a hole or hit an obstruction. (Eight miles an hour is about twice as fast as you can walk.) It will tip at a much slower speed if you are turning. Slow down and be very careful to avoid obstructions or holes. The chances of upsetting are four times greater when speed is doubled.

If you have hilly or sloping fields, be especially careful to avoid conditions that may lead to an upset. The chance of a tractor upsetting backward increases if the front end is higher than the back end. This means that you should be very careful when driving or pulling a load up a hill. Let the clutch out very slowly when starting up a slope. Adjust the rear wheels to a wide position when working along the slope, to help protect from a sideways upset.

POWER-TAKE-OFF

Taking power from the power-take-off (PTO) shaft on the tractor is an easy way to drive some machines, such as combines, mowers, or forage choppers. The standard speed for a PTO shaft is either 540 or 1,000 revolutions per minute. An unguarded shaft is dangerous at any speed when it is turning. It can quickly grab your clothes should you touch it. Once caught, you are helpless against the power of your tractor, no matter how big you are. Never operate a machine unless the PTO is covered with a standard shield. One type of shield covers the top and sides of the shaft. Another type is a loose shield that is fastened to the PTO with anti-friction bearings. It will rotate slowly when the PTO is in use but will stop when it is touched. Caution—

You can't always tell whether a PTO shaft is guarded by a loose shield while it is running. To be safe, treat it as an unguarded shaft and stay away from it. The PTO stub should be protected when the PTO is not in use. This can be done with a stub shield that completely covers the shaft. If you don't have one for your tractor, it is not too difficult to make one. A master shield covers the top of the stub shaft and is standard equipment to allow all tractors to be connected to any power-driven equipment. It should always be in place.

Some of the newer tractors also have a front PTO shaft under the tractor. It should be given the same protection with shields as a rear PTO.

Fig. 11 Speed is the number one cause of tractor accidents.

Fig. 12 Tractors upset quicker in a turn.

Fig. 13 Caught by an unguarded PTO shaft.

Fig. 14 A PTO guard that turns slowly with the shaft. You can’t always tell if a shaft is covered. To be safe, stay away from all moving shafts.
SAFE HANDLING AND STORING OF FUELS

If not handled and stored properly, petroleum products can cause fires and explosions. The explosive force of 1 gallon of gasoline, vaporized and mixed with air, is equal to 87 pounds of dynamite.

Liquid fuel cannot burn. It must be vaporized and mixed with air. You can demonstrate this with a candle. Light the candle and watch it burn for a few seconds. Notice how the paraffin first melts from a solid to a liquid and then is vaporized by the heat from the flame. When the candle is snuffed, the vapors that continue for a few seconds can be re-lighted some distance from the wick.

An underground tank provides the safest storage for petroleum fuels, other than liquified petroleum gas (LPG). Where underground storage is not feasible, safe fuel storage may be provided by a good aboveground tank. Locate it as far as practical from buildings. (Forty feet is considered a minimum.) You can get specific suggestions for safe fuel storage from your fuel supplier. A shutoff valve between the hose and the tank is a must. It should be the kind that will stop flow of fuel in case of fire. Keep the area around the storage tanks clean of weeds and trash.

If flammable liquids must be used indoors, always keep them in a safety can with a spring-closed cover to prevent the escape of vapors.

Do not use gasoline for cleaning purposes. Gasoline gives off flammable vapors at temperatures down to 45 degrees below zero. Use a solvent for cleaning. It is much safer and will clean as well as, or better than gasoline. Never refuel a tractor while it is running or even while the engine is hot. Fuel vapors are heavier than air and may collect around the engine where they may be easily ignited by a hot manifold or a spark. If you spill fuel while refueling, wait a few minutes before starting the engine. Keep the tractor clean and watch for fuel leaks. Examine all fuel connections, the sediment bulb, and the carburetor. Fix all leaks immediately.

FIRE EXTINGUISHERS

Do you have a fire extinguisher on your tractor? Do you also have one in the shed where the tractor is stored? You need to have fire extinguishers in these areas and know how to use them if you have to, when a fire starts. Use only extinguishers that carry a stamp of approval by a recognized testing laboratory. They should be approved for use on petroleum fires.

Carbon dioxide (CO₂) and dry chemical extinguishers are two examples of approved extinguishers. Carbon tetrachloride extinguishers are no longer recommended for any kind of fire, because they produce a gas that is poison when breathed.

SAFETY AND YOUR RADIATOR

If the radiator has a pressure cooling system, let it cool for awhile before removing the radiator cap. The water in a pressure cooling system quickly turns to steam when the pressure is suddenly released. Always remove the cap slowly and place a cloth over it first as added precaution against being burned by the steam.

EXHAUST GASES CAN KILL

Exhaust gases contain carbon monoxide (CO), which is a deadly poison. You can't smell it or see it so you have no way of knowing when a deadly amount is present. If you must run an engine inside, keep the doors open.
LET'S DISCUSS SOME ACCIDENT SITUATIONS

To help you learn how to avoid accident situations, let’s start with a discussion of some accidents that have actually happened. Read the stories of the accidents. Discuss them with other members and your leader. Then use the blanks to tell how the accident could have been prevented. Be on your toes; the answer may not be as simple as you think.

Situation 1—Farmer A was pulling a large drag harrow in a field crossed by a small ditch. Due to constant plugging of trash under the harrow, Farmer A took the stay bars off the hydraulic hitch of the tractor and raised the hitch as high as it would go. This stopped the plugging, but the harrow caught on an old stump as he crossed the ditch. The tractor tipped over backward. Gasoline spilled from the tank and started a fire. Farmer A was pinned under the tractor and suffered a broken leg and severe burns before being rescued by a neighbor. The tractor was a total loss.

How could this accident have been prevented? ________________________

Situation 2—A new tractor had just been delivered by the local dealer to Farmer B, whose son was 10 years old. A few days after the tractor was delivered, the boy was showing off the new tractor to his 9-year-old friend. He had watched his father start the tractor, so he decided to start it too. It started right away, but the PTO was engaged. The 9-year-old became curious and grabbed the turning PTO stub with his gloved hand. The stub was not shielded. The glove was quickly caught in the PTO, twisting off the boy’s arm at the shoulder.

How could this accident have been prevented? ________________________

Situation 3—Farmer C tried to start a tractor but found the starter locked. In order to loosen the locked starter, he put the tractor in gear and hooked on with a second tractor to give it a little pull. In his haste, he had forgotten to shut off the switch. The first tractor started and crawled up the rear tires of the second tractor. Farmer C was knocked off the seat and suffered severe bruises.

How could this accident have been prevented? ________________________

Situation 4—A 7-year-old boy was sent by his mother to take a jug of water to his father's baling crew in a nearby field. On the way back to the house he got tired and lay down in a windrow to take a rest. He went to sleep and didn’t hear the baler coming. No one in the baler crew saw him and he was run through the baler and instantly killed.

How could this accident have been prevented? ________________________

(Over)
LET'S GO TO WORK

The best way to prevent an accident is to eliminate hazards that might cause an accident. Ask Dad to give you a hand. Use this work sheet to list hazards you can find on your farm and tell what you did to eliminate them.

1. **Roadways, farmstead, and lanes.** Look for obstructions and holes that might cause an upset.

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<th>Hazards found</th>
<th>How they were eliminated</th>
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2. **Tractor.** Give your tractor a complete safety inspection. Look for low tires, fuel leaks, loose seat, missing shields, etc.

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3. **Fuel storage.** Check location of tanks from nearest building. Check for shutoff valves, safety cans, relief valves for LPG tanks, etc.

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4. **Shop area and storage shed.** Are flammable petroleum products stored where they might cause a fire? Are there fire extinguishers? Are the tools where they belong? There may be other hazards.

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Note: Fill out this work unit, using your own tractor at home. Be ready to discuss your experiences with the other 4-H members at your next club meeting.
MEMBERS' CHECK-UP SHEET

SECOND YEAR UNIT 1

PLACE THE LETTER FOR THE CORRECT ANSWER AT THE RIGHT OF THE PAGE.

1. PTO shields (A-can) (B-cannot) be used when the tractor is a different make than the attached equipment.  

2. When pulling a heavy load up a slope, keep the hitch (A-as low as possible) (B-as high as possible).  

3. Vapor from fuel is (A-lighter) (B-heavier) than air.  

4. It is better to (A-back out) (B-drive out) of a ditch when the rear wheels start to spin.  

5. Raising the hitch on the tractor (A-decreases) (B-increases) traction and (A-increases) (B-decreases) the possibility of tipping backward when hitched to a heavy load.  

6. A tractor is about (A-5) (B-500) (C-5,000) times more powerful than you are.  

7. It is the (A-carbon monoxide) (B-carbon dioxide) in exhaust gases that can kill you.  

8. Raising the hitch on the tractor (A-decreases) (B-increases) the chance for a backward upset.  

9. When speed is doubled the chance for an upset is (A-doubled) (B-four times as great) (C-the same).  

10. List three rules that you believe should be followed by every tractor operator.  

1.  

2.  

3.  

Note: This Check-Up Sheet is intended to test what you have learned and to stimulate discussion with the other members. The more you discuss these questions with your leader and the other members the more you learn.
CHECK • UP SHEET

TRACTOR SAFETY ON THE FARM

SECOND YEAR UNIT 1

[Text not legible due to image quality]
TRACTOR SAFETY ON THE HIGHWAY

About one-third of all fatal tractor accidents occur off the farm. Collisions with motor vehicles take a heavy toll, but many off-the-farm tractor accidents do not involve a collision but rather are caused by other factors such as upsets, loss of control, and falls by extra riders.

Only an experienced operator should be permitted to operate farm equipment on public roads. Don’t ask your younger brother to drive the tractor to the house for you. The best way to prevent accidents is to avoid using the roads more than is absolutely necessary. Use the lanes or headlands in your fields whenever possible. If you must use a highway or road, arrange to travel when traffic is the lightest and be alert to prevent accidents.

TRACTORS ARE NOT BUILT FOR HIGHWAYS

Your tractor was not intended for use on highways and public roads. For one thing, even when traveling in road gear its speed is much slower than motor vehicle traffic and it is a set-up for an accident, like a “sitting duck” in a shooting gallery. There are several dangerous things that can happen to a tractor on the highway, even without becoming involved with other traffic. It can hit an obstruction and upset, or it can go out of control and wind up in the ditch. And the highway is certainly no place to give someone a ride on your tractor. There is no safe place on a tractor for anyone but the operator. While on the highway you can’t hear other traffic because of the noise your tractor engine makes, so that leaves only your eyes to warn you of other traffic. But your vision is limited to watching the road ahead. If you have to use the highway very often you might want to install a large rear-view mirror to let you watch for traffic in both directions.

In traffic studies of collisions involving a tractor and a car or truck, the tractor operator is usually the one who becomes a fatality. Your tractor gives you almost no protection against injury. If you should collide with a car or other motor vehicles, you have a good chance of being pinned under the tractor or thrown violently from the seat.

SPEED AND IDENTIFICATION ARE PROBLEMS

Many motorists who have been involved in accidents with tractors have reported that they failed to identify the tractor or were not aware of its presence until it was too late. The tractor may have been visible but not moving at a speed fast enough to cause notice. Let’s look at a typical accident situation.

A car is traveling down the highway at 60 miles per hour, which is equal to 88 feet per second. If you were to pull out on the highway with your tractor when the car is 1/16 of a mile (330 feet) down the road, the driver of the car has less than 4 seconds to see you and bring his car under control. Suppose he doesn’t see you for 1 second. That brings him 88 feet closer and leaves only 3 seconds. It may take him another 1½ seconds to collect his thoughts, decide what to do and start to apply the brakes. By this time he is only 110 feet away, but he needs a least 200 feet to bring his car to a full stop. A collision and serious accident are almost a certainty. Check traffic carefully before pulling onto the highway with your tractor.
TRACTOR SAFETY ON THE HIGHWAY

STATE LAWS RELATING TO FARM EQUIPMENT

There are certain laws in your state that apply to the operation of farm equipment on public roads. These laws cover the operation, lighting, and identification of farm equipment on public roads and vary from one state to the next. To obtain the information on the laws that apply to your state, check with your local state police. Perhaps they can furnish you with a copy of the traffic laws for farm equipment. This information would make a good report for your next club meeting.

SAFE DAYTIME DRIVING

Avoid the use of busy highways even if it means you must drive a long way out of your way. If you have to use a two-lane highway, drive on the shoulder if possible and go slowly enough to see obstructions or holes that could cause an upset. Sometimes you have no choice but to use the highway surface. When you do, avoid the dangerous practice of driving with one wheel on the pavement and the other on the shoulder. This practice encourages faster traffic to try to pass when there isn't enough room. If oncoming traffic doesn't yield part of its lane, the car attempting to pass will crowd the tractor off the highway or side-swipe it, catching the left rear wheel. It is better to occupy one full lane the same as if you were driving a car. At least this will help to keep cars from passing you without first making sure there is no oncoming traffic.

Hilly, winding roads are especially hazardous because the driver of an oncoming vehicle cannot see you and you cannot see him. As a result there may be a collision or someone has to take to the ditch.

The best way to avoid highway accidents is to stay off the road as much as possible. If you must use the highway, use it when traffic is the lightest, and make your equipment as easy to identify as possible. Some states require the use of warning flags. This is a good idea even if your state doesn't require it. Use a bright red or orange flag at least 18 inches square and attach it to a pole so it is displayed well above the tractor. A similar flag should be used on equipment the tractor is pulling.

Fig. 5 Identify your tractor as a slow-moving vehicle. The triangle is a reflector for both daytime and nighttime use.

Fig. 6 Drive on the shoulder if there is plenty of room.

Fig. 7 A dangerous practice that can lead to accidents.
TRACTOR SAFETY ON THE HIGHWAY

PRACTICE COURTESY

Safety on the highway begins with courtesy. When traffic piles up behind you, pull off the road at the first opportunity and let it pass. Remember that it is a privilege for you to operate your tractor and equipment on a highway. Don’t abuse this privilege. Practice courtesy. Know and obey the rules of the road as they apply to the tractor and other slow-moving equipment in your state.

SAFE DRIVING AT NIGHT

Operating your farm equipment on a highway at night presents a serious problem since it is difficult for motorists to know of your presence. The best rule is to stay off the highway at night with slow-moving equipment. Plan your work so that your equipment is moved during the daylight hours and at a time when traffic is lightest.

If you must travel at night, be sure your tractor is provided with adequate lights, and that supplemental lighting is provided for the towed equipment. Your local state laws should be followed in the lighting of your equipment. You may find that they are similar to the laws suggested by the Uniform Vehicle Code. This Code states that tractors should have one or two white lights visible 500 feet forward, and a red light visible 500 feet to the rear. It is dangerous to use a white light to the rear because it might cause a motorist to think the light is the headlight of an oncoming car. It is also dangerous, and sometimes even illegal, to use a flashing red light. In many localities a flashing red light has been reserved for use on emergency vehicles such as ambulances and police cars.

If equipment is towed by the tractor there should be an additional red light visible 500 feet to the rear and located to indicate the farthest projection of any part of the equipment to the side of traffic. In addition, red tail lights or reflective tape can be applied to the extreme right and left corners of the towed equipment. Lights, electrical connections, and mounting brackets for lighting farm equipment have been standardized so they can be used on all combinations of tractors and equipment.

BLIND CORNERS

One of the major hazards in rural areas is blind intersections and driveway entrances that have growing crops or shrubbery that restrict vision toward the other lanes of traffic. Check with your leader. Perhaps your club could make a project of clearing some of the blind corners in your community. Be sure you first obtain permission from the landowners and tenants. Clear your driveway so that visibility is extended for at least 700 feet in both directions.
SAFE EQUIPMENT

In the First and Second Year projects you learned about the importance of keeping your equipment in safe operating condition. It is even more important to have your equipment in safe condition when it is taken onto the highway.

When you travel on highways or public roads you are traveling at speeds much faster than you would use for field work. This means that the mechanical condition of your tractor must be perfect. A routine daily safety inspection is the best way to find and eliminate hazards before they can cause trouble. Be particularly alert for loose or missing bolts and nuts in the wheels, and check for cracks in the wheel castings. Take a good look at the tires to make sure they are suitable for use on the highway. Check the tire pressure.

Inspect the steering mechanism for loose play. You may not have noticed it in the field, but it doesn't take much looseness to cause trouble on the highway.

In normal field use, brakes do not always wear evenly. This is because the tractor is usually turned more in one direction than the other. If the brakes are not adjusted evenly, applying both brakes in a sudden stop could cause the tractor to upset. Adjustment of the brakes is discussed in this book in Unit 4 "Steering, Brakes, and Front Wheels."

Tractors can pull far more weight than they can safely stop in an emergency. If you are pulling a heavy load behind your tractor, drive slower and allow plenty of distance for stopping when approaching an intersection or stop sign. As a safety precaution, start slowing down far enough ahead so that a complete stop can be made without the brakes.

Use great care when stopping a tractor with a load behind. It takes only a little braking pressure on the load to cause the hitch to jackknife and upset your tractor.

Your tractor tires may contain a liquid or other heavy ballast. If this is the case, be sure both tires are filled to the same level. If the load in the rear tires becomes unbalanced while the tractor is traveling at a high rate of speed, the tractor can go out of control. You may have to reduce speed in order to maintain control of your tractor.

Be careful when going down a hill or grade. Shift to a low gear before starting down a hill and leave the tractor in gear. CAUTION—Some of the transmissions in modern tractors will not hold a load in certain gears when going down a grade. Check your Operator's Manual to see which gears can be used safely when going down a hill.

Fig. 13 Checking for loose steering. Is your tractor safe?

Fig. 14 Keep your brakes adjusted.

Fig. 15 You can't make a quick stop when pulling a load.

Fig. 16 Keep your tractor in gear when going down hill.
Safety Starts with Courtesy

Let's discuss some accident situations that have actually happened. Read the story of each accident and then discuss it with your leader and the other members. Use the blanks to tell us what you have learned that could help prevent a similar accident from happening to you.

**Situation 1** Farmer A was pulling an empty wagon down a single-lane gravel road late at night. He was traveling about 18 miles an hour. When he met an oncoming car he pulled off to the side. The rear wheel dropped into a hole, upsetting the tractor. Farmer A was crushed under the tractor and died instantly.

How could this accident have been prevented? ________________________ 

**Situation 2** Farmer B was driving down a highway with two wagonloads of potatoes behind his tractor. When he approached a stop sign and started to apply his brakes he saw a car coming from his right and realized that he might not be able to stop in time. He then jammed harder on the brakes, but they were not adjusted evenly and the tractor pulled sharply to the left. This caused the wagons to jackknife and upset the tractor. The motorist was able to stop safely but Farmer B was thrown from his tractor and suffered a broken arm and a skull fracture, narrowly escaping being crushed by his tractor.

How could this accident have been prevented? ________________________ 

**Situation 3** Farmer C was returning home late at night after diskin in a nearby field. He was driving down the road in front of his house. His tractor was equipped with one white light to the front but the only lights he had to the rear were reflectors on each end of the disk. A motorist came down the road behind him, saw the two reflectors and, thinking they were markers for bridge abutments, drove between them. As the car rammed into the disk, Farmer C fell in the path of the disk and died instantly.

How could this accident have been prevented? ________________________ 

**Situation 4** A 16-year-old boy was returning a tractor that had been overhauled in the high school shop. Four other boys went along for the ride. During a little horseplay one of the boys fell from the tractor and caught his pant-leg on the hitch. He was dragged along the ground for about 50 feet before the tractor could be stopped. The boy suffered severe cuts and bruises and spent a week in the hospital.

How could this accident have been prevented? ________________________ 

(Over)
1. Do you operate your tractor or other equipment on a rural road or highway? _______
   How often? ____________________________________
   List any dangerous situations that you have encountered. __________________

2. Do you use safety warning flags? _______. Describe how they are used. ________

3. Do you use any special lighting on your tractor or equipment for travel at night? _______
   Describe how you have lighted your equipment for travel at night. ______________

4. Make a safety inspection of your tractor. Is it safe for operation on a highway? _______

Don't wait. Correct any unsafe items right away.

5. Are there any gears on your tractor that should not be used when pulling a load down a hill? _______
   Which ones? __________________________________

6. How can you help reduce tractor accidents on highways and rural roads? ______________

Note: Fill out this work unit, using your own tractor at home. Be ready to discuss your experiences with other 4-H members at your next club meeting.
MEMBERS' CHECK-UP

THIRD YEAR UNIT 1 TRACTOR SAFETY ON THE HIGHWAY

Place the letter for the correct answer at the right of the page.

1. It is (A—more) (B—less) dangerous to move farm machinery on the highway than to use it on the farm.

2. The stopping distance for a car going 60 miles per hour, including reaction time and braking distance, is approximately (A—100 feet) (B—280 feet) (C—366 feet) for a wet pavement.

3. The electrical socket on tractors for extending a warning light to a trailed implement (A—is) (B—is not) standardized.

4. It is safer to (A—pull halfway off the road) (B—get completely off the road) if someone tries to pass you on a two-lane highway.

5. The tractor, being a slow-moving vehicle, (A—always) (B—sometimes) (C—never) has the right-of-way over cars.

6. The first step to operating a tractor on the highway is to (A—learn the traffic laws which apply to your state) (B—learn to drive a car).

7. In a collision between a tractor and a car the driver of the (A—car) (B—tractor) is more likely to become a fatality.

8. Lights on tractors should be visible for a distance of (A—200 feet) (B—1,500 feet) (C—500 feet)

9. Safe operation of a tractor on a highway begins with (A—courtesy) (B—assuming that others will look out for your safety).

10. Records show that most accidents are caused by (A—working when tired) (B—trying to hurry) (C—taking chances) (D—not using what you have learned about being a safe tractor operator).

Note: This Check-Up Sheet is intended to test what you have learned and to stimulate discussion with the other members. The more you discuss these questions with your leader and the other members the more you learn.
HITCHES, PTO, AND HYDRAULIC CONTROLS

Have you ever thought about the many different ways in which your tractor can be used? Some tools, such as a drag harrow, are merely hitched to the drawbar. If you have a wheel disk you might also use a remote-controlled hydraulic cylinder. Still other implements, such as a forage chopper, may be driven by the PTO (power-take-off) shaft from the tractor, with a hydraulic cylinder being used for adjusting the height of the feeding unit. You should know how to connect implements correctly, and how to operate the equipment safely.

CHECK THE DRAWBAR HEIGHT

When you hitch your tractor to an implement, it is important always to use the drawbar. Do not try to pull a load from the axle or seat, or from one of the links of a three-point hitch. When you do, there is danger of upsetting your tractor or damaging it mechanically.

Check the height of the hitch on your tractor. The distance should be from 13 to 17 inches as measured between ground level and the hitch point on the drawbar. Adjusting your drawbar to this height not only provides safer hitching but is also standard height for use of the PTO shaft.

CAUTION: When using a tractor that is equipped with a hydraulically controlled drawbar to pull a load, use the stay bars provided with your tractor to lock the hitch in position. Raising the hitch to increase traction is a dangerous practice that can cause a backward upset.

HITCHES FOR PTO OPERATION

The drawbar on most tractors can be adjusted for either a close hitch or an extended hitch. You will need to use the extended hitch for connecting to a machine that is driven by the PTO shaft. There are two standard speeds for the PTO shaft on newer tractors. One is 540 rpm, the other is 1,000. If you use a PTO speed of 540 rpm, the hitch point must be 14 inches from the end of the PTO shaft. If you use a PTO speed of 1,000 rpm, the distance from the hitch point to the end of the PTO shaft must be 16 inches. Trying to use a drawbar connection that is too short will cause the universal joints on the PTO shaft to bind when you make a short turn.

If your tractor hitch can't be adjusted to the proper distance, check with your dealer. He should have a drawbar extension which will provide the proper length.

When using the PTO shaft, be sure the drawbar is centered directly under the shaft and securely fastened.
HITCHES, PTO, AND HYDRAULIC CONTROLS

HITCHES FOR MOUNTED EQUIPMENT

Most modern tractors are equipped with hydraulic controls for raising, lowering, and adjusting rear-mounted equipment. This is why more rear-mounted equipment is used than in the past. Previously, equipment was raised and lowered with long hand-levers and this became quite tiresome.

Rear-mounted equipment is connected to the tractor with “integral hitches.” Integral hitches may have one-, two-, or three-point connections between the rear-mounted implement and the tractor. Of these three types, the three-point hitch is the most common.

Three-point hitches are standardized so that implements and tractors of different makes and models can be used interchangeably. If your tractor does not have a three-point hitch you can probably get an adapter that will let you use three-point mounted equipment.

The sizes of three-point hitches are standardized by categories. Small tractors use a Category I hitch and larger tractors use a Category II hitch. Figs. 7 and 8 show the measurements of these two hitches. As tractors and implements continue to increase in size, additional categories will be added. By using special adapters, Category I equipment can be used on tractors with Category II hitches.

THREE-POINT HITCH ADJUSTMENTS

When a rear-mounted implement is connected to a tractor, the main adjustments are provided by the three-point linkage. On a plow, for example, the length of the top link can be adjusted to provide the proper pitch or depth control. If you wanted the plow to go deeper you would shorten the top link. If you wanted the plow to run shallower you would lengthen the top link.

Adjustments are also provided for leveling the rear-mounted implements. This is usually done by a hand crank on the linkage that controls the height of the right-hand (as viewed from the rear of the tractor) draft link. On some tractors both of the draft links can be controlled with a leveling crank.

The raising and lowering of the entire three-point hitching system is powered by the hydraulic system. There is a hand lever on the tractor that lets you raise and lower the implements and adjust it to run at a given depth.
HITCHES, PTO, AND HYDRAULIC CONTROLS

TWO STANDARD PTO SPEEDS

As mentioned earlier, there are two standard speeds for the PTO shaft. The old standard of 540 rpm was used on all tractors until 1958. At that time a new standard speed of 1,000 rpm was accepted. The new standard speed was needed in order to increase the amount of power and speed that could be transmitted to a machine.

It will probably take several years for the new speed to come into general use. During the change-over period many of the new tractors are providing for both standard speeds. This is done by making the PTO so that it can be operated at either 540 or 1,000 rpm by adjusting a pin or a lever. The stub shaft for 540 rpm has a 6-tooth spline, while the stub shaft for 1,000 rpm has 21 teeth. Because the stub shafts have different kinds of splines you can’t accidentally operate a machine at the wrong speed.

AUXILIARY POWER SHAFT

Some mounted equipment must be driven by the PTO but cannot be easily connected to the rear PTO shaft. Therefore, some of the newer tractors have a front or side power shaft that rotates at 1,000 rpm. It may be a separate stub shaft, or the stub shaft for the rear PTO may be used.

PTO CLUTCH

For many years the PTO was driven from the transmission and was controlled by the engine clutch. If you were pulling a machine such as a combine and the combine started to overload, there was no way to stop the forward motion and let the combine continue to run to clear itself.

With the transmission-driven PTO, when you stopped the tractor movement you also stopped power to the machine. If you wanted the machine to continue to operate you had to shift into neutral and re-engage the clutch.

To overcome this disadvantage the independent or continuous running PTO was developed. In this case the PTO is controlled by a separate clutch that can be used whether the tractor is in motion or standing still.

USE PTO SHIELDS

Any rotating shaft that is not covered by a guard can be dangerous. Even a smooth shaft will grab clothing and cause it to start wrapping should you brush against it. Once caught, you are no match for the speed and power of a PTO shaft. Keep the shields in place at all times. Use the standard shields provided with your tractor and equipment. Keep the stub shafts covered when they are not being used. They could be unintentionally engaged and cause an accident.
HYDRAULIC SYSTEMS

The hydraulic system on your tractor provides a quick and easy means for attaching and lifting various implements and controlling their adjustment. There are many different kinds of hydraulic systems. Some have their own oil supply while others may be part of a central system that is also used for power steering or power brakes. In some models the transmission and hydraulic system use the same oil.

To know how to use the hydraulic system on your tractor study your Operator's Manual carefully. It will tell you where all of the adjustments and controls are located and how to use them. Once you become familiar with the hydraulic system on your tractor you will find there is almost no limit to the different ways it can be used.

REAR-MOUNTED EQUIPMENT

The hydraulic system controls the raising, lowering, and adjustment of the linkage for rear-mounted equipment. You may find that your tractor has a control for running mounted equipment at a constant depth regardless of the amount of pull required. Or you can adjust the control so that the load remains the same and the depth will vary slightly. How you adjust this control will depend on the equipment you are using and the conditions under which it operates.

REMOTE CYLINDERS

Single-acting cylinders are connected to the hydraulic system by only one hose and can exert force in only one direction. They are usually used on equipment where a simple raising and lowering action is needed. In such cases they are located so that the load returns the cylinder to its home position. Double-acting cylinders have two hoses and can exert force on an implement in both directions. Double-acting cylinders are commonly used on equipment where it is necessary to adjust a machine to a given position. These cylinders are standardized so that they can be used on various combinations of tractors and equipment.

When used on a tool such as a plow, double-acting cylinders may contain a device that controls the length of the stroke. With this control you can select the length of stroke needed to operate the equipment at the desired depth.

SERVICING THE HYDRAULIC SYSTEM

Dirt is the biggest enemy of the hydraulic system. It can ruin the seals and close-fitting parts that keep the system under high pressure. Always maintain the proper oil level in the reservoir and change the oil at the recommended interval. It is important to use the proper oil for your hydraulic system. Some oils contain additives that are harmful to the seals. Be careful with the hoses and hose connections. Keep them clean and use the dust seals provided when the hoses are disconnected. If your hydraulic system has a filter, be sure you clean it as recommended in your Operator's Manual.
1. Check the drawbar on your tractor. What is the height of the hitch point? ____ inches. Can the height be adjusted? ____________________________________________

2. Does your tractor have a swinging drawbar? _______ Where should it be located when hitched to a machine that is driven by the PTO shaft? ____________________________________________

3. Which machines on your farm need to be connected to a swinging drawbar when it is allowed to swing freely? ____________________________________________

4. Does your tractor have a rear-mounted hitch? _______ How many adjustments and controls does it have? _______ What are they? ____________________________________________

5. Can the PTO shaft be operated at either 540 or 1,000 rpm? _______ How is it changed from one speed to the other? ____________________________________________

6. Is the PTO shaft driven from the transmission or does it have a separate clutch? _______ Can the PTO clutch be adjusted? _______ How? ____________________________________________

7. What kinds of PTO shields are provided for your tractor? ____________________________________________

8. Does your tractor have a hydraulic system? _______ Is it a separate system or is it combined with some other system on your tractor? ____________________________________________

Explain ____________________________________________

(Over)
9. How many remote cylinders can be used with your tractor? _________________

10. Can your tractor use both single- and double-acting cylinders? ______________
    If so, how is this done? ______________________________________________________

11. What precautions do you take to keep dirt out of the hydraulic system? __________
    ___________________________________________________________________________
    ___________________________________________________________________________

12. Make a list of the safety precautions you should take for each of the following:
    a. Hitching to the drawbar, or attaching rear-mounted equipment. ________________
       __________________________________________________________________________
       __________________________________________________________________________
       __________________________________________________________________________
       __________________________________________________________________________

    b. Connecting and using the PTO shaft. ________________________
       __________________________________________________________________________
       __________________________________________________________________________
       __________________________________________________________________________

    c. Connecting and using hydraulic controls. _______________________
       __________________________________________________________________________
       __________________________________________________________________________

Note: Fill out this work unit, using your own tractor at home. Be ready to discuss your experiences with other 4-H members at your next club meeting.
MEMBERS’ CHECK-UP

THIRD YEAR UNIT 3

HITCHES, PTO, AND HYDRAULIC CONTROLS

Place the letter for the correct answer at the right of the page.

1. Raising the drawbar height (A-increases) (B-decreases) the chance of a backward ______ upset.

2. The proper horizontal distance between the end of the PTO shaft and the hitch point ______
on the drawbar for operating the PTO at 1,000 rpm is (A-14 inches) (B-16 inches).

3. The spline for a 540 rpm PTO shaft (A-is) (B-is not) the same as the spline for a ______
1,000 rpm shaft.

4. Three-point hitches (A-are not) (B-are) standardized.

5. Single-acting hydraulic cylinders (A-exert force in one direction only) (B-exert force ______
in both directions).

6. Auxiliary power shafts all run at (A-540 rpm) (B-1,000 rpm) (C-no certain ______ speed).

7. When an implement is operated with the PTO shaft in use, the drawbar should be in ______
the (A-close) (B-extended) position.

8. Category II mounted equipment (A-can) (B-cannot) be used on a tractor with a ______
Category I rear-mounted hitch.

9. Shortening the top link of a three-point hitch will make a plow run (A-deeper) (B-_______
shallower).

10. It (A-is) (B-is not) always safe to use regular crankcase oil in the hydraulic system. ______

Note: This Check-Up Sheet is intended to test what you have learned and to stimulate discussion with the other members. The more you discuss these questions with your leader and the other members the more you learn.
SAFE USE OF FARM MACHINERY

Farming is classified as a dangerous occupation. In fact, it is estimated that farming has a higher accident rate per man hour than any occupation in industry. This may seem strange when, by comparison, some of the machines used in factories are more dangerous than farm machines. It is the conditions under which they are used that makes the difference. A factory worker uses the same machine every day and follows a standard routine that includes all necessary precautions. On the other hand farming methods and machines are constantly changing. Other than the tractor, each of the machines is used only a few days a year, and the operator never gets a chance to establish a routine that lets him work with his machine with complete safety. As an operator of farm machines, you have to make up for these shortcomings with your ability to reason out a method for using your equipment with complete safety. In other words you will have to establish some hard and fast rules for being safe — and then follow them completely at all times.

THE FACTS

A report by the United States Department of Agriculture tells us that each year about 1 out of every 5 of our farm population has an accident serious enough to cause time loss from the job. One person in 33 suffers a serious accident resulting in a disabling injury. One in 1,600 ends up a fatality. In each of these groups, accidents with farm machinery account for approximately one-third of the total, making this by far the most frequent cause of accidents involving our farm population.

WHAT CAUSES ACCIDENTS?

Have you ever tried to answer this question? Perhaps you have at some time hit your finger with a hammer or suffered some other minor injury. Do you remember how it happened? Were you in a hurry? Maybe you were hurt because of someone else's carelessness.

Many different surveys have been made to find out why accidents happen. In nearly every case the results are similar to the following summary:

<table>
<thead>
<tr>
<th>Cause of accident</th>
<th>Percent of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unavoidable (lightning, or other forces of nature)</td>
<td>2-4</td>
</tr>
<tr>
<td>Use of faulty equipment</td>
<td>10</td>
</tr>
<tr>
<td>Carelessness (includes all human factors)</td>
<td>86-88</td>
</tr>
</tbody>
</table>

As you can see from this table there really isn't much excuse for an accident.

YOU ARE NO MATCH FOR A MACHINE

Any moving part of any machine, whether it be a pulley, blade, sprocket, belt, shaft, gear, chain, knife, hammer, or otherwise, is faster and more powerful than you are. The high-speed blade of a power lawn mower is capable of cutting off your toes even though it is powered by a very small engine. And a shaft that appears to be turning slowly can grab your clothes and wrap you up before you can make a simple move to avoid the accident.

SHUT IT OFF!

This is the most important rule of all. Whether a machine is simple or complex, and regardless of its size, speed, or power—always shut it off before working on it. It is the only sure way you can avoid getting into trouble with a machine. If you shut off the power before working on a machine for any reason, you will at least know that you are doing the job safely even though it may take a little longer.
SAFE USE OF FARM MACHINERY

If you have a PTO-driven machine you need to be alert to the possibility that the machine will coast for a while after you have disengaged the power shaft. This is particularly true for a machine such as a baler or forage chopper. Always allow plenty of time for the machine to come to a complete stop before you open a cover or attempt to work on it.

KEEP SHIELDS IN PLACE
Shields are intended to be used on moving parts of machines to protect the operator. Sometimes it is tempting to leave off a shield to make it easier to adjust or repair the machine. But this is a dangerous practice that can lead to an accident. Give your machinery a careful inspection and see where shields are missing. Replace all missing shields if they are available. If you don’t have the shield or can’t get one from your dealer perhaps you can make one.

DRESS PROPERLY
An almost unbelievable number of accidents happen because of loose or improperly fitting clothing. It only takes a small string caught in a gear or shaft to cause a serious accident. Be especially careful of gloves, sleeves, and pant legs.

AVOID FATIGUE
If you work when you are overly tired, you are inviting an accident. You will do things that you would normally never do if you were properly rested. There are a few things that can be done to avoid fatigue even when you know that you will have to work long hours. Eat a balanced diet. Take along, or have someone bring you, a snack to eat between meals, in the middle of the morning and afternoon. If possible, let someone else operate the machine for a while, even if only for a short time, to give you a rest. Fatigue is listed as a major cause of accidents.

OTHER GOOD SAFETY RULES
Following are some good safety rules that apply to many different machines used on your farm. As you read this list, be thinking of some others that apply to your machines at home. There is a place in the yellow work unit sheet to add to this list.

1. Set tractor wheels out—this is an important rule to help prevent tipping accidents.
2. Always set the brakes—before leaving the tractor seat, be sure the brakes are set. This may prevent an implement from running over you.
3. Don’t use a stick or other object to unclog a machine unless you have first shut off the machine.
4. Keep equipment adjusted—well-adjusted equipment will save a lot of lost tempers and prevent accidents.
5. Watch out for others—always make sure other people, especially children, are kept away from the area where machinery is working.

NOW IT’S UP TO YOU
Throughout the 4-H Tractor Program you have had a chance to learn how accidents are caused and how they can be prevented. Remember that an accident can happen under one or both of two conditions: When you commit an unsafe act, or when you allow an unsafe condition to exist. Your farm is only as safe as you make it—as safe as you think and act. No matter how much you have learned about safety, it doesn’t help unless you put what you know into practice. And you are the only one who can make this decision. Start right now—pledge yourself to safe operation of your farm machinery.

"JOIN ME IN A PLEDGE FOR SAFE OPERATION OF EQUIPMENT"
Select one of the larger, power-driven machines on your farm for this unit. A cotton picker, beet harvester, potato digger, corn picker, combine, forage chopper, or baler, would be a good one to use. You will need your Operator's Manual to help you with this unit. Eliminate all hazards.

1. Check all of the shafts that require a shield. **How many are needed?**

   **How many were missing?**  
   **Which ones?**

   Could any of the missing shields have caused an accident?

   **Why?**

2. Now check all places where guards are needed to cover gears, sprockets, pulleys, belts, chains, etc. How many are needed?  

   **How many were missing?**

   **Which ones?**

   Could any of the missing guards have caused an accident?

   **Why?**

3. List any places on the machine that are not normally covered with a shield or guard but might cause an accident (the cutter bar of a combine, for example).

   **How can you make sure none of these places will cause an accident?**

4. Is it necessary to wear close-fitting clothes when operating this machine?

   **Why?**
5. Make a list of the accidents that you think are most likely to happen while you are operating this machine. In each case tell how the accident can be prevented.

<table>
<thead>
<tr>
<th>Possible accident</th>
<th>How it can be prevented</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td></td>
</tr>
<tr>
<td>d.</td>
<td></td>
</tr>
<tr>
<td>e.</td>
<td></td>
</tr>
<tr>
<td>f.</td>
<td></td>
</tr>
</tbody>
</table>

6. If, while being operated, this machine becomes plugged, tell how you could safely correct the trouble.

7. List some other machines on your farm and tell what might be hazardous about their use. Then tell how you can operate them safely.

<table>
<thead>
<tr>
<th>Machine</th>
<th>Precautions to take</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td></td>
</tr>
<tr>
<td>d.</td>
<td></td>
</tr>
</tbody>
</table>

8. List some rules for the safe operation of all the machines on your farm.

a. ____________________________ c. ____________________________

b. ____________________________ d. ____________________________

Note: Fill out this work unit, using your own machinery at home. Be ready to discuss your experiences with other 4-H members at your next club meeting.
MEMBERS’ CHECK-UP

FOURTH BOOK UNIT 1

SAFE USE OF FARM MACHINERY

Place the letter for the correct answer at the right of the page.

1. Farm machinery is involved in (A—10) (B—20) (C—35) percent of the accidents involving the farm population.

2. It has been estimated that (A—50) (B—30) (C—over 80) percent of accidents are due to plain carelessness.

3. Your first reaction in the case of an emergency (A—may require as long as 1 second or more) (B—is usually less than ½ second) (C—is to do nothing).

4. On the basis of the accident rate per man-hour, it is safer to (A—work in a factory) (B—work on a farm).

5. A tractor with a wide front end is (A—more) (B—less) likely to tip than a tricycle type tractor.

6. Accidents happen to approximately (A—20) (B—10) (C—40) percent of our farm population each year.

7. Many accidents with farm machinery happen when (A—the machine reaches out and grabs the operator) (B—the operator starts tinkering with the machine while it is running.)

8. It is estimated that faulty equipment is a factor in (A—2) (B—24) (C—10) percent of the accidents with farm machinery.

9. When getting ready to operate power-driven equipment, the first step is to (A—start it up and see if it still runs) (B—be sure all of the shields and guards are in place) (C—check the speed of the PTO).

10. Safe operation of farm machinery is (A—impossible) (B—a matter of pure chance) (C—a matter of making up your mind to be a safe operator).

Note: This Check-Up Sheet is intended to test what you have learned and to stimulate discussion with the other members. The more you discuss these questions with your leader and the other members the more you learn.
Compiled by 4-H and Engineering Staffs, Kansas State University

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File: 5.2-6—3M—6-74—3,000 reprinted at an estimated cost of 70 cents each—4-78g—1929A