

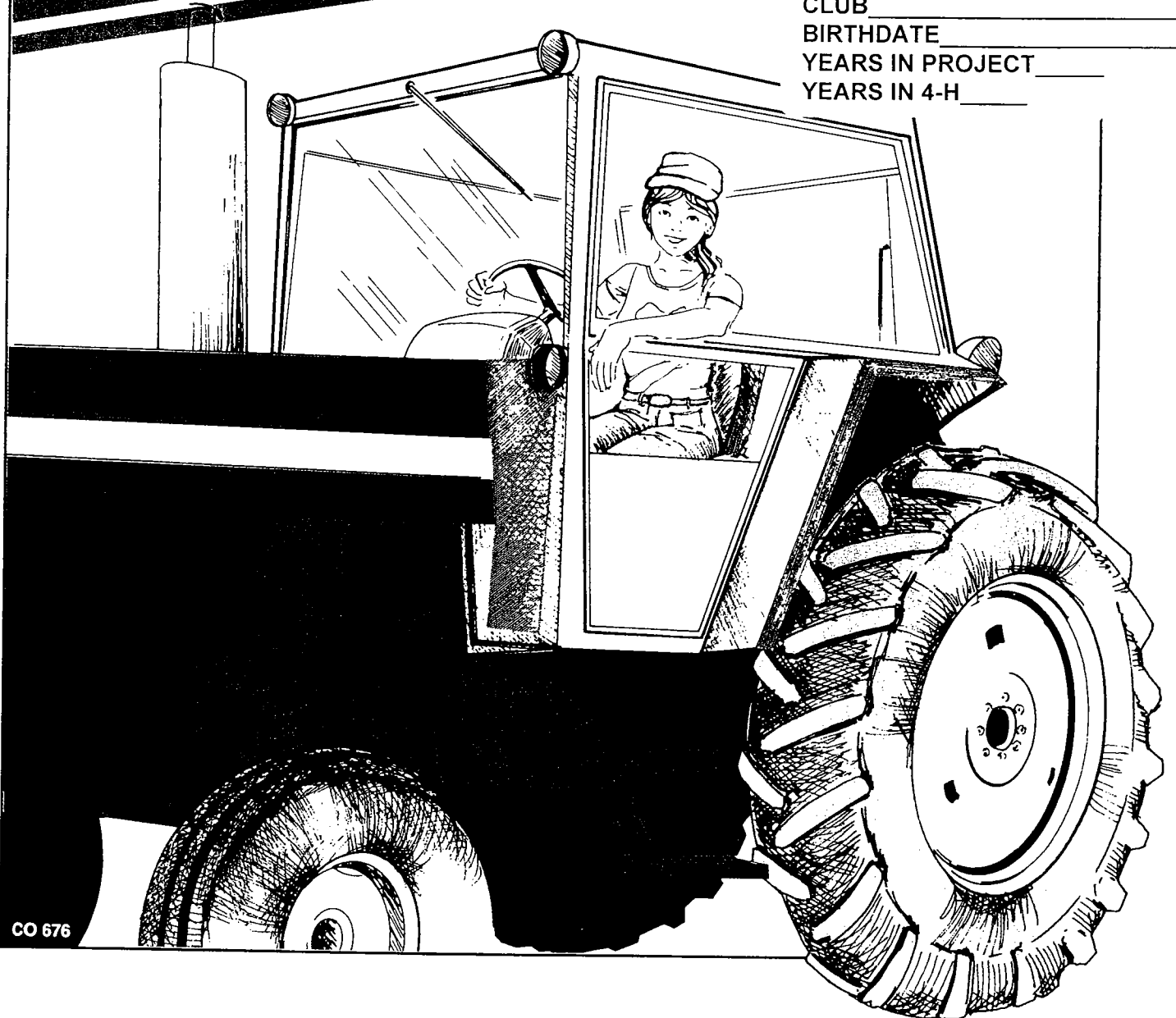
Petroleum Power Program

TRACTOR PROJECT

Unit 2

*Assuring Safe and Efficient
Tractor Operation*

NAME _____
CLUB _____
BIRTHDATE _____
YEARS IN PROJECT _____
YEARS IN 4-H _____



Contents

Acknowledgements

This educational material has been prepared in consultation with the National 4-H Tractor Task Force comprised of representatives of Extension Service, United States Department of Agriculture, the Cooperative Extension Service of the State Land-Grant Universities and National 4-H Council.

Special thanks are extended to Amoco Foundation, Inc., donor for the National 4-H Petroleum Power Awards Program, for financial assistance. Special thanks are also extended to Deere & Company for use of the technical illustrations used throughout this publication. Illustrations shown are from the following Deere publications:

FMO Agricultural Machinery Safety
FMO Preventive Maintenance
FOS Electrical Systems
FOS Engines
FOS Hydraulics
FOS Power Trains



This material is published by National 4-H Council, 7100 Connecticut Avenue, Chevy Chase, Maryland, 20815. National 4-H Council is a not-for-profit educational organization that utilizes private resources to help expand and strengthen the 4-H program. 4-H is the youth education program of the Cooperative Extension Service of the State Land-Grant Universities and the U.S. Department of Agriculture.

Programs and educational materials supported by National 4-H Council are available to all persons regardless of race, color, sex, age, religion, national origin or handicap. Council is an equal opportunity employer.

©1986

I. Introduction	3
II. Safe Tractor Operation	4
The Tractor, Safety and You	4
Thinking and Acting Safely	4
Begin With Safe Equipment	4
Safety Practices to Know and Use	4
Universal Hand Signals	6
III. Record Keeping	9
Servicing Forms	9
Recording Fuel, Oil and Repairs	10
Operating Costs	11
IV. Fuels and Lubricants	11
Fuels	11
Engine Oils	11
Lubricants	12
V. Fuel Systems	14
Diesel Fuel System	14
Spark-Ignition Engines	15
Engine Air Supply and Cleaners (Filters)	16
VI. Lubricating the Tractor	19
Engine Lubrication	19
Oil Filters and Systems	19
Servicing the Lubrication System	20
Greasing the Tractor	20
Lubricating Other Systems	21
VII. Electrical System	22
The Battery	22
Starting Circuit	23
Charging Circuit	23
Ignition Circuit	24
VIII. Cooling System	27
Water-Cooled Systems	27
Air-Cooled Systems	29
IX. Hydraulic System	31
The Hydraulic Principle	31
Hydraulic System Maintenance	32
X. Drive Train	35
The Clutch	35
Transmissions	36
Differentials	37
Final Drives	38
Maintenance	38
XI. Glossary	41

4-H TRACTOR PROJECT

Second Year

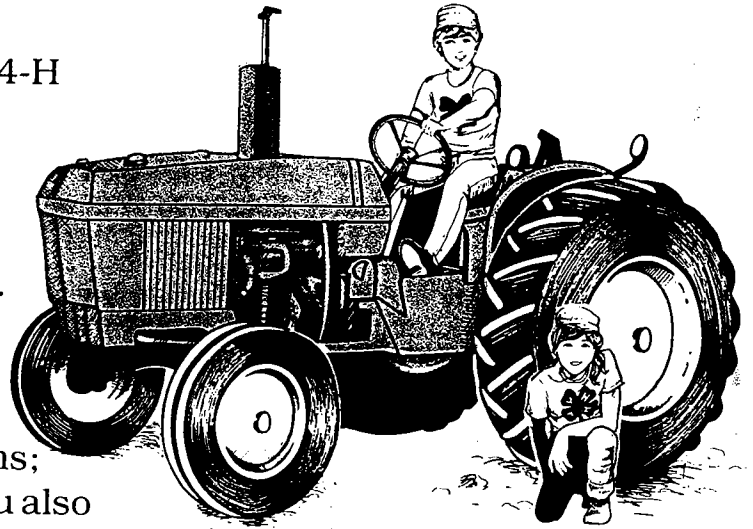
Assuring Safe & Efficient Tractor Operation

Welcome to the second unit in the 4-H tractor project series. This year my twin sister Carla and our farm friends join me in guiding you through this manual to help ensure safe tractor operation and maintenance.

Unit one helped you get acquainted with the tractor. You studied the history of the tractor; safety practices; basic information about tractor systems; and minor maintenance and service. You also should have become familiar with the operator's manual, instrument panel and controls, and starting and stopping the tractor in preparing yourself to drive. The underlying theme was *safety*. The next step, in this unit, is *operation, care and maintenance*.

We challenge you to more indepth study of tractor systems, fuels and lubricants, servicing the tractor, keeping operating cost records, and learning more about tractor operation and maintenance, including universal hand signals for communicating with tractor drivers.

As always, "Learning-by-Doing" is the key to 4-H success. So remember to complete the suggested activities and answer the quiz questions supplied at the end of each lesson. Both will help round out your knowledge and skills in tractor safety, operation and care.



Wishing You Good Luck!

*Careful Carl & Carla
and Friends*

Safe Tractor

The Tractor, Safety & You

You have learned several reasons why it is important to maintain a tractor properly. Good tractor care results in longer tractor life, more power and lower operating costs. If you learn how to do small but important maintenance jobs yourself, you will get better production from your tractor while helping to reduce the need for major repairs and high maintenance costs.

While learning to care for your tractor, you should also be learning safe operating procedures. 'Thinking' safety and 'acting' safely around the farm can help save lives.

Thinking and Acting Safely

"I was in a hurry." ... "I 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 accidents? Why? Because we become hurried, careless, preoccupied and try to do more in a given amount of time than can be done safely. When we get behind in our work we take too many chances. That results in accidents!

Did you know that the tractor is involved in more accidents than any other farm machine? One source reports that when an accident occurs due to human error it is usually because someone failed to obey a safety precaution and made one or more of these mistakes:

- 1** Forgot an operating function—such as not setting the brake or not placing the gearshift into "park" position before dismounting.
- 2** Took a shortcut—such as trying to operate tractor controls from the ground.
- 3** Took a safety risk—such as stepping over a rotating power take-off (PTO) shaft or refueling while smoking.
- 4** Ignored a warning—such as "Disengage power and shut off engine before adjusting or lubricating the machine."
- 5** Failed to recognize a hazard.

As a member of the 4-H tractor program you should make a commitment to helping reduce tractor accidents. You can become a safe tractor operator by forming two important safety habits: (1) Be sure the equipment you operate is safe, and (2) Keep a proper attitude—one that lets you think safety and act safely so you can avoid hazardous or accidental situations.

Begin 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. 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. Include the seat, steering, breaks, clutch, platform, wheels, tires, hitch and PTO in your check. You can add other items as necessary.

Seats on 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 the bolts and screws. If any are loose or missing make repairs immediately.

Good brakes are important, too. Brakes wear with use. For this reason they must be checked regularly. 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!

Safety Practices to Know and Use

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

Where underground storage is not feasible, safe fuel storage may be provided by a good above-ground tank. Locate it as far as practical from buildings. (Forty feet is considered a minimum.) A shutoff valve between the hose and the tank is a must. The valve should be one that will stop the flow of fuel in case of fire.

Operation

Never refuel a tractor while it is running or even while the engine is hot. It's the fuel vapor which burns and a hot manifold or spark could ignite it. If fuel spills, always let it evaporate before starting the engine.

Never allow smoking or an open flame near fuel storage areas.



Fire Extinguishers. Do you have a fire extinguisher on your tractor? Do you 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. Use only extinguishers that are approved for use on petroleum fires. Carbon dioxide (CO₂) and dry chemical extinguishers are approved extinguishers. (See Fig. 1-1).



Figure 1-1

KEEP A FIRE EXTINGUISHER ON HAND IN THE TRACTOR SHED. MAKE SURE IT IS APPROVED FOR USE ON PETROLEUM FIRES.

Radiators. If the radiator has a pressure cooling system let it cool before removing the radiator cap. The water in this system quickly turns to steam when the cap is removed and the pressure is suddenly released. When removing the radiator cap, first place several layers of cloth over the cap as a precaution against being burned by the steam. Then turn the cap slowly, letting out a little steam at a time, and remove.

Exhaust gases contain carbon monoxide (CO), a deadly poison. It can kill! You can't smell it or see it so you have no way of knowing when a deadly amount is present. Always run an engine out of doors so the fumes can escape. If you must run an engine inside, keep the doors open for good ventilation.

Tractor Overturns

Five out of ten tractor-related deaths occur when the machine rolls over on someone. There are many ways a tractor can overturn. Let's look at three common causes.

A tractor can tip over sideways if a wheel drops into a hole or hits an obstruction. It can also tip over when making turns. The greater the speed the more likely the tractor will tip over. Slow down. Be careful to avoid obstructions or holes and be careful when making turns.

When working in hilly or sloping fields be cautious of sideways or backward upset. Have the rear wheels adjusted to a wide position when working along a slope to help protect from a sideways upset. Also, be very careful when driving or pulling a load up a hill. The chance of a tractor upsetting backward increases when the front end is higher than the back end. Let the clutch out very slowly when starting up a slope. Keep the hitch point at standard level, which is 13-21 inches above the ground depending on tractor size. Pulling a heavy load with the drawbar too high will cause a tractor to upset backward.

Tractors can even upset in level areas. Be especially careful when working along deep ditches or streams. Keep the tractor back from the edge for a distance at least equal to the depth of the ditch.

Tractor Run Overs

Two out of every ten persons (20%) killed by tractors are run over. About half are run over after falling from their tractors.

Some important rules to remember:

- 1** The operator should be the only person on the tractor any time it is in motion.
- 2** Operate the tractor only when in the tractor seat.
- 3** Fasten your safety belt if your tractor is equipped with a roll-over protection device, but don't use the belt if your tractor has no such device.
- 4** Be sure you know where all helpers or bystanders are at all times. Make sure they are not in the tractor's path.

Following these rules will help protect you and others from run-over situations.

Power Take-Off Devices

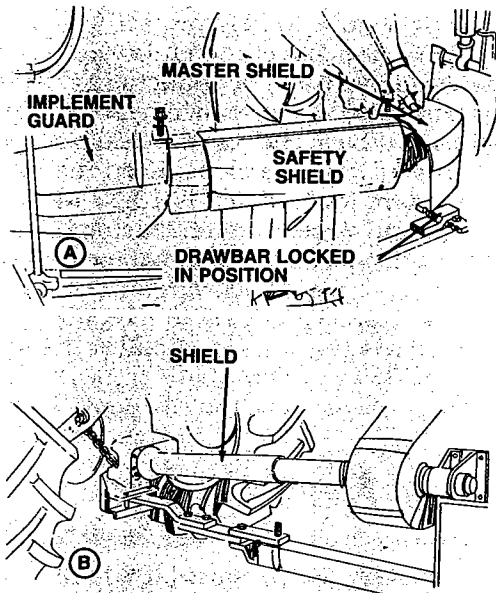
Even though the PTO shaft is almost always well-marked as a danger point, one out of ten deaths from tractor operation occur at the power take-off. An unguarded shaft is dangerous at any

speed. It can quickly catch loose clothing, twine, rope or chains you might be wearing or holding. Once caught, you are helpless against the power of your tractor.

Never operate a tractor unless the power take-off is covered with a shield (Fig. 1-2). One type of shield covers the top and sides of the shaft. Another is fastened to the PTO. It will rotate slowly when the PTO is in use but will stop if it is touched. You can't always tell whether a PTO shaft is guarded by a loose shield while operating. To be safe, treat it as an unguarded shaft and stay away from it.

Figure 1-2

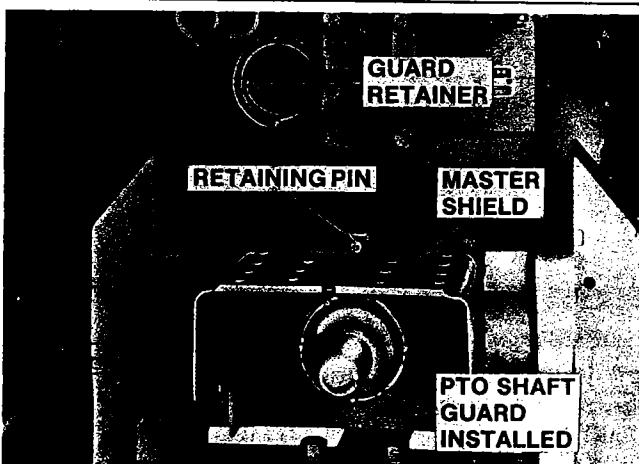
SHIELDS MUST BE USED TO PROTECT PERSONS FROM ROTATING PTO SHAFTS.



The PTO stub should be protected when it is not in use (Fig. 1-3). This can be done with a stub shield. Some tractors also have front PTO shafts. These should be shielded for protection the same as a rear PTO.

Figure 1-3

A SHIELD AND GUARD SHOULD COVER THE PTO SHAFT STUB.



Universal Hand Signals

You probably know what it's like to try to talk to your mom or dad when the water's running or when household appliances are in use. It is difficult to hear for the noise. Well, the same principle applies when the tractor is in use. When the noise level is high you can't always hear what another person is saying, so hand signals have been developed to assist in giving directions while working in the field.

There's a universal set of hand signals that you and others should learn (Fig. 1-3). These are helpful in noisy surroundings or when working at some distance from another person. Take time to learn them. You can start at home in front of the mirror. Graduate to in-person drills with a friend. Practice them in the field at every opportunity. Here's how Careful Carl and Carla practice in front of the mirror (Fig. 1-4).

Learn by Doing

1. Check to make sure all protective devices (PTO shields, canopies, seat belts, etc.) are available and in working order on a tractor. You should also check over implements, such as power lawnmowers and garden tractors, to determine whether required protective shields and guards are in place.

Find recent statistics on tractor-related deaths and accidents in your state or the United States. (National Safety Council publications in the library or local Extension agents are good sources.) What are some preventive measures that could have avoided certain accidents?

2. Do some research. Give a report on a tractor-related accident. Point out ways the accident could have been avoided.
3. Learn and practice the set of universal hand signals used to communicate with the tractor operator. Team up with a partner and take turns calling out conditions requiring the signals, so you can learn to use them comfortably when needed.
4. 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 relighted some distance from the wick.
5. Sometimes it's difficult to know what to do in an emergency. In many instances, people tend to freeze and do nothing at all or make the wrong move. Here's an easy way to demonstrate

this fact. Hold one end of a broomstick 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 handle. Chances are, your friend only tightened his hold and could not let go. A person's natural reaction is

to tighten his grip and hold on. This is why so many people get caught in machinery or running equipment. The machine suddenly unclogs itself and the operator can't let go, so the hand goes into the machine, or they wait too late to let go and their clothing gets caught, pulling them into the machine.

Figure 1-4

THESE UNIVERSAL HAND SIGNALS ARE FOR COMMUNICATING UNDER NOISY CONDITIONS AND IN OTHER SPECIAL CASES.

Start the Engine

Start the engine. Move arm in a circle at belt level.



Stop the Engine

Stop the engine. Move your right arm across your neck from left to right.



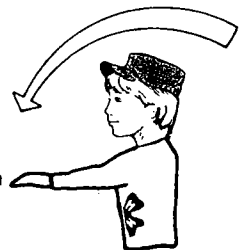
Come to Me

Come to me (Can also be come to me because I need assistance). Lift your arm vertically over your head with the back of your hand to the rear and turn your arm in large horizontal circles.



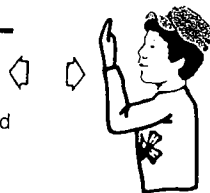
Move Out

Move out. Face in the needed direction of movement. Put your arm straight out behind you. Then, swing your arm over your head and forward until your arm is straight out in front of you with the back of your hand up.



Move Toward Me—Follow Me

Move toward me or follow me. Look toward person or vehicle you need to move. Hold one hand in front of you with the back of the hand toward the vehicle and move your arm.



This Far To Go

This far to go. Put your hands in front of your face with the back of your hands outward. Move your hands in or out as an indication how far to go.



Raise Equipment

Raise equipment. Point up with one finger and at the same time, move your hand in a circle at head level.



Lower Equipment

Lower equipment. Point to the ground with one finger and at the same time move your hand in a circle.



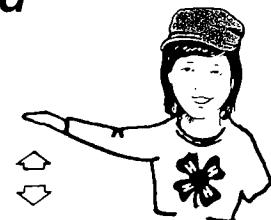
Increase Speed

Increase speed. Lift your hand to shoulder.



Decrease Speed

Decrease speed. Put your arm out horizontally with the back of your hand up and then move your arm down about 45 degrees minimum many times. Keep your arm straight and do not move your arm above your shoulder.



Stop

Stop. Raise your arm fully up with the back of your hand to the rear. Keep this position until the signal is understood.



Checking Up On Safe Tractor Operation

1. What three conditions cause the most deaths attributed to tractor operations? State at least one measure for preventing each unsafe condition.
 - A. Condition _____
Preventive Measure _____
 - B. Condition _____
Preventive Measure _____
 - C. Condition _____
Preventive Measure _____
2. If the operator is cautious, a tractor may be started and operated slowly while standing on the ground, as long as there are no implements attached. T F
3. All tractors should be equipped with seat belts and the operator should use them when in the tractor seat. T F
4. As a general rule, the tractor's PTO shaft does not become dangerous until it has developed at least one-half its rated power. T F
5. (A) Carbon dioxide (B) Carbon monoxide in exhaust gases can kill you.

Record Keeping

It is extremely important that you service a tractor regularly and according to the operator's manual. Keeping records is a way of verifying services performed.

Records help guard against forgetting to perform services on time and they provide information to help you figure operating costs. Records do not have to be complicated. You simply write down the services performed when they are done and the cost of the supplies used.

The sample record forms in this unit are simplified but complete. They provide a record of operation and services performed and a record of fuel, oil and repair expenses. You can use these or any others which allow you to keep similar information. Facts you always want to note include: the date; number of hours operated; services performed; and any other notes or observations you wish to make.

Your operator's manual is an important guide to record keeping. Refer to the maintenance and service schedule. If you study the instructions carefully and keep those records faithfully, you'll be well repaid by savings in repairs, time and longer tractor life.

Servicing Forms

The first form (Fig. 2-1) contains a list of tractor services and the normal periods for doing these. Note that the services are grouped by how frequently they must be done. Below the listing of the services, spaces are provided for checking off the hours the tractor is used. Each square represents one hour of operation and there are 10 blocks or hours in each vertical line. The date should be inserted for the first hour of use.

Moving down the first column of blocks, enter a check mark for each hour of operation. On the next day of operation, begin a new series of blocks by entering the date in the next square.

Whenever a group of services is performed, that day insert the code letter for that group. If you look at the sample form here, you see that the tractor was used five hours each day on October 31 and November 1. The "A" services (10 hours) were performed. The next day, November 2, the tractor was used nine hours and, for the sake of convenience, it was serviced before being taken out for the next day's work.

From the chart you can see that for convenience the 50-hour check-up and servicing were given at 49 hours. At this time all the services listed for the 50-hour or "B" periods were completed, as well as

those for the 10-hour "A" service. The same applies to the other service periods. Each time you do the "C" services you do the "A" and "B" services, and so on.

Figure 2-1

A SERVICING RECORD FORM AND SAMPLE ENTRIES FOR A TRACTOR

Record of Hours and Types of Services Performed

A	Hrs	}	_____	}	C	Hrs	_____
			_____				_____
			_____				_____
			_____				_____
			_____				_____
B	Hrs	}	_____	}	D	Hrs	_____
			_____				_____
			_____				_____
			_____				_____
			_____				_____
	Hrs	}	_____	}	E	Hrs	_____
			_____				_____
			_____				_____
			_____				_____
			_____				_____
	Hrs	}	_____	}	F	Hrs	_____
			_____				_____
			_____				_____
			_____				_____
			_____				_____

50 HRS.	100 HRS.	150 HRS.	200 HRS.	250 HRS.
---------	----------	----------	----------	----------

Preparing the Service List

When preparing a list of services for your tractor, refer to your operator's manual and select the jobs that should be done at stated intervals. The most common intervals are daily (or usually every 10 hours) and at 50, 100, 200, 500, 750 and 1,000 hours. If no definite time is listed for a service, ask your local dealer. Some services are set on a seasonal basis. These should be listed to fit the hours of annual operation.

List the services for your tractor at the top of the blank form as shown in Fig. 2-1. These services are examples and may not apply to your particular tractor. However, this form can be easily adapted to apply to any tractor.

Also, don't let normal service intervals take the place of common judgment. Intervals are calculated for average operating conditions. Under dusty conditions, check and service the air filters more frequently. Change the engine oil for cold or warm weather operation when the weather changes.

Recording Fuel, Oil and Repairs

A record that shows the amount of fuel and oil used for each job is of great benefit in determining the cost of tractor operations. It also is of value in determining charges for custom work, that is, renting out your tractor to do work for someone else. The record form in Fig. 2-2 is designed to provide such information.

Figure 2-2

A USEFUL FORM FOR RECORDING EXPENSES AND REPAIRS FOR A TRACTOR.

Record of Fuel, Oil and Repairs

DATE	TYPE of WORK	FUEL USED			OIL USED	HOURS	NOTES on other LUBRICATION COSTS. REPAIRS, etc.
		GAUGE AT START	GAUGE AT STOP	GALLONS USED	QUARTS		

Fuels and Lubricants

A tractor won't run without fuel, oil and other lubricants. And it won't operate properly and efficiently unless the correct products are used. Let's look at how these products are classified and when to use them.

When you use the correct fuel in a properly maintained engine, you can help ensure that your tractor will produce all the power for which it was designed. Greases and oils enable the tractor to operate efficiently, and they help prolong engine life by cutting down on wear.

It is important for you to know which fuels and lubricants are well suited for certain operating conditions. Review your operator's manual for specifics.

Fuels

Diesel. Reliable suppliers provide diesel fuel formulated for high-speed diesel engines, such as those in tractors, other farm machinery and industrial engines.

Your operator's manual specifies that any recommended diesel fuel have a minimum "cetane" number. This is a measure of the fuel's ability to self-ignite. The higher the cetane number, the better the fuel self-ignites when heated. Remember that the diesel engine has no spark plug. The fuel must self-ignite from heat of compression immediately after it is injected into the cylinder.

Most modern diesel engines for tractors and other heavy equipment are designed to operate on fuels with cetane numbers between 40 and 60. Even a good diesel fuel still may not self-ignite rapidly in cold weather. Ether, with a cetane number of perhaps up to 95, is sometimes used to assist in cold weather starting. However, do not use ether for starting diesel engines unless it is recommended by your tractor manufacturer.

Gasoline is available in many mixtures: "regular," "unleaded," "premium," and "super premium." Your operator's manual will tell you which grade to use in your tractor.

The major differences (except for adding lead) between the gasoline grades mentioned depend on the octane number of the fuel. The octane rating measures the ability of the fuel to prevent "knocking." Lower octane fuels will knock in high compression engines because they are not formulated to be compressed so much. Knocking occurs when fuel ignites unevenly in the combustion cylinder. Instead of burning evenly, the fuel mixture, in effect, explodes. This causes excessive and uneven forces which the pistons,

valves and bearings are not designed to absorb. If knocking continues, it can seriously damage internal engine parts.

Gasohol is a mixture of 90 percent unleaded gasoline and 10 percent ethanol (grain alcohol). It is available in some areas as a substitute for gasoline. Ethanol contains less energy per gallon than gasoline. An engine will develop more power from ethanol only if it is designed and tuned for a higher octane fuel.

LP-Gas is available for use in farm tractors. However, it is not very popular because it requires special equipment to transfer it into the tractor fuel tank. It is a clean burning fuel and LP engines require fewer repairs than gasoline or diesel engines.

Engine Oils

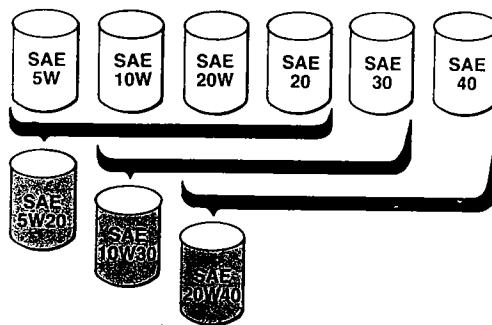
Many engine oils are available to the consumer. It may seem difficult to choose the correct one for your tractor. But if you know the standard system of classification you can be sure you are always using the proper oil.

After motor oils are refined, they are given many tests so that manufacturers know they are making a uniform product.

Viscosity Classifications: The viscosity test is one of the most important ones for the user. Viscosity tells how well the oil flows at different temperatures. You have probably heard people speak of a "light" or "heavy" oil. They are referring to viscosity.

Figure 3-1

MULTI-VISCOSITY OILS REPLACE SEVERAL SINGLE-VISCOSITY OILS.



Oils with additives to provide good low-temperature properties and prevent too rapid thinning when heated are classed as multigrade oils (Fig. 3-1). Such oils are listed as 5W-20, 10W-30, 10W-40 or 20W-40. These are well suited

to start-and-stop operation. They are especially useful for seasons in which extremes of warm and cold temperatures occur.

The SAE grade of oil to use in your tractor depends on crankcase temperature and engine design. An oil with a low SAE number is a thinner oil and an SAE 40 is a thicker oil.

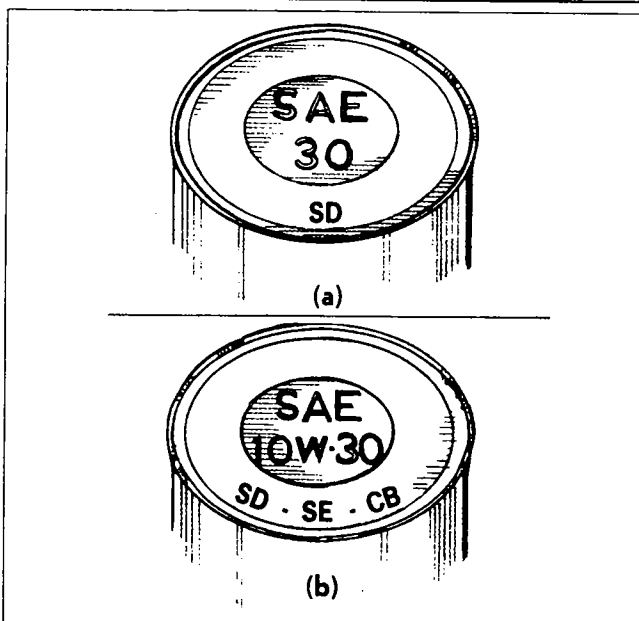
Service Classifications: Engine oils also are classified according to the suitability of service. These classifications, which tell the "quality" of the oil, have been developed by the American Petroleum Institute (API).

Current API classifications have either the prefix "S" for service station engine services or "C" for commercial and fleet engine applications. It's easy to remember that S categories are mainly for spark-ignition engines while C categories are for diesel engines.

A second letter denotes the sequence of performance tests a motor oil has passed. The simplest service categories are SA and CA. Motor oils meeting specifications for these categories offer little more than basic lubricating properties. Such motor oils would offer little protection in today's modern, high-performance engines. As performance requirements become more complex, motor oils are improved to meet or surpass engine protection needs (Fig. 3-2).

Figure 3-2

NEWER MOTOR OILS ON THE MARKET USUALLY MEET OR EXCEED MORE THAN ONE API SERVICE CLASSIFICATION



Each time a new series of tests is developed, the second letter is changed in the API classification. Thus, motor oils passing the SF and CD test sequences are the "best" oils available, in terms of protection they offer the engine (Table 3-1). Always use a grade carrying the same or higher API classification of oil specified for your tractor. For example, CD quality oil may be used to replace CC quality.

Table 3-1

API Service Designations for Engine Oils

SAE Letter Designation	API Identification of Engine Service
SA	Utility Gasoline and Diesel Engine Service
SB	Minimum-Duty Gasoline Engine Service
SC	1964-67 Gasoline Engine Warranty Service
SD	1968-71 Gasoline Engine Warranty Service
SE	1972 Gasoline Engine Warranty Service
SF	1980 Gasoline Engine Warranty Service for many Automotive Applications
CA	Light-Duty Diesel Engine Service
CB	Moderate-Duty Diesel Engine Service
CC	Moderate-Duty Diesel and Gasoline Engine Service
CD	Severe-Duty Diesel Engine Service

Lubricants

Gear lubricants are classified in the same way as engine oils—by viscosity and service classification. While they resemble the thicker engine oils, they perform different jobs in the transmission, differential, final drive units or power take-off.

Gear oils range from the simple, for use in older systems, to hydraulic-type lubricants for use in newer machines. These newer gear systems usually have smaller, stronger gears able to withstand tremendous loads that produce high pressures and friction between the moving parts.

Grease is a solid or semi-solid lubricant, usually a lubricating oil with a thickener and sometimes other additives. The thickener is often a type of soap.

Different greases were needed to lubricate various parts of the tractor years ago. The newer multi-purpose greases usually are suitable for almost any tractor application.

Synthetic Lubricants. Ordinary lubricants are produced by refining mineral (petroleum) oils to the desired quality and adding any other compounds to meet specific performance requirements. In recent years, many manufacturers have introduced "synthetic" lubricating products. These fluid lubricants and greases are made by building up or synthesizing a product (usually petroleum product) for a specific purpose.

Manufacturers claim that the greatest advantage of synthetics is their longer service life. A synthetic oil, for example, may perform effectively for four times as long as a mineral-based oil. These newer oils also remain viscous at much lower temperatures than a mineral oil of the same SAE number.

Synthetic products carry the same SAE and API classifications as mineral-based products. Check with your tractor dealer to be sure synthetic products can be used on your tractor. This is especially important when systems are under a manufacturer's warranty.

Learn by Doing

1. Visit your local service station, farm supply outlet or tractor dealer. Make a list of the various lubricants available. Compare your list with the lubricants recommended in your tractor operator's manual. How many of those available may be substituted to meet the tractor's requirements? Which ones are unsuitable and why?
2. Obtain some automobile or tractor engine parts that have been replaced because they are badly worn. Try to determine whether poor lubrication was a major contributor to their failure. You might want to obtain an estimate on the cost of replacing the parts, if you can. Make a display so others can see how important proper lubrication is.
3. Tape record an engine "pinging" and use it in a presentation at your club meeting.
4. Take a sample of oil and divide into three samples. Place one in a deep freezer, warm one in an oven, and leave one at room temperature. Punch a hole in a can. One at a time, compare the time necessary for an ounce of each to drip through the hole in the can.

Checking Up On Fuels and Lubricants

1. Why is ether sometimes recommended for helping start a diesel tractor in very cold weather? _____

2. Match the lubricants in the left column with the characteristics in the right column which best describe their viscosities.

SAE 10-40 engine oil	Does not flow at normal temperatures.
SAE 120 gear oil	Flows well over a wide range of temperatures.
SAE 50 engine oil	Not viscous enough for cold weather engine operation.
No. 5 lubricant	Similar to slow-flowing engine oil.
3. You have just purchased a new diesel tractor. Your operator's manual would specify an engine oil having at least the _____ service designation.
 (A) CA (B) SF (C) CD (D) SD
4. An engine oil carrying the SA specification will last longer than one having the CD specification. T F
5. So-called synthetic lubricants last longer in an engine because they contain special nonpetroleum chemicals. T F
6. "Regular," "unleaded," and "premium" are terms used to distinguish between types of
 A) ethanol, B) gasoline, C) natural gas?
7. Always use a grade of oil carrying A) higher/same, B) lower/same API classification, as specified in your operator's manual?

Fuel S

You will remember from your earlier tractor studies that gasoline, LP-Gas and diesel engines get their names from the fuels they use and all have different fuel systems. But there are basic similarities. A tank stores the fuel, one or more pumps transfer the fuel, and the injectors (diesel engines) or carburetors (spark-ignition engines) atomize the fuel so it burns easily. Fuel systems also include lines and filters to transport and clean the fuel, and serve as a means of providing large quantities of clean air for mixing with the fuel. (See Fig. 4-1).

Figure 4-1

BASIC FUEL SYSTEM.

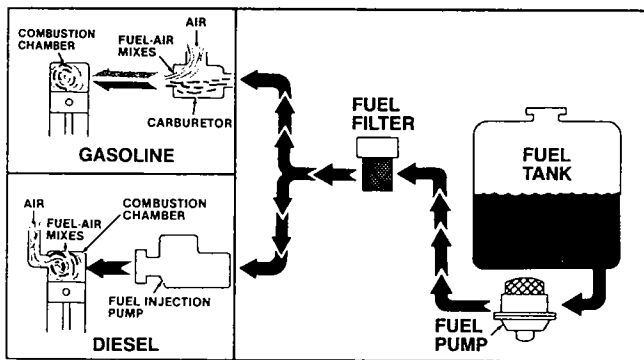
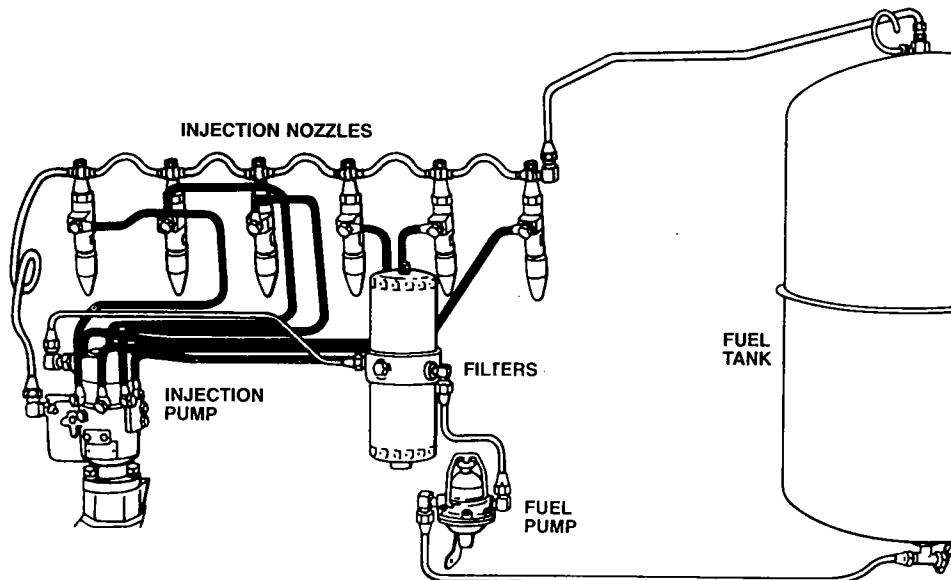


Figure 4-2

MAIN COMPONENTS OF A DIESEL FUEL SYSTEM (DISTRIBUTOR TYPE SHOWN).



Diesel Fuel Systems

Injection Pump. Most diesel engines on farm tractors have two fuel pumps. A fuel transfer pump forces fuel under low pressure from the tank to the injection pump. The injection pump puts the fuel under high pressure (from 1,900 to 5,000 pounds per square inch) and distributes it to each injector. The transfer pump delivers fuel to the injection pump.

Many makes of diesel tractors use a distributor injection pump (see Fig. 4-2). It features an engine-driven driveshaft which imparts rotary motion to pump components. The fuel transfer pump at one end of the shaft supplies fuel under low pressure through the rotor. Fuel is pumped to the injection nozzles by two pistons or plungers working toward each other.

A diesel engine does not have a choke to assist with cold starts. Some diesel tractors have a means for injecting a starting fluid during cold weather. Starting fluids often are ether, which volatilizes to a gas and ignites easily. These fluids are highly explosive and only work at temperatures down to 0°F. At temperatures below 0°F an electric supplemental heater mounted in the cooling system is needed.

