Used Farm Equipment Assessing Quality, Safety and Economics
Michigan State University
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Small Farms Series
James W. Garthe, Dennis J. Murphy, and William K. Waters Pennsylvania State University
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USED FARM EQUIPMENT

Assessing Quality, Safety, and Economics

SMALL FARMS SERIES

Northeast Regional Agricultural Engineering Service

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Used Farm Equipment

Assessing Quality, Safety, and Economics

Written by

James W. Garthe, Extension Agricultural Engineer, Pennsylvania State University
Dennis J. Murphy, Extension Safety Specialist, Pennsylvania State University
William K. Waters, Area Farm Management Agent, Kittanning, Pennsylvania

Illustrations by Ellen McHenry
Editing and Design by Marcia Sanders

NORTHEAST REGIONAL AGRICULTURAL ENGINEERING SERVICE
Cornell University
152 Riley-Robb Hall
Ithaca, New York 14853

CONTENTS

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Introduction

Buying used farm machinery can be a productive, money-saving experience. A buyer who knows what to look for in regard to quality, safety, and economy will be able to build a collection of dependable, long-lasting farm equipment.

Become a knowledgeable buyer by following the plans in this guide for logical, methodical inspection of farm machinery. First, learn how to evaluate the quality and serviceability of components in relation to the entire machine. Second, know the key safety features which reduce accidents and damage to farm equipment and its users. Contemporary safety features may not be found on used equipment, and there are several known weaknesses in the designs of yesteryear. Lastly, study the tips on how to economically justify the purchase of certain pieces of used equipment. Consider all costs of owning and operating a machine, including its contemplated purchase price.

"Let The Buyer Beware"

This maxim definitely applies to buyers of used farm equipment, since it is up to the purchaser to establish the mechanical soundness of a machine. This publication will help buyers quickly assess the condition of equipment by looking for clues to past or future problems, maintenance, and use. These clues will help establish the worth of a machine and determine a rough estimate for restoring the item to working order. Buyers will learn to spot cover-ups used by some sellers for their own financial benefit and the buyer's loss. However, this publication does not attempt to help buyers match or size equipment for a farming enterprise.

Sources of Used Equipment

Four common sources of used equipment are:

- Dealers
- Friends or neighbors
- Farm auctions or dispersal sales
- Commercial auctions

For inexperienced buyers, buying from a reputable, local farm machinery dealer is the best way to start. A dealer prizes a good reputation and often makes an effort to know about the previous owner and some history of the item for sale. The dealer is also in a position to offer pre-sale or post-sale servicing to suit the buyer's needs.

Buying from a friend or neighbor is a fairly safe practice, since the buyer usually has some knowledge of the seller. If you don't know the seller, find out more about a machine by asking others. More importantly, make sure the owner is neat, orderly, and pays attention to detail. If a seller runs a disorganized, sloppy enterprise, chances are the maintenance on machinery is also sloppy. In this case, don't buy unless you negotiate a good price and are willing to replace or repair parts.

Buying at an auction or dispersal sale can be tricky for even the experienced buyer. Always attend the viewing day held before a sale or at least arrive early on the day of the sale. Preview time allows a buyer the opportunity to inspect closely and operate those machines that are in running order.

At auctions, some machinery is put in by dealers at a preset reserve price; if its reserve price is not reached in the bidding, the item is withdrawn. Set an upper limit on the price you are willing to pay, and stick to it. Watch that you don't fall into the trap of bidding against the owner, a ploy sometimes used to push a price up. Also, at farm auctions, look around the farm and note the type and size of equipment present to get an idea of the work to which a machine has been subjected.

Buying at a commercial auction is very risky for the novice. These auctions are for high-speed, high-volume selling mainly to dealers and wholesalers. If you must go this route, take along a friend to help clarify the price as you bid. Don't try to nod or wink as the pros do. Get the auctioneer's attention and have him or her "speak English" to you so you don't pay a higher price at the last second. Another option is to accompany a reputable used machinery dealer who will evaluate equipment and bid for you.

Your Needs

Before looking at any used equipment, assess your true needs. Consider these three points:

- **Affordability:** Will the purchase price plus costs of repairing, operating, and maintaining this item yield a net profit?
- **Dependability:** Will you have to spend excessive time continually repairing and maintaining the item?
- **Compatibility:** Will the item fit into your present line of equipment? Will it serve many purposes, and will it be possible to adapt it to do what you want done in a few years?

These three points are extremely important. You must ask these questions before buying anything which is used. Sometimes, in today's high-tech society, people feel they need a machine to do a task that could be done easily by hand. For some tasks, you may save time and money by hiring workers instead of buying a machine.

Bigger is not always better. Consider the compatibility with existing machinery in your enterprise, the land area available to farm, and storage facilities for the equipment.

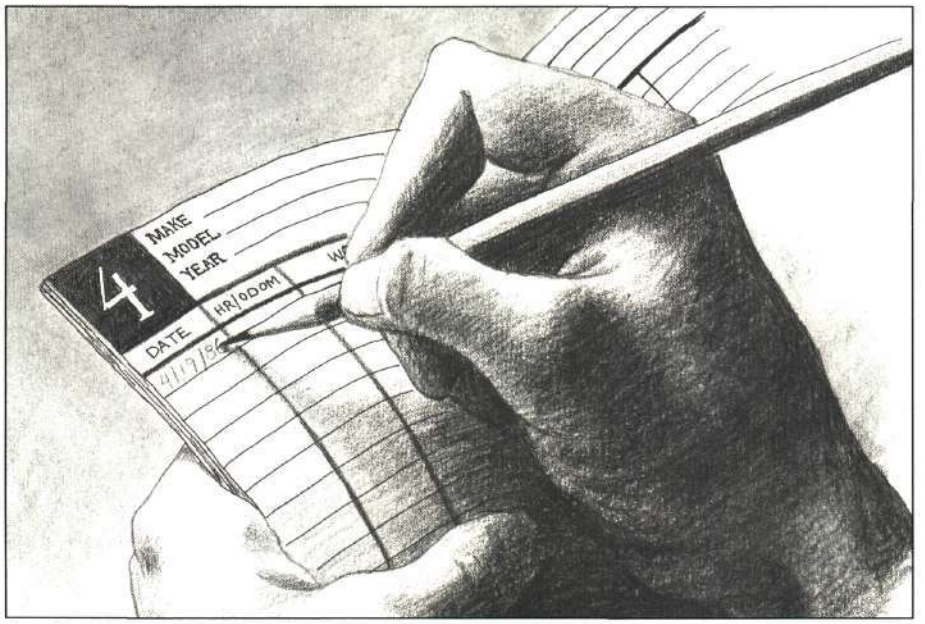
The Hazards of Used Equipment

Buyers should reduce the safety risk and liability associated with used farm equipment by planning to bring safety features up to date. The process of designing safety features for machinery is an evolving one. Thus, the newer the piece of equipment, the safer it is likely to be. However, be aware that many original safety features may have been removed or made inoperable by previous owners.

A consideration in selecting used machinery is "Who will be operating or spending time around the equipment?" If the answer includes children, adolescents, regular or temporary employees, friends, or nonexperienced family members, then for both moral and legal reasons, be particularly picky about the safety features on the potential purchase. The chance of an accident increases when inexperienced operators and unsafe equipment are combined.

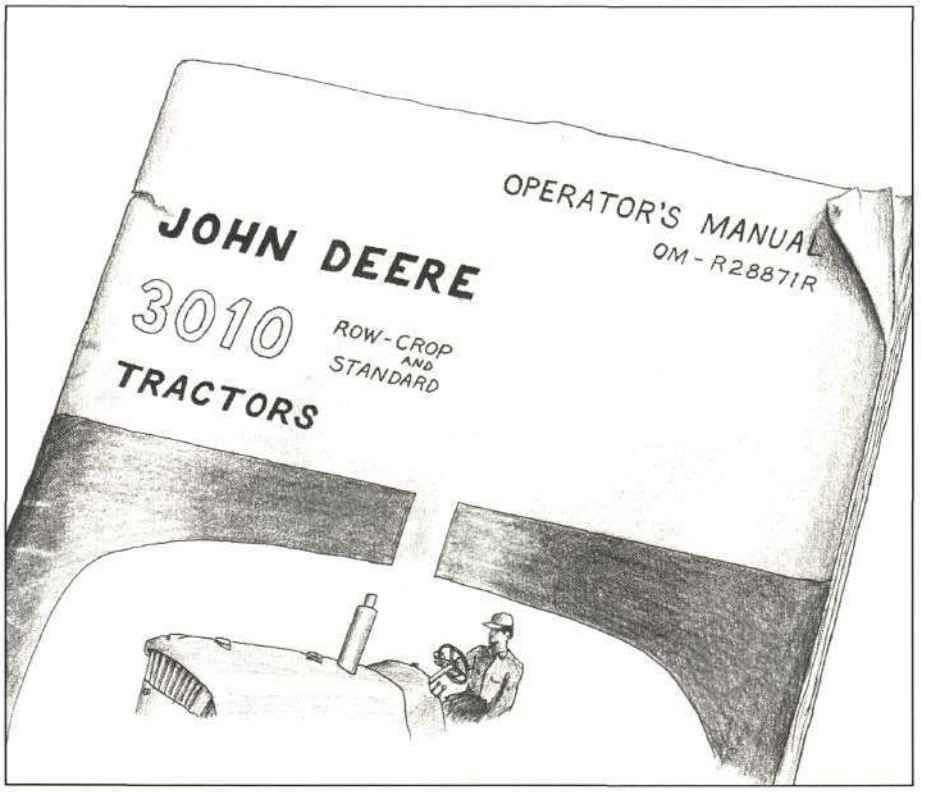
Assess the Seller

Only the past owners of a machine know exactly how it has been used, what maintenance it has seen, and any problems it may have. A seller will not spell out all of an item's bad points, so the buyer has to know what to look for and ask questions about.



Log book

Ask if a log book exists for the piece of equipment. Usually, one does not exist, but sellers who do produce a log or maintenance records should get a thumbs-up sign for their effort. Owners who cared enough to keep records have usually cared well for their equipment.



Operator's manual

Page through the operator's manual to see if it appears to have been used. Look for pencil markings, underlined passages, check marks, or handwritten comments as clues. For example, if the lubrication service chart looks used, the manual was probably referenced for periodic maintenance. If no manual exists, perhaps you are not buying from the original owner. If the seller is the original owner, the absence of the manual may indicate the absence of proper maintenance and operation.

To obtain a copy of the manual for a used model, contact a dealer or the manufacturer of the equipment. If you can't find either, perhaps the manufacturer has merged with another company. Your county Cooperative Extension agent should be able to locate a manufacturer's address.

Quick Visual Inspection

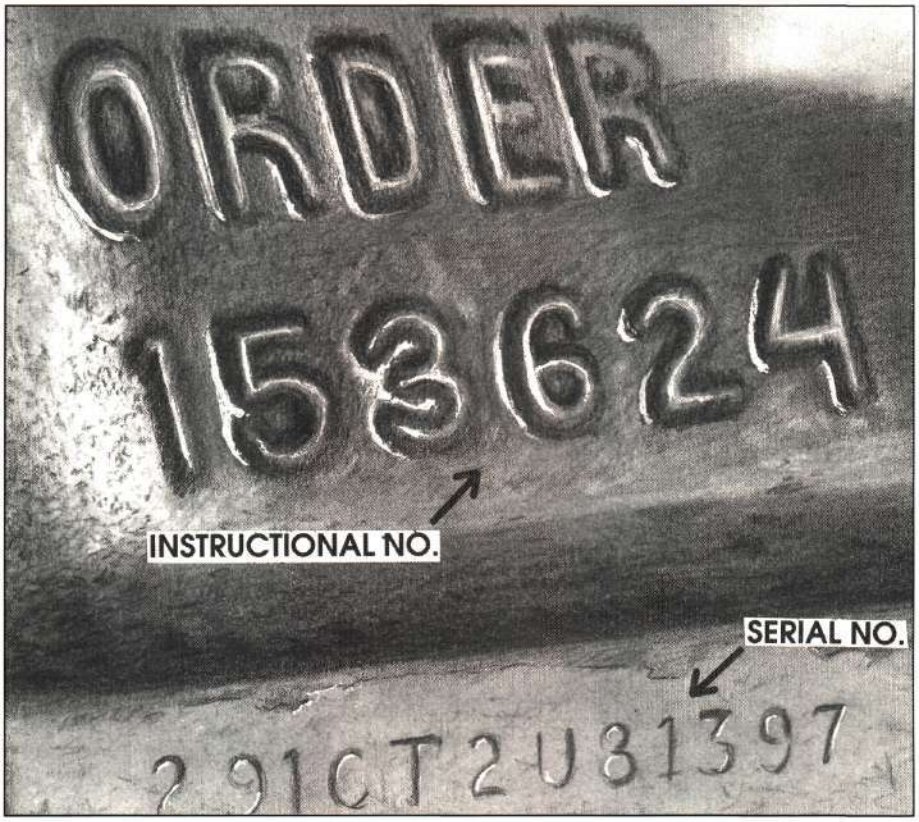
After initial discussion with a seller, give the machine a visual checkup. Look for identification numbers, clues to needed repair jobs, and signs of sloppy maintenance or improperly done repairs on the item for sale.

Watch out for mismatched hardware on a unit. Although blends of hardware sizes and types may do the job, they may indicate a quick fix-it that was never repaired properly. Such expedients often indicate that the owner's maintenance program was probably as poorly organized as his hardware selection. It may also indicate a weak spot in a system or an area stressed or abused by the operator.

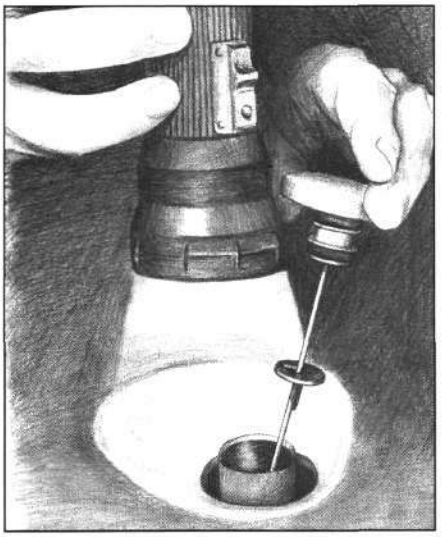
Cover-ups on agricultural equipment do occur, so look for product identification number (PIN) plates as shown on the right. If a plate is missing or badly damaged, beware. Scrape around the plate to see if the unit has been repainted or if a bogus plate has been placed where the original was. If you suspect something, look closely at the rivet heads for recent hammer or punch marks. Sometimes PIN plates are surface-masked for painting at the factory, but the edges are usually painted. Check to see if the unmasked paint matches the color of the unit and fills the seams where plate and machine meet.

Make sure the PIN plate has not been tampered with

Many buyers believe embossed numbers on castings have significance in identifying a machine, or in the case of engine-powered units, in identifying the engine itself. Most of the time, however, these raised characters are not serial or model numbers, but are instructional (e.g., engine firing order) or more typically, casting numbers. Casting numbers are placed by the pattern maker for industry use only. Serial numbers are punched or imprinted into a smooth, machined surface in an area not easily damaged or covered by attachments. Most operator or service manuals specify the location of the serial number.

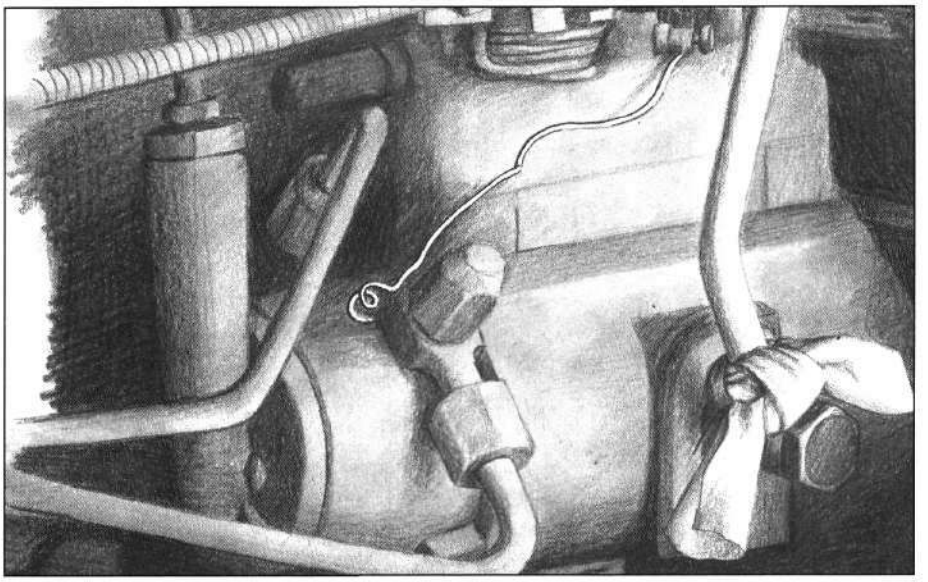


Serial numbers are usually stamped, not embossed, on casings



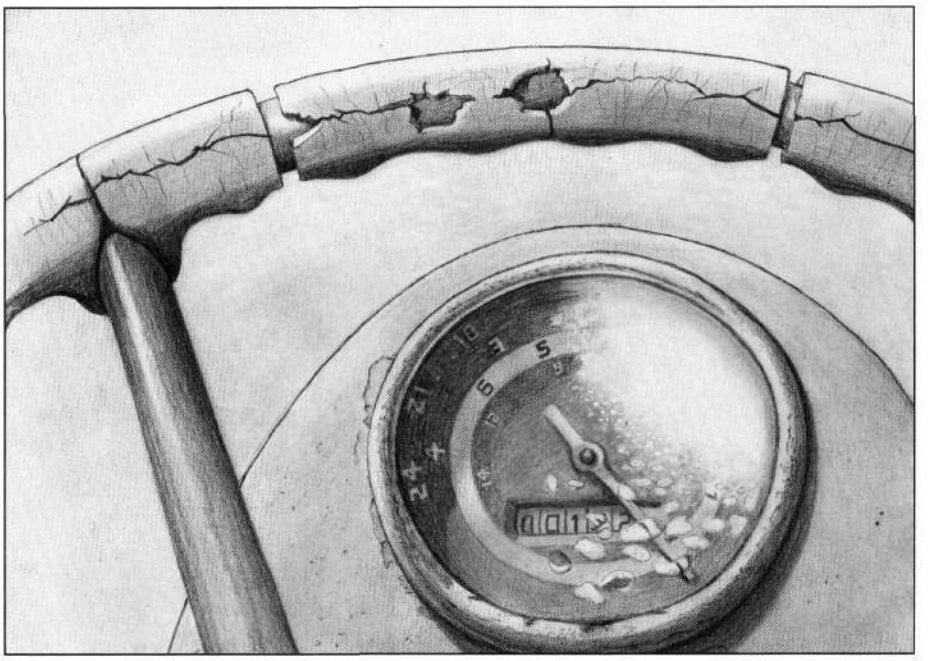
Shine flashlight into reservoirs

If you plan to shop for an engine-powered unit, bring along a flashlight. Shine a bright light into hydraulic reservoirs, fuel tanks, and other containment reservoirs. Look for water pools, chipped, spalled (pitting where metal flakes break off) or galled (scoring where metal chunks break off) gear teeth, rust or chemical corrosion, and even turbulence currents if the machine is in operation.



Unreliable quick fix-its

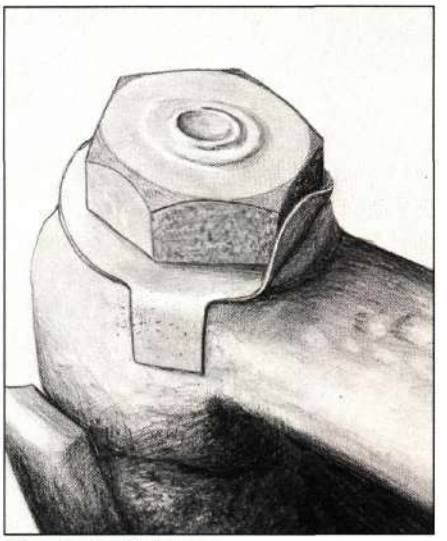
When you see random rags, wire, twine, clamps, etc., on a machine, the first impression may be that they aren't hurting anything. Just remember that these makeshift remedies probably have a function—a function that perhaps is unsafe or about to fail. Such patch jobs should be red flags to a buyer because they represent a poor attitude toward maintenance. Look for signs of quick fix-its which have been removed to doll up equipment for resale. Signs include scratched paint, dried or sticky tape adhesive, patches of clean paint surrounded by weathered paint, or residual twine or wire shreds in crevices or between mating parts.



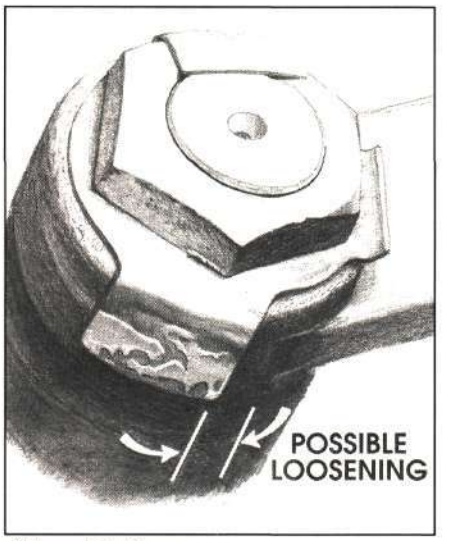
Damage from outdoor storage

Outdoor storage of machinery causes more damage to equipment than most owners realize. Telltale signs, such as cracked steering wheels, fogged gauges, or faded paint, indicate that Mother Nature has taken her toll. If the steering wheel is worn out, as shown in the illustration, plastics and elastomers elsewhere are usually cracked and dried out. If water is in the gauges, it is a good bet water is also in the bearings, oil sump, hydraulic system, or other places it should not be.

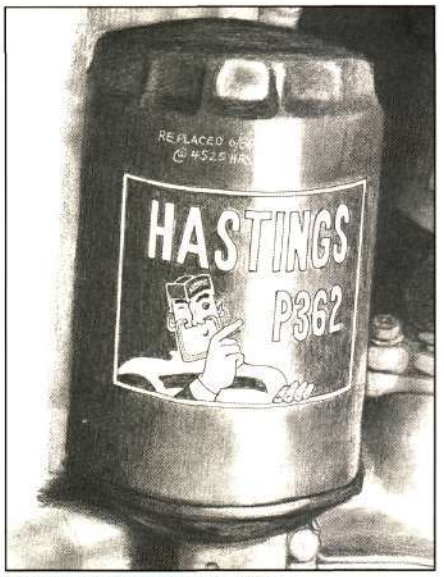
Look over fasteners closely to determine if any components have been disassembled. For example, compare the two steering arms shown. The unaltered one has original paint masking the threads on the steering arm shaft, the nut retaining tab shows no sign of having been bent since assembly at the factory, and dirt and grease buildup is dry and unaltered. The altered arm has paint chipped off both the threads and the retainer plate. The tabs on the altered nut retainer were installed by a novice, since the nut could loosen 1/6 turn before the lower tab would contact the arm.



Unaltered fastener

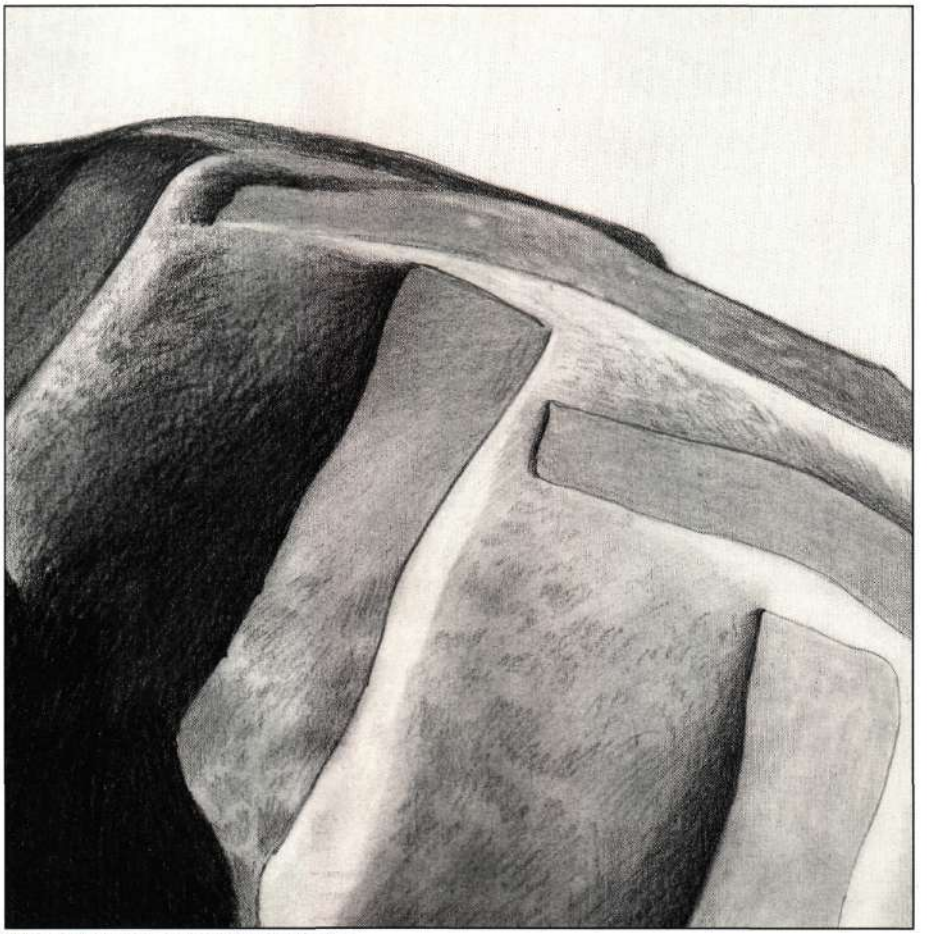


Altered fastener



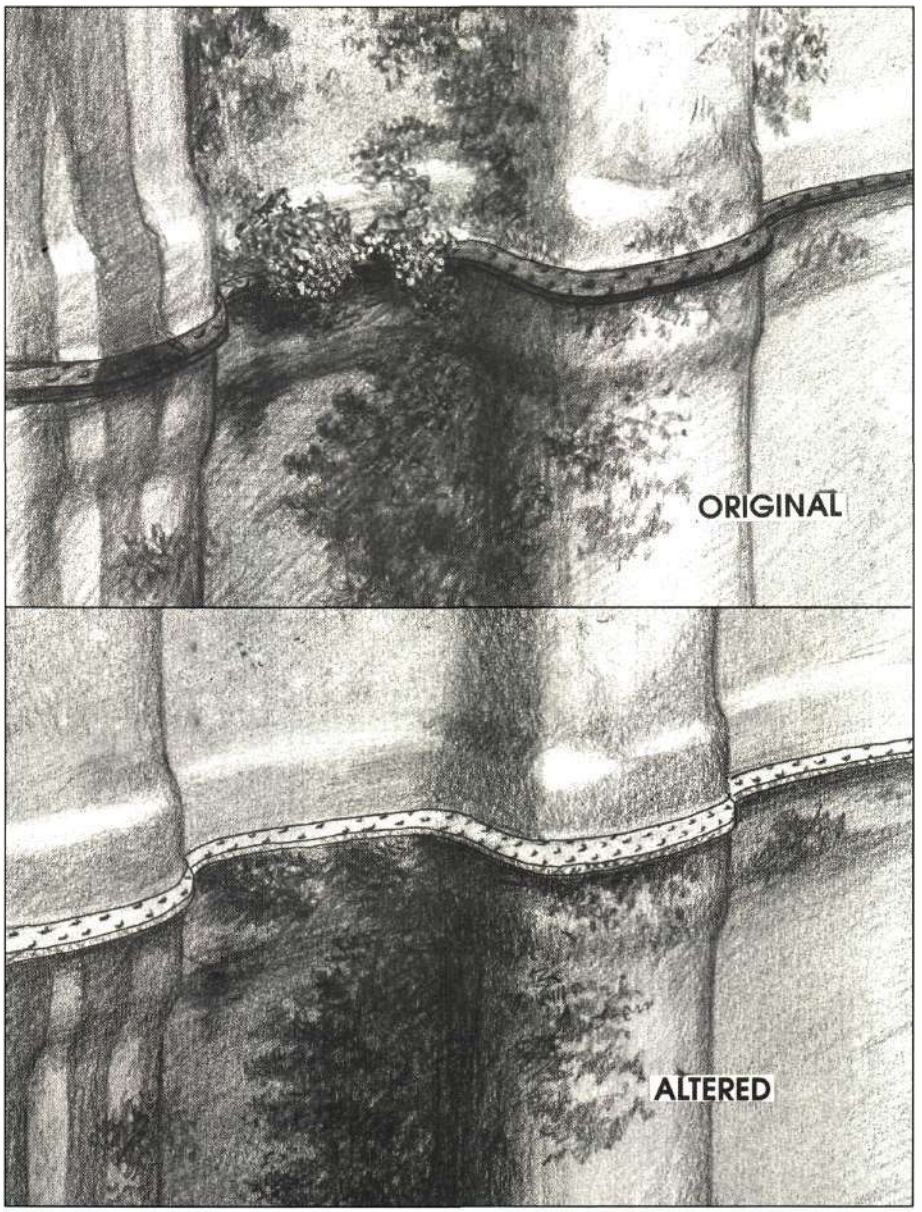
Clean and readable filter

To evaluate overall machine maintenance quickly, glance at the fuel filter, engine oil filter, or hydraulic filter. If they are clean and the logos are readable, the machine has had some degree of periodic maintenance and may be worthy of a more thorough inspection. If filters are brand new, however, they may have been installed to clean up the unit for sale. If a simple filter change has been neglected, certainly more extensive maintenance has been overlooked, too.



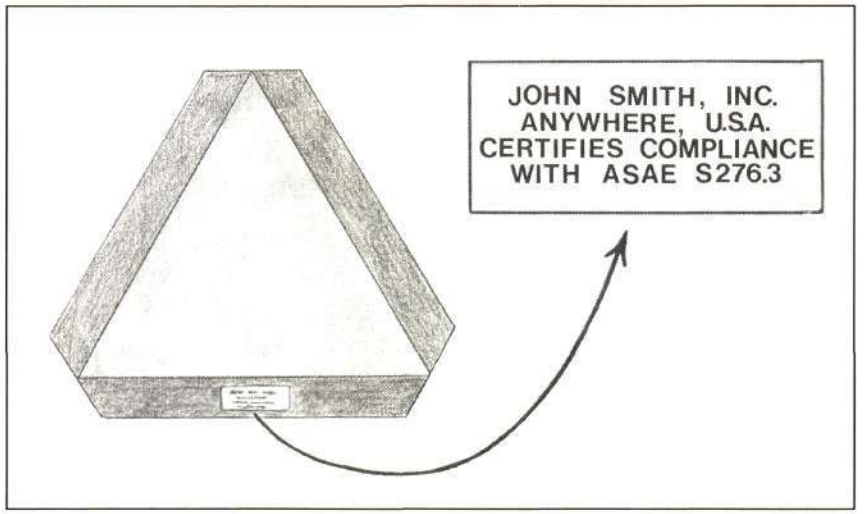
Tire lugs worn due to road use

Tires often show the history of a mobile machine. The tractor tire shown above has seen a lot of road use, probably in higher gears. Tires used extensively on hard-surfaced roads have lugs worn unevenly across their length with sharply defined edges. In contrast, tire lugs worn evenly across their length probably have seen mostly field work. Think about how road use versus field use might affect the machine condition and how it might influence your decision to buy. For example, dusty, heavy drawbar loads on a field-use tractor might be tough on air and lubrication systems, as well as on the transmission.



A close look in the head gasket region may reveal past engine problems

On tractors, make sure paint around the head gasket is original. If oil and dirt streaks have been altered, typically above the head gasket, the cylinder head gasket was probably replaced recently. A new head gasket may not be a sign that major problems existed in the engine, but you should ask the seller why the head was removed. Some owners remove heads but unknowingly reuse the old gasket; be wary if marks show a head removal but the gasket edges are old and stained.

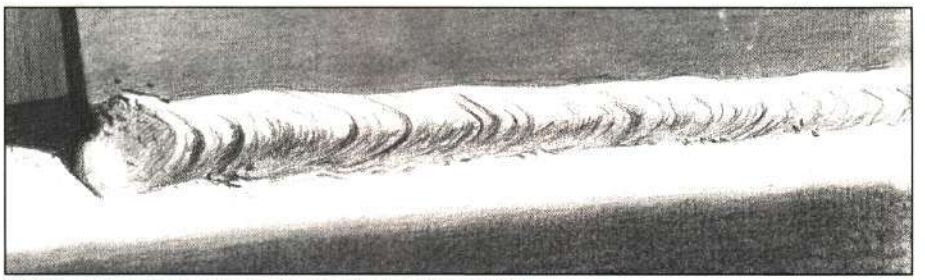


FARM SAFETY TIP

An SMV emblem designates machinery as a "slow-moving vehicle" and should be displayed on all tractors and trailing equipment. Most states have laws requiring their use. Both the center and border should shine brightly, even in daylight. Look for a tag certifying that the emblem was manufactured according to ASAE standards. Signs with faded yellow centers are not effective.

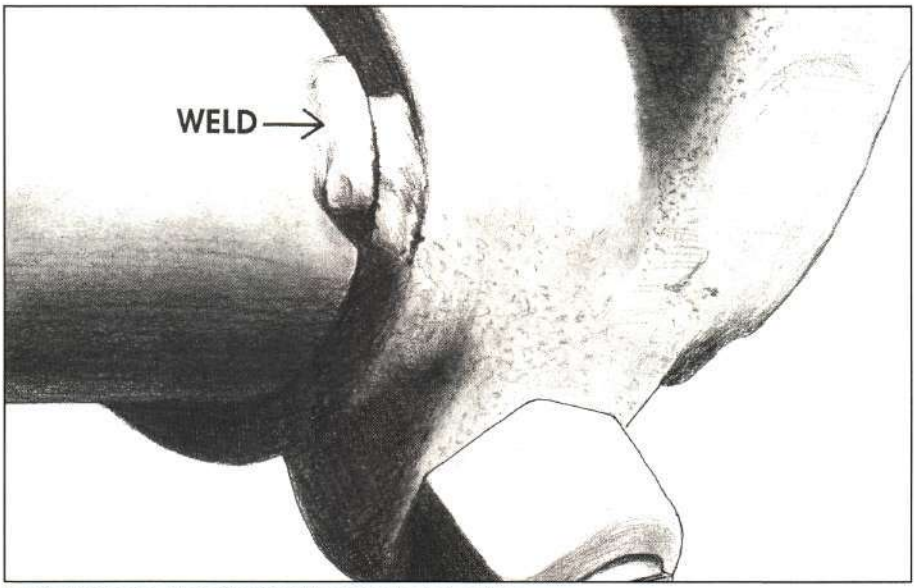
Welds

A neat, smooth weld is usually a strong weld. Whether the weld was designed to be in a specific place or whether it was part of a repair, the quality of a weld can be used as an overall indicator of machine quality and care.



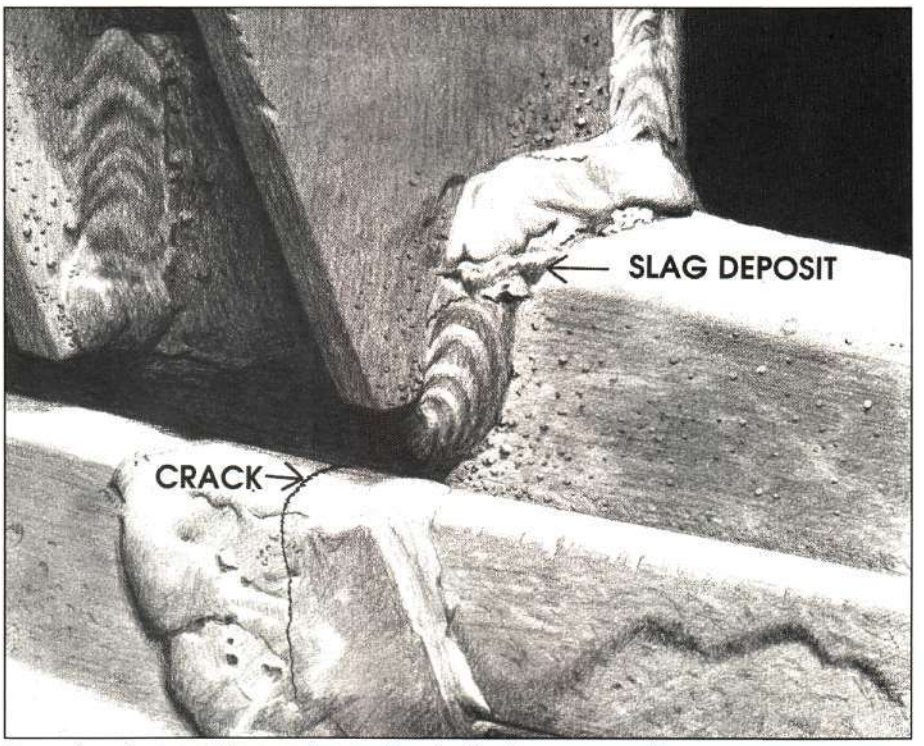
Neat, smooth welds are usually strong welds

Watch for bolted, pinned, or clamped joints which have been patch welded. This is an indication of an inadequate original design, or perhaps the machine has been used beyond its design capacity. In the example shown, additional damage has been caused by welding and it will be difficult to mend. Often, dissimilar metal parts are unknowingly welded, causing stress zones, alloy separation, or annealing (softening) around the weld.



Part slippage despite welding and clamping

Welds with excessive spatter or slag deposits may not be weak, but they are usually clues to poor repair. Beware of cracked welds, which may be an indication of poor fusion of the metals, stress from machinery abuse, or both. Look at patched pieces to see if they were properly aligned prior to welding. Follow the weld to obscure, hard-to-reach locations to determine if the broken parts were welded together in place or taken off the machine and properly prepared and aligned before welding. If pieces were welded in place, look at any nearby components to see if warpage or heat from welding has affected other parts (e.g., heat damaged oil seals, warped shafts, galled bearings).

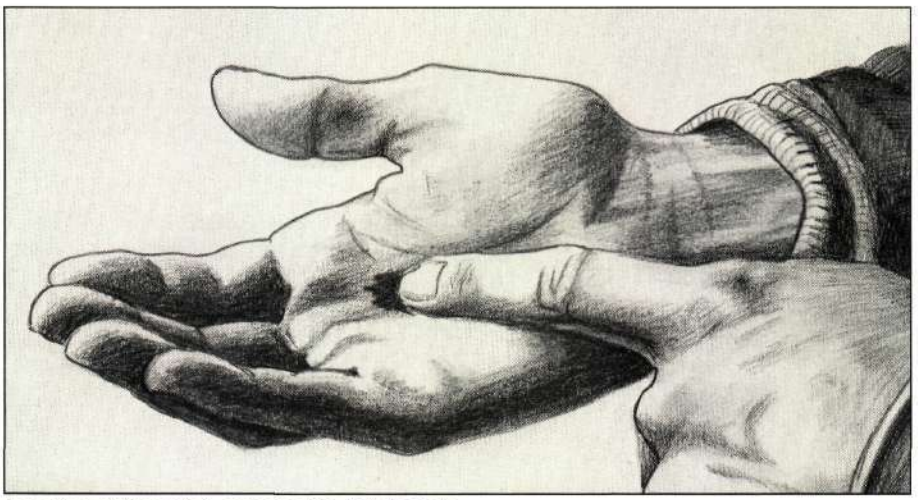


Excessive slag, spatter, and cracking indicate poor repair

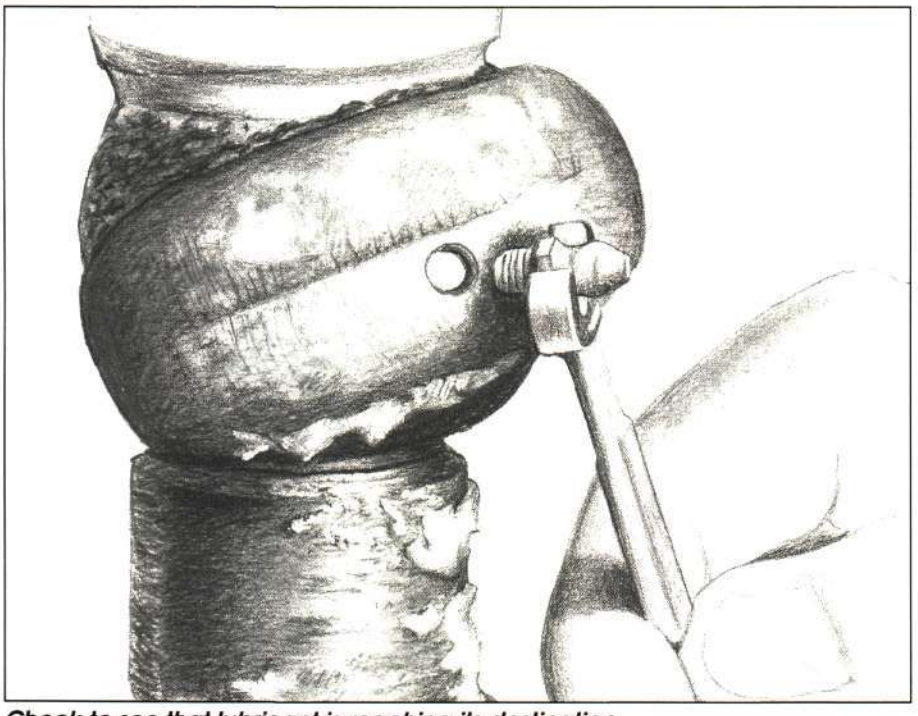
Lubricants

Practically any moving part needs some form of lubricant to reduce wear. Using the proper lubricant is important, but just as important is the way lubricant is applied, since lubricants need maintenance, too. This section will help buyers determine whether or not a lubricated machine component received the attention it deserved.

Take advantage of your sense of touch. Lubricants, in particular, collect dirt and metal chips and retain them, making it easy to detect extreme neglect. On repainted equipment, spread grease with your finger while feeling and looking for grains of sand. Too often machinery is "restored" by sandblasting it intact and repainting. Unfortunately, the sand and lubricant mixture acts as an abrasive compound and accelerates wear.

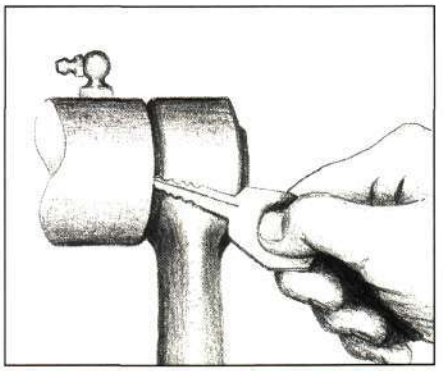


Feel for dirt, metal, or sand in lubricants



Check to see that lubricant is reaching its destination

Sandblasting is an excellent method for preparing a metal surface for painting. Unfortunately, novices, those in a hurry, or cover-up artists often sandblast improperly. Proper sandblasting entails disassembly of machinery before blasting and extensive cleaning before reassembly. Sand under high pressure gets into places nothing else does, and it stays there. Use a pointed object to probe lubricated areas, then look and feel for sand. If you find sand and a fresh coat of paint, buy somewhere else.

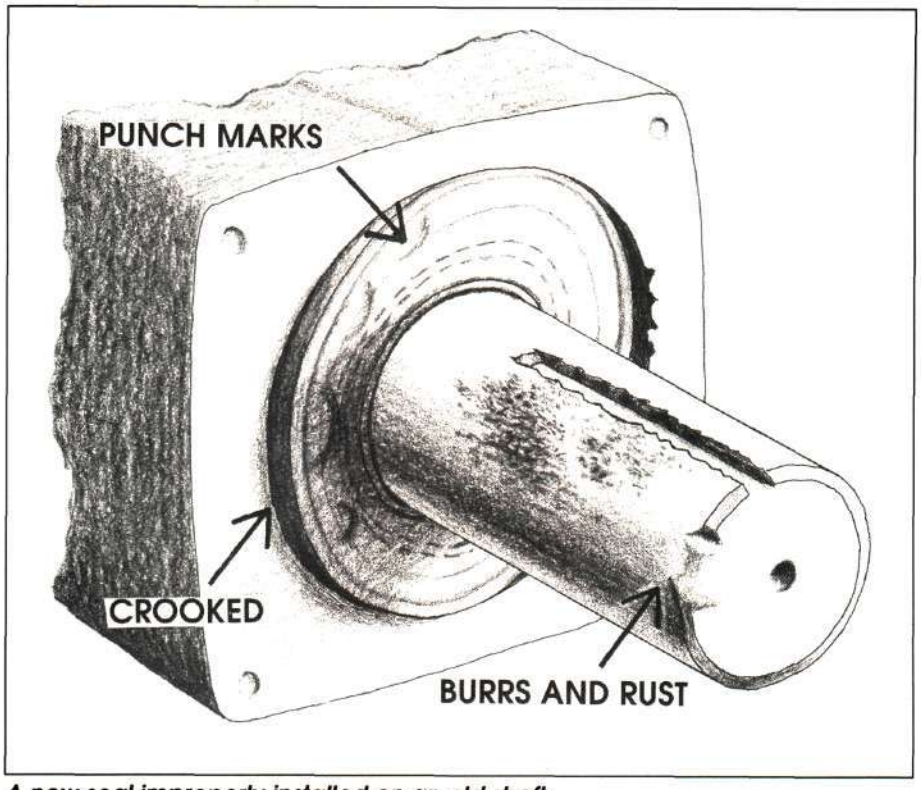


Probe lubed areas to inspect grease

Sometimes it is hard to determine if components have been properly lubricated. A buildup of grease in an area is not necessarily an indication that a joint or bearing has adequate grease where it's needed. Shiny, tacky, clean grease should be revealed when the grease fitting is removed. If the grease well looks dry or the grease is lumpy, the unit hasn't been greased properly. If a component is loose and can be wiggled, excessive wear has occurred.

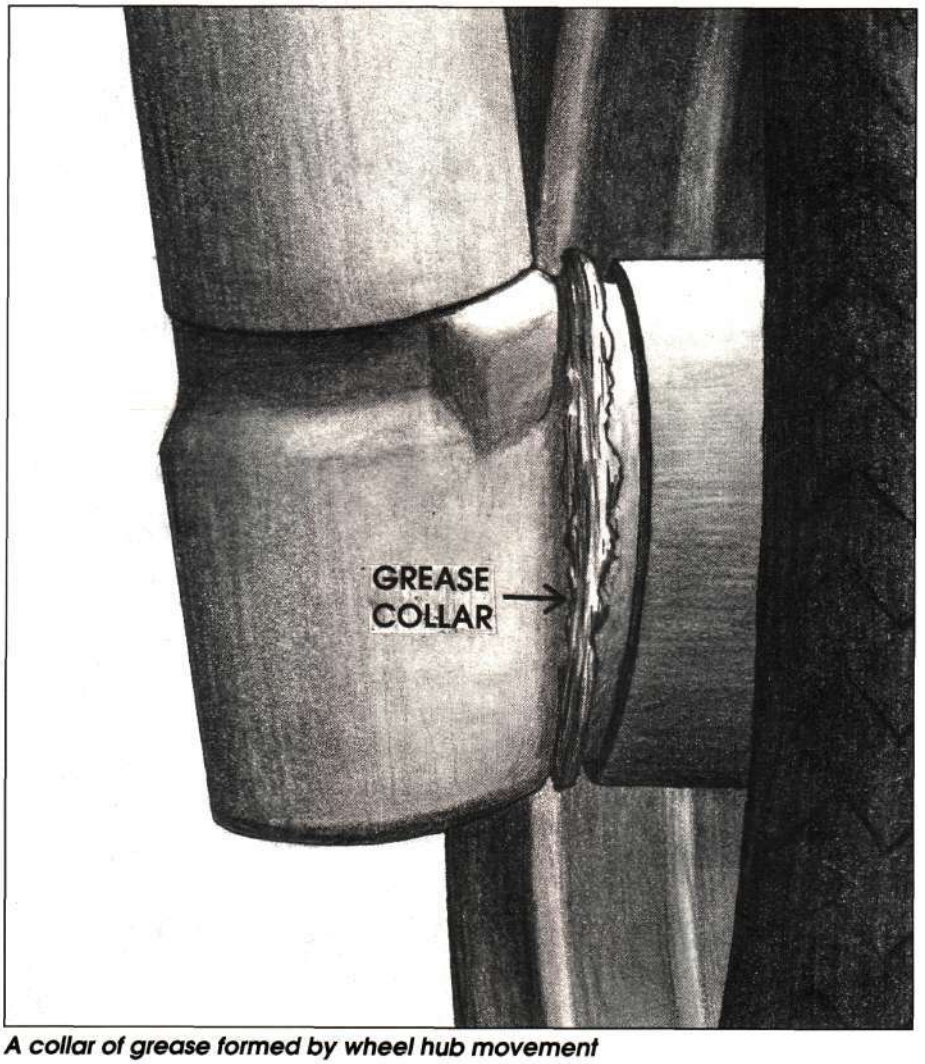
Seals and Bearings

The condition of the seals can reveal a lot about the maintenance a machine has experienced, so examine them closely. Hammer or punch marks are clues that the seal was not installed using recommended tools or methods. A "new bearings and seals" claim by the seller doesn't mean much if the seals are crooked and damaged by hammer marks. Sliding a new seal over a shaft with rough keyways, nicks, or rust is almost certain to damage the seal and create a leak. The zone where the seal contacts the shaft may be worn to the point where the designed lip pressure on the seal is reduced because it is riding within a slight groove. A new seal on a worn shaft will usually result in a lubricant loss from the bearing.

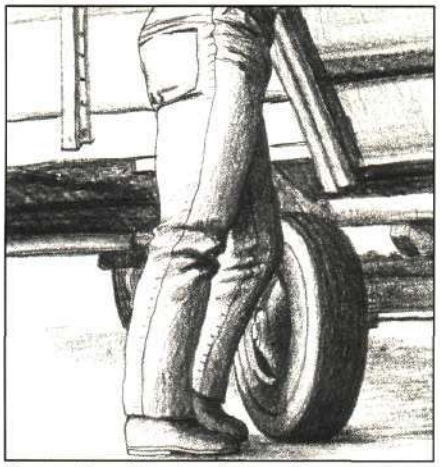


A new seal improperly installed on an old shaft

A collar of grease on wheel bearings indicates either a failing bearing or one which needs to be properly seated by tightening the spindle nut. The collar has been formed by lateral movement of the hub, which plows excess grease into a ring, or collar. Usually, these symptoms mean bearing assemblies and seals need to be replaced because the lateral shifting has introduced dirt, grit, and water past the seal to the bearing.



A collar of grease formed by wheel hub movement

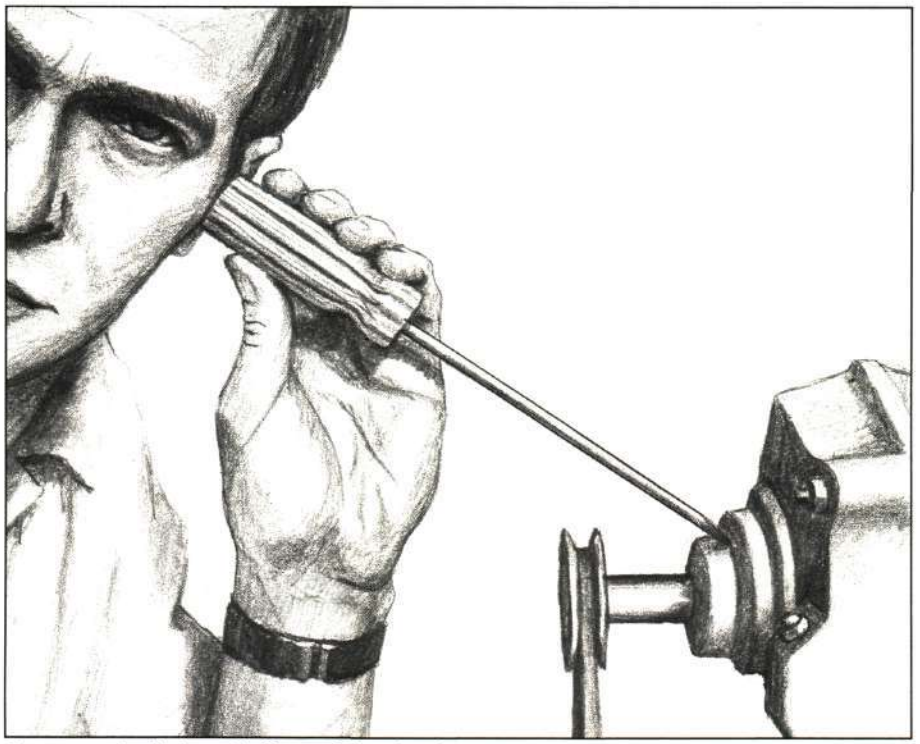


Bump tires to check bearings

A simple way to see if wheel bearings are improperly seated or worn is to bump the tire with your knee. Even the slightest clunk indicates a possible problem. Look closely for grease leakage, which indicates seal damage and possibly bearing damage.

Check engine oil seals and ground under the oil pan for fresh oil

On engines, a bad front or rear main bearing oil seal can cause a loss of oil and indicates the age of a machine. Look for oil spots on the ground near machinery, then look underneath the engine, both in front of and to the rear of the oil pan. If you see scattered fresh oil, the seals are probably worn out. Coincidentally, if the seals are bad, the crankshaft bearings may also be worn, because they too have been in the engine since it was new. Proper installation of new seals and bearings can be expensive.

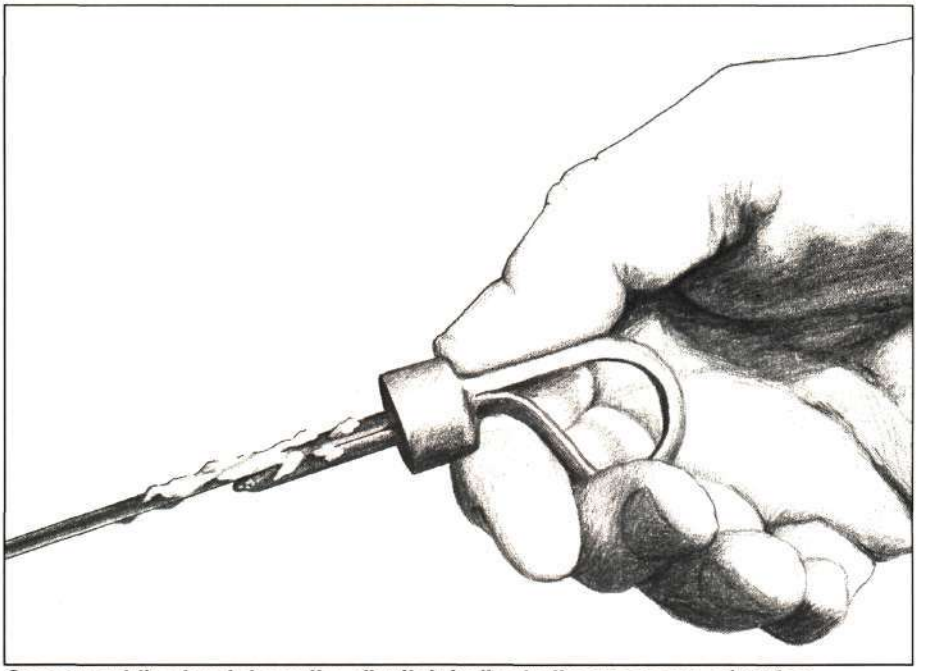


Use a probe to locate the origin of noise

If the machine is operable, listen for noisy bearings. The vibrations of a bad bearing can be amplified with a probe placed on the bearing housing, as shown here. Move around to other bearings to establish different levels of vibration. A bad bearing will sound like a jack hammer when the probe is placed lightly against your ear. ***Warning: Do not do this if moving parts could entangle loose clothing or the probe.***

Water–Oil Emulsions

A healthy engine will have negligible water in its oil. In both diesel and gasoline engines, creamy white droplets or accumulations near the top of the dipstick indicate a water-oil emulsion. Water could have come from a leaky coolant system, outdoor storage, or vapor from combustion of fuel accumulating in the oil sump. Valve guide or piston ring wear can lead to large amounts of blow-by vapors showing up as water in the oil sump. Also, check the crankcase breather tube outlet for caked oil and dirt or an obvious flow of exhaust gases, which signal that piston rings may be worn.



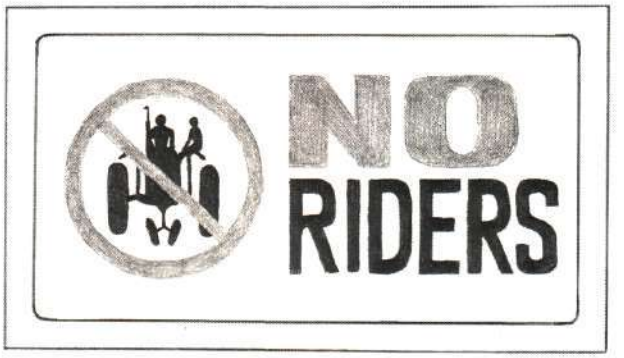
Creamy white droplets on the dipstick indicate the presence of water

If time permits, take small hydraulic oil or engine oil samples by tapping off the bottom of the reservoir. It's messy, but it allows you to look for water, which will exit first. A few drops of water can be tolerated and is not cause for alarm. Thick, gooey sludge is an indicator of poor maintenance. If metal chips are present or the oil has a silver-grey sheen, move on to the next machine or sale.

Collect and inspect oil samples when possible

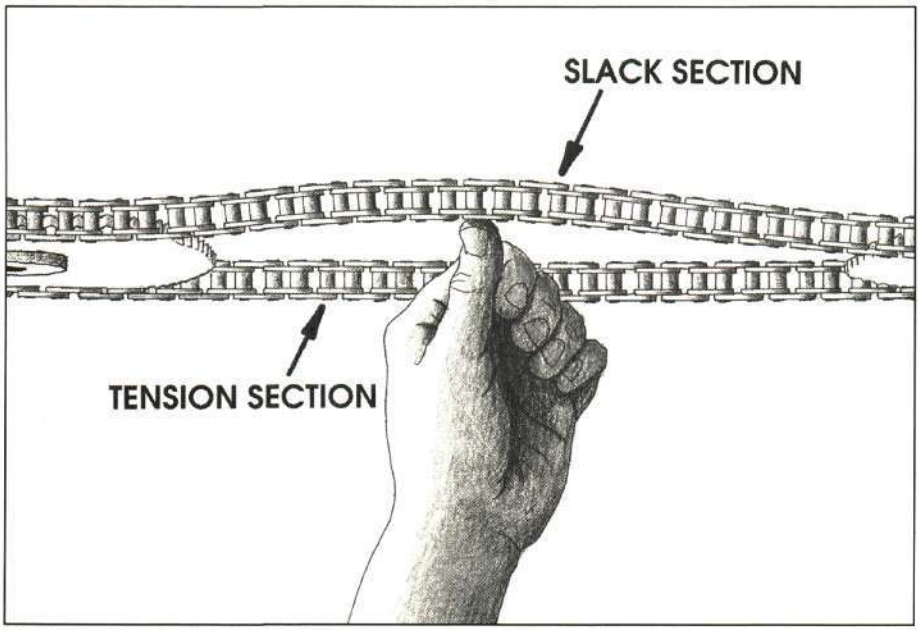
FARM SAFETY TIP

"No Riders" stickers should be attached to tractors. This policy should be strictly enforced, because fenders lack shock absorbers and handholds for riders, and rear wheel axles and drawbars do not provide safe footing for passengers. Adults are often concentrating on operating machinery and fail to anticipate sudden starts, turns, or bounces. Children do not have the strength in their fingers to hang on tightly to a bouncy tractor for more than a few seconds at a time. Extra rider accidents kill dozens every year, and the majority of the victims are under ten years of age.

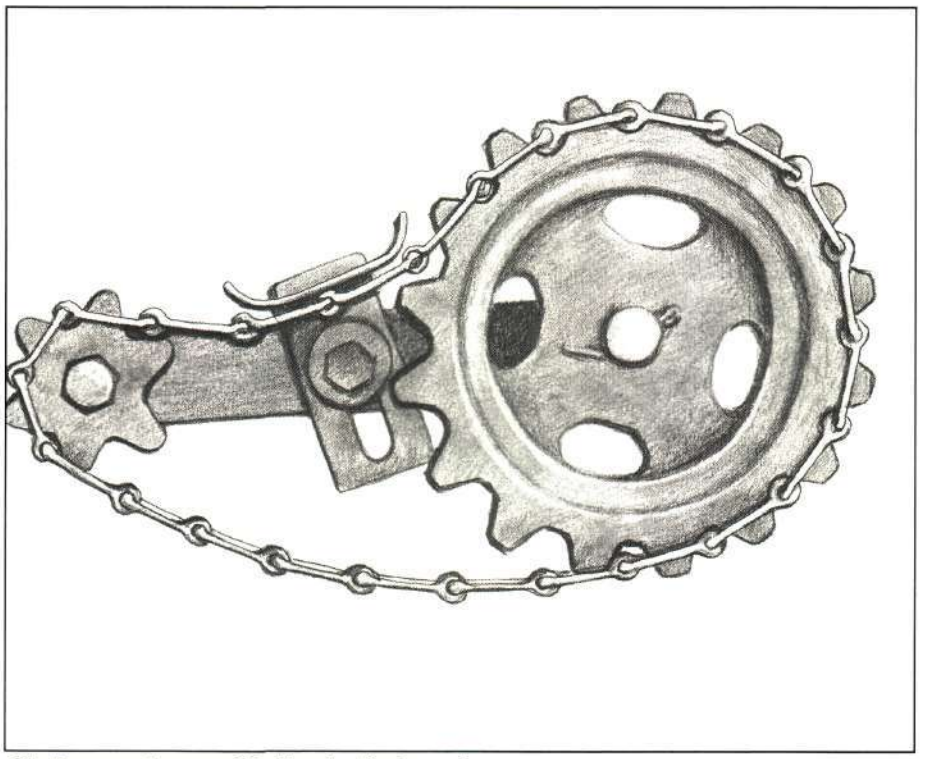


Power Transfer Parts

Engineers call them power transmission components; they are those mechanical elements which get power from one machine to another and from one end of a machine to the other. In transmitting power, a certain amount of efficiency is lost in these parts due to friction. Parts which are bent, worn, or improperly lubricated waste energy. As parts wear and age, self-destruction is accelerated if parts are neglected. Knowing how to assess the remaining useful life of these drive components will save downtime in the future.



Push on the slack side to test for wear



Chain wear beyond limits of adjustment

Chains and Sprockets

A new roller chain undergoes very little lateral movement. A quick test to determine the extent of roller chain wear is to push sideways on the slack section of the chain. If the chain moves sideways more than 10% of the span between sprockets, it is worn significantly. Chain lubrication is often neglected. Look between the roller and a side link as you push on the slack section. If you see moist lubricant, that's a good sign. If the chain is bone dry and has a lot of lateral movement, it should be replaced, since it is probably so worn that it will not retain lubricant well and will need tensioning often.

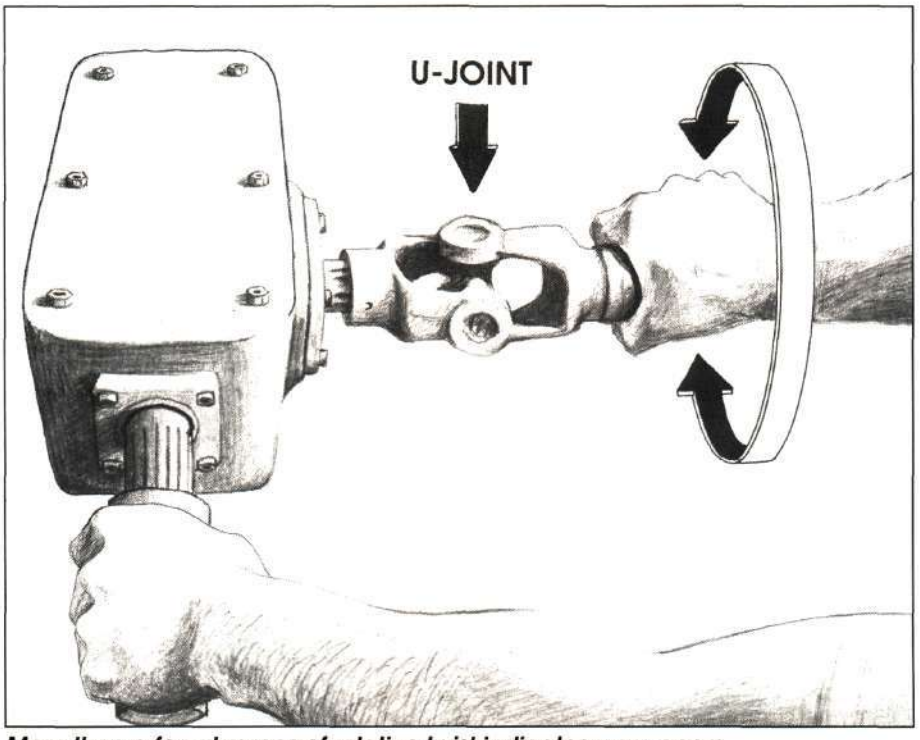
When you see the situation pictured on the left, the machine has seen plenty of service. The idler or tensioner has been fully extended, but the chain is still slack. Also, the sprocket teeth are badly worn. Some owners will simply remove a link or two from the chain. Although this philosophy will help keep the machine running a while longer, it may not be reliable. If the rest of the machine is also in poor condition, steer clear; if the rest of the machine is in good shape, replace the worn sprockets and install a new chain.

Gearboxes and Chaincases

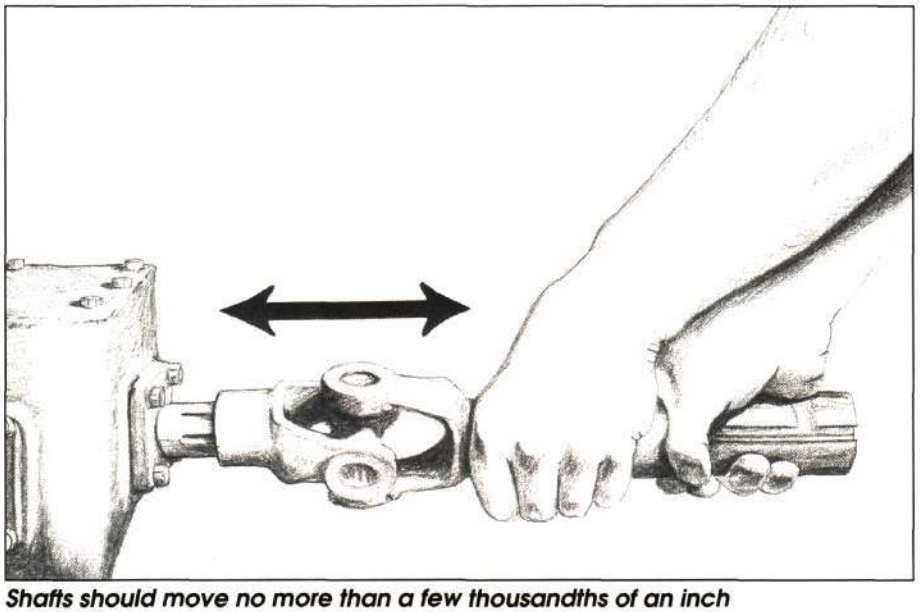
Certain gearboxes can be quickly inspected for looseness, called backlash, between gears or sprockets by twisting one shaft while keeping the other shaft fixed. A few degrees of relative twist is acceptable, but more twist is a clue that the gears inside are worn. Chaincases can be inspected in a similar manner, but there are often idler adjustment devices that take up excess chain looseness. Idlers should be checked to determine if adjustment has been neglected.

In some instances, the universal joint bearings may be checked for wear at the same time. Watch the U-joint carefully as you twist; if the yokes twist with respect to one another or seem to "hop," the universal bearings or the entire assembly will have to be replaced.

To check gearboxes for wear, grab an output or input shaft, then push and pull on it. Any movement or end play greater than a few thousandths of an inch may signal worn gears or the need for shims or thrust washers.



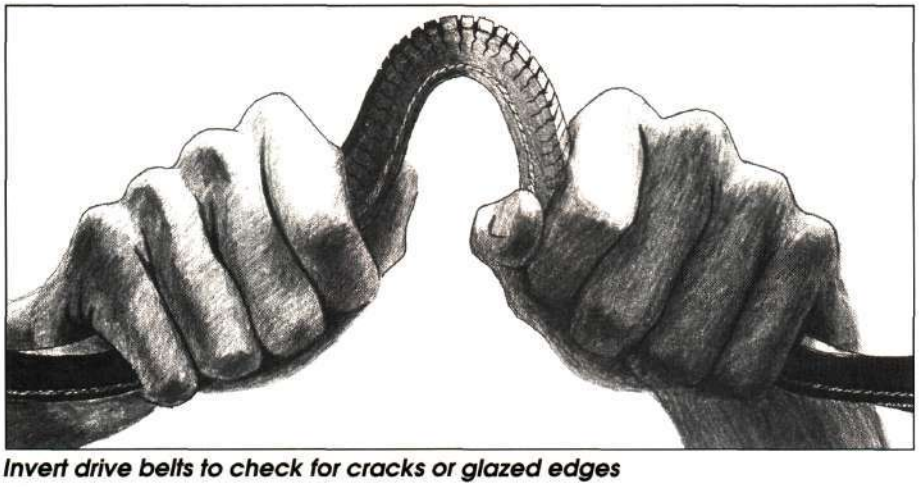
More than a few degrees of relative twist indicates worn gears



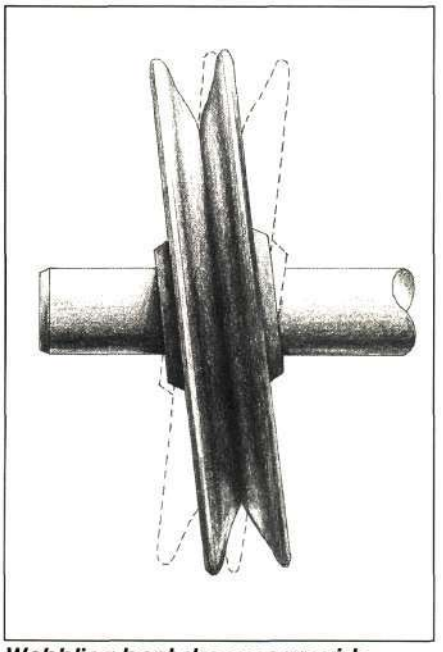
Shafts should move no more than a few thousandths of an inch

Sheaves and Belts

Some pieces of equipment have many drive belts, and a lot of time and money may be required to replace them all. Invert or twist the belts backward, then bend them. If they're cracked badly on the bottom edges, they are almost worn out. If the bottom edge is glazed, it is probably bottoming out within the sheave and should be replaced.

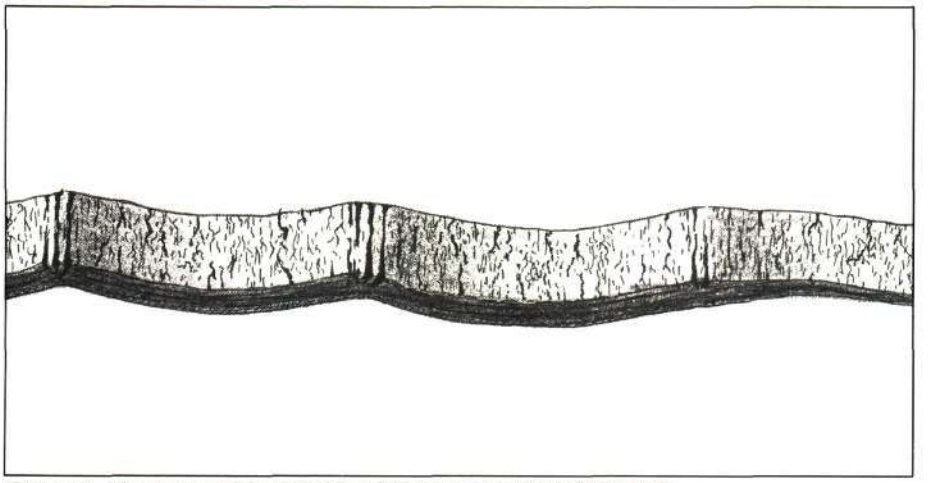


Invert drive belts to check for cracks or glazed edges



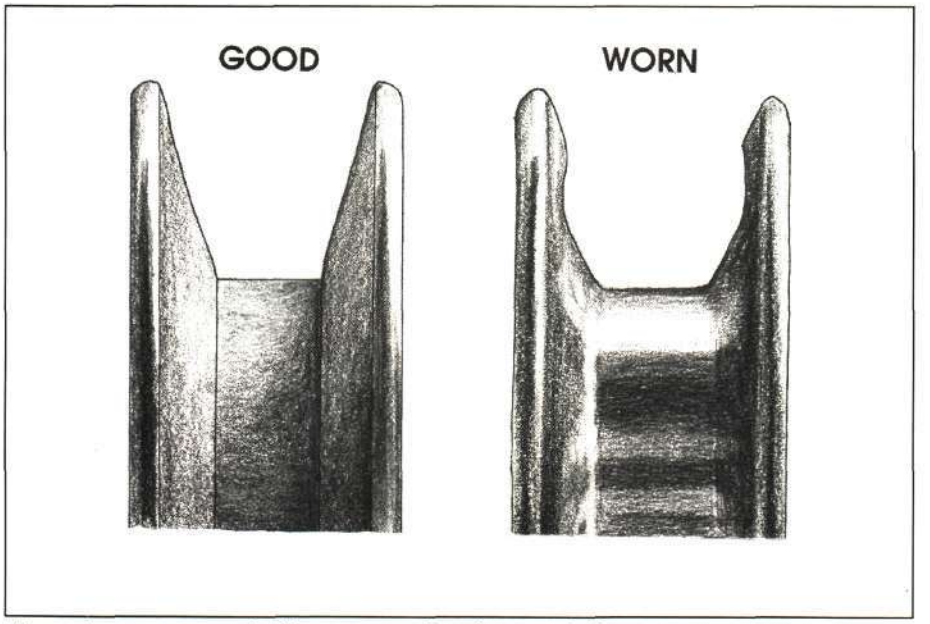
Wobbling bent sheaves provide clues to related problems

Bent sheaves (pulleys) usually are not a major concern, but the resulting wobble can provide clues to other problems. More important, it may indicate that the sheave was damaged in a collision, or from removal or installation. Check whatever the pulley is attached to to see if it is damaged or if it was worked on or replaced. Has another component in the drive train caused the failure? Belts in a wobbly system may fail prematurely, so check them carefully.



Curved, charred segments on belts indicate belt slippage

A V-belt which looks like the one to the left will soon fail. The curved segments show that the belt was slipping on the drive sheave, resulting in heat damage to the belt. The question you should ask is "Why did the belt slip?" or "Why did the belt stall while the sheave continued to drive?" The belt may just be poorly tensioned, but something may be jammed farther down the drive train. In addition, a bearing may have failed or may be failing, or perhaps some closely aligned parts in the drive system have collided or are worn to the point that they don't mesh properly. Belt tension may not be the only problem.

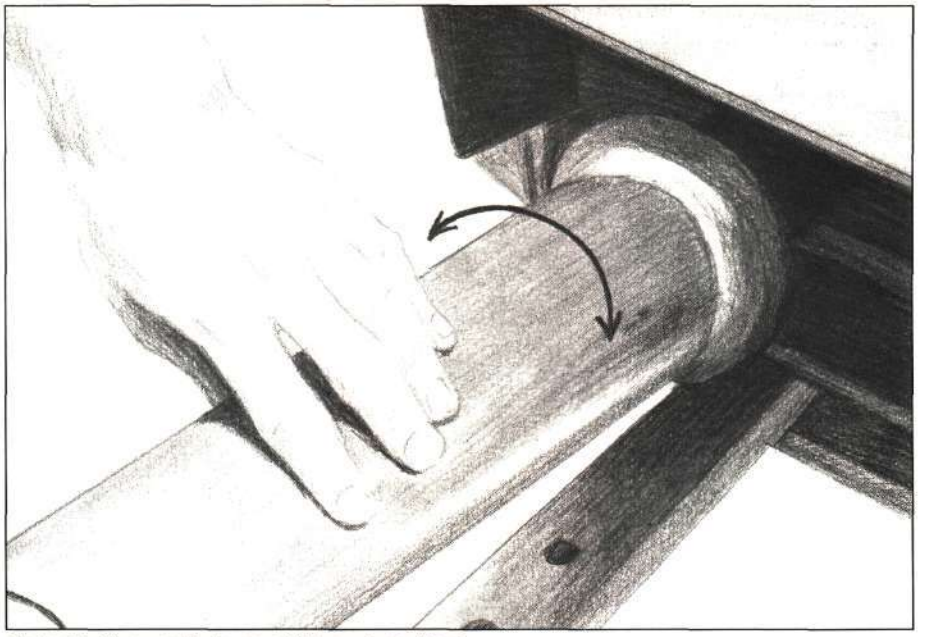


Worn sheaves cause belt wear, overheating, and slippage

If a drive belt has bottomed out, the belt's lower edge and the bottom of the sheave groove will be shiny. Take a close look at the drive sheaves. If they are worn, like the one shown, the bottom edge of the belt is probably bottoming out in the groove. Buying a new belt is a short term solution; the sheave must be replaced to solve the problem.

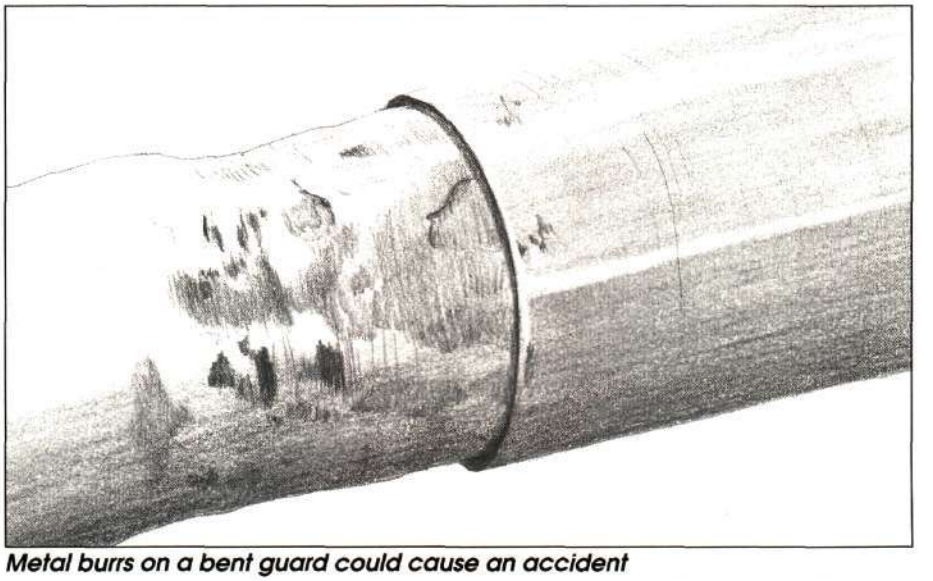
Driveline Shields

Power take-off (PTO) shafts should be completely enclosed by a guard. The guard is designed to stop if something or someone brushes up against it. When the machine is not running, check the proper operation of a shaft guard by spinning it in both directions with your hand. If the guard catches, it should be replaced.



Spin shaft guards to see if they turn freely

Look for bent guards on all driveline shafts. Bent guards may not slip properly and often have burrs that can catch clothing and cause it to wrap. At nine to sixteen revolutions per second, a person is not likely to get away if caught.

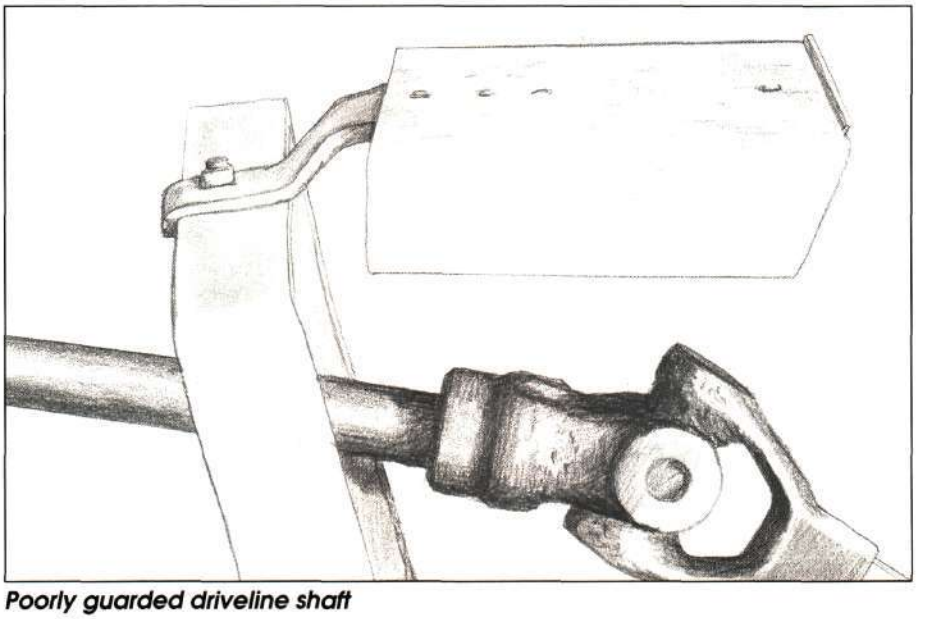


Metal burrs on a bent guard could cause an accident

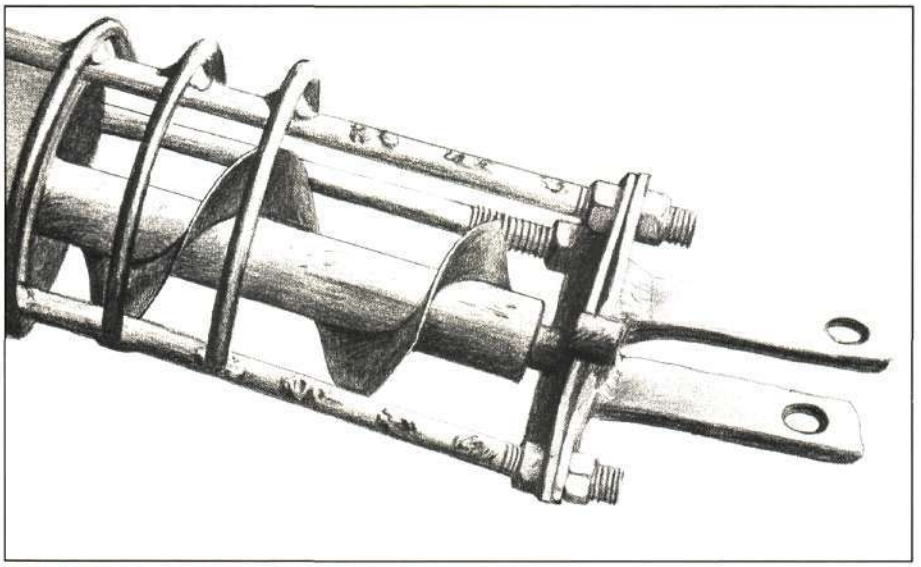
FARM SAFETY TIP

Always make sure the PTO is off before starting or getting off of a tractor. Never grease, check, or adjust a PTO-powered machine while the power is on and the shaft is turning. All guards should properly enclose the drive shaft.

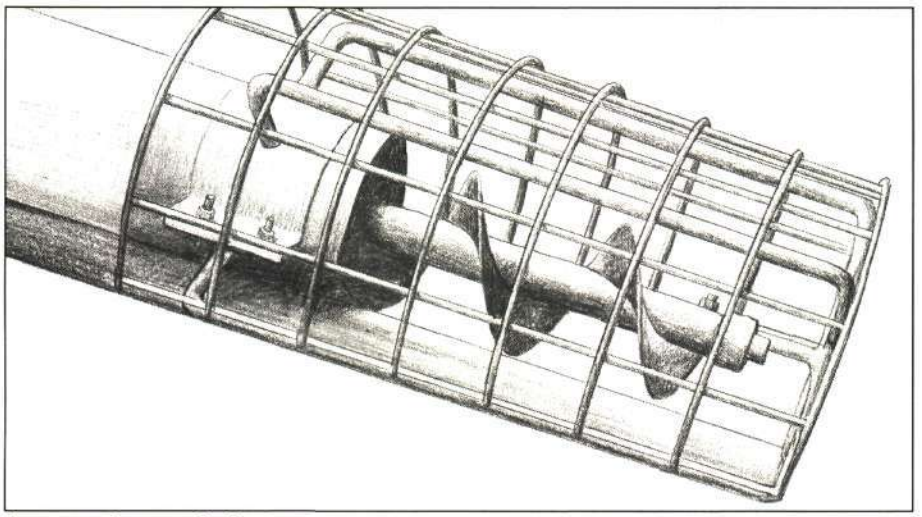
A small shield like the one pictured here offers essentially no protection to operators. Pant legs, dangling threads, shirttails, long shoelaces, and long hair are too often caught, pulling a person around a shaft.



Poorly guarded driveline shaft



A poorly guarded auger is a dangerous purchase



A properly guarded auger

Read hazard warning signs on all equipment

Augers

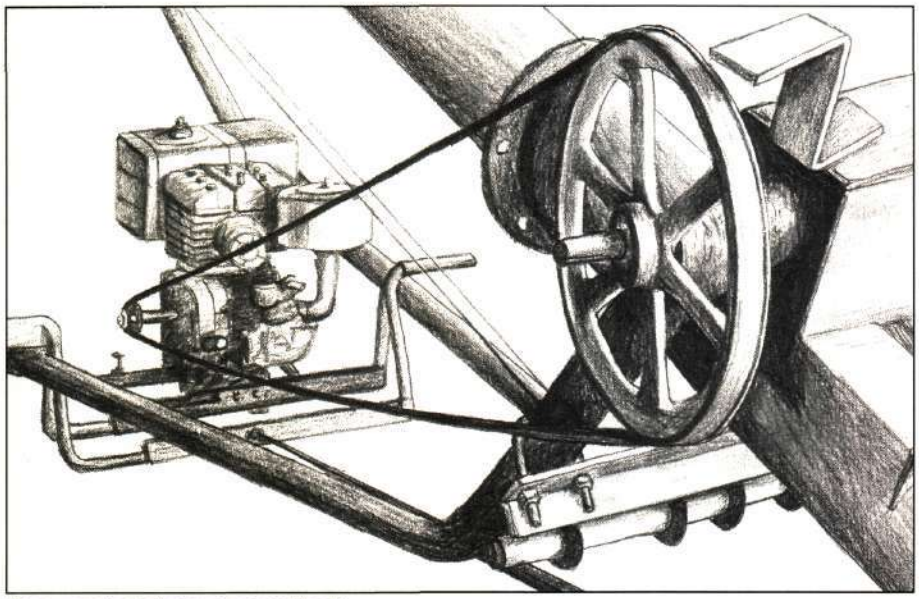
Per hour of use, an auger is the most hazardous piece of machinery on the farm. Proper auger guarding is designed to prevent feet and hands from contacting the auger flighting while maximizing the flow of grain up the auger. It is recommended that no single guard dimension be more than 4 3/4 inches. The maximum opening should be no more than 10 square inches, and the guard should maintain a 2 1/2-inch clearance from the flighting of the auger. The auger shown at upper left is inadequately guarded.

The auger shown here is a properly guarded auger. It meets the criteria described above and is strong enough not to bend or break from normal use.

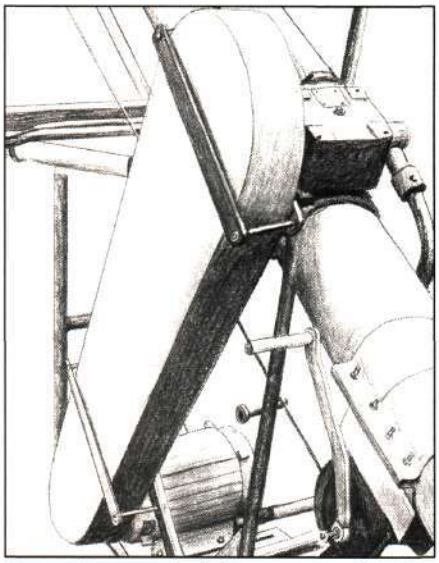
It is tempting to move augers, unloaders, and elevators in their raised positions to save time, but it is very difficult to judge the clearance between overhead power lines and the raised ends of the equipment. Many operators who have tried are dead as a result of shock from contact with power lines. Always read warning signs to remind yourself of safe procedures, and know the clearances of all power lines on the property on which you are working.

Belt Drives

The pulleys and belt shown below have no shielding. This type of unguarded hazard makes farm machinery dangerous. In contrast, the pulleys and belt shown to the right have excellent guarding. The moving parts are completely enclosed and the guard is protected by steel supports at both ends.



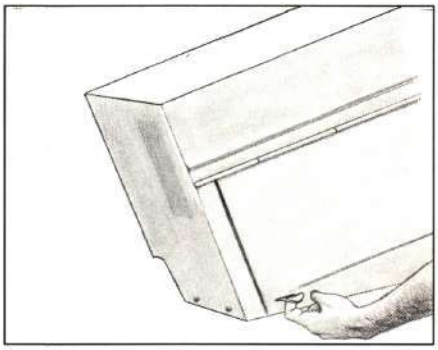
Unguarded sheaves and belt



Properly guarded sheaves and belt

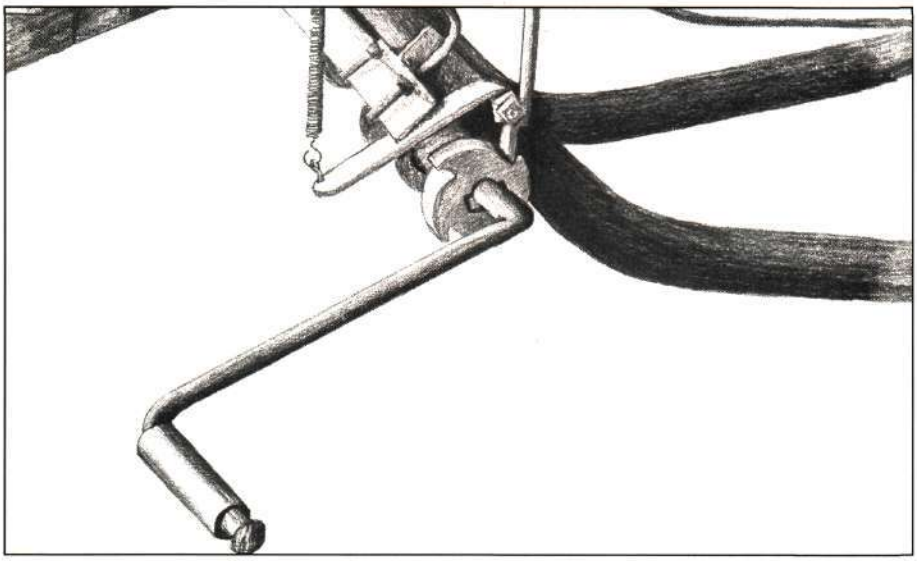
Hand-Manipulated Mechanisms

Make sure the latches on hinged machine guards are operable. If the latch doesn't work, the guard is likely to flop and interfere with machine operation, or it may make opening the guard difficult. In either case, an owner may remove the guard because of the aggravation it presents. However, removed guards cannot protect anyone.



Try guard latches

Check hand cranks and their associated mechanisms, such as springs or locking devices, to make sure they are in good working order. Numerous accidents have occurred during the raising and lowering of equipment because of worn or difficult-to-operate latches and handles.



Raise and lower equipment with hand cranks to see if cranks work properly

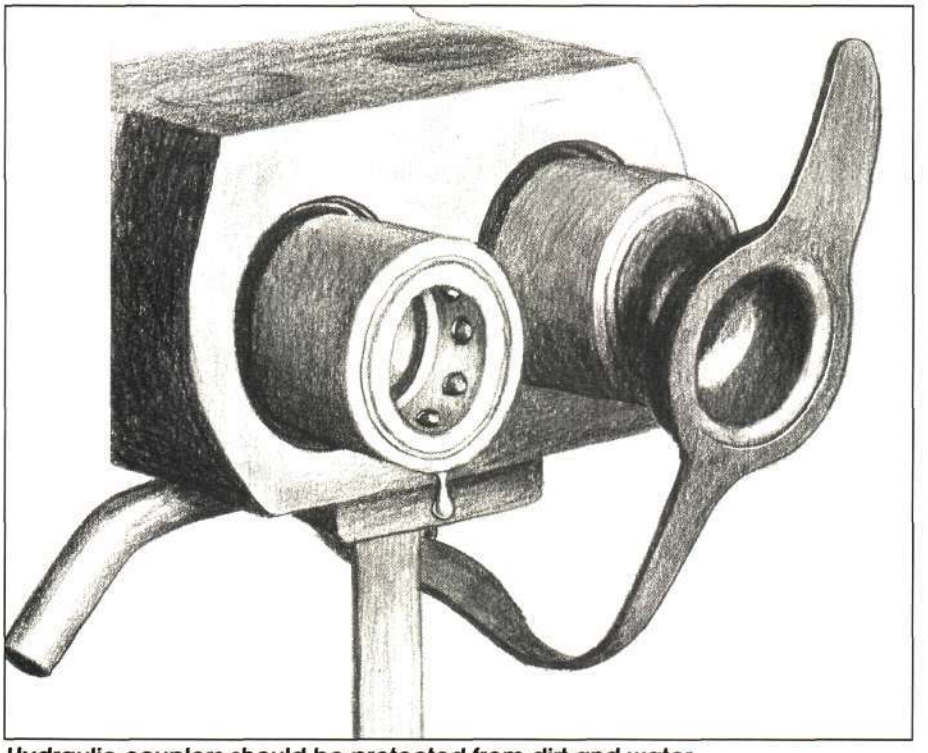
FARM SAFETY TIP

Warning signs should be placed on cover plates and guards of all machine parts that rotate and could cause injury, especially parts that are free-wheeling after power is shut off.

Hydraulic Systems

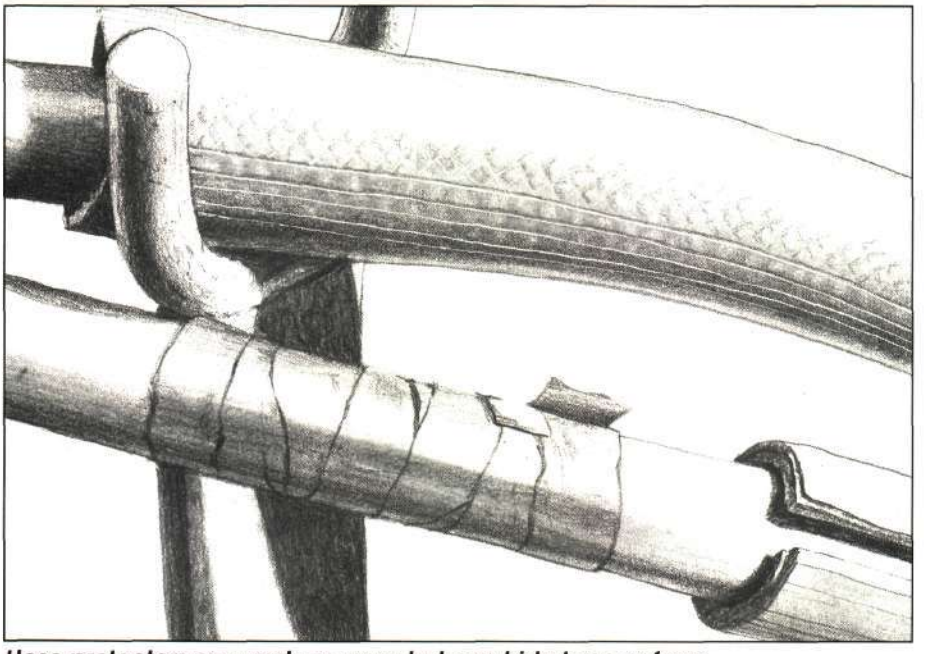
Power transmission by fluids is one of the most versatile of all power transmission systems. Hydraulic systems can be tricky to maintain because of the harsh environments to which they are subjected.

Water and dirt are a hydraulic system's worst enemies. Hydraulic components are often neglected, possibly because they are not well understood by the average operator. However, the fluid will stay clean if the system works properly and is maintained well. In a sense, the fluid is the "melting pot" of the system and can be used as an indicator of system health.



Hydraulic couplers should be protected from dirt and water

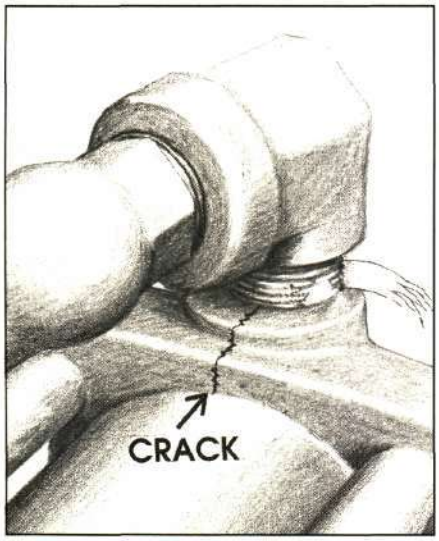
Hydraulic couplers which are clean and capped are a good sign. If the couplers are capped, removing the cap as shown should reveal shiny metal and droplets of clean hydraulic oil. Uncapped, dirty couplers, both male and female ends, are often a clue that dirt or water has entered the system. Rusty retainer balls indicate that couplers have been exposed to the weather.



Hose protectors may reduce wear but can hide tape or frays

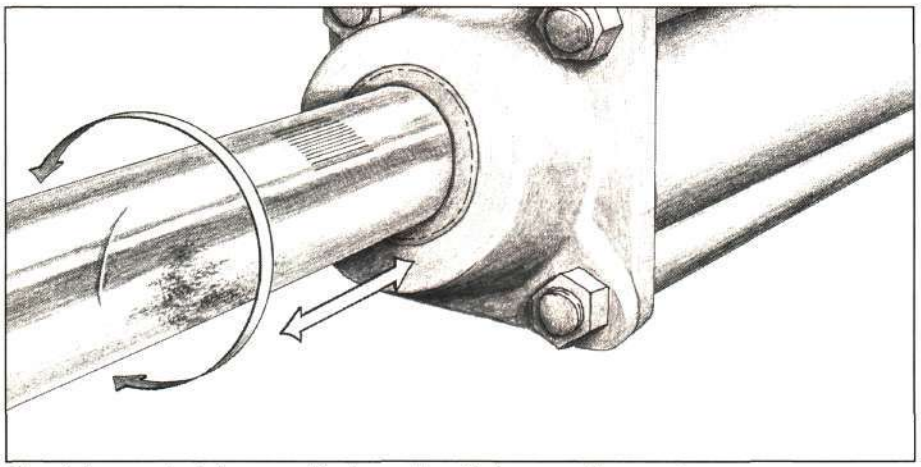
Hydraulic hose chafing and splitting is not only potentially dangerous, but the need for new hoses is an expense to be considered. If hose protectors are on the hoses, slide them away and you may find taped or cracked rubber, revealing the inner metal reinforcing strands. Under pressure, fluid can be sprayed out of a pinhole with enough force to penetrate unprotected skin. If an injury is not treated properly, it could lead to amputation of a limb. Making sure the hose is not under pressure and while wearing gloves, twist the hose with both hands. If the hose reinforcing strands show during twisting, the hose should be replaced before use. If the hose twists easily, the outer rubber layer may have separated from the wire strands, indicating replacement time is near.

Inspect the rod on hydraulic cylinders for defects, such as score marks, nicks, or rust. High-quality rods are chrome-plated for wear resistance, surface finish, and rust control. Any slight blemish on the rod will eventually damage the delicate seal located behind the outer protective wiper. If possible, twist the rod to see if it is bent; a bent rod will destroy the seal and end bearing surface. Push and pull on the rod; if it feels spongy, air is in the system. The cylinder may not have been operated enough to purge air from the system, or it may be a clue that fluid leaked out over time.

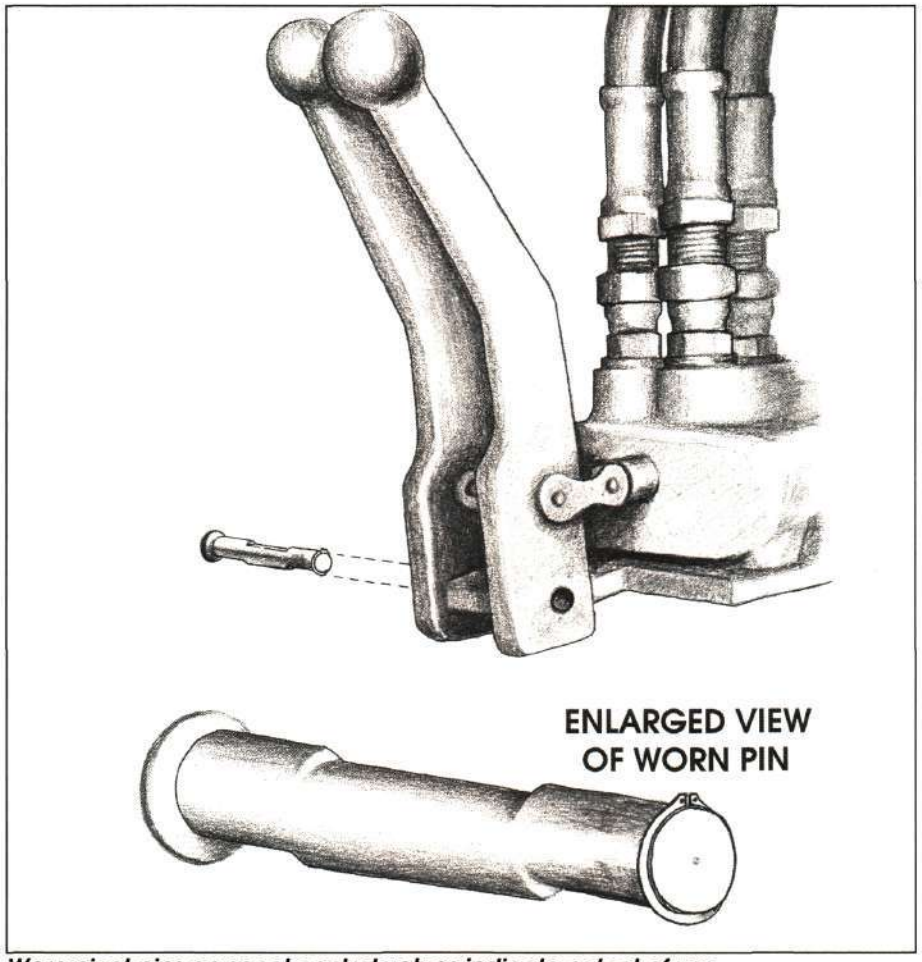


Crack caused by overtightening

On hydraulic cylinders, make sure the inlet and outlet plumbing is tight. Loose fittings will leak and may draw water in when the system cools and contracts after use in wet conditions. Teflon tape is a good thread sealant, but is not recommended for hydraulic systems. When improperly installed, small pieces can break free and restrict or plug filter elements. Due to Teflon's low friction qualities, inexperienced mechanics may overtighten a joint and cause the flange to split, resulting in fluid loss. Fittings should be inspected carefully.



Blemishes and nicks on cylinder rods will damage the seals

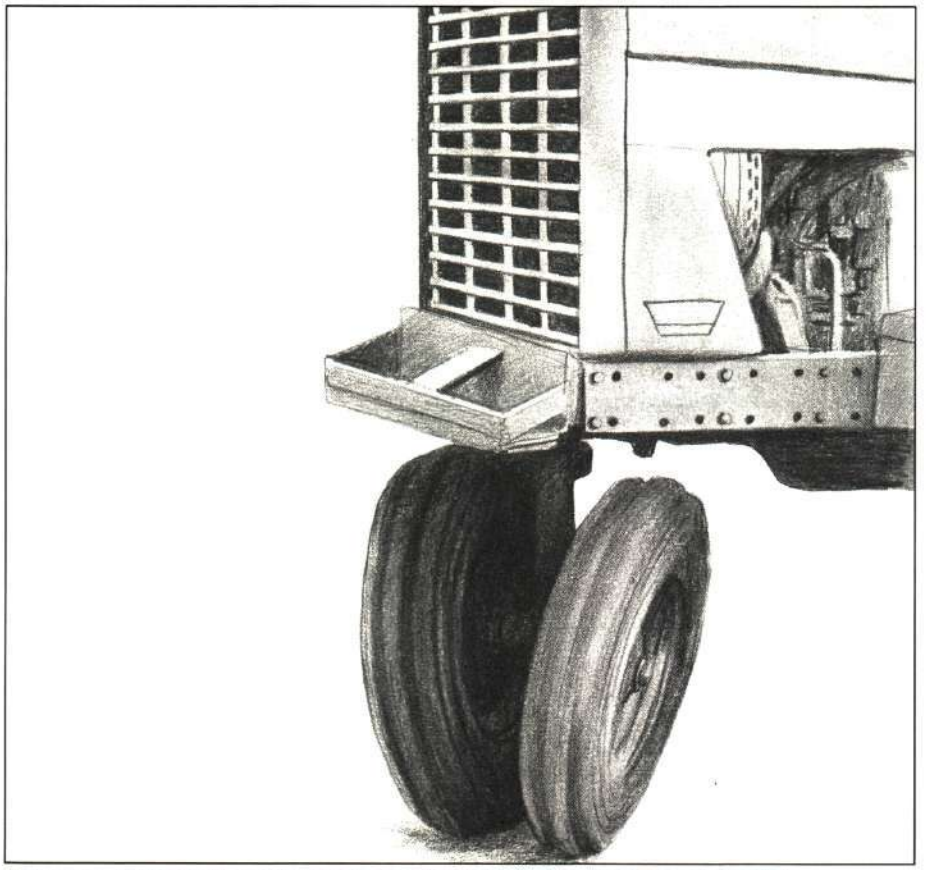


Worn pivot pins on spool control valves indicate extent of use

Hydraulic control valves, called spool valves, should be inspected to determine the amount of use they have endured. Control levers which flop around and have poorly defined stroke have had plenty of use. Worn pivot pins, as shown, are indicators that a valve has seen many cycles. Fully extend the spools and check for longitudinal score marks; wiggle them a bit to see if hydraulic oil seeps out. If it is possible to run the engine, bring the hydraulic system up to operating pressure and check for leaks. A valve under pressure should be capable of slowly and smoothly directing pressurized fluid to do work. If motors or cylinders chatter or operate erratically, internal valve problems may exist.

Tractors

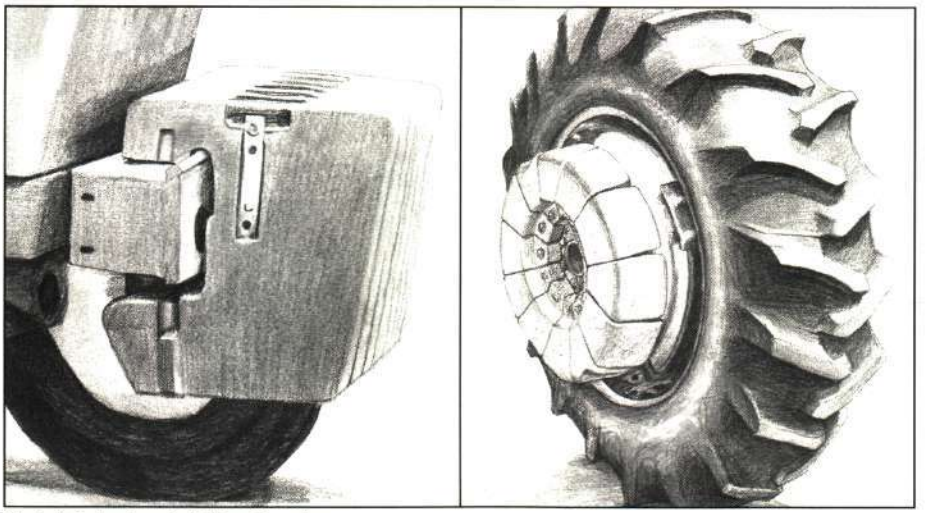
When you find a tractor that you think is suited to your needs, begin a complete inspection of the engine, transmission, and all other working parts. Welds, lubricants, hydraulics, and the power transfer parts discussed previously also apply to tractors, so check all of those areas. The best advice to heed before buying a used tractor is to operate the unit yourself. If you're buying a tractor that doesn't run, the owner should be willing to drop the price substantially. Ask direct questions. If possible, try the tractor under load in a field setting, making sure it gets up to operating temperature.



A tricycle tractor tips over more easily than a wide front-end tractor

Tractor Design

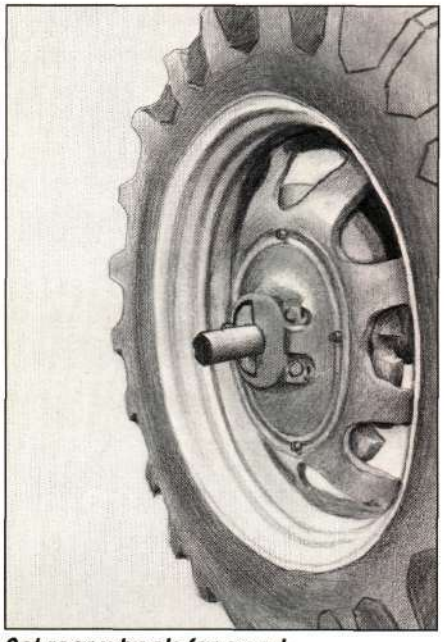
Approach a tractor and walk around it to evaluate several design points. The tricycle or narrow front-end tractor shown to the left tips over on its side easier than a comparable wide front-end tractor. Narrow front-ends are particularly dangerous if front-end loaders or saddle tanks are mounted on a tractor which does not have a Roll-Over Protective Structure (ROPS).



Weights help stabilize tractors

Check a tractor's capacity for additional weights. Front-end and rear-wheel weights help to keep a tractor stable and reduce the risk of overturn. Tractor overturns are involved in about 50% of all farm labor fatalities.

Rear tractor wheels should be spread as far apart as possible to increase stability and reduce side overturns. Side overturns are the predominant type of overturn, killing a few hundred operators in the United States each year. In the picture to the right, the rear wheels can be spread farther apart on the axle.

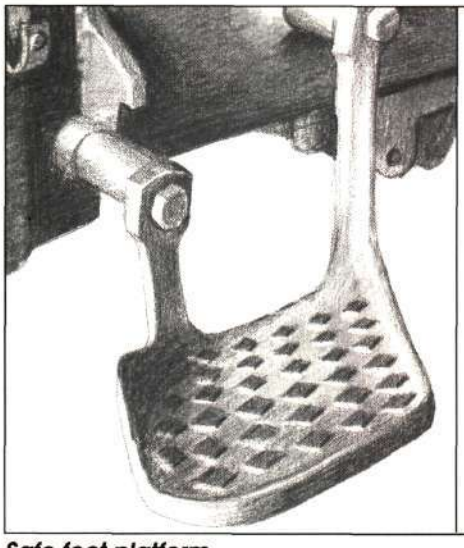


Set rear wheels far apart

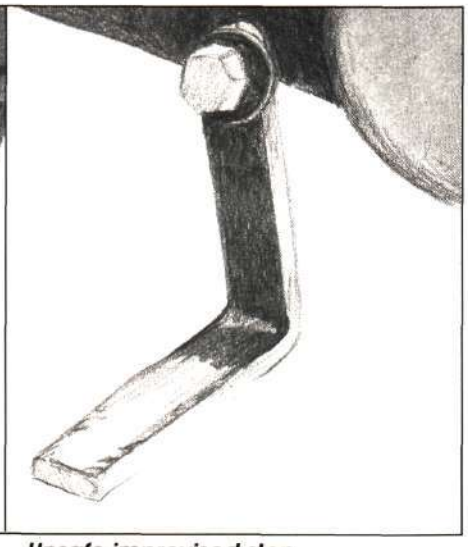
FARM SAFETY TIP

Approximately 10% of fatal tractor accidents occur when drivers fall or are bounced from their seats. Cushioned seats with proper arm rests should replace metal pan seats, and approved ROPS and safety belts should be installed when possible. Handholds can be mounted on fenders to provide additional support to drivers as they mount or dismount the tractor.

Attempt to climb aboard the tractor, but be careful. Slips and falls while getting on and off tractors result in many serious injuries. Wide, grated foot platforms help operators move quickly with little risk of slipping. In addition to being very slick, the improvised step pictured on the far right does not have enough surface area to safely allow a person to balance his or her weight.

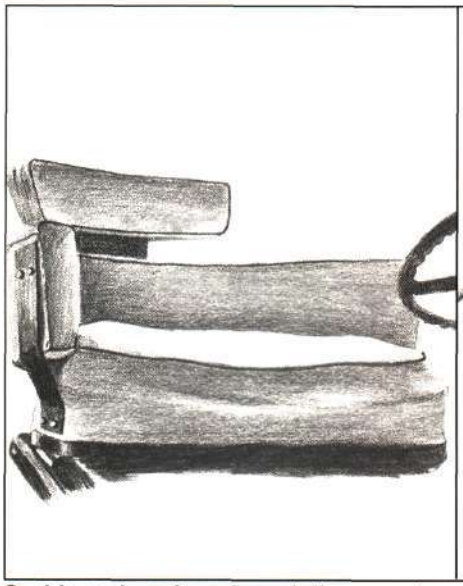


Safe foot platform

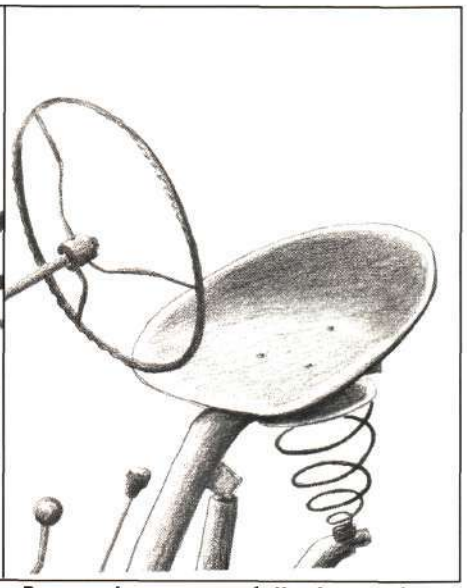


Unsafe improvised step

Once you are up on the tractor, sit and familiarize yourself with the features and controls surrounding you. Cushioned seats with arm rests and lower back support result in less fatigue. They help keep the operator more physically and mentally alert and reduce the chance of accidents. Hard, metal pan seats jar riders more and often allow a rider to be thrown or bounced out of the seat. Very young drivers and elderly drivers, in particular, need tractor seats that help them stay put.

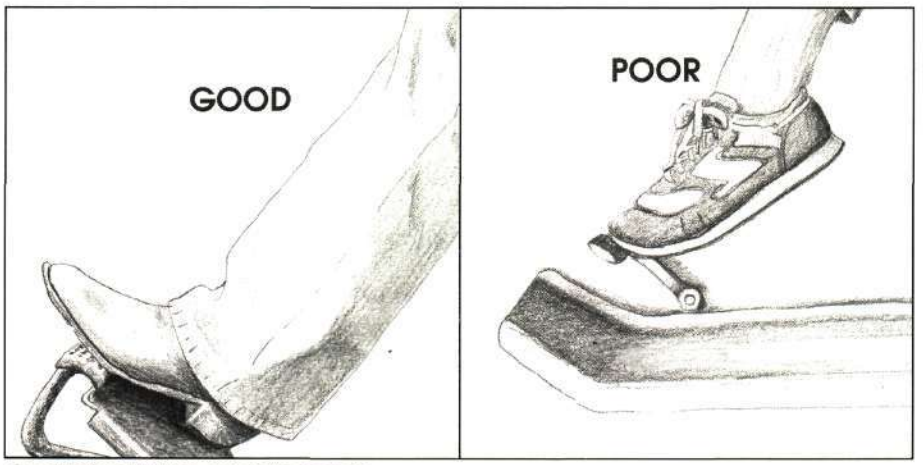


Cushioned seats reduce fatigue and provide more secure seating

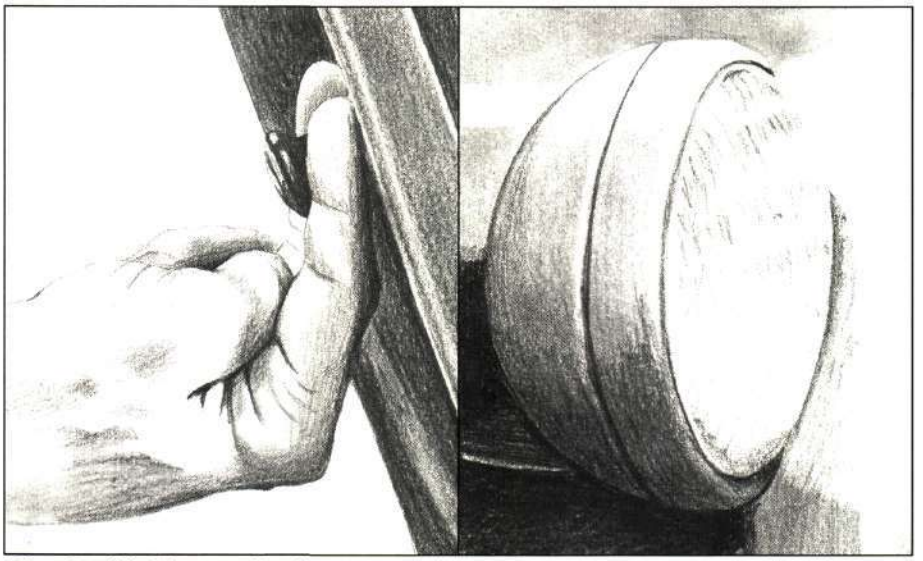


Pan seats are more fatiguing and allow riders to bounce off more easily

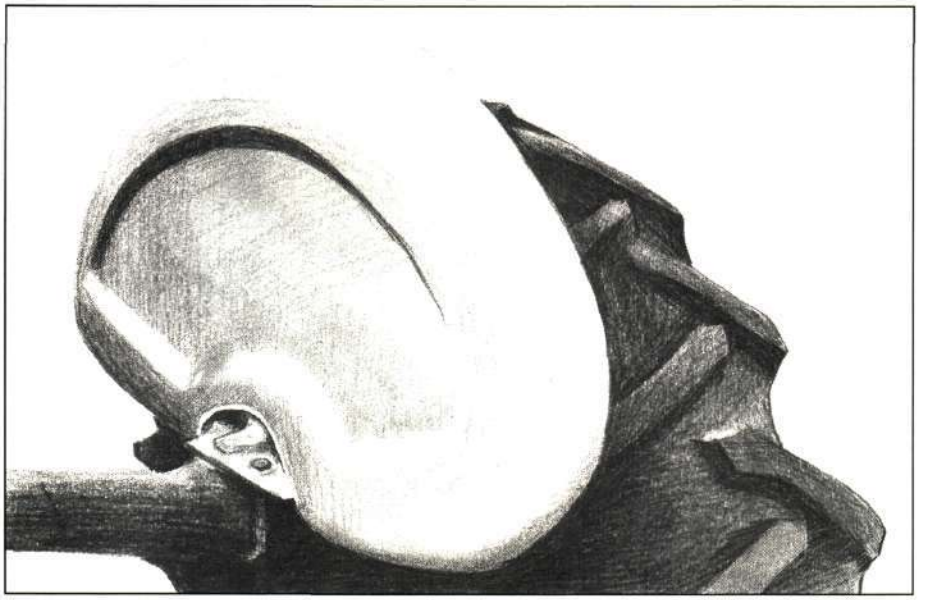
Can you reach all of the controls easily from the tractor seat? What about others who may use the machine? If possible, have the smallest person who might operate the equipment try out all the controls. The child in the picture below cannot reach the pedal safely.



Controls must be easy to reach



Check all lights on a tractor



Fenders protect the driver from flying objects

Control levers on tractors should be clearly marked as to what the controls and their directions of movement are. Unmarked controls may lead to an accident if an inexperienced driver must operate the tractor. You should look for marked controls on all used equipment.

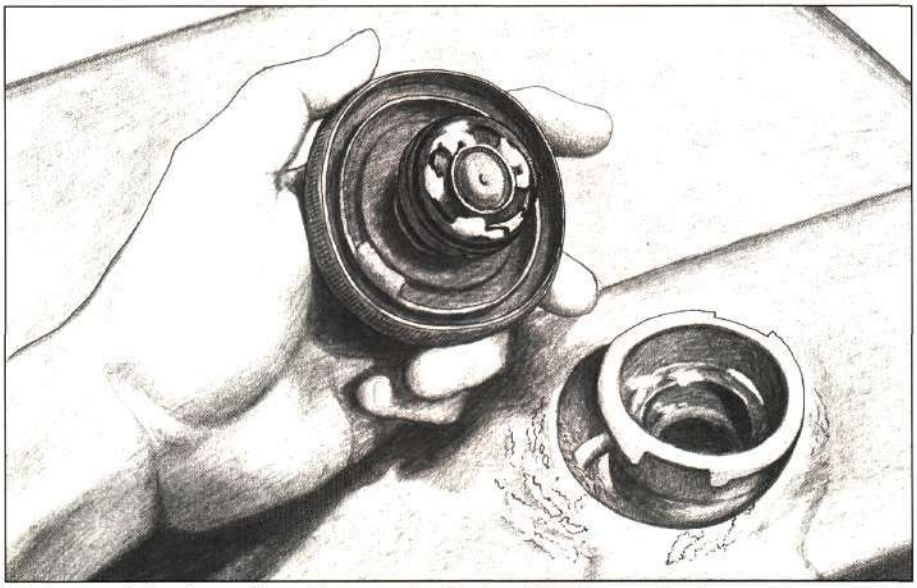
Clearly marked control lever

Lights that are in working order are an important safety item often overlooked by tractor buyers. A tractor should have two headlamps, a rear work light, and at least one taillight. Try turning on all lights to see if they work. Burned-out or faded lamps make it difficult to see details of ground irregularities and machinery operating conditions that can warn of an impending hazard or unsafe situation. Bright headlights also make it easier for approaching motorists to spot tractors during daylight road travel.

All tractors should have fenders. A fender offers protection from mud and small rocks thrown from the tractor tire and keeps the driver from being thrown into the wheel if bounced out of the seat. A fender also can be used to mount a handhold and tractor lights.

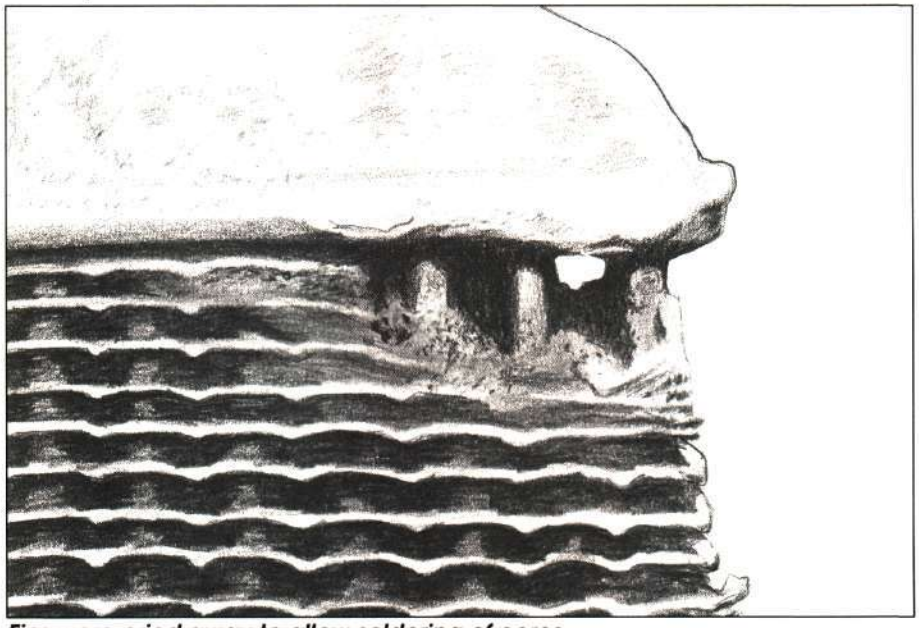
Coolant Systems

A careful inspection of the radiator fill area may reveal several inferior conditions. Creamy white deposits on the underside of the cap are signs that exhaust gases or oil may be leaking into the coolant system, possibly through a head gasket leak or water jacket leak in the block. If paint in the area of the cap is discolored or flaking, the engine may have overheated somewhere along the line. Overheating could have been due to coolant loss, a plugged thermostat, a plugged radiator, a collapsed hose, a faulty water pump, or a major head gasket leak.



Creamy white deposits on the cap indicate oil in the coolant

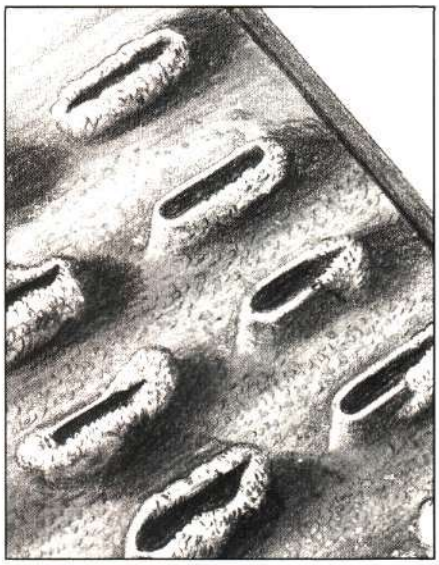
If the radiator looks like this externally, it is probably ready for the scrap heap. Here, the cores leaked, so the fins were pried away to provide room for soldering. Red, blue, or green stains along the fins indicate a leak. Maybe it is just a pinhole leak now, but vibration and 10 to 15 psi pressure could create a larger leak and ruin the radiator.



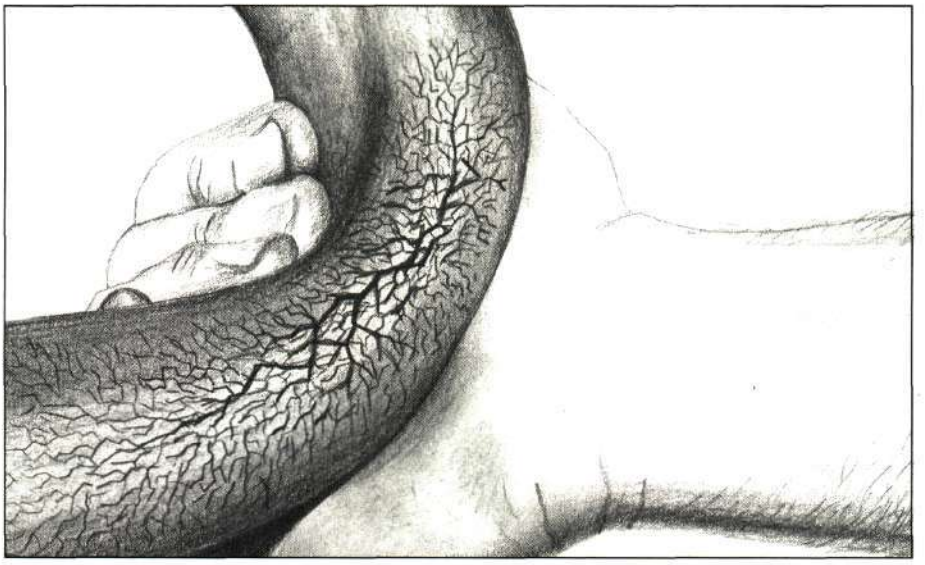
Fins were pried away to allow soldering of cores

Regardless of the season, stay away from machines which have not contained antifreeze. In addition to lowering the freezing point of water in a radiator, antifreeze contains rust inhibitors and buffers to neutralize acid accumulations and protect the radiator.

Radiators are not cheap to replace. Any corrosion inside a radiator, as pictured here, is a bad sign. Many of the cores may be nearly plugged with deposits that reduce cooling capacity. Corrosion of this magnitude may mean the radiator will need to be replaced. Radiator flush compounds may remove the deposits but can cause leaks. In the example shown, the damage has been done already, probably by infrequent coolant changes or by using hard or dirty water in the radiator.



Severe radiator corrosion

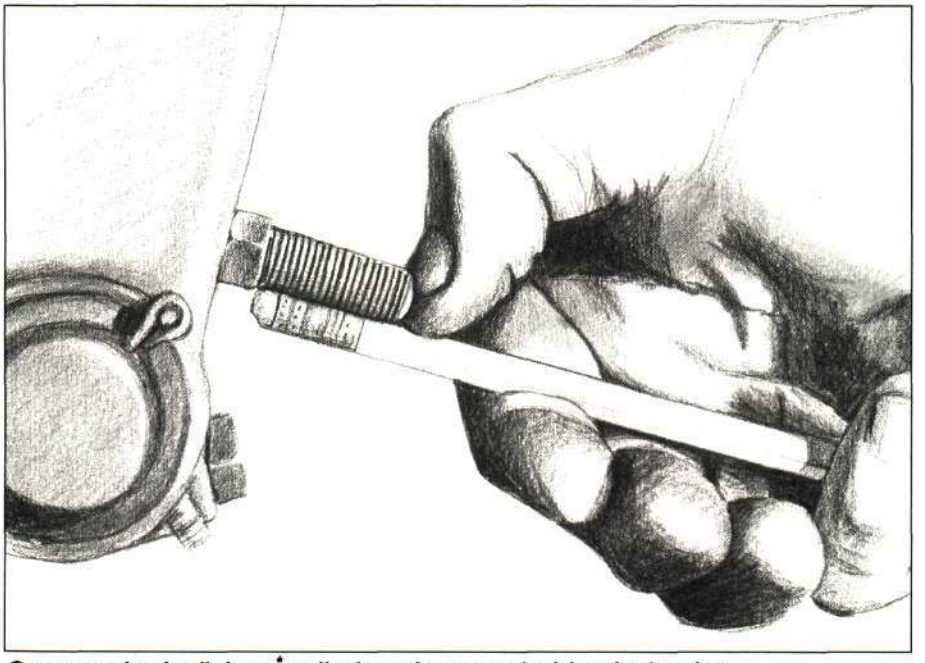


Squeeze radiator hoses to check for sponginess or cracks

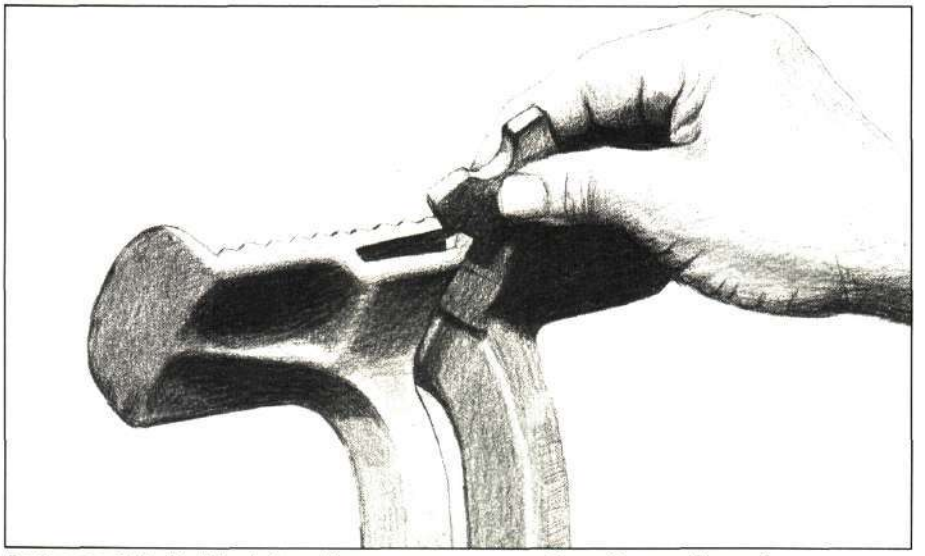
Make sure the radiator is not hot, then squeeze radiator hoses to see if they are weathered and cracked. Very spongy hoses should be replaced. Sponginess on the suction side, usually the lower of two hoses, signals possible hose collapse when the engine is operating. It is difficult to find problems by feeling wire-reinforced hoses, so try twisting the hose. This stretching will collapse the hose and show cracks if it is near failure.

Brakes and Clutches

On independent mechanical brakes, check the linkage adjustment on one side of the machine, then go to the other side to compare dimensions. Unlock the interlock so you can depress each pedal separately; they should move in about the same manner. If movement is not similar, the brakes probably need more work than just adjusting the linkage. New linings and possibly new return (retractor) springs may be needed. Brakes are typically one of the most neglected systems on agricultural equipment, so expect to do some repairs, especially if the unit is more than 20 years old.



Compare brake linkage adjustments on each side of a tractor



Brake pedals that lock together are necessary for safe road travel

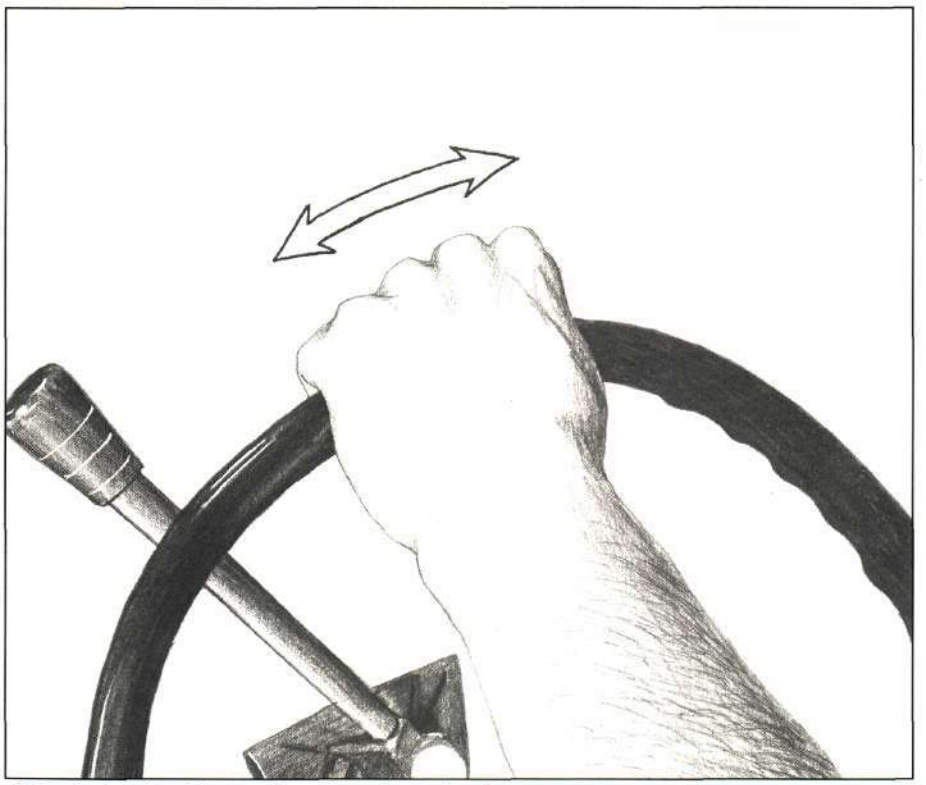
Locking the brake pedals together, as shown here, is essential for safe tractor driving at road speeds. Even lightly touching a single brake at road speed can throw a tractor off course. Locked brake pedals give a driver a larger target to step on for emergency braking. Ease of locking encourages this safety practice; if the locking mechanism does not work easily, operators tend to neglect using it. Watch out for rust buildup, broken-off latches, or bent parts that will not latch.

With the engine running at fast idle, both brakes locked together, and the transmission in a mid-range gear, gently feather-out the clutch while depressing the brakes. This will check the clutch, the brakes, and the response of the engine governor. The governor should smoothly increase engine speed as the engine struggles to move the machine forward. You should be able to stall or nearly stall the engine with the brakes. Is the clutch engagement smooth and positive, or does it seem to slip? Slippage indicates adjustment or repair may be necessary. Does the machine pull left or right, indicating poorly adjusted or faulty brakes?

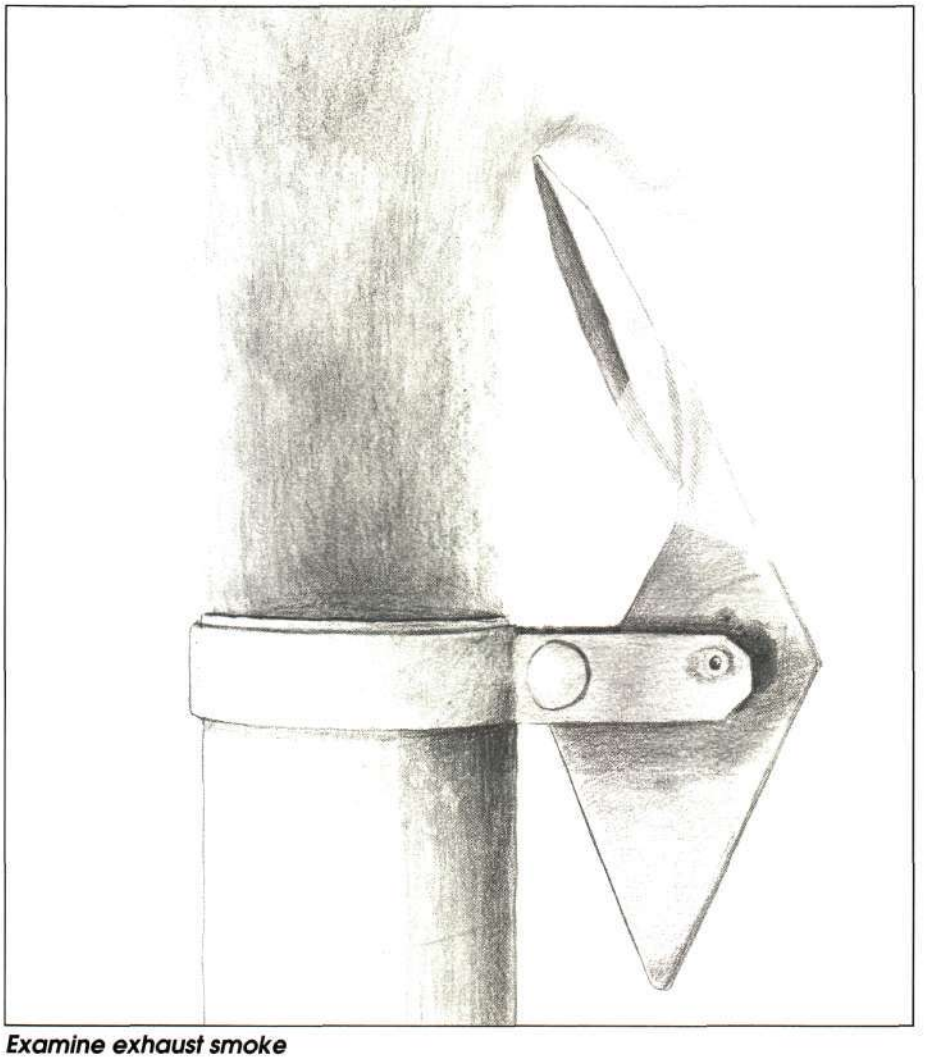
Check brake and clutch engagement simultaneously

On mechanical clutches which are not hydraulically assisted, sometimes a pending clutch problem can be detected by manually disengaging the clutch pedal. With the brakes set, transmission in neutral, and engine running, slowly depress the clutch to feel for smooth movement in the linkage. Once the pedal is down, listen and feel for a noisy, rough clutch release (throwout) bearing. If you feel vibrations or the clutch pedal movement is rough, there's a good chance the clutch needs to be overhauled. Although release bearing replacement appears simple, it often entails splitting the tractor, and once you've gone that far, it's best to replace clutch disc, pressure plate, etc. In short, it could cost you more than the tractor is worth.

Check mechanical clutches manually



Check steering by rocking steering wheel



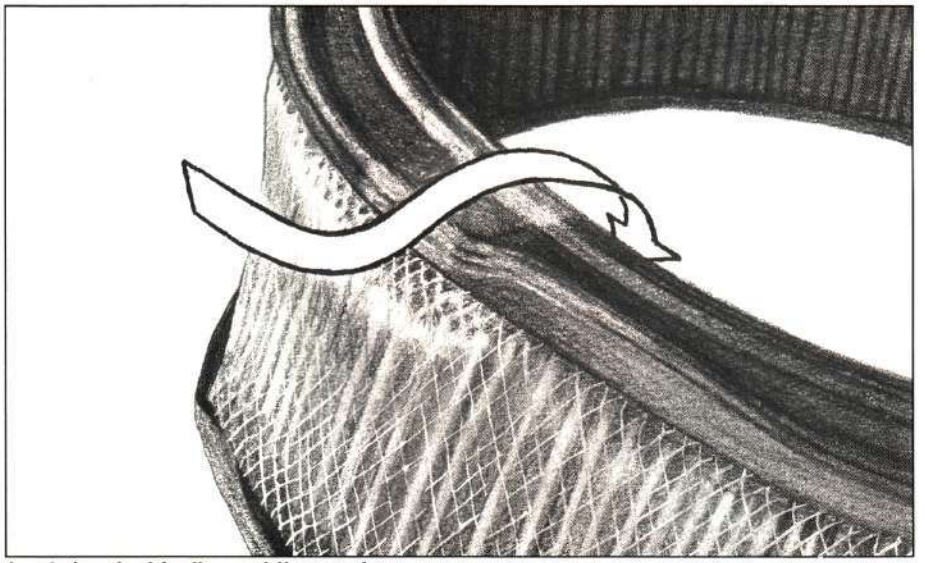
Examine exhaust smoke

Other Important Tractor Checkups

With the engine running, check power steering by rocking the steering wheel left and right. Front wheels should begin to move smoothly without relief valve squeal. Rough front wheel movement might indicate bent hydraulic cylinder rods, worn or seized knuckle joints due to lack of lubrication, or low hydraulic fluid level. With manual steering, hand movement greater than a few inches left or right before front wheels move may indicate worn steering gears (backlash) or worn pivot points in the linkages. Check the gearbox for lubricant leaks around the output shaft seals. Restricted steering wheel movement may indicate bent or twisted linkages or control arms, or poorly lubricated or binding joints.

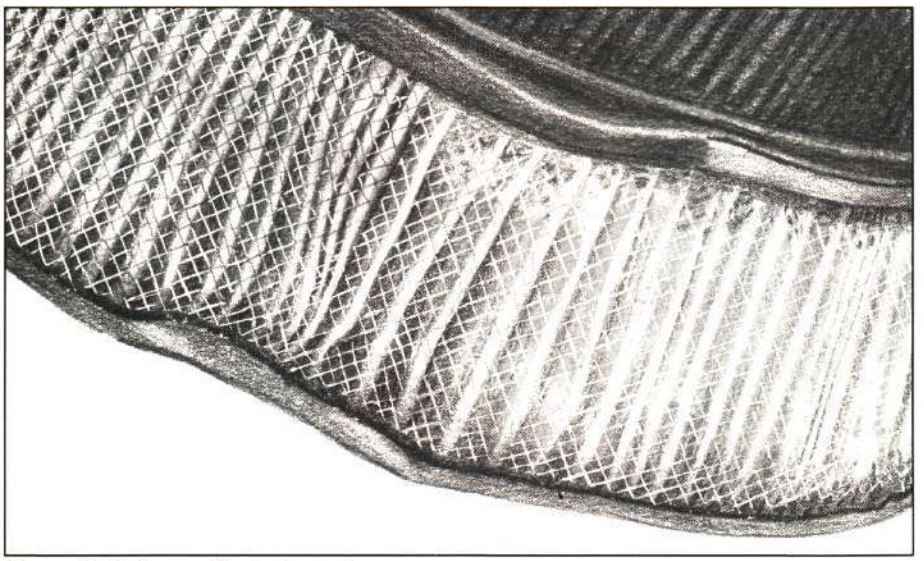
If the engine can be run, examine the exhaust smoke. At constant engine speed, black smoke may mean improper fuel, a faulty fuel injection system, incorrect engine timing, or an improperly adjusted carburetor. White smoke at constant engine speed could be due to the wrong fuel type, a low engine temperature because the tractor was not warmed up or has a faulty thermostat, incorrect engine timing, or a coolant leak into the combustion chamber. Even experts are fooled by exhaust smoke systems. Generally, continuous black smoke in diesels is an injection pump/injector-related problem. If white smoke persists, allow the radiator to cool and remove the radiator cap. Then, while the engine is running again, check for gas bubbles which may indicate a coolant leak.

In dry air filtration systems, remove the filter element from the canister. Look for a dusty spot along the flexible gasket where the element has been bent or improperly seated in the canister. Dust has found a path of least resistance and bypassed the filter to enter the engine and cause unnecessary wear.



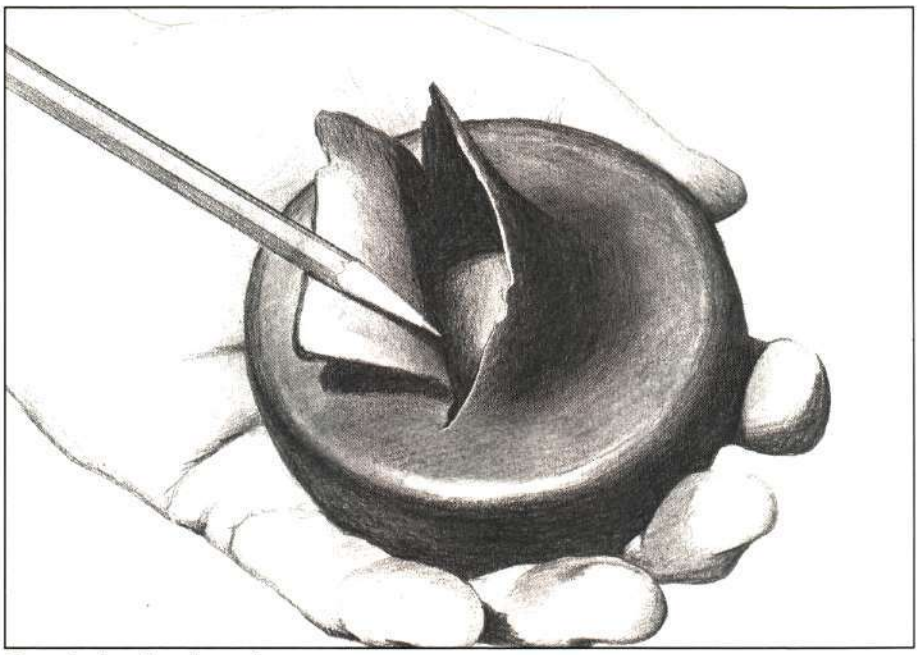
Look for dust trails past the seal

Crumpled filter elements seal poorly at the gasket area and may be fractured, which may cause leaking where the pleats are glued to the end caps.

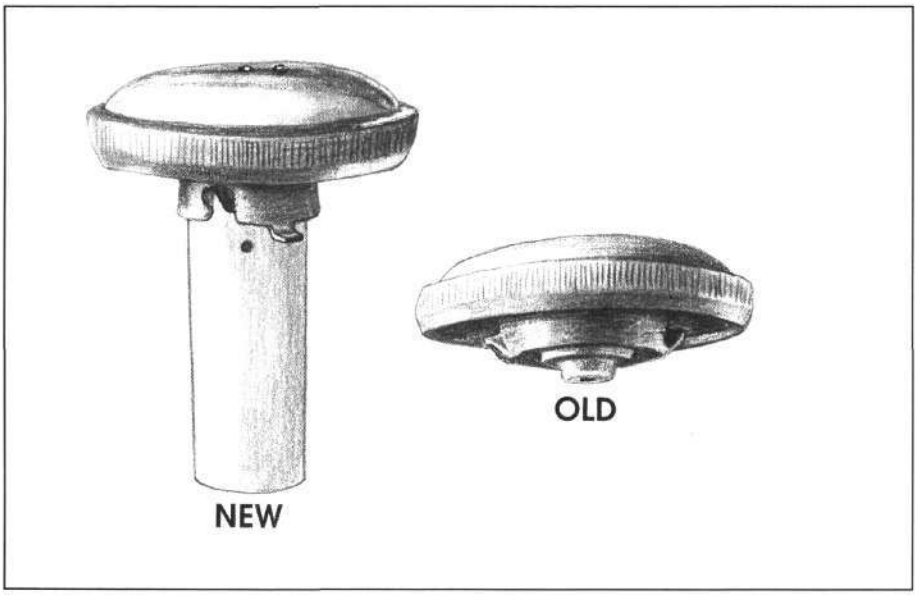


Crumpled elements seal poorly

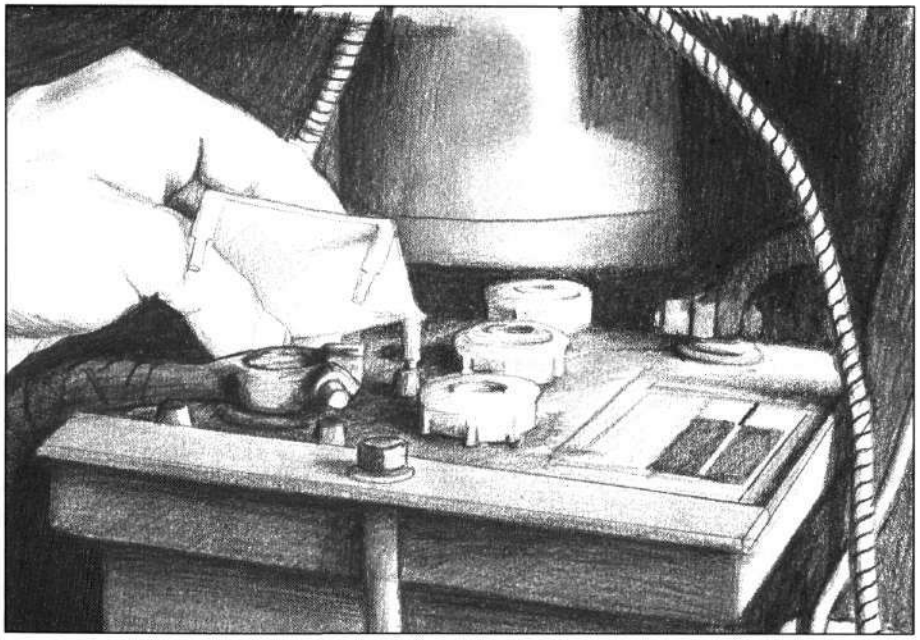
Dust unloader valves collect and store dirt which settles from dry air filter elements. If the rubber is dried, cracked, or torn, as shown on the right, a vacuum created by the engine can pull air and dust into the flawed valve, bypassing the dirty air flow path designed into the filtration system. Excessive dirt accumulates in localized areas of the filter, causing restrictions and plugged elements.



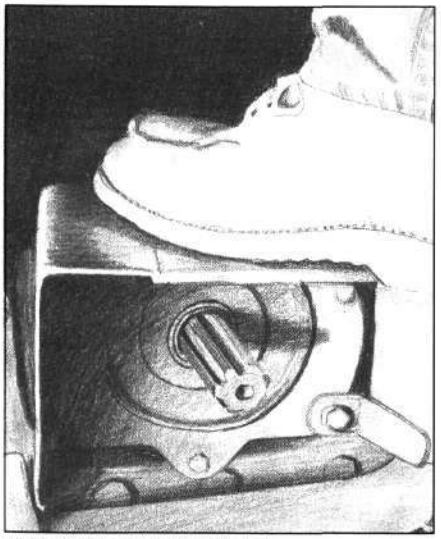
Torn dust unloader valve



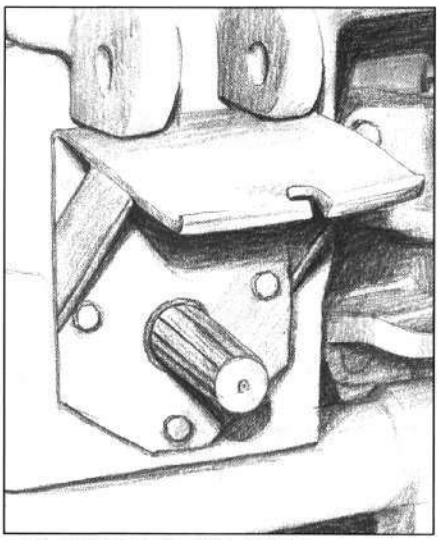
Replace old gas caps



Terminal posts on batteries should be protected



Safe PTO master shield



Old and unsafe PTO shield

Always check for replacement gas caps on any International Harvester and Case gasoline tractors; check any Ford gasoline tractors produced after 1939. The volatility of gasoline is greater today than several years ago. Because gas tanks on these tractors are located in close proximity to the tractor engine, fuel pressure sometimes builds up beyond the capacity of the original gas cap. If the cap is opened when fuel is very hot, gas may spray out of the tank and contact the operator. The original gas cap is much flatter than a newer replacement cap. Check with dealers about replacement caps if the tractor you are considering has an old-styled cap.

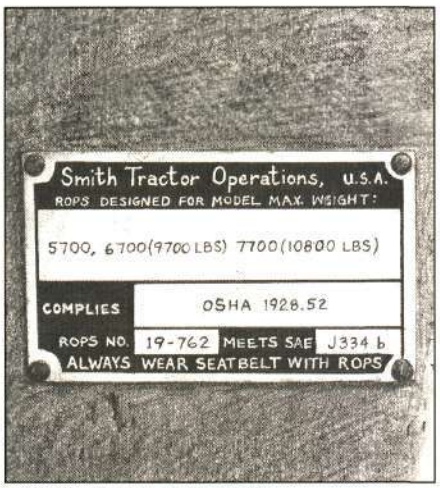
A battery must be firmly anchored and the terminal posts protected to prevent damage. A damaged battery could allow escape of dangerous amounts of hydrogen gas and sulfuric acid. Hydrogen gas is explosive, and sulfuric acid is caustic and will result in chemical burns.

Power Take-Off Guards

PTO stubs are the site of many fatal or crippling injuries. The tractor master shield shown on the far left protects a person from the PTO stub, the first U-joint of attached equipment, and the coupling pin. Though not recommended, the master shield is often used as a step; therefore, it should be substantial enough to withstand the weight of a 265-pound person. The old type of PTO guard on the near left should be removed and the tractor fitted with a newer, more enclosing shield.

Roll-Over Protective Structures

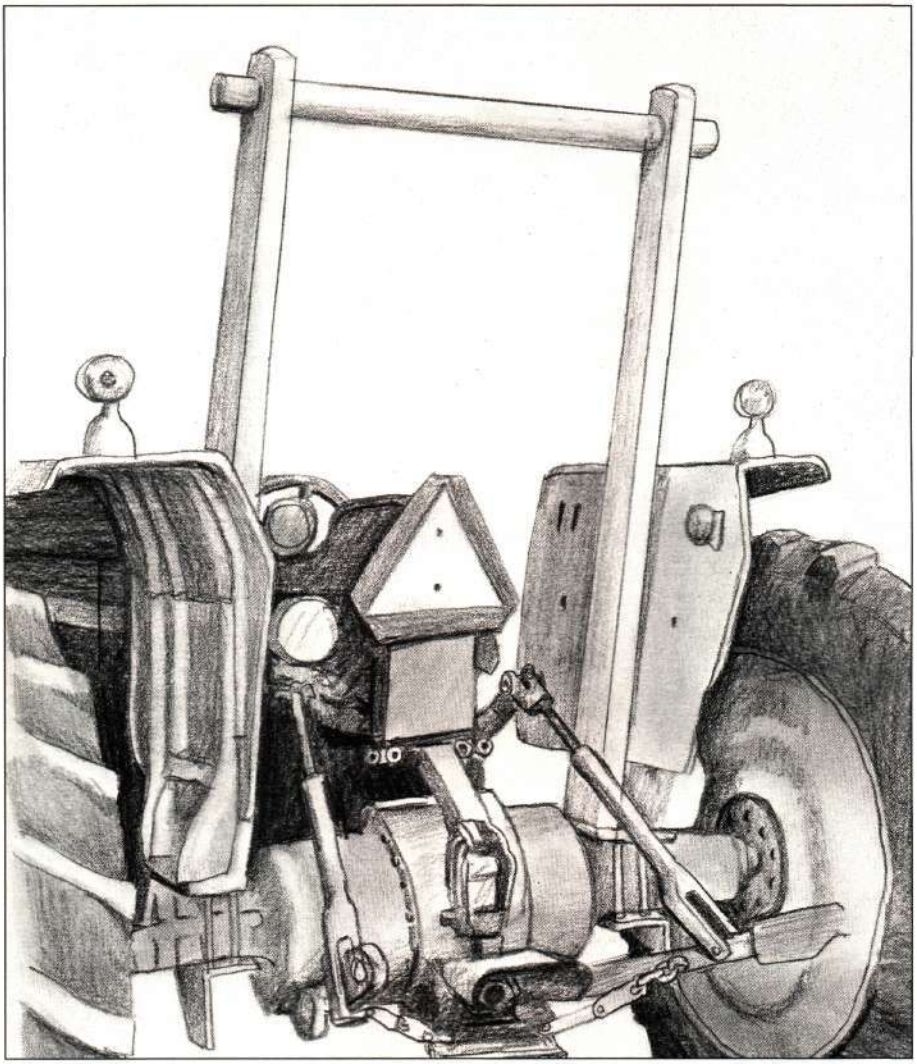
The illustration on the right shows an example of a two-post Roll-Over Protective Structure (ROPS). Make sure all attachment bolts are in place and not bent. Bent anchoring bolts may indicate that a previous roll-over occurred, which can mean the ROPS may fail in a future roll-over.



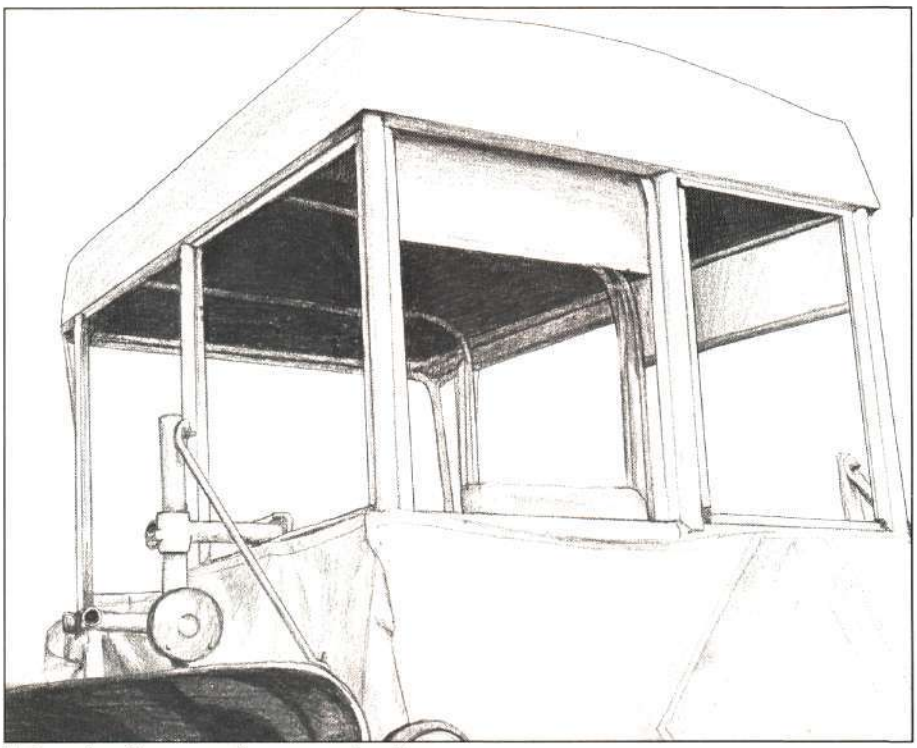
ROPS certification plate

It is not always easy to tell whether a tractor has a certified Roll-Over Protective Structure (ROPS) or just a cab to keep out the wind and sun. One way to identify a ROPS is to look for the certificate that is usually on one of the upright posts or to look for a seat belt. Only tractors with an approved ROPS are allowed to have seat belts. ROPS have been available for many models of tractors since the late 1960s.

The cab at the right may appear to offer roll-over protection, but it is not an approved ROPS. It would crumple under the weight of the tractor during a roll-over.



Two-post roll-over protective structure (ROPS)



This cab offers no roll-over protection

Economics of Owning & Operating

Owning and operating farm equipment is just one of the satisfactions of farming and country living. Unfortunately, the low profit margins of modern farming and the high costs of machinery make it necessary to carefully evaluate equipment purchases. Final decisions should minimize machinery costs for a level of productivity and efficiency that will maximize profits. Small-scale operators, in particular, should be aware of the costs of owning and operating farm equipment to avoid overinvesting. Several options for acquiring machinery include purchasing new or used equipment, custom hiring, leasing, joint ownership, and trading work.

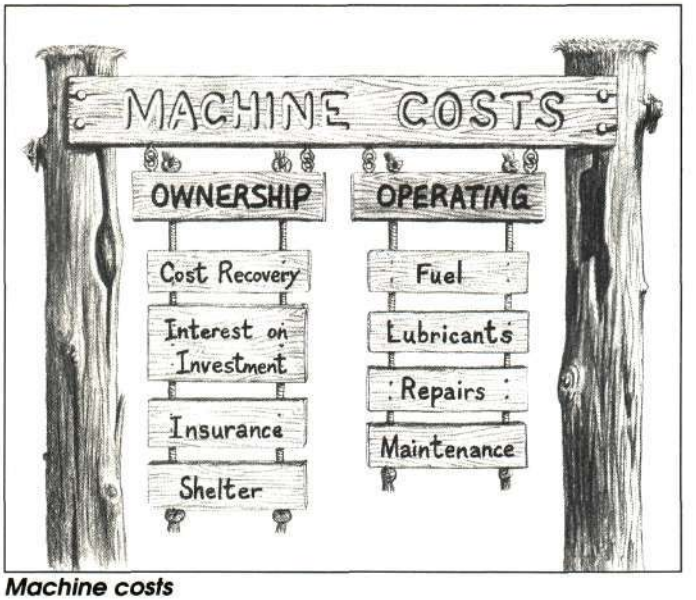
An important consideration for small-scale farmers is machine usage, that is, having sufficient acreage to yield the income necessary to pay for the ownership and operating expenses of the machines. Used farm equipment can play an important role here, since it usually can be purchased at substantially lower prices than new machines. The prices of new machines have risen dramatically, and substantial use is required to cover the ownership costs.

Recent federal income tax laws have been enacted which reduce tax advantages of machine ownership. The investment tax credit has been repealed, capital gains exclusions are gone, and new restrictions on using losses from farming to shelter other income have been introduced. As a result, decisions to invest in machinery and other phases of agriculture must be based more on economic returns and less on tax benefits.

Market prices for farm products, volatile as they are, have certainly not kept pace with production costs and, in many cases, are lower than in past years. This further reduces the profit margin and makes the case for buying low-cost used equipment even stronger.

Many farm operators have discovered that their operations are overinvested, particularly in machinery. This mistake, once made, is very difficult to undo, since machines lose value over time. The best approach is to understand machine costs and purchase equipment that is within the income ability of the farm. Careful planning of machine selection is one of the most important management tasks a farmer tackles.

Machine costs come under two headings: ownership costs and operating costs. Understanding the difference is crucial to your profit potential. Ownership costs include: depreciation (cost recovery), interest on the investment, risk-protecting insurance, and shelter costs. These costs are fixed; the same dollar amount is expended each year regardless of use. Most are non-cash in nature and thus are "hidden."Operating costs include: fuel, lubrication, and repair and maintenance costs. Repair costs escalate sharply in the latter stages of the machine's useful life. Farm income must be high enough in the long run to cover all costs, both cash and non-cash.

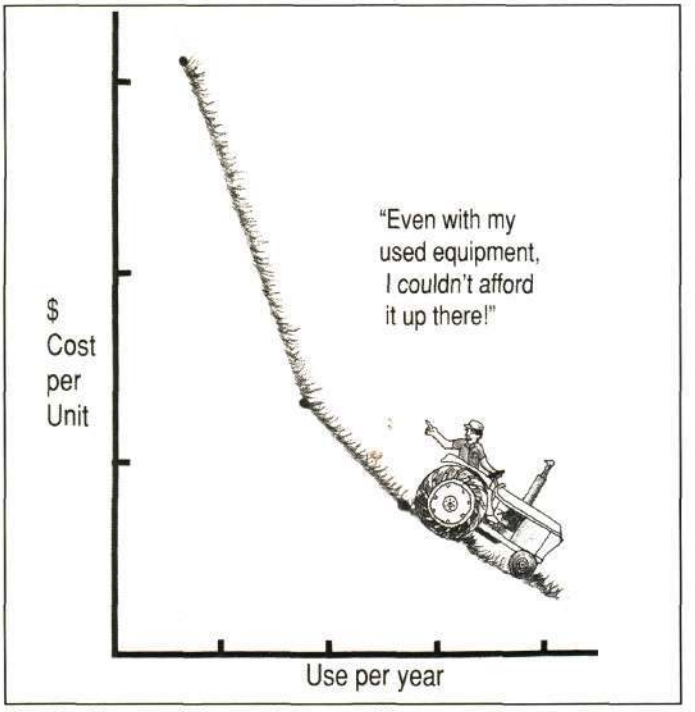


Machine costs

Machine usage is an important factor in the purchase of used machinery. Low machine usage may result in high unit production costs due to the fixed nature of ownership costs. For instance, a machine with an ownership cost of $900 per year operating on 50 acres yielding 100 bushels per acre would generate costs of $18.00 per acre and 18¢ per bushel. Using the same machine on 100 acres would cost $9.00 per acre or 9¢ per bushel. In this example, the fixed ownership value was used to compare the production costs of the machine based only on its usage. Operating costs of equipment, seed, chemicals, labor, and other

related costs are not included in the above production cost estimates.

Having enough work for machines is crucial in keeping unit production costs down. The purchase of used machinery is a useful way to minimize unit production costs for small-scale operators, since the initial cost of used machines is only a fraction of the cost of new ones. Idle machines lose money; busy machines help make a profit.



Production costs based on machine usage

Ownership costs can be predicted before you purchase either new or used machines. An accurate estimate can be prepared by your Cooperative Extension Farm Management Specialist. For a ball park estimate, multiply the purchase price of your machine by the appropriate percentage in Table 1 below. These costs include interest rates of 6%. Add half a percentage point for each additional one percent of interest rate.

Table 1. Ownership cost prediction percentages

If Purchased:	NEW	USED
Tractors	12%	15%
Other machines	13%	16%

Examples: A new tractor has a price tag of $27,000. Ownership cost = $3,240 per year ($27,000 x .12). A used tractor is priced at $9,000. Ownership cost = $1,350 per year ($9,000 x .15).

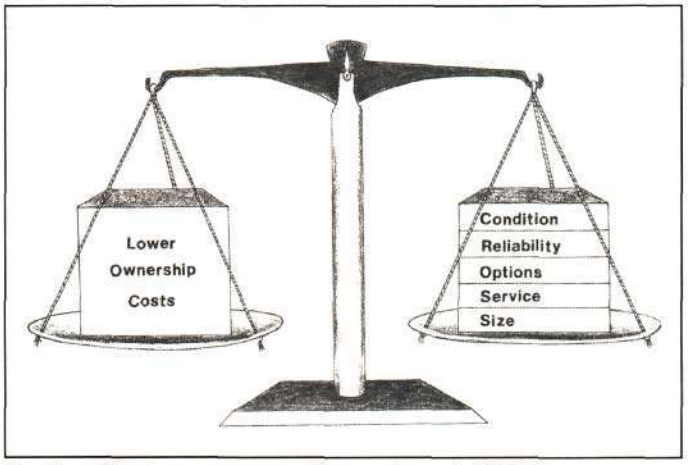
The greatest advantage of buying used machines goes to the farm operator with low usage. In effect, the "second user" can save considerable investment, resulting in lower annual cost per hour for ownership and repairs, as shown in Table 2. The figures show the difference between buying a new 55 horsepower (Hp) tractor for $18,100 versus purchasing an eight year old 55 Hp tractor for $6,165 for 300 hours of annual use. In spite of higher repair cost for the used tractor, the annual cost savings are $982 and a savings of $3.28 per hour for repair and maintenance over the costs of the new tractor.

Table 2. Comparison of average annual costs for new and used tractors

USED 300 HOURS/YEAR		
Average Annual Cost*	New	Used
Cost Recovery	$1,095	$258
Interest at 6%	757	293
Repairs	146	584
Insurance	181	62
Shelter	259	259
TOTAL	$2,438	$1,456
Cost Per Hour	$8.13	$4.85

* Operating costs other than repairs were not included in Table 2. The estimates given include an average annual inflation projection of 4%.

Source: Table 2 was developed using Mini Machine Analysis, Version 2.0, written by William K. Waters, and is available from The Pennsylvania State University Extension Computer Services.



Trade-off between ownership costs and CROSS

The purchase of used machinery may keep overall ownership costs down, but there is a trade-off involved which should be considered: a balance between lower ownership costs and "CROSS." An

acronym of sorts, CROSS is a way to remember ***condition*** of the machine, its ***reliability,*** the available ***options,*** dependable ***service,*** and adequate ***size*** to accomplish the work. This trade-off is very important and should be carefully explored. Breakdowns or lack of adequate capacity, among other problems, may quickly diminish the advantages of less costly used machines. Consider other machines and ways of obtaining machine use.

Financing the purchase of used machinery by borrowing increases the cost by the amount of interest due. You should determine whether purchasing is the best alternative. If borrowing money is necessary, keep some simple rules in mind to help reduce costs. (1) Don't borrow the full amount; make a down payment of at least 20% or more, (2) shop for the lowest interest rate, (3) repay the loan in as short a period as possible consistent with your farm business, but always within the expected life of the machine, and (4) arrange for a note of some sort; never borrow for machinery on real estate equity. Remember, the interest rate charged and loan life are the key factors which influence the interest cost and hence the total cost of the purchase.

Table 3. Total interest cost per $1,000 of loan

	INTEREST RATE	
Life of Loan	10%	15%
3 Years	$162	$248
5 Years	275	427
7 Years	395	621

Operating costs for power units such as tractors and self-propelled machines consist of fuel, lubricants, repairs, and maintenance. Fuel consumption is relative to horsepower, lubricant costs are about 15% of fuel costs, and repairs depend on use. Repair costs escalate with the age and use, thus operating costs increase with time. The keys to controlling operating costs are preventive maintenance and, to some extent, shelter. Engine maintenance is especially important to maintain performance, reliability, and lower repair costs. The purchaser of used equipment should evaluate the condition of the machine for evidence of proper preventive maintenance as discussed earlier in this book.

The small-scale operator should be aware of the magnitude of total machine costs for various common field operations necessary to carry on a farm operation. The machine costs for production of corn for grain, corn silage, alfalfa harvest and maintenance, and alfalfa stand establishment are shown in Table 4.

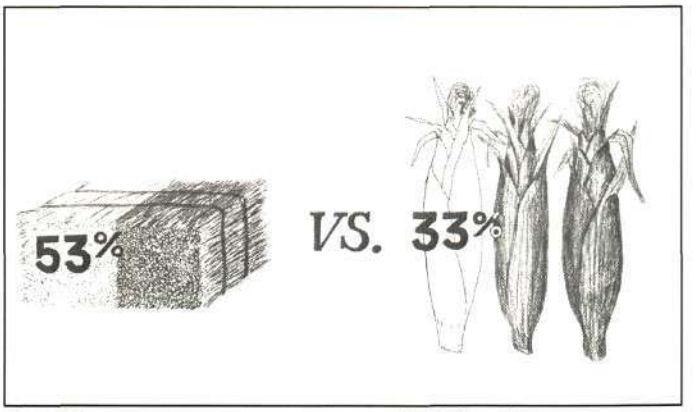
Table 4. Machine costs per acre for various field operations

	MACHINE COST PER ACRE*		
	Operating	Ownership	Total
Corn, grain	$27.56	$36.57	$64.13
Corn, silage	$22.13	$52.63	$74.76
Alfalfa, harvest and maintenance	$39.25	$65.02	$104.27
Alfalfa, stand establishment	$13.14	$32.79	$45.93

* Corn grain and silage data is based on studies of the 1985 Pennsylvania Corn Club; Alfalfa harvest, maintenance, and stand establishment data is based on studies of the 1985 Pennsylvania Alfalfa Growers Program.

Source: The Pennsylvania State Agronomy Guide, 1987-88

This cost study data comes from farms with a mixture of owned equipment and custom operations. The total costs reflect the varying degrees of machine use: four or five operations to plant alfalfa, a dozen or so operations for three to four cuts of alfalfa, and the number of operations for corn harvests in between. For the most part, this data is from full time farming operations. The small-scale operator may have higher ownership costs than shown here because of the smaller acreage utilized.

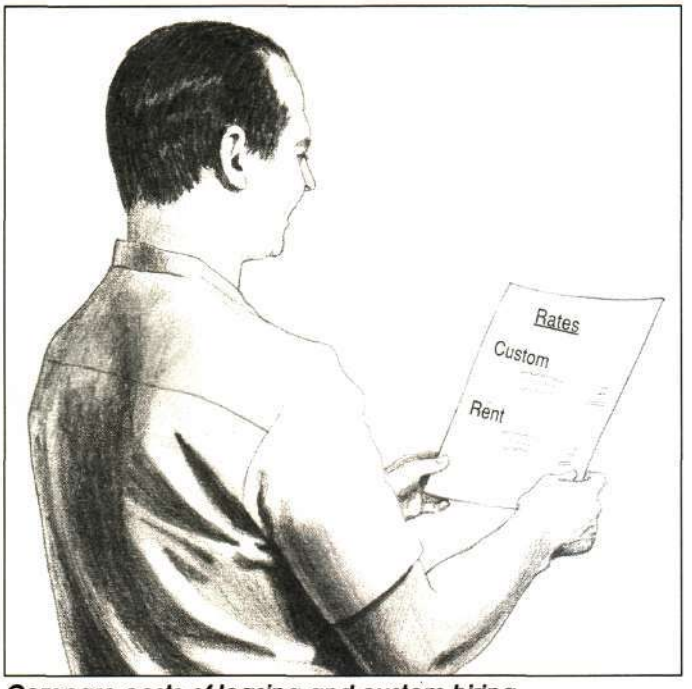


Machine costs as a percentage of total costs vary according to the crop being produced

Total machine costs vary for different jobs done on the farm, some being very costly. Further studies on Pennsylvania farms indicate that 53% of alfalfa production costs are machine ownership and

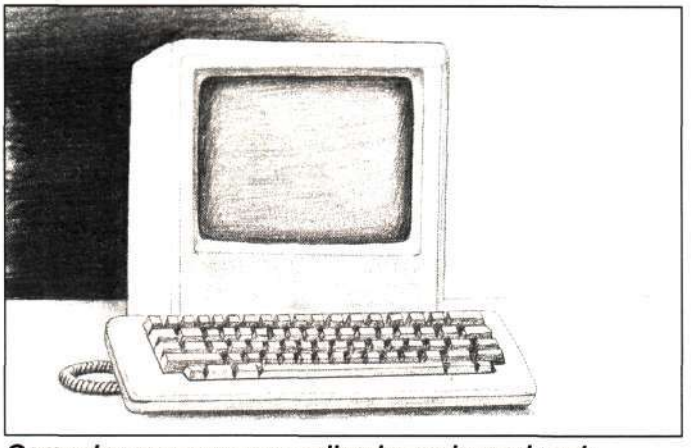
operating costs, while 33% of corn production costs are machine costs. This data consists of averages; thus, the costs from farm to farm can be considerably higher or lower. The central point is that, due to the magnitude of machine costs in crop production, machine selection and preventive maintenance are extremely important in terms of keeping crop costs down. ***The small-scale operator should be wary of oversized machines, since they will add unnecessary costs to production.***

Custom machine hiring and leasing are optional methods of obtaining machine use and, for small-scale operators, are often the least costly method where available. Custom rates are usually very reasonable in comparison with ownership costs, although obtaining service when needed may be a problem, especially with harvest and tillage operations. Spraying, fertilizing, and feed grinding lend themselves very well to custom operation. Leasing may be available in two forms—by the job or for a year or longer. A year-long lease will reduce initial investment needs but may be more expensive than ownership in the long run; before leasing, make a comparison with ownership costs. Leasing by the job is available in some regions and is an excellent alternative for small-scale operators.



Compare costs of leasing and custom hiring

Joint ownership and use of machines with a neighbor are methods of reducing investment and annual ownership costs. This should be attempted only between persons who share a good relationship. The idea is to share initial costs and maintenance costs and to have sufficient work for the machine to be economically used. A written agreement should accompany this arrangement, with provisions for buying out the other party should one wish to terminate the agreement. Trading work accomplishes the same thing—"I own a plow, you own a disk, we'll do each other's work." In effect, this shares investment and operating costs. Again, this should only take place between neighbors who get along well.



Computer programs can estimate equipment costs

Cooperative Extension Services offer a variety of information useful for evaluating machine problems, including machine selection. Many county agents have access to computer programs which can estimate ownership and operating costs on prospective purchases. Estimating costs of used machines in this manner allows the operator to compare the costs with the other options of purchasing new equipment, leasing, or custom hiring.

Used equipment for many farm tasks offers a viable alternative to excessive machine investment, especially for small-scale and part-time operators who may not have enterprises large enough to return sufficient income for the cost of new machines. Assessing the quality, safety features, and economic considerations before purchasing will help to minimize ownership costs, expensive downtime, maintenance costs, and operating hazards.

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