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Farm Tractor Safety¹

Until someone opens a drive-thru oil change and fluid check for tractors, you'll have to be the mechanic on duty to monitor fluids and basic operations. Fundamental maintenance includes regularly lubricating all fittings and moving parts (particularly the front-end loader) and checking the oil, the hydraulic fluid, battery water, tire pressure and filters. Setup a schedule, and stick to it, recording the information on a calendar or card for ready reference. Geisbert advises owners to service their tractors every spring and fall or, for machines in frequent use, every 100 hours. Some dealers provide mobile service trucks that travel to the farm for routine maintenance. Otherwise, you'll have to deliver the tractor into the service center, which may mean a long, slow road trip or expensive pickup and delivery service by the dealership. Expect to pay several hundred dollars for each maintenance visit, if transportation is part of the package. Though they come at a cost, such devoted care and along with protection from the elements in a shed are keys to tractor longevity.

Shopping for a tractor can be as challenging as searching for the perfect horse. Not only are there many choices, but tractors, just like horses, require careful vetting for "soundness," appropriateness and safety. Though they're motorized vehicles, tractors do not operate exactly like cars and trucks, and you may feel like a beginner behind the wheel all over again. Most tractors have two sets of gears shifted by a clutch, and once the tractor is in gear, you need only to release the clutch to move the machine forward. Some models built in the last 10 years don't even have clutches. There's no gas pedal to press (you move a hand lever), but you have two sets of brakes which can be operated independently to turn the tractor in a tight radius around the

braked wheel. Give yourself time and a flat, uncluttered, unobstructed driving area to accustom yourself to operating a new machine. Tractors respond much less promptly to the controls than road vehicles do, and the consequences of driver error can be alarming. A tractor can damage or crush virtually anything in its path, be it a wheelbarrow, a fence post or a vehicle.

If you were not raised on a farm or have doubts about operating machinery, you may benefit from attending a tractor-training course. Some states offer educational programs in machinery operation and safety for people 16 years old and under. There are courses for younger drivers, as well as adults. Participants learn how to back the tractor, attach implements and prevent rollovers.

To find out about classes in your area, contact a farm-machinery dealership or your county extension office. Again, the parallel to new-horse ownership holds true: There's no shame in seeking out expert instruction when you are unsure of managing that newcomer to your stable. Once you're comfortable and in control in the saddle/seat, you would not give it up for the world.

Compiled by Melvin Hendrix, PermaCycle Organics, 15 May 2006, Cleveland, Ohio.

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The Small Tractor FAQ

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Tractors look like what they are supposed to do. With gears, levers, pulleys and hydraulic cylinders instead of mysterious black boxes and plug-in circuit boards, a tractor is a machine you can understand, an appealing steel and rubber symbol of an honest day's work. One thumb through a tractor manufacturer's brochures and it's hard not to imagine yourself pulling a moldboard plow, steering a sickle-bar cutter through blue-tinged rows of alfalfa, or hauling a heavy hay wagon. Buy a big enough tractor and you can not only till the fields, but dig ponds, strip mine your woodlot, or pull a combine.

There was a time, in the mythical heyday of the American working farm, when the choice among small tractors was simple: you could buy a one-bottom or a two-bottom tractor, measured by whether the moldboard plow it would pull could turn one or two rows at a time. Today, tractor dealers offer more choices than the souk in Jerusalem. There are garden tractors with more horsepower than the traditional two-bottom tractor; two-wheel tractors with accessory lists that include big-league items like plows, discs, sickle-bar cutters, and flail mowers; and ATVs (Terrain Vehicles) with seeder/spreader and spraying attachments. Machines with the familiar plain vanilla shape -- big wheels in the back and small wheels in the front -- come in sizes from monsters that would dwarf a small farmhouse to toylike machines that can scarcely mow a tract house lawn. There are machines with four wheels the same size, big wheels in the front and small wheels in the back, loading platforms front and/or rear, row tractors shaped like arthritic

and the salesman explains what it does. It's

Special needs require specialized machines, whether a commercial front-mount mower for an estate lawn, a row tractor for garden crops, a two-wheeled tractor for intensive cultivation of a small plot, or a tracked machine for grading. For the common tractor chores on most small and country places -- mowing lawns, clipping pastures and meadows, hauling firewood, manure and brush, mowing and raking hay, and light cultivation and tillage -- the most versatile machines are garden and utility tractors, which are scaled between the smaller riding mowers and lawn tractors, and full-size general purpose tractors.

Garden tractors are primarily mowing machines, powered by ten to twenty horsepower air-cooled gas engines, although a few are available with diesel power. The larger models have hydraulic rockshafts, auxiliary hydraulics for snow blades and throwers, category "0" three-point hitches, and rear PTOs (see sidebar). Most are offered with belly-mount mowers. The smaller lawn tractors have eight to twelve horsepower gas engines; they generally lack hydraulics and three-point hitch, although some have provisions for mounting a snowblade or other accessories.

New, a garden tractor can cost anywhere from \$2500 to \$7500; the belly-mount mower will add another \$400 to \$1000. Adding a three-point hitch, a rear PTO, and hitch-mounted implements will quickly jack the price up. There are companies like Brindley which specialize in small implements for garden tractors, including miniature plows, disc harrows, and field cultivators. For powered accessories, like grooming mowers, rotary cutters, sickle bar cutters, firewood

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splitters and tillers, you are generally restricted to the manufacturer of the tractor for accessories. A John Deere grooming mower won't fit a Ford garden tractor.

Utility tractors, the Japanese contribution to small-scale farming, are small diesel tractors, generally available with four-wheel drive, and in horsepower ranges from twelve up to sixty or more. The Kubota and Satoh Beaver brands are well-known; some of the others are better known under American brand names. John Deere, for example, imports the Yanmar tractors, with a few changes and a coat of green paint. The bigger utility tractors can handle almost any piece of equipment on a small farm; with four-wheel drive, low centers of gravity, and the high-torque diesel power, they are more efficient than substantially larger older tractors. The smaller utility tractors, in the fifteen to twenty horsepower range, are ideal for mowing large lawns, meadows and pastures, loader and hauling work, and small-scale tillage and cultivation. Utility tractors are generally equipped with three-point hitches and standard (540 rpm) PTOs.

You can expect to pay anywhere from \$5500 to \$20,000 for a utility tractor, with the cost escalating rapidly as the size of the tractor increases, and as you pile on options like a hydrostatic transmission, power steering, and selective hydraulics. Unless you shop for used implements at farm auctions, you can expect to pay \$1000 or more for a belly-mount or three-point hitch grooming mower, \$600-\$2000 for a rotary cutter, and anywhere from \$500 for a simple rear-mounted loader to \$2000-\$3500 for a front loader.

The small diesels that power these utility tractors are rugged, standardized engines, many of them manufactured in Japan. In tractor service, they require minimal service and maintenance: no fiddling with points and plugs, no worries about moisture in the ignition system, no

and a shot of lube in the zerk fittings, and they run and run and run. With the exception of a few filters, all Chinese tractors, diesels are liquid-cooled. The coolant system needs to be checked, flushed and refilled periodically, but the chore is generally easier than servicing a passenger car, because most tractors have better access to the engine than a car.

The newer small gasoline engines, like the Onan and Kohler engines, and even the ubiquitous Briggs & Strattons, are much improved over their sometimes balky predecessors, and a powered small tractor is cheaper to buy than a diesel. If you're handy you can certainly change spark plugs and adjust the carburetor yourself, but no matter how diligent you are, a gasoline engine probably won't last as long as a diesel, will require more maintenance, and won't run as economically.

As a short-hand for identifying tractors, horsepower is about as useful as overall length for it gives you a "ballpark" figure, but it doesn't really tell you what the machine can do. A ten-horsepower diesel utility tractor with four-wheel drive can do a lot of hauling and pulling, including loader work, lifting logs, and pulling a four-foot brush hog. A twenty-horsepower garden tractor can mow lawns and plow driveways, but would have trouble on rough ground with heavy hauling. The difference is in traction, clearance, useful horsepower, and the availability of implements. The diesel engine of the utility tractor provides more torque at tractor speeds; the bigger wheels and heavier weight provide greater traction; the higher clearance allows the utility tractor to romp over terrain where the garden tractor would need an

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airlift; and the three-point hitch and standard PTO enable the owner to use implements that are rarely available for a garden tractor. The trade-off is that the garden tractor is more maneuverable on the lawn or scraping snow off the drive, and the lighter weight of the garden tractor is less harsh on a manicured lawn.

Weight, wheelbase, and width are as important as horsepower in determining what work a tractor can do. It doesn't take much horsepower to pull a loaded wagon of hay or firewood, especially when the tractor is geared down to those superlow gears that pull at one mile per hour. But try to stop a fifteen hundred pound tractor towing a three-ton wagon on a downhill slope and you may end up part of a steel pretzel. Wheelbase and overall length determine the loads that a tractor can safely carry in a front loader or on the rear hitch. Heavy loads play havoc with the stability of short-wheelbase tractors.

The standards for measuring horsepower are about as uniform as the standards for measuring the output of stereo equipment. The usual comparison is the rated PTO horsepower of tractors equipped with standard (540 rpm) PTOs, but even there, some manufacturers rate the tractor at maximum PTO speed instead of the standard 540 rpm. The real utility of horsepower ratings is selecting implements for the tractor; or, if you are wise, in selecting a tractor after you have picked the implements you will need. For example, a three-point hitch grooming mower needs a tractor that puts out 15-25 horsepower at the PTO. Less horsepower won't turn the mower; more horsepower may burn out the gear box on the mower.

With the exception of tractor-pulls and wagon-hauling, tractors don't do much useful work by themselves. If you want to mow, you need a mower. To clip pastures and meadows, you need a

brush hog (rotary cutter), sickle-bar cutter, or flail mower. To haul manure and stones, you need a loader. To pull fence posts, lift logs, or hold a hog over a scalding drum, you need a boom crane. The list is endless: spreaders, blades, mulchers, plows, discs, cultivators, posthole diggers, tedders, rakes, back-hoes, utility platforms, bale handlers, rock pickers, rotary tillers, seeders. If you have specialized needs, there are tractor-driven or tractor-pulled accessories to solve the problem: rippers for compacted soil, chippers for orchard clippings, scrapers for landscape grading.

Fortunately, you don't always need the perfect implement to get a job done. A brush hog is ideal for clipping pastures; it also does a decent job of mulching orchard clippings. A post hole auger is designed to dig holes; it can also be adapted as a boom crane. A loader is perfect for hauling; it can also plow the snow off your driveway, regrade the gravel, and haul brush, stones, or firewood. If you had a lot of driveways to plow, you might want a blade instead; if you had lots of gravel or dirt to grade you might want a box scraper; but the loader will do it. The trick is to select versatile implements, with the emphasis on the jobs that are most important on your place. Once you know which implements you will need, you can pick a tractor to pull them.

The fox knows many things: a versatile tractor with enough implements may be able to do all the jobs that need doing on your place. It may take some trade-offs: a tractor big enough to pull the five-foot rotary cutter you need to keep the brush down, or rugged enough to haul logs from boggy woods, may be too big to pull a grooming mower for the lawn. A tractor compact enough

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to maneuver around the lawn may be too delicate to take on the rough ground of an overgrown meadow.

If you use a tractor mostly for two or three jobs, such as mowing and loader work on a horse farm, you may want to search for a tractor that can handle a particular combination of implements: a belly-mount mower that will raise to a high clearance, together with a loader ~~can~~ be lifted out of the way, would enable you to mow and load barn scrapings without ~~implements~~.

The alternative is the hedgehog: he does one job and does it very well. Instead of using a shed full of implements to adapt the tractor to different jobs, you can use a shed full of machines, ~~such~~ suited for a single job: a commercial front-mounted mower for the lawn, a two-wheel rotary ~~for~~ for the garden, a grinder-mulcher for the clippings, an old John Deere B to drive the cordwood saw. If you have a big enough checkbook to afford them, a big enough shed to store them, and time to keep them all running, you could end up with the perfect machine for each chore. Remember, though, that no matter how carefully you lay them up, internal combustion engines are happier running than sitting on the sidelines. A machine that sits idle too long may balk ~~when~~ when called on for service.

Whether you go for one versatile tractor, or a collection of specialized tractors, the machine ~~has~~ has to be sized for the job. Here it is important to distinguish between different kinds of work. Ground-engaging work, pulling implements that dig or cut into the earth, like a plow or a disc, makes the biggest demands on a tractor. To pull a plow you need horsepower, ground ~~and~~ and traction. Some garden tractors include ground-engaging tools, like miniature moldboard

plows, among their available implements, but a plow pulled by a garden tractor, no matter the horsepower, does more scratching than turning of the earth. what

Cutting tools, like a mower or a brush hog (rotary cutter) demand less pulling power from the tractor, but a specific range of PTO horsepower. Some cutting tools, such as a sickle-bar cutter, require a good-sized tractor because of the asymmetrical loads of the cutter extended from one side of the tractor. Without adequate ballast in front and traction from the offside rear wheel, the tractor tries to spin on the spot instead of moving straight ahead. In many situations, terrain, rather than horsepower, can be the limiting factor. A brush hog that cuts two-inch saplings may need only ten PTO horsepower to turn the blades, but the tractor has to be big enough and rugged enough to pull the cutter through the overgrown meadow.

Finally, there are lifting tools, like loaders and boom cranes, which depend on the hydraulic capacity of the tractor. Usually the problem is not the load capacity of the three-point hitch or loader, but the size of the tractor. If you are going to lift logs in the woods, you need clearance, stability, and tires that will not stick in the muck. And while a loader may advertise itself as having a capacity of seven-hundred pounds, if the opposite end of the tractor isn't sufficiently counter-weighted, you may find the hydraulics lifting the end of the tractor instead of the pile of rocks in the loader.

Implements all have to be hitched onto the tractor, which for most tractors larger than a lawn tractor means a three-point hitch. The standardized three-point hitches, in sizes from category "0"

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for garden tractors to category "3" for agricultural behemoths, evolved to remedy the mutual incompatibility of implements and tractors from different manufacturers. Implements which fit a three-point hitch are fastened by lynchpins to three arms, two hydraulically (or in some very small tractors, mechanically) controlled lower arms, and a free-pivoting upper arm, or topline. One of the lower arms can be adjusted to level the implements from side to side, and the length of the topline can be adjusted to level the implements from front to rear. Depending upon the vertical distance between the attachment points of the lower arms and the topline, the implement will either be lifted almost vertically by the rockshaft control, or will be tilted back, toward the tractor, as it is lifted. It takes about five minutes to hook an implement to a tractor with a three-point hitch.

Most utility tractors have category "1" hitches with lifting capacities from 800 to 1500 pounds; garden tractors are usually equipped with category "0" hitches with lifting capacities of 400 to 700 pounds. There are far more implements available for category "1" hitches than for the smaller category "0" hitches, and in many cases implements for the smaller hitch are more expensive. If you are planning to use a mower on the three-point hitch, it is a good idea to look for a "float" feature, which allows the lower arms to float independently when the mower goes over uneven ground.

There are alternatives to a three-point hitch, including coupler-hitches on small garden and utility tractors, and a variety of proprietary hitches on older tractors. If the tractor doesn't come with all of the implements you need, you can plan on spending a lot of time snooping at farm sales, or crouched over with welding equipment to adapt modern implements to a non-standard hitch. Remember that the tractor may be retired or traded before an implement has outlived its

usefulness. If you have a flail mower that only fits a John Deere 400 garden tractor, you are going to need a new flail mower if you trade the tractor. The aftermarket for specialized implements fitted only to a single tractor is limited; three-point hitch implements are generally easy to sell or trade.

Not every implement attaches to a hitch at the back end of the tractor. Most garden tractors and the smaller utility tractors accept mowers on belly-mounts. A belly-mounted lawn mower is easier to maneuver than a mower towed behind on a three-point hitch, but if you have to remove grease, mud, and grass clippings falling on your face -- to unbolt or uncouple the mower, which then has to be dragged out from under the tractor.

Of course, there are tradeoffs. To mow along an edge with a belly-mount, you look down. Mow rough edges with a mower on a three-point hitch, and you begin to wish your head were screwed on backwards.

Front loaders, blades, and snow-blowers generally hook onto proprietary mounts. If you need to load barn scrapings into a manure spreader, there is no substitute for a front-loader, but you have a heavy implement which takes time to attach and remove, and which requires considerable ballast at the back of the tractor that must also be removed if you are going to use the tractor with other implements. If your need is for a loader to move material from the barnyard or compost heap to the garden, you may be able to get along with a scoop or loader mounted on the three-

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point hitch, which is substantially cheaper, easier to put on and off the tractor, and simpler to maintain. Some rear-loaders, such as the Westendorf Rear-Ender, use catches and chains ~~rollers~~ on the drawbar to enable the three-point hitch to control a dumping action and a fixed scraping position. You have to get used to driving as much of the time in reverse as forward, ~~that's true of a front loader too, and rear-loaders require less ballasting to maintain the balance of the tractor.~~ Rear blades can also be versatile. They usually lack the full hydraulic swiveling action of a front blade, but offer economy, ease of mounting and unmounting, and the convenience of being able to swivel three-hundred sixty degrees.

Most tractors large enough to have a hydraulic rockshaft also have a manifold or other take-off point for hydraulic power that can be run to a log-splitter, or through selective control valves ~~to a~~ front loader or blade. Some implements, like a backhoe, demand enough hydraulic capacity to require an auxiliary pump fitted to the PTO. If you are planning to add hydraulic implements, make sure the tractor hydraulics are compatible with the implements. The hydraulic systems on most garden tractors are only powerful enough to lift and lower a blade or mower; they do not have the power for a log splitter or a loader.

Hydrostatic drive is more than an automatic transmission. A hydrostatic drive allows you to control your speed and direction with a single dash-mounted lever, or a heel-toe pedal, and without using a clutch. Some buyers choose a hydrostatic transmission for small tractors on the grounds that it is easier to operate and will get the kids or a reluctant wife (or husband) onto ~~the~~ tractor. My own feeling is that hydrostatic transmission makes more sense for a tractor that is ~~in~~ constant use, like a commercial loader operator. For the relatively light duty of a non-~~usage, especially~~ if the tractor is used primarily for mowing and other chores that do not

frequent shifting, a manual transmission is cheaper, easier to maintain, less likely to overload, and does not suffer the loss of efficiency inherent in hydraulic pumps and motors (approximately twenty percent). Try to pull too hard with a manual transmission and you stall the engine. The same pull with a hydrostatic transmission could burn out expensive hydraulic seals.

If you choose a manual transmission, one good feature to look for if you are doing any loader work is a "shuttle" shift, which allows you to go from reverse to a moderate forward gear with straightline shift. With a hydrostatic transmission, if the control is a heel-toe pedal, check for a manual lock for long stretches of mowing or transport, when you won't want to keep your foot on the pedal.

Power steering is frequently available on tractors as small as garden tractors and riding mowers. For constant use, such as commercial mowing, especially with tractors that are heavily loaded on the front wheels, power steering is an arm-saver. For intermittent use, many owners may prefer the precision of manual steering. When the turns are really tight, the differential brakes (independent brakes for each rear wheel, which can be locked together for over-the-road use) do as much of the turning as the wheel. One disadvantage of power steering on smaller tractors is that the tractor can be slower to warm up in the winter, because the additional hydraulic fluid has to be brought up to operating temperature before the tractor can be driven.

Four-wheel drive lets you scale the tractor down, using a smaller engine and smaller tractor, which is economical and easier to maneuver. When you need extra traction for occasional heavy

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hauling or tillage, you engage the four-wheel drive. Four-wheel drive tractors are also more stable, because they can have somewhat smaller rear wheels, larger front wheels, and a lower center of gravity, and because they can be ballasted with the weight more evenly split between front and rear wheels. The heavy loading over the rear wheels on a two-wheel drive tractor creates a tendency to do what kids on dirt bikes call "wheelies."

Another option to increase traction is a differential lock. The differential is the gearing which enables a vehicle to go around corners by permitting the rear wheels to turn at different speeds. The differential also lets one wheel spin in the mud or ice so that you get nowhere. The differential lock, usually a small pedal that you depress with your right heel, temporarily locks the two wheels in synchronization, increasing the traction until you get past the slippery spot. Most differential locks automatically release when the two wheels recover their normal traction. It is dangerous to drive around corners or on uneven terrain with the differential locked.

Small tractors are generally offered with a choice of agricultural ("bar") tires, or turf tires. The bar tires provide substantially better traction on soft ground, and are the choice if most of your work is plowing, loading in muddy or mucky areas, or pulling heavy loads in boggy ground. Those cleats which give such fabulous traction in the mud will tear up a lawn and make a mess of a pasture in the spring when you use the tractor to haul hay to stock or to spread lime or seed. "High-flotation" turf tires minimize damage to soft ground. You can improve the traction of turf tires by adding chains if you need double duty. Liquid fill for tires or removable ballast, either bolted onto the wheels or "suitcase" weights on brackets, can also be used to improve traction.

Choosing a tractor is like choosing a computer. With a computer, you decide what you want it

for, select the software you will need, then choose a machine that will run that software. With a tractor, it makes sense to start with a list of what jobs have to get done, how often they need to be done, and how much tractor time they will take. Some jobs may be important enough to demand a dedicated implement. Others may be so occasional that you can rent equipment to do the job, or adapt implements that are less than ideal. Once you have a list of the implements that you need, figure out how big a tractor you need to use those implements on your place.

The trick in compiling a list is to put down the jobs that need to get done on your place, rather than the jobs that you fantasize by the fireside on winter nights. If you are sure that in a year or two you are going to plant six acres of corn on what is now a second-growth meadow, you may want a tractor big enough to pull a two-bottom plow. But if you buy a tractor too big or too unwieldy to pull a mower over the acre of lawn that has to be mowed every week, you may find that the tractor doesn't get much use, and that you need a riding mower in addition to the behemoth.

It is just as much a mistake to expect too much of a small tractor. You can buy plows and disc harrows and front loaders and even backhoes for garden tractors, but a garden tractor is primarily a lawn mowing machine. It will do a dandy job of mowing, pulling small carts, and plowing snow off a driveway; once the land has been broken by a larger machine, a garden tractor with rotary tiller will do a fine job of cultivating a large garden plot. But it cannot substitute for a general purpose or utility tractor for hauling, clipping overgrown brush, or heavy tillage.

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A final consideration may influence your choice of a tractor. One of the pleasures of country living is the easy swap of tools and "custom" work. If one of your neighbors has a posthole that would be just right for fencing your meadow, that's not a bad reason to buy a tractor with a hitch and PTO that will fit the auger, especially if you also buy that lime spreader that is just what both of you need to renovate your pastures.

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Tractor Maintenance

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When your car needs an oil change, you can drive down to the nearest service station, let them throw it up on the lift, and go home in half an hour. With a tractor, unless you live next door to a tractor dealer or mechanic, service is not so simple. The alternative is to do the routine maintenance yourself.

The most important service for any machine is regular oil and oil-filter changes. If you use a one-gallon pan to collect the used oil, and then find facilities for storage or disposal, the hardest part of the job is done. (Used motor oil is terrific to paint equipment like a sicklebar mower before winter storage; or mix a few gallons with sand in a five gallon pail and use it to wipe off

(for use and hoes.) You will probably need an oil filter wrench, which you can buy in any auto store. Be sure to use the grade of oil recommended by the manufacturer of the tractor. Diesel engines, with their high compression, put incredible demands on lube oil. And order your oil filters well in advance; auto parts stores or even tractor supply stores may not stock what you need.

The other important routine maintenance is regular changes of the transmission and hydraulic fluid, and cleaning of the filter screen or replacement of the filter elements. Try to keep the hydraulic system as clean as possible, by wiping off the filler cap and filler tube before you unscrew the cap, using lint-free rags. It takes only a speck of dirt to wreck the seals on a hydraulic cylinder or a hydrostatic transmission.

Diesel engines are generally reliable, if you give them plenty of clean air and clean fuel. The dusty conditions of summer mowing or field work can wreak havoc with air filters, which should be cleaned or replaced at least as often as recommended in the maintenance manual. Clean fuel means buying good diesel fuel (they aren't all the same), storing it in a clean container and wiping off the fuel filler cap and tube before pouring in more fuel, keeping the fuel filter clean, and either shifting grades of diesel fuel or adding diesel fuel conditioner in cold weather. Number 2 diesel fuel begins to gel and separate off waxes at temperatures below freezing, leaving an engine that will start but not run. It will probably happen the morning that you have a half-mile of drive to plow, so prepare by fueling up with Number 1 diesel fuel, or by having a bottle of diesel fuel conditioner ready.

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Gasoline engines aren't quite as fussy about fuel and air, but the ignition system has to be maintained, which means regular spark plug changes, and whatever routine servicing the alternator or magneto and points, distributor, or electronic ignition requires. If you are patient, you can adjust the carburetor yourself, although many of the larger garden tractor engines are considerably more sophisticated and demanding than the familiar Briggs and Stratton powerplants on small rotary mowers.

The other routine service that any tractor needs is frequent, regular attention with a grease gun. Some of the lubrication intervals listed in the owner's manuals may seem overly fussy, but remember that the grease you squeeze into a zerk fitting is not only providing lubrication, but keeping moisture and dirt out. It only takes a drop of moisture to start rust, or a speck of dirt to score a bearing. Regular application of the grease gun is cheap insurance.

With a good half-inch drive and a set of socket wrenches (metric for a utility tractor or an imported garden tractor), you can probably disassemble, tighten, or adjust almost any part of the tractor. A torque wrench is a good idea if you don't have a feel for how tight a nut ought to be (tight as you can get it is not a good idea; an overtightened nut stretches the bolt permanently). For larger implements and utility tractors, a three-quarter inch drive set is useful, and a length of pipe to fit over the ratchet or t-bar wrenches will loosen frozen nuts. A length of pipe will easily generate 400-500 foot pounds of torque, so it should be used with care in tightening nuts.

Given regular servicing and grease, clean fuel and oil, and attention to loose nuts, rust, rattles, leaks, and the other signs that something is awry, diesel tractors are reliable and relatively trouble-free. Even gasoline tractors can go a long time without attention by a mechanic. But

sooner or later, even if you are handy with tools, you will need outside help, whether for a routine five-hundred hour service that requires adjustment of diesel injectors, an annual or bi-annual tune-up of a gasoline engine, or welding of a broken hitch.

It isn't hard to find qualified mechanics. Garden tractors can often be repaired by the mower and chain saw shops that specialize in small gasoline engines. A utility tractor will usually require a mechanic who is experienced with small diesel engines and hydraulic systems.

The real problem is getting the tractor to the mechanic. For more than short distances on local roads, over-the-road transport of a tractor is dangerous, and (unless the tractor is registered) illegal. You can drive a garden tractor up into a pickup bed with a ramp or a pair of two by eights, or you can rent or borrow a trailer. For larger utility tractors, you will need a tilt-bed truck equipment trailer and a class two or stronger hitch on your pulling vehicle.

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Tractor Safety: Stay on Top of It!

AE-1121, February 1997

George Maher, Agricultural Safety Specialist

The farm tractor is often considered the farmer's best friend. But, all too often, the tractor is the agent of injury and death. Tractor injury incidents account for nearly 16 percent of the agricultural machinery-involved injuries in North Dakota from 1991 through 1994. Only the combine was involved in more injuries. In the same time span, tractors were involved in nearly 25 percent of the agricultural-related fatalities in North Dakota.

Types of Tractor Injury-Incidents

There are several types of tractor mishaps that result in injury. Common mishaps are:

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By-Pass Starting

Starting a tractor while standing on the ground beside the machine is not a safe procedure. To do this, the operator must either make certain electrical connections on the starter motor, or reach up and over to turn the ignition key. An operator standing on the ground cannot be sure if the transmission is in neutral or in park.

If a manual transmission is in gear when the engine is by-pass started, the tractor probably will run over the operator. The tractor will start moving as soon as the engine starts to turn over. There may be a slight delay if the tractor has either a hydrostatic transmission or power-shift type transmission, but the delay will not be sufficient for the operator to get out of the way.

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New tractors are sold with a shield covering the starter motor to prevent by-pass starting. Older tractors did not have this shield. Now, a retro-fit shield that covers the by-pass contacts and prevents by-pass starting is available. This shield should not be removed from the starter motor except for servicing the starter motor, then replaced immediately.

Front-End Loader Incidents

Front-end loaders are used for many jobs in agriculture, essentially lifting and moving objects and materials. These versatile implements are often misused by stretching their lifting capacity, inappropriate use, and lack of safety equipment.

Heavy objects such as big round bales, mini-bulk containers, farm machinery parts, and other items are often lifted with front-end loaders. There is a limit to how much a loader can safely lift. The limit may be affected by condition of hydraulic lines and hoses, pressure capacity of the hydraulic pump, proper ballasting of the tractor, strength of front axle assembly, and condition of front tires. The owner/operator of a loader-equipped tractor is usually knowledgeable about its condition and capacity, but caution and good judgement must always be applied.

Adequate ballasting of the loader-equipped tractor is essential for safe lifting. If the rear of the tractor is somewhat light and bouncy as the loader starts to lift the load, additional ballasting is needed. At this point, the safe operator will not proceed with lifting, but will lower the load

and to add ballast to the rear of the machine.

Agricultural workers have been fatally crushed as a result of attempting to move big round bales with a front-end loader not equipped with grapple forks. The grapple forks grasp the big round bale and prevent it from rolling rearward, out of the bucket and down the arms of the loader toward the operator. The safe worker always selects a grapple fork equipped front-end loader to move big round bales and lifts the load high only when it needs to be. Another choice would be a spear type bale mover, mounted on either the front or rear of the tractor.

Speed -- working too fast for existing conditions -- is often a factor in front-end loader injury-incidents. An elevated front-end loader raises the center of gravity of the unit, making it easier to tip due to momentum and/or centrifugal force. Always keep the load and the speed low when using the front-end loader.

The front-end loader is not intended or designed for lifting people for any type of work. There are no safety features to provide support for people while in the bucket. System controls are designed for safe movement of a loader bucket with a person in it.

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Rearward Tractor Rollovers

Tractor rollovers happen when the center of gravity moves past a baseline of stability, either to the side or the rear of the machine. The center of gravity must be kept within the baseline of stability to keep the tractor right side up.

Agricultural tractors will easily tip to the rear when the rear wheels cannot rotate enough to move the machine forward. As the front of a tractor rises and rotates opposite to the rear axle, momentum and engine power work together to keep the tractor body rotating and lifting. The process of a rearward tractor rollover can take as little as three fourths of a second, less than the reaction time of the average worker.

Five situations where this can happen are when:

- the tractor is stuck in mud or snow, preventing the rear wheels from rotating.
- the rear wheels cannot turn because chains, boards, or other materials are used to improve traction and actually prevent the wheels from rotating.
- the tractor is climbing a hill that is too steep. The steeper the hill, the more the risk.
- the clutch is released too quickly with the transmission in a lower gear and the engine running at a high speed.
- a load is hitched above the drawbar of the tractor.

Improper Hitching

Many agricultural workers are injured or killed as a result of improper hitching of a tractor to a load. Loads for pulling should be hitched only to the drawbar or the three-point hitch. There is no place on the rear of a tractor that is safer, or more effective for pulling, than the drawbar.

Loads that are attached by looping a chain around the axle housing, seat base, or upper link of the three-point hitch reduce the pulling capacity of the tractor and increase the possibility of a rearward tractor rollover.

The drawbar mounted on a three-point hitch system can be moved up and down to fit many situations, but the safest situation is when the drawbar is at the height recommended in the operator's manual. Raising this drawbar decreases safety and pulling effectiveness of the tractor. Stay braces should be installed where possible to maintain a safe drawbar height.

Rearward tractor rollovers can be prevented by:

- releasing the clutch only when the rear wheels CAN rotate forward.
- using a reverse gear to break tractor tires from frozen conditions.
- choosing NOT to climb steep hills in a forward direction with a tractor.
- using a reverse gear to back the tractor up a steep hill where it is feasible.
- using only enough engine speed to start the tractor moving and using the clutch smoothly.
- changing tractor speed gradually by applying power smoothly.

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ballasting the tractor properly for the work to be done.
appropriate use of tire chains, boards and other materials to improve traction of wheels that are slipping.
hitching loads properly to the drawbar.

Sideways Tractor Rollovers

Similar to rearward tractor rollovers, sideways roll-overs happen when the center of gravity of the machine passes over one of the baselines of stability. Three situations most common for sideways rollovers are:

- when the tractor is driven on a hillside that is too steep
- when the front-end loader is elevated too high for a given load on a hillside that is too steep or in a turn at excessive speed
- when the tractor is driven too close to the edge of a roadside ditch or other steep slope.

The wider the tractor (from outside edge to outside edge of the rear wheels) the more stable the machine is for any given angle of tilt to the side. Also, as the center of gravity is more centrally located within the baseline of stability, the more stable it is. Proper ballasting of the tractor will help to keep the center of gravity low and safely centered.

The operator is responsible for keeping the tractor's center of gravity within its stability envelope for the tractor, and when is an elevated load is too high for a given speed. The safe operator is always aware of the operating environment and safely alters his/her driving to match those changing conditions.

ROPS -- Roll Over Protective Structures

It is nearly impossible to buy a new tractor without a ROPS already installed, along with seatbelts. Much of the used-tractor market is filled with ROPS-equipped tractors. But many farms and ranches have a ready supply of older tractors without ROPS. Many of them can be equipped with a retrofit ROPS, but the value of the tractor isn't considered enough to warrant the expense. A more important question is, does the life of the operator who drives that tractor warrant the expense of the ROPS.

An important part of the ROPS is the seat belt that keeps the operator within the safety envelope. Wearing the seat belt, even when working fields as flat as a tabletop, will help prevent poor posture in the seat and ease back strain. The seat belt works, but only if it is worn.

Some tractors are used in situations where the full height of a ROPS would be an inconvenience to the work being done. Foldable ROPS are now available on most new tractors. They should be folded only when needed to enter or clear an overhead obstruction. When the ROPS is in the folded position the seatbelt should not be worn since the ROPS is not effective in that position.

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Always secure the ROPS in the upright position as soon as possible after the close clearance work is done.

Falls From Tractors

Many agricultural workers have suffered wrist, arm, hip, leg, and ankle injuries as a result of falling from their tractors. Most of these falls are due to unsafe, improper mounting and dismounting the steps of the tractor. The steps on the tractor should be used the same as the steps of a ladder; either two hands and one foot or one hand and two feet should be in contact with the steps at all times. Climbing the steps with no hands holding on or taking two steps at a time is inviting an injury-incident.

The operator should always face the tractor when going up or down the steps - the handholds will then always be in position to be used; otherwise they are in back of the worker and out of reach. Many pants cuffs or boot loops have caught on the clutch pedal as the operator moves forward off the platform, pitching him/her forward, off the tractor. This can be prevented by facing the tractor when going up or down the steps and using the handholds.

Extra Riders

Extra riders are never safe on a tractor. There is no place for them to stand or sit safely. There

have fallen from compactors as an extra rider, even if the cab windows supposedly locked. Many falls from a tractor result in injury or death; the rear wheel is right there, ready to fatally crush the fallen extra rider.

Tractor Runovers

Tractor runovers often happen due to:

- the driver's inability to see small children and other people in the line of travel.
- extra riders falling from the steps, cab, or drawbar.
- backing the tractor toward machinery to be attached.
- by-pass starting.

These injury-incidents happen and are preventable.

A child or unseen adult in the vicinity of the tractor is at risk of being run over. The operator must be sure the area is clear before moving the tractor. Children should not be permitted to play in the area where tractors and other machinery are operating. Children should be restricted to a safely fenced play area.

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Tractors should be driven responsibly at all times, but especially when near populated areas such as the farm buildings. The operator should always drive the tractor and machinery at a safe speed for the given situation. Also, keep the brake pedals locked together for simultaneous braking of the rear wheels in these areas.

The time saved by operating the tractor at a higher rate of speed in potentially populated areas (the farmstead) is simply too little to justify risking human life. Reduce the speed, and be cautious when people are present.

Caught-Between Crushing

Backing up to attach machinery

Agricultural workers can easily become crushed between a tractor and the machinery being attached. The worker is standing between the tractor and the machine as the operator is backing up the tractor. There is either a breakdown of communication or control of the tractor is lost; the worker on the ground is in the wrong spot, the tractor moves rearward too much, or the tractor operator cannot see the worker, who is then crushed between the machines.

The safe solution to this situation is, the worker should not enter the area between the tractor and the machine until the tractor has been stopped, shifted into neutral, and the brakes applied. The

worker should step out of the area between if adjustments have to be made between the tractor and the machine, particularly if the tractor has adjustable wheels.

Articulated four wheel drive tractors

The area between the front and rear wheels on either side of an articulated four wheel drive tractor is a very dangerous place. Slight movement of the steering wheel will cause the tractor to move or articulate in the middle, bringing the front and rear wheels of one side or the other closer together with more than enough power to crush a human.

If the steering wheel of some tractors is moved, even with the engine not running, the tractor will articulate later when the engine is started. Not all four wheel drive tractors are so closely coupled between front and rear sections that a crush will happen, but it is an area to stay out of as much as possible, especially when the engine is started or running.

PTO Stub Shaft Entanglement

Most tractors, new or old, have a PTO stub shaft protruding from the rear. All newer and most older tractors were equipped with a PTO master shield to cover the stub shaft. Most of these

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shields are difficult to remove, but some have been. This leaves the stub shaft exposed and puts the operator at risk of entanglement with it.

Many tractors are equipped with stub shaft shields that cover the entire stub shaft when not in use. These shields usually screw into place and are often misplaced soon after being removed. Tractors are often found with this shield missing. If this shield is missing, it is to the operator's advantage to replace it and restore another safety feature of the tractor. Refer to NDSU Extension Service Circular AE-1070, Straight Facts About PTO Shafts and Shields, which discusses the dangers of exposed PTO shafts.

Master shields for PTO stub shafts should never be removed from the tractor except for maintenance work, and then should be replaced immediately after. Stub shaft shields should never be taken off except when the PTO stub shaft is to be used and replaced immediately after PTO use.

Tractor Operator Responsibilities

The farm tractor is not a machine that can be operated safely without responsibility on the part of the driver. There are eight primary responsibilities the safe tractor operator must meet whenever the tractor is used. They are:

conducts pre-operation checks
avoids injury-incident situations
maintains safety features
uses tractor as intended
refuels safely
starts and stops safely
adjusts the tractor for safety

The safe worker will recognize dangerous situations and make changes to remove the hazard. He/she will not proceed with work until it is safe to do so, knowing and believing that no job is so important that injury or human life should be at risk.

Maintaining the Safety Features

The safety-oriented owner/operator of a farm tractor maintains all of the safety features on it. Not all tractors have the same or equivalent safety features when new. The safe owner/operator will add safety updates to machinery as they become available.

Safety features to be maintained on agricultural tractors relate to the following:

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- tractor stability
- tractor visibility and recognition
- safety decals
- operator comfort and control
- protection from hazards

Safety features include ROPS (rollover protective structure) with seatbelt, posture-designed lighting for highway and field, SMV (slow moving vehicle) sign, flashing amber hazard lights, turn signals, fenders, engine shrouding, PTO master shield, PTO stub shaft shield, manual override power steering, neutral start interlocking switch, steps with handholds, hazard decals, and breakaway hydraulic couplers.

Tractor operators need to know these features and how they work, as well as how to use them and maintain them. Safety features that have been allowed to deteriorate and become ineffective are a hazard. The operator assumes the protection is there, depends on it and is at greater risk if it is missing.

Owners and operators of tractors need to know that it is their responsibility to maintain safety decals in good condition. Owners are responsible for providing safe equipment for their employees. The decals are there to provide important safety information about the tractor and safety features. The decals can't do their job if they cannot be read; replace them as they wear due to weather and use.

Prevention of Injury-Incidents

Of the many tractor injury-incidents that happen, few are caused by machinery or equipment failure. Most are caused, directly or indirectly, by carelessness and unnecessary hurry. Use safe procedures, pay attention to what is being done and how it is being done, and THINK about what you are doing -- then tractor safety isn't too difficult or time-consuming.

Additional Information

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