

A hydraulic system should contain no air bubbles in the fluid. That is why you hear mechanics talk about "bleeding the air" out of brake lines.

Hydraulic System Maintenance

A hydraulic system operates by the pressure created when oil or another fluid is forced through a line or hose. The hydraulic fluid transmits the pressure applied at one point to another point, multiplying the force in the process (a small *applied* force produces a large *working* force). Hydraulics provide the stopping power of brakes on a car, for example.



Check the fluid level in the hydraulic system regularly. Keep it filled to the proper level with clean hydraulic fluid of the type recommended in the operator's manual.

Fluid leakage is a fire hazard and, if left unrepaired, can cause major damage to a hydraulic system. Check all hydraulic lines and connections for leaks every 50 hours, or daily if your operator's manual recommends doing so. Look for:

- **Pressure-side leaks.** Locate leaks in the pressure side of the system by inspecting the outside of lines and connections. Use cardboard, *not* your hands, to check for hydraulic leaks.
- **Air leaks.** If the system is drawing in air, the fluid in the reservoir will bubble and foam.
- **Pinched or dented lines.** Line restrictions can cause loss of hydraulic power. Replace damaged lines.

Caution: Escaping fluid under pressure can penetrate the skin, causing serious injury. Avoid this hazard by relieving pressure before disconnecting hydraulic lines. Tighten all connections before applying pressure. Always use a piece of cardboard to check for hydraulic leaks—**never** use your hands. If high-pressure fluids enter your skin, seek medical help immediately.



Tighten any fittings that you find to be leaking. Use two wrenches to avoid twisting the lines. Tighten the fittings only until snug and the leak stops. Do not overtighten.



When tightening leaking hydraulic fittings, use two wrenches to avoid twisting the line, and tighten only until snug.

Electrical System Maintenance

Keep electrical connections and terminals tight and clean. Leave connectors alone if you can. When handling those that must regularly be pulled apart and reconnected, always pull them apart by holding the connector, not the wire. Before reconnecting them, check for dirt, debris, and corrosion.

Push connectors together firmly but do not force them. If you must use force, that could indicate problems with corrosion or misaligned pins. Connectors in corrosive environments, such as on fertilizer equipment, are especially at risk of corrosion. Clean them after each season of use.

Make sure spade-type connectors grip firmly. Loose spade connectors can lead to random electrical failures.



Inspect electrical wiring when the equipment is cold. Be sure connections are solid and no wires are abraded.

Regularly inspect wires, cables, and harnesses for wear and abrasion. Run your fingers over spots you can't see. If you see or feel any type of wear, or find wires rubbing against parts of the machinery, move the wires if possible, or protect them with pieces of PVC conduit. Rodents can chew and damage electrical wires. Protect farm equipment from rodents during storage.

Wiring harnesses are systems of insulated wires bound together with terminals ready to be attached.

Keep battery fluid levels full (unnecessary on sealed batteries) and make sure the terminals are clean. If the terminals are corroded, loosen the corrosion with a stiff brush. Sprinkle a baking-soda solution (4 tablespoons of baking soda mixed in a quart of water) over the terminals, then flush it off with water.

Check that battery cables are in good shape, including the ground connection. With more computer-based electronics in tractors and other farm equipment today, a good ground is especially important. Replace worn battery cables.

Checking a 12-volt Battery's Voltage

Step 1—Connect a digital voltmeter's positive lead to the positive battery terminal.

Step 2—Connect the voltmeter's negative lead to the negative battery terminal.

Step 3—System voltage should read 12.0 to 12.6 volts DC or higher with no electrical loads on the system.



To make a solution for cleaning battery terminals, mix a quarter pound of baking soda in a quart of water.

Different gear combinations transmit power at different speeds and with different amounts of turning force. Low gear combines low speed with high power. High gears transmit more speed but less turning power.

Care of the Power Train

Power from the engine is transmitted to the drive wheels or the power-output shaft of a machine by means of the power train. The transmission is one component of the power train. A transmission uses a series of gears to convert the power produced by an engine into the turning force and speed required by the wheels or the output shaft.

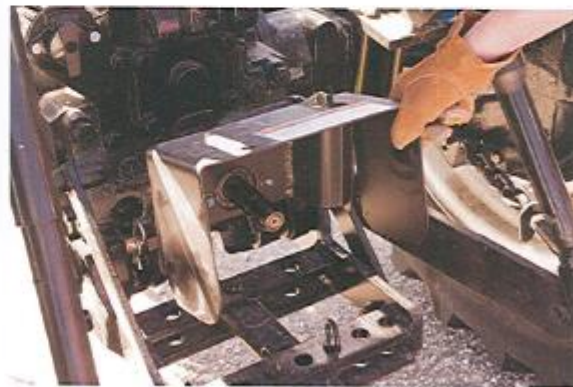
The connecting set of gears and shafts by which power is transmitted from an engine to the machinery it is driving is called the *power train*.

Most farm tractors have manual transmissions. If you know someone who drives a stick-shift car, then you are familiar with the basics of a driver-operated clutch and a movable gearshift lever. You manually shift gears to operate at the appropriate speed and power.



When the clutch pedal is depressed, the engine and transmission are not connected.

The transmission connects to the engine through the clutch. When the clutch pedal is depressed, the engine and the transmission are disconnected. When the clutch is engaged, the gears inside the transmission engage, and power is transmitted from the engine to the driven machine.



Many machines also have power takeoff (PTO) clutches. A PTO shaft allows the engine power of a tractor to drive attached machinery or implements. For safety, keep all PTO shields in place.

Transmission-Hydraulic Fluid

Most tractors use combined transmission-hydraulic fluid to lubricate the power train and operate the hydraulic system. In any tractor, use the type of fluid or fluids recommended in the operator's manual. Check fluid levels daily and maintain their proper levels. Change fluids and filters at the recommended intervals. Avoid contaminating fluids with water or dirt. Always clean dust and dirt from around fill plugs, dipsticks, and drain plugs before removing them.



Transmission fluid level is checked with a dipstick. The operator's manual will specify the correct fill level and what type and weight of transmission fluid to use.



Follow the instructions in the operator's manual for greasing a machine. The manual will tell you how often grease is needed, where to put it, and what kind to use.

Greasing

For part of optional requirement 4a, you are to grease the fittings on an engine-powered machine. For this task, you will use a *grease gun*. Some grease guns are air-powered—compressed air forces the grease from the gun and into the fittings on the machinery. Other common types of grease guns are hand-powered—you manually pump grease into the fittings.

Here are a few pointers on proper greasing.

- Keep grease in clean, dry containers. Dirt or moisture can ruin moving parts.
- Clean fittings before applying grease, and wipe them clean after applying grease.
- Lubricate a machine *after* using it, not just before. Warm parts take grease better than cold metal.
- Do not overgrease. Applying too much lubricant is a common mistake.

Maintenance Schedules

Keep a record of what you do to service and maintain machinery, and when you do it. Routine maintenance tasks will need to be done after every 10 hours of operation. Refer to the manufacturer's recommended service schedule. Also pay attention to the maintenance reminders that pop up on the electronic instrument displays of newer tractors and combines.

Before starting or using any engine-powered machinery or equipment, perform a preoperational check:

- Check the engine coolant.
- Check the engine oil.
- Check the hydraulic and transmission fluid.
- Check the battery voltage.

Other items to check regularly, as needed or recommended, may include these:

- Tires—condition and pressure
- Drive belts—tension
- Nuts and bolts—tightened to proper torques
- Other—
(add as appropriate for specific machinery)



Regularly check the condition of tires. Keep tires properly inflated.

Winter Storage

The operation of some machines does not stop at the end of the growing season. In some areas, however, little or no field work is done for several months, and farm machines are stored for the winter. One recommended winter storage procedure is described here. You should follow the storage instructions in the operator's manual.

- Wash or clean the machine.
- Drain the engine oil and replace the oil filter. Put in new oil that is a lighter viscosity than the oil used when the machine is being heavily used. Let the engine run so all parts get well oiled.
- Drain the transmission and hydraulic systems. Refill with the correct fluid and a corrosion and rust inhibitor, if recommended. Operate the systems to circulate clean fluid.



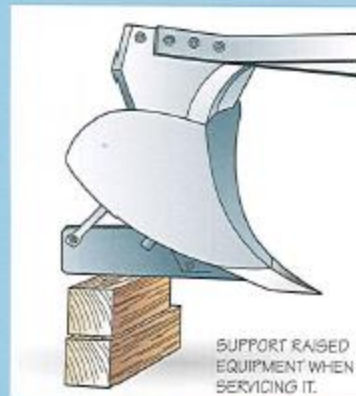
- If you do not use antifreeze, drain and flush the cooling system and leave the drain plugs out.
- Drain the fuel tank (gasoline and diesel only). Do not empty an LP-gas fuel tank without checking with your LP-gas dealer. Remove, clean, and replace the fuel sediment bowl and filters. Add 2 gallons of fuel (mixed with rust inhibitor, if recommended) to the fuel tank. Run the engine for several minutes and then drain the tank again, as well as the fuel lines and carburetor. Leave all drain cocks open.
- If recommended, add rust inhibitor to the engine crankcase and air intake. Using plastic bags and tape, seal the ends of the air inlet pipe, exhaust pipe, crankcase breather pipe, and hydraulic system breather pipe.



- Remove and check the battery. If it is properly charged, store it in a cool, dry place where the temperature will stay above freezing. Check the battery every month during storage, and recharge if necessary.



- Remove any weights from the machine, including from the tires. Drain water from the tires if there is danger of freezing. Remove the tires if the machine is not to be supported off the ground during storage. If you do not want to remove the tires, raise the machine so that the tires are off the ground. Support the machine securely with support stands or blocks.



- Check and inflate tires to normal pressures.
- On machines with a conventional dry clutch, block the clutch pedal in the disengaged position. Release the tension on all drive belts and chains. Apply grease or rust preventative to chains.
- Clean off rust, then prime and paint those areas to prevent further rusting.
- Coat all exposed metal surfaces, such as axles and hydraulic piston rods, with grease or a rust and corrosion preventative. Lubricate all points that normally require lubrication.
- Make a list of parts or repairs that are needed to prepare the machine for operation when it is removed from storage.
- Put the machine under cover. If the equipment is not stored in a building, cover it with a tarpaulin.

If a machine must be serviced in the raised position, use jack stands and block it up.



Safety With Agricultural Machinery

Anyone who operates farm machinery should follow these safety practices.

- Conduct a preoperational inspection. Walk around the machine, looking carefully for any safety hazards or problems such as broken parts, loose nuts, or leaking hoses.
- Allow only one person to a machine—do not carry riders. Never let anyone sit on a tractor's fenders or ride on the drawbar or on towed machinery.
- Wear the seatbelt on farm machinery thus equipped.
- Engage the clutch slowly, especially on a hill and when pulling out of a ditch.
- On rough ground, use low gear. Never drive in high gear when people are around.
- Keep the transmission in gear—do not “coast.”
- Wait for the tractor to stop and set the brakes before getting off. Never jump from a moving tractor.
- Keep all safety shields and guards in place.
- Always shut off machinery before making adjustments or repairs.

Any farm machine or other vehicle that travels at 25 miles per hour or less must display the slow-moving vehicle (SMV) emblem on the rear of the vehicle when it is driven on a highway or public road. Note that the triangle points upward.

For all work in, on, and around machinery, remember that he who works the safe way lives to play another day.



Keep equipment clean. Mud or grease on machinery steps and surfaces can cause serious falls.



Every tractor should carry a fire extinguisher.

Safety With Tillage Tools

Plows cut and loosen the soil. A harrow is drawn over plowed land to level the soil surface and break up clods. Cultivators stir the soil and control weeds in growing crops. These and other kinds of machines for working the soil are known as *tillage tools*.



Chisel plows do not invert soil.



Harrow level the soil.

Row-crop cultivators are designed to pass between rows of crops without damaging the plants.

When hitching up a tractor to a tillage tool, stay in your seat on the tractor. If the equipment does not have an automatic hitch, you might use a long rod with a hook on one end to lift the hitch bar or tongue into position. Then lean over and drop the hitch pin into place. If you must get off the tractor to hitch up machinery, be sure to come to a complete stop and set the tractor brakes before you step down.



The drawbar is a heavy steel bar that extends rearward from under the tractor. Tillage machines and other farm implements attach to the drawbar or to a three-point hitch. Never allow anyone to ride on the drawbar or on towed machinery.

Safety With Planting Equipment

Row-crop planters place seeds in the soil at the proper depth and spacing. A grain drill plants small grains such as wheat and oats close together. Air seeders that allow tilling, seeding, and fertilizing in one pass are popular where grain is produced on large, flat areas of land, such as the Great Plains. Transplanters and other specialized planters are used for fruits and vegetables such as strawberries and tomatoes, and even for planting trees.



A grain drill plants small grains.



A row-crop planter drops seeds at regular intervals within the row. On newer machinery, electronic monitors count the seeds as they drop and control the seeding rate so that neither too much seed nor too little gets planted.



An air seeder combines tilling, seeding, and fertilizing in one field pass.

Use the right-size planter for the project and for the tractor you are using. If the weight of the planter is too much for the tractor, it could overturn. Operate at a safe speed; allow plenty of room for turning.

Make sure the planter has no broken, damaged, loose, or missing parts. Lifting and lowering devices, especially, should be in good working order. Be sure gears and chains are properly and securely shielded.

Safety With Harvesters

Mowers, windrowers, rakes, balers, combines, cotton strippers, potato diggers—these and other kinds of harvesters bring in the crops. A windrower cuts hay and places it in a row to dry. Balers pick up hay and roll or tie it into round or rectangular bales. Small grains and seed crops like wheat, oats, barley, rice, corn, soybeans, sunflowers, peanuts are harvested with combines.



Windrower



Large round hay baler



Small rectangular baler

Harvesting equipment is complicated. The various machines have cutters, knives, teeth, blades, beaters, and other mechanisms that can inflict severe injuries. When you prepare a harvester for the harvest season, make sure the safety releases work properly and the shields or guards for cutters, gears, belts, and revolving shafts are securely in place. Keep all equipment properly adjusted. Always stop the tractor engine before working on a mower, baler, or other harvesting equipment. Follow all safety precautions and procedures listed in the operator's manual.

Many harvesters have special attachments. Use the right attachments for the task.

Never make adjustments or repairs when machinery is running.



Combines

A combine carries out ("combines") five steps in harvesting a crop. It cuts, threshes, and cleans seed or grain, lifts the seed or grain to a storage tank or bin, and returns the straw and stalks to the ground, all in one operation.



Corn combine



A combine with a full grain bin is top-heavy and can easily overturn if not driven with care.

Most self-propelled combines are powered by diesel engines similar to tractor engines. Before starting a combine engine, be certain no one is on or around the combine's moving parts. Keep a combine clean. Trash accumulating around the exhaust system can catch fire. Every combine should carry a fire extinguisher. Before storing a combine, clean it of all dust and chaff, inside and out.

Inspect a combine before taking it into the field. Before you make any adjustments, be sure you know and understand what takes place in the machine. Follow the instructions in the operator's manual.

Cotton Pickers and Strippers

Two basic types of self-propelled machines are used to harvest cotton. *Cotton pickers* remove the cotton lint and seed from only the bolls that have matured. Revolving spindles catch the lint and pull it from the open bolls. Green bolls are left on the stalks to be harvested after they have matured.

Cotton strippers remove all the cotton bolls from the stalks, the green ones as well as the mature bolls. A stream of air is usually used to separate the lighter mature bolls from the heavy green bolls.



Green cotton boll

Mature cotton boll and cotton lint

Cleaning a cotton picker or stripper—cleaning it well and often—is more critically important than with most other machines. Leaf trash, dead plant parts, and cotton lint are highly flammable. When such materials build up, fires can easily start.

Help prevent fires during cotton harvesting by keeping the engine clean and free of lint, dust, and dead leaves. Regularly clean the area between hot-running engine parts and the hood. Also check exhaust pipes and the muffler for leaks. Hot exhaust gases or sparks can start fires. **Let all parts cool before you touch or clean them.**

Cotton pickers and strippers are uniquely complex machines with more safety hazards than most other equipment. You should leave most of the maintenance and service work on these machines to a knowledgeable adult.



Cotton stripper



Careers in Agricultural Mechanics

Hundreds of different professions fall under the general heading of "agricultural mechanics." In this field, you might work on engines small or large, on farm implements, tractors, combines, chainsaws, lawnmowers, diesel trucks—the list is long. You might work in a rural community or in a city. Agricultural machinery is used in urban areas to install and maintain turfgrass and other plants at ball fields, golf courses, and parks. If you enjoy fixing things, if you like working with tools and machinery, then you will want to look into the great variety of career opportunities involving agricultural mechanics.



Tractor or Farm Equipment Mechanic

From your work for the Farm Mechanics merit badge, you have a good idea of what a mechanic does to maintain and repair farm machinery and vehicles such as tractors and harvesters. Good mechanics are logical thinkers and troubleshooters who are able to figure out what is wrong with a piece of machinery and how to fix it. They are good with details and careful in their work.

Not surprisingly, a mechanic needs manual dexterity. Handling tools skillfully and making adjustments precisely are essential abilities.

Also vital—and less obvious—are good communication skills. When someone brings a malfunctioning machine into the shop for repair, the mechanic starts to diagnose the trouble by listening to the customer describe the problem, asking questions, and paying attention to the answers. Good listening skills and people skills are important.

Education and Training Required

In school, take agriculture and shop classes that offer hands-on experience in mechanics, welding, automotive repair, small-engine repair, basic electronics, and (if offered) such specialties as turfgrass management or greenhouse and grounds maintenance. Join the National FFA Organization, an agricultural education organization designed for students. Agriculture is increasingly computerized. As a tractor or farm equipment mechanic, you will work on computer-controlled machinery and use computerized diagnostic tools.

The different career paths you might follow can include

- Specialized training by machinery manufacturers
- Two-year technical (associate's) degrees from community colleges
- Four-year technical (bachelor's) degrees from universities and colleges

Most farm equipment mechanics work for tractor and equipment dealers, adjusting and repairing machines at the dealership or in the field. Employers generally prefer to hire people who have completed formal training programs after graduating from high school. Many of the large tractor and equipment manufacturers have training programs to prepare individuals to work at their authorized dealerships. These training programs may be hosted at the dealerships or at community colleges or other technical institutes. Graduates of these programs are ready to work for specific manufacturer dealerships.

Community college programs give students the chance to take additional coursework to earn an associate's (two-year) degree in a technical field. The extra courses prepare students to go beyond repair and maintenance positions. With the additional training, graduates may move into supervisory and business roles.

A mechanic who uses high-tech tools and techniques is generally known as a technician.



Community college programs give students the chance to take additional coursework to earn an associate's (two-year) degree in a technical field. The extra courses prepare students to go beyond repair and maintenance positions. With the additional training, graduates may move into supervisory and business roles.

Some colleges offer two-year certificate programs for turfgrass and agricultural equipment service technicians. Technicians who are formally trained in the maintenance and repair of agricultural machinery are in demand.



Diesel Mechanics and Service Technicians

Diesel engines power not only farm tractors, combines, work trucks, and pickups, but also big-rig trucks, buses, and passenger cars. Bulldozers, cranes, road graders, and railroad locomotives also are diesel-powered. Career opportunities are good for qualified diesel mechanics and service technicians.

Technicians may specialize in engine repair, transmission work, electrical systems, or brake systems. In smaller shops, however, a technician commonly handles all kinds of repairs, from working on a vehicle's electrical system one day to doing major engine repairs the next.

A diesel engine can have various electronic controls and onboard computers. In shops today, diesel service technicians use handheld or laptop computers to diagnose engine problems and adjust settings. To keep up with constant changes in technology, technicians must take training and learn new techniques.

Many community colleges and vocational/technical schools offer programs in diesel mechanics. Programs lasting one to two years lead to a certificate of completion or to an associate's degree. Many employers prefer to hire graduates of these kinds of formal training programs because they have a good foundation in the latest diesel technology and electronics.

Experienced technicians may move into field service positions, where they have more chances to tackle problems independently and earn better pay. Technicians and mechanics with leadership skills may become shop supervisors or service managers. Those who are good at sales sometimes become sales representatives. Some experienced mechanics open their own repair shops.

ASE Certification

The nonprofit National Institute for Automotive Service Excellence has a voluntary certification program for mechanics and technicians. The ASE administers more than 40 exams. The tests are grouped into specialties for automobile, medium/heavy truck, school bus, and other technicians as well as engine machinists, parts specialists, and electronic diesel engine diagnosis specialists.

To become ASE-certified, a candidate must pass at least one exam and provide proof of two years of relevant work experience. To remain certified, those with ASE credentials must be retested every five years. The tests are not easy. About one out of three test-takers fails.

ASE-certified technicians usually wear ASE insignia and carry credentials that list their exact areas of expertise (brakes, engine repair, etc.). To learn more, visit the ASE Web site with your parent's permission (see the resources section of this pamphlet).

College/University Programs

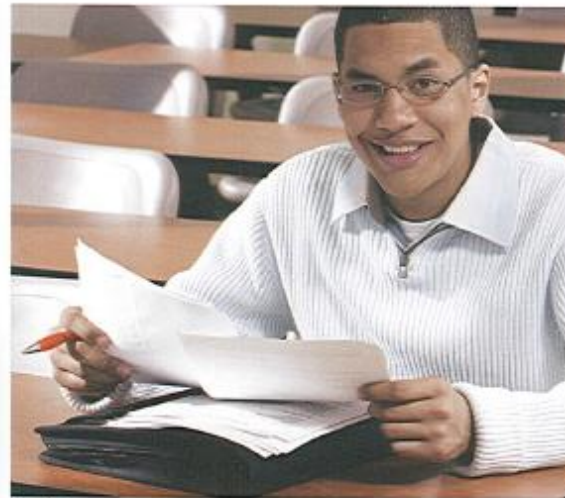
Earning a bachelor of science degree from a university or college prepares graduates for management positions at machinery dealerships or related businesses. There is less emphasis on you "turning wrenches" and more on directing the people, money, and machinery at a business or facility. Courses of study in this area include agricultural systems management, agricultural engineering technology, and agricultural business.



If you are interested in the design and manufacturing of farm tractors and equipment, consider earning a degree in agricultural engineering or a similarly named program. To teach agriculture at the high school or college level, you will need a degree in agricultural education.

Preparing for College

Get involved in the agriculture program if your school offers one. Take English, math, biology, chemistry, physics, computer classes, and business classes. At college you will study these subjects as well as economics, communications, and mechanics. Depending on your specialty area and interests, you may study hydraulic systems, diesel power systems, power transmission, machine instrumentation and controls, electronics and electrical systems, soil and water conservation, natural resources, engineering design, or machinery safety.



Agricultural systems management is a field of study that combines agricultural sciences, engineering principles, and business management. ASM students learn about soils, crops, and natural resources. They also learn about engines, electronics, and hydraulics. On the business side, they study economics, finance, and accounting.

Computer skills are essential. Agricultural mechanics students learn to use computers to control machines, plan layouts of equipment and buildings, and create graphics for written reports, to name only a few applications.

Career Prospects

College graduates with expertise in agricultural mechanics work for many different kinds of manufacturers that make farm, forestry, construction, lawn-care, and landscaping equipment. They may sell tractors or show customers how the equipment works, or teach dealers how to install and service equipment. Some graduates manage farms and agriculture-related businesses. Some work in the food industry; others work for government agencies or research centers.

Ag engineers and ag systems graduates are in demand. Farm equipment manufacturers need more engineers than are graduating from universities. Their broad-based, practical education qualifies them for a wide variety of careers in management, marketing, sales, and service.

Whichever path you choose—technical training or college degree—a rewarding career awaits as you pursue opportunities in agricultural mechanics.



In many ways, plant nurseries and greenhouses are like small, enclosed farms. Some agricultural engineers specialize in designing practical and efficient greenhouses. At NASA, engineers with this special expertise are designing greenhouses that could someday be built on Mars to help feed the first Martian colonists. Here on Earth, engineers design planting and transplantation equipment for use in greenhouse and nursery operations.

Possible Careers in Agricultural Mechanics**Technical Training**

- Diesel mechanic or service technician
- Heavy construction equipment technician
- Lawn equipment service mechanic
- Parts specialist
- Service manager
- Shop supervisor
- Small-engine mechanic
- Tractor or farm equipment mechanic
- Turfgrass and agricultural equipment service technician
- Welder

College Degree

- Agribusiness management
- Agricultural engineering
- Agricultural machinery and safety
- Agricultural systems management
- Farm management
- Food processing plant operations
- Forest engineering
- Golf course management
- Machine systems engineering
- Manufacturing
- Marketing
- Natural resources conservation and protection
- Nursery and greenhouse engineering
- Power systems and machinery design
- Product sales
- Technical support and service
- Vocational agriculture instruction



Survey work can be one facet of a career in natural resources conservation.



Farm Mechanics Resources

Scouting Literature

Automotive Maintenance, Composite Materials, Electricity, Electronics, Energy, Engineering, Environmental Science, Fire Safety, First Aid, Forestry, Plant Science, Soil and Water Conservation, and Woodwork merit badge pamphlets

Visit the Boy Scouts of America's official retail Web site (with your parent's permission) at <http://www.scoutstuff.org> for a complete listing of all merit badge pamphlets and other helpful Scouting materials and supplies.

Books

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Maintenance*. Elsevier Science &
Technology Books, 1997.

Multimedia

Centers for Disease Control and
Prevention. National Ag Safety
Database: Videos. Web site: <http://www.cdc.gov/nasd/menu/video/video.html>

Organizations and Web Sites

American Society of Agricultural and Biological Engineers

2950 Niles Road
St. Joseph, MI 49085
Telephone: 269-429-0300
Web site: <http://www.asabe.org>

Associated Equipment Distributors

615 W. 22nd St.
Oak Brook, IL 60523
Telephone: 630-574-0650
Web site: <http://www.aedcareers.com>

Association of Diesel Specialists

10 Laboratory Drive
P.O. Box 13966
Research Triangle Park, NC 27709
Telephone: 919-406-8804
Web site: <http://www.diesel.org>

Case IH

700 State St.
Racine, WI 53404
Telephone: 262-636-6011
Web site: <http://www.caseih.com>

Deere & Company World Headquarters

One John Deere Place
Moline, IL 61265
Telephone: 309-765-8000
Web site: <http://www.deere.com>

Discover Biological and Agricultural Engineering

Web site: <http://www.asabe.org/pr/DiscoverBAE.ppt>

Junior Engineering Technical Society

1420 King St., Suite 405
Alexandria, VA 22314
Telephone: 703-548-5387
Web site: <http://www.jets.org>

National Farm Machinery Show

P.O. Box 37130
Louisville, KY 40233-7130
Telephone: 502-367-5180
Web site:
<http://www.farmmachineryshow.org>

National FFA Organization

6060 FFA Drive
P.O. Box 68960
Indianapolis, IN 46268-0960
Telephone: 317-802-6060
Web site: <http://www.ffa.org>

National Institute for Automotive Service Excellence

101 Blue Seal Drive SE, Suite 101
Leesburg, VA 20175
Telephone: 703-669-6600
Toll-free information line: 888-ASE-TEST
Web site: <http://www.asecert.org>

National Safety Council

Agricultural Safety
1121 Spring Lake Drive
Itasca, IL 60143-3201
Telephone: 630-285-1121
Web site:
<http://www.nsc.org/issues/agrisafe.htm>
Fact sheets:
<http://www.nsc.org/farmsafe/facts.htm>

Planning Farm Shops for Work and Energy Efficiency

Purdue University Cooperative
Extension Service
Web site: <http://www.ces.purdue.edu/extmedia/AE/AE-104.html>

Proper Use and Care of Hand Tools

Web site: <http://www.kleintools.com/usecarehandbook>

Reader's Digest Tool School

Web site:
<http://www.rd.com/content/tool-school>

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