CHAPTER 2

ENVIRONMENTAL AND HAZARDOUS MATERIALS

OBJECTIVES

After studying Chapter 2, the reader should be able to:

1. Define the Occupational Safety and Health Act (OSHA).
2. Explain the term *Material Safety Data Sheet (MSDS).*
3. Identify hazardous waste materials in accordance with state and federal regulations.
4. Describe the steps required to safely handle and store automotive chemicals and waste.
5. Follow proper safety precautions while handling hazardous waste materials.
6. Discuss the ASE requirements for all service technicians in order to adhere to environmentally appropriate actions and behavior.

KEY TERMS

Asbestosis (p. 30)
Blood-borne pathogens (p. 36)
Department of Transportation (DOT) (p. 33)
Environmental Protection Agency (EPA) (p. 28)
Hazardous waste materials (p. 28)
High-Efficiency Particulate Air Filter (HEPA) (p. 30)
Lung cancer (p. 30)
Material Safety Data Sheet (MSDS) (p. 29)
Mesothelioma (p. 30)
Occupational Safety and Health Act (OSHA) (p. 28)
Right-to-know laws (p. 29)
Solvent (p. 32)
Used brake fluid (p. 31)
Used coolant (p. 34)
Used oil (p. 31)
Workplace Hazardous Materials Information Systems (WHIMS) (p. 29)

INTRODUCTION

The safe handling of hazardous waste materials is extremely important in the automotive shop. The improper handling of hazardous material affects us all, not just those in the shop. Shop personnel must be informed of their rights and responsibilities regarding hazardous waste disposal as legislated by right-to-know laws. Shop personnel must also be familiar with hazardous materials in the automotive shop and the proper disposal methods for these materials according to state and federal regulations.

OCCUPATIONAL SAFETY AND HEALTH ACT (OSHA)

The United States Congress passed the **Occupational Safety and Health Act (OSHA)** in 1970. The purpose of this legislation is to assist and encourage the citizens of the United States in their efforts to assure safe and healthful working conditions. OSHA provides research, information, education, and training in the field of occupational safety and health, and assures safe and healthful working conditions for working men and women by authorizing enforcement of the standards developed under the act. Since approximately 25% of workers are exposed to health and safety hazards on the job, the OSHA standards are necessary to monitor, control, and educate workers regarding health and safety in the workplace.

Health Care Rights

The OSHA regulations concerning on-the-job safety place certain responsibilities on the employer and give employees specific rights. Any person who feels there might be unsafe conditions in the workplace, whether asbestos exposure, chemical poisoning, or any other problem, should discuss the issue with fellow workers, the union representative (where applicable), and the supervisor or employer. If no action is taken and there is reason to believe the employer is not complying with OSHA standards, a complaint can be filed with OSHA, which will be investigated. The law forbids employers from taking action against employees who file a complaint concerning a health or safety hazard. However, if workers fear reprisal as the result of a complaint, they may request that OSHA withhold their names from the employer.

Hazardous Waste

Hazardous waste materials are chemicals, or components, that the shop no longer needs and pose a danger to the environment and people if they are disposed of in ordinary garbage cans or sewers. However, one should note that no material is considered hazardous waste until the shop has finished using it and is ready to dispose of it. The **Environmental Protection Agency (EPA)** publishes a list of hazardous materials that is included in the Code of Federal Regulations. The EPA considers waste hazardous if it is included on the EPA list of hazardous materials or if it can be described in one or more of the following ways:

Reactive. Any material that reacts violently with water or any other chemical is considered hazardous.

Corrosive. If a material burns the skin or dissolves metals and other materials, a technician should consider it hazardous. A pH scale is used, with the number 7 indicating neutral. Pure water has a pH of 7. Lower numbers indicate an acidic solution and higher numbers indicate a caustic solution. If, when exposed to low pH acid solutions, a material releases cyanide gas, hydrogen sulfide gas, or similar gases, it is considered hazardous.

Toxic. Materials are hazardous if they leak one or more of eight different heavy metals in concentrations greater than 100 times the primary drinking water standard.

Ignitable. A liquid is hazardous if it has a flash point below 140°F (60°C), and a solid is hazardous if it ignites spontaneously.

Radioactive. Any substance that emits measurable levels of radiation is hazardous. When individuals bring containers of highly radioactive substances into the shop environment, qualified personnel with the appropriate equipment must test them.

CAUTION: When handling hazardous waste material, one must always wear proper protective clothing and use equipment detailed in the right-to-know laws, including respirator equipment when needed. All recommended procedures must be followed accurately. Personal injury may result from improper clothing, equipment, and procedures when handling hazardous materials.

WARNING: Hazardous waste disposal laws include serious penalties for anyone responsible for breaking these laws.

RESOURCE CONSERVATION AND RECOVERY ACT (RCRA)

Federal and state laws control the disposal of hazardous waste materials. Every shop employee must be familiar with these laws. Hazardous waste disposal laws include the Resource Conservation and Recovery Act (RCRA), which states that hazardous material users are responsible for hazardous materials from the time they become a waste until the proper waste

disposal is completed. Many shops hire an independent hazardous waste hauler to dispose of hazardous waste material. The shop owner, or manager, should have a written contract with the waste hauler. In this case, the user must store hazardous waste material properly and safely and be responsible for its transportation until it arrives at an approved hazardous waste disposal site and is processed according to the law. A shop may also choose to recycle the hazardous waste material in the shop rather than have it hauled to an approved hazardous waste disposal site. The RCRA controls these types of automotive waste:

- paint and body repair products waste,
- solvents for parts and equipment cleaning,
- batteries and battery acid,
- mild acids used for metal cleaning and preparation,
- waste oil and engine coolants or antifreeze,
- air conditioning refrigerants and oils, and
- engine oil filters.

The **right-to-know laws** state that employees have a right to know when the materials they use at work are hazardous. The right-to-know laws started with the *Hazard Communication Standard* published by the Occupational Safety and Health Administration (OSHA) in 1983. Originally, this document was intended for chemical companies and manufacturers that required employees to handle hazardous materials in their work situation. Meanwhile, the federal courts have decided to apply these laws to all companies, including automotive service shops. Under the right-to-know laws, the employer has responsibilities regarding the handling of hazardous materials by employees. All employees must be trained about the types of hazardous materials they will encounter in the workplace, and the employees must be informed about their rights under legislation regarding the handling of hazardous materials.

CLEAN AIR ACT

Air-conditioning (A/C) systems and refrigerant are regulated by the Clean Air Act, Title VI, Section 609. Technician certification and service equipment is also regulated. Any technician working on automotive A/C systems must be certified. A/C refrigerants must not be released or vented into the atmosphere, and used refrigerants must be recovered.

MATERIAL SAFETY DATA SHEETS (MSDSs)

All hazardous materials must be properly labeled, and information about each hazardous material must be posted on **material safety data sheets (MSDSs)**, available from the manufacturer (Figure 2-1). In Canada, MSDSs are called **workplace hazardous materials information systems (WHIMS)**.

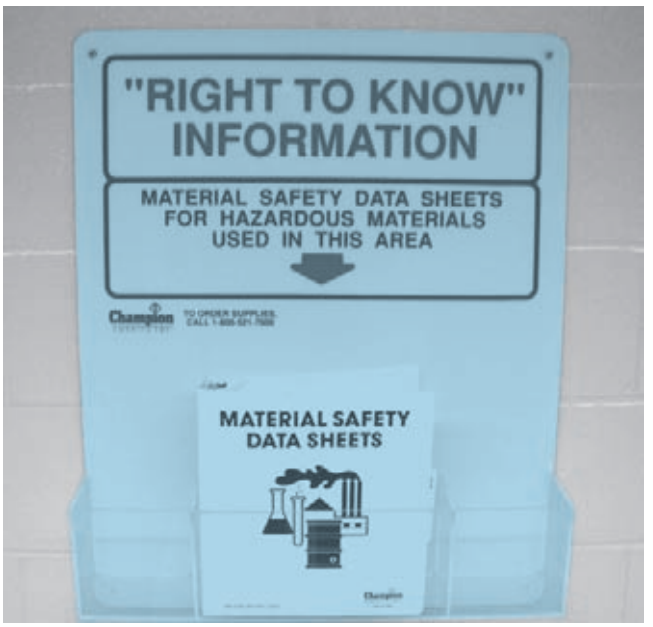

FIGURE 2-1 Material safety data sheets (MSDSs) should be readily available for use by anyone in the area who may come into contact with hazardous materials. *(Courtesy of James Halderman)*

The employer has a responsibility to place MSDSs where they are easily accessible by all employees. The MSDSs provide the following information about the hazardous material: chemical name, physical characteristics, protective handling equipment, explosion/fire hazards, incompatible materials, health hazards, medical conditions aggravated by exposure, emergency and first-aid procedures, safe handling, and spill/leak procedures.

The employer also has a responsibility to make sure that all hazardous materials are properly labeled. The label information must include health, fire, and reactivity hazards posed by the material and the protective equipment necessary to handle the material. The manufacturer must supply all warning and precautionary information about hazardous materials, and this information must be read and understood by the employee before handling the material.

ASBESTOS EXPOSURE HAZARD

Friction materials such as brake and clutch linings may contain asbestos. Although asbestos has been eliminated from most original equipment friction materials, the automotive service technician cannot know whether the vehicle being

serviced is or is not equipped with friction materials containing asbestos. It is important that all friction materials be handled as if they contain asbestos.

Asbestos exposure can cause scar tissue to form in the lungs. This condition, called **asbestosis**, causes gradually increasing shortness of breath and permanent scarring of the lungs. Even low exposures to asbestos can cause **mesothelioma**, a type of fatal cancer of the lining of the chest or abdominal cavity. Asbestos exposure can also increase the risk of **lung cancer** as well as cancer of the voice box, stomach, and large intestine. It usually takes 15 to 30 years or more for cancer or asbestos lung scarring to show up after exposure. (Scientists call this the *latency period.*)

Government agencies recommend that asbestos exposure should be eliminated or controlled to the lowest level possible and have developed recommendations and standards that the automotive service technician and equipment manufacturers should follow. These agencies include the National Institute for Occupational Safety and Health (NIOSH), the Occupational Safety and Health Administration (OSHA), and the Environmental Protection Agency (EPA).

OSHA Asbestos Standards

The Occupational Safety and Health Administration (OSHA) has established three levels of asbestos exposure. Any vehicle service establishment that does either brake or clutch work must limit employee exposure to asbestos to less than 0.2 fibers per cubic centimeter (cc) as determined by an air sample. If the level of employee exposure is greater than specified, corrective measures must be taken and a large fine may be imposed.

NOTE: Research has found that worn asbestos fibers, such as from automotive brakes or clutches, may not be as hazardous as first believed. Worn asbestos fibers do not have sharp flared ends that can latch onto tissue, but rather are worn down to a dust form that resembles talc. Grinding or sawing operations on unworn brake shoes or clutch discs *will* contain *harmful* asbestos fibers. To limit health damage, always use proper handling procedures while working around any component that may contain asbestos.

EPA Asbestos Regulations

The federal Environmental Protection Agency (EPA) has established procedures for the removal and disposal of asbestos. The EPA procedures require that products containing asbestos be "wetted" to prevent the asbestos fibers from becoming airborne. According to the EPA, asbestos-containing materials can be disposed of as regular waste—asbestos is only considered hazardous when it is airborne.

Asbestos Handling Guidelines

The air in the shop area can be tested by a testing laboratory, but this can be expensive. Tests have determined that asbestos levels can easily be kept below the recommended levels by using a solvent or a special vacuum.

NOTE: Even though manufacturers are removing asbestos from brake and clutch lining materials, the service technician cannot tell whether the old brake pads or shoes or clutch discs contain asbestos. Therefore, to be safe, the technician should assume that all brake pads or shoes or clutch discs contain asbestos.

HEPA Vacuum. A special **high-efficiency particulate air filter** (**HEPA**) vacuum system has been proven to be effective in keeping asbestos exposure levels below 0.1 fibers per cubic centimeter.

Liquid/Solvent Brake Cleaners. Many technicians use an aerosol can of brake cleaning solvent to wet the brake dust and prevent it from becoming airborne. Some of the brake cleaning solvents may be hazardous; be sure to read the product label. Commercial brake cleaners are available that use a concentrated cleaner that is mixed with water (Figure 2-2). The waste liquid is filtered, and when dry, the filter can be disposed of as solid waste.

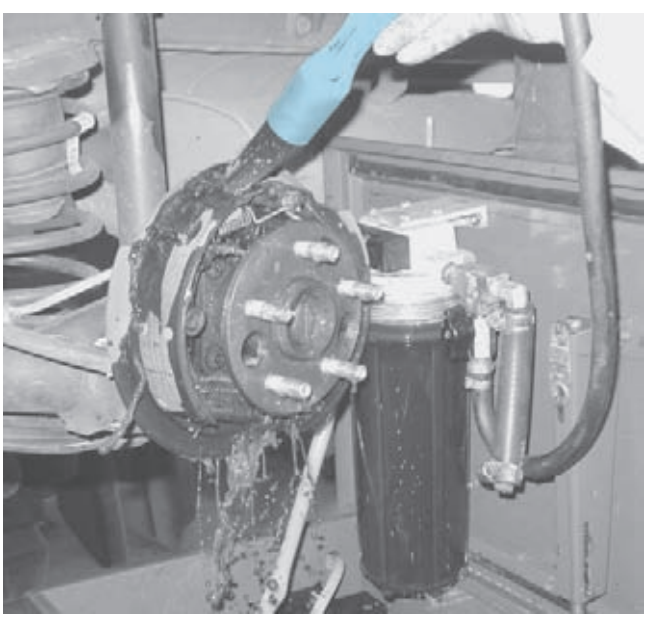

FIGURE 2-2 All brakes should be washed with liquid to help keep brake dust from becoming airborne. *(Courtesy of James Halderman)*

CAUTION: Never use compressed air to blow brake dust. The fine talclike brake dust can create a health hazard even if asbestos is not present or is present in dust rather than fiber form.

Disposal of Brake Dust and Brake Shoes. As mentioned, the hazard of asbestos occurs when asbestos fibers are airborne. Once the asbestos has been wetted down, it is then considered to be solid waste, not hazardous waste. Old brake shoes and pads should be enclosed, preferably in a plastic bag, to help prevent any of the brake material from becoming airborne.

PROPER DISPOSAL

Always follow current federal and local laws considering disposal of all waste.

Used Brake Fluid

Most brake fluid is made from polyglycol; it is water soluble and can be considered hazardous if it has absorbed metals from the brake system.

- Collect **used brake fluid** in containers clearly marked to indicate that they are dedicated for that purpose.
- If your used brake fluid is hazardous, manage it appropriately and use only an authorized waste receiver for its disposal.
- If your used brake fluid is nonhazardous, your local solid waste collection provider will tell you how to dispose of it properly.
- Do not mix used brake fluid with used engine oil.
- Do not pour used brake fluid down drains or onto the ground.
- Recycle used brake fluid through a registered recycler.

Used Oil

Used oil is identified as any petroleum-based or synthetic oil that has been used. During normal use, impurities such as dirt, metal scrapings, water, or chemicals can get mixed in with the oil. Eventually, this used oil must be replaced with virgin or re-refined oil. The EPA's used oil management standards include a three-pronged approach to determine if a substance meets the definition of used oil. To meet this definition, a substance must satisfy each of the following three criteria:

1. **Origin.** The first criterion for identifying used oil is based on the origin of the oil. Used oil must have been refined from crude oil or made from synthetic materials. Animal and vegetable oils are excluded from the EPA's definition of used oil.
2. **Use.** The second criterion is based on whether and how the oil is used. Oils used as lubricants, hydraulic fluids, heat transfer fluids, and for other similar purposes are considered used oil. Unused oil, such as bottom clean-out waste from virgin fuel oil storage tanks or virgin fuel oil recovered from a spill, do not meet the EPA's definition of used oil because these oils have never been "used." The EPA's definition also excludes products used as cleaning agents or solely for their solvent properties, as well as certain petroleum-derived products like antifreeze and kerosene.
3. **Contaminants.** The third criterion is based on whether the oil is contaminated with either physical or chemical impurities. Oil that is physically or chemically contaminated is considered used oil by the EPA's definition and includes residues and contaminants generated from handling, storing, and processing used oil.

NOTE: The release of only 1 gallon of used oil (a typical oil change) can make a million gallons of fresh water undrinkable.

If used oil is dumped down the drain and enters a sewage treatment plant, concentrations as small as 50 to 100 ppm (parts per million) in the wastewater can foul the sewage treatment processes. Never mix a listed hazardous waste, gasoline, wastewater, hologenated solvents, antifreeze, or an unknown waste material with used oil. Adding any of these substances will cause the used oil to become contaminated, which classifies it as hazardous waste.

Disposal of Used Oil. Once oil has been used, it can be collected, recycled, and used over and over again. An estimated 380 million gallons of used oil are recycled each year. Recycled used oil can sometimes be used again for the same job or for a completely different task. For example, used motor oil can be re-refined and sold as motor oil or processed for heating fuel. After collecting used oil in an appropriate container (for example, a 55-gallon steel drum), the material must be disposed of in one of two ways:

- Shipped off-site for recycling
- Burned in an on-site or off-site EPA-approved heater for energy recovery

Used Oil Storage. Used oil must be stored in compliance with existing *underground storage tank (UST)* or an *aboveground storage tank (AGST)* standards or kept in separate containers. Containers are portable receptacles, such as a 55-gallon steel drum.

Keep used-oil storage drums in good condition. This means that they should be covered, secured from vandals, properly labeled, and maintained in compliance with local fire codes. Frequent inspections for leaks, corrosion, spillage, and so on are an essential part of container maintenance.

Never store used oil in anything other than the proper tanks and storage containers. Used oil may also be stored in containers that are permitted to store regulated hazardous waste.

Follow used oil filters disposal regulations. Used oil filters contain used engine oil that may be hazardous. Before an oil filter is placed in the trash or sent for recycling, it must be drained using one of the following hot-draining methods approved by the EPA:

- Puncture the filter antidrain back valve or filter dome end and hot-drain for at least 12 hours.
- Hot-drain and crush.
- Dismantle and hot-drain.
- Use any other hot-draining method that will remove all the used oil from the filter.

After the oil has been drained from the oil filter, the filter housing can be disposed of in any of the following ways:

- Recycling
- Pickup by a service contract company
- Disposed of in regular trash

Solvents

The major sources of chemical danger are liquid and aerosol brake cleaning fluids that contain chlorinated hydrocarbon **solvents**. The most common of these solvents are 1,1,1-trichloroethane, trichloroethylene, and tetrachloroethylene, which is also known as perchloroethylene, or "perk" for short. These solvents are all members of the same chemical family and share the same basic characteristics. They are colorless liquids with an odor of chloroform or ether. In large enough quantities these solvents can dull the senses, induce sleep, or cause a stupor. Very high levels of exposure over even a short period of time can be fatal. Repeated exposure to these solvents, in high concentrations and over long periods of time, can result in liver, kidney, and lung damage and may potentially cause cancer. Additionally, if these solvents are exposed to high heat or an open flame, they decompose into deadly gases such as hydrogen chloride, phosgene, and carbon monoxide.

Because 1,1,1-trichloroethane and trichloroethylene are known to be ozone depleters, the EPA prohibited their manufacture after January 1, 1996. "Perks" do not deplete the ozone and their use continues. Several other chemicals that do not deplete the ozone, such as heptane, hexane, and xylene, are now being used in nonchlorinated brake cleaning solvents. Some manufacturers are also producing solvents they describe as environmentally responsible that are biodegradable and noncarcinogenic.

Another solvent that can affect health is *n*-Hexane, a major component in several brands of automotive and industrial cleaners.

Some local areas like the South Coast Air Quality Management District in Southern California have regulations and standards for air quality and various chemicals that can affect air quality, including chemicals like solvents that evaporate.

Sources of Chemical Poisoning. The health hazards presented by automotive cleaning solvents occur from three different forms of exposure: ingestion, inhalation, or physical contact. It should be obvious that swallowing automotive cleaning solvent is harmful, and such occurrences are not common. Automotive cleaning solvents should always be handled and stored properly and kept out of reach of children. The dangers of inhalation are perhaps the most serious problem—even very low levels of solvent vapors are hazardous. For example, the current OSHA standard (1910.1000) for airborne trichloroethylene is 100 ppm (parts per million) in the ambient air averaged over an 8-hour period. The ceiling level for exposure is 200 ppm, and there is a maximum acceptable peak level of 300 ppm for 5 minutes in any 2-hour period. The limits for other chlorinated hydrocarbon solvents, and for other chemicals replacing the chlorinated ones, are similar. These alternative chemicals are being used because they do not deplete the ozone layer, not because they are necessarily any safer to breathe, ingest, or touch.

Ingestion and inhalation are common forms of poisoning from many hazardous substances, but allowing automotive cleaning solvents to come in contact with the skin presents a danger unknown to many people. Not only do these solvents strip natural oils from the skin and cause irritation of the tissues, they also have the ability to be absorbed through the skin directly into the bloodstream. The transfer begins immediately upon contact and continues until the liquid is wiped or washed away.

There is no specific standard for physical contact with chlorinated hydrocarbon solvents or the chemicals replacing them. All contact should be avoided whenever possible. The law requires an employer to provide appropriate protective equipment and ensure proper work practices by an employee handling these chemicals.

Effects of Chemical Poisoning. The effects of exposure to chlorinated hydrocarbon and other types of solvents can take many forms. Short-term exposure at low levels can cause headache, nausea, drowsiness, dizziness, lack of coordination, or unconsciousness. It may also cause irritation of the eyes, nose, and throat and flushing of the face and neck. Short-term exposure to higher concentrations can cause liver damage with symptoms such as yellow jaundice or dark urine. Liver damage may not become evident until several weeks after the exposure. Long-term or repeated exposure to

perk (1,1,1-tetrachloroethylene) may cause irritation or burning of the skin. It also increases the risk of damage to the liver or kidneys. If you experience any of these symptoms, seek medical treatment immediately, and tell the doctor about your exposure to brake cleaning solvents.

Chemical Precautions. Unlike many industrial applications of chlorinated hydrocarbon solvents, automotive parts/brake cleaning sprays and liquids present relatively limited opportunity for exposure to dangerous levels of contamination. The possibility still exists, however, and just as with asbestos, there are safety precautions that should be followed to minimize the risk.

Always use any automotive cleaning solvent in an open, well-ventilated area and avoid breathing the vapors. Take precautions to prevent physical contact with the liquid solvent and clean any spills from the skin promptly, using soap and water. Wear protective clothing and immediately remove any piece of clothing that becomes dampened with solvent. Do not wear the item again until it has been cleaned. Wear safety goggles or other eye protection when spraying brake cleaning solvents. The safest procedure is to avoid using these chemicals completely.

Status of Solvents as Hazardous and Regulatory Status. Most used solvents are classified as hazardous wastes. Other characteristics include:

- Solvents with flash points below 140°F are considered flammable and, like gasoline, are federally regulated by the **Department of Transportation (DOT)**.
- Solvents and oils with flash points above 140°F are considered combustible and, like engine oil, are also regulated by DOT.

It is the responsibility of the repair shop to determine if their spent solvent is hazardous waste. Waste solvents that are considered hazardous waste have a flash point below 140°F (60°C). Hot water or aqueous parts cleaners may be used to avoid disposing of spent solvent as hazardous waste. Solvent-type parts cleaners with filters are available to greatly extend solvent life and reduce spent solvent disposal costs. Solvent reclaimers are available that clean and restore the solvent so that it lasts indefinitely.

Used Solvents. Used or spent solvents are liquid materials that have been generated as waste and may contain xylene, methanol, ethyl ether, and methyl isobutyl ketone (MIBK). These materials must be stored in OSHA-approved safety containers with tightly closed lids or caps (Figure 2-4). These

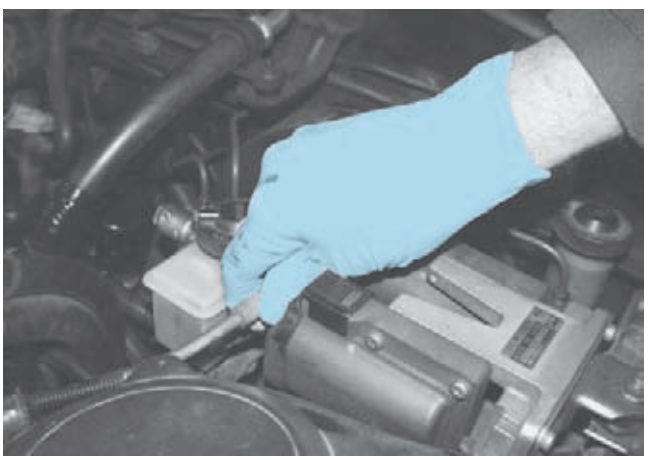

FIGURE 2-3 Protective gloves should be worn whenever working around grease or oil to help prevent possible skin problems. They help keep your hands clean, too! *(Courtesy of James Halderman)*

FIGURE 2-4 Typical fireproof flammable storage cabinet. *(Courtesy of James Halderman)*

SAFETY TIP

HAND SAFETY

Service technicians should wear protective rubber or rubberlike gloves or wash their hands with soap and water after handling engine oil, differential or transmission fluids, or other shop chemicals (Figure 2-3).

The service technician should not wear watches, rings, or other jewelry that could come in contact with electrical or moving parts of a vehicle.

storage receptacles must show no signs of leaks or significant damage due to dents or rust. In addition, the containers must be stored in a protected area equipped with secondary containment or spill protectors, such as a spill pallet. Additional requirements include:

- Containers should be clearly labeled "Hazardous Waste" and include the date the material was first placed into the storage receptacle.
- Labeling is not required for solvents being used in a parts washer.
- Used solvents will not be counted toward a facility's monthly output of hazardous waste if the vendor under contract removes the material.
- Used solvents may be disposed of by recycling with a local vendor, such as SafetyKleen, who removes the used solvent according to specific terms in the vendor agreement. See Figure 2-5.

Coolant Disposal

Coolant is a mixture of antifreeze and water. Proper disposal of **used coolant** applies to all types of antifreeze coolant, including the following:

- **Ethylene glycol—**This is the type that has been used almost exclusively since the 1950s. It is sweet-tasting and can harm or kill humans, wild animals, or pets if swallowed (usually yellow-green).

NOTE: There is no universal color standard for antifreeze.

- **Propylene glycol—**Similar to ethylene glycol, this type of coolant is less harmful to pets and animals because it is not sweet-tasting, although it is still harmful if swallowed.
- **Organic acid technology (OAT)—**antifreeze coolant (orange).
- **Hybrid organic acid technology (HOAT)—**(orange, yellow, or green).
- **VW/Audi pink—**Most of these coolants are HOAT (ethylene glycol-based with some silicate and containing an organic acid) and are phosphate-free.
- **Asian red—**This coolant is ethylene glycol-based and is silicate-free, yet contains phosphate.
- **Mercedes yellow—**This conventional ethylene glycol coolant has low amounts of silicate and no phosphates.
- **Korean or European blue—**This conventional ethylene glycol coolant has low amounts of silicate and no phosphates.

New antifreeze is not considered to be hazardous even though it can cause death if ingested. Used antifreeze may be hazardous due to dissolved metals from engine and other components of the cooling system. These metals can include iron, steel, aluminum, copper, brass, and lead (from older radiators and heater cores).

1. Coolant should be recycled either on-site or off-site.
2. Used coolant should be stored in a sealed and labeled container (Figure 2-6).
3. With a permit, used coolant can be disposed of by pouring into municipal sewers. Check with local authorities and obtain a permit before discharging used coolant into sanitary sewers.

FIGURE 2-5 All solvents and other hazardous waste should be disposed of properly. *(Courtesy of James Halderman)*

Lead–Acid Battery Waste

About 70 million spent lead–acid batteries are disposed of each year in the United States alone. Lead is classified as a toxic metal and the acid used in lead–acid batteries is highly corrosive. The vast majority (95–98%) of these batteries are recycled through lead reclamation operations and secondary lead smelters for use in the manufacture of new batteries.

Status of Batteries as Hazardous and Regulatory Status. Used lead–acid batteries must be reclaimed or recycled. Leaking batteries must be stored and transported as hazardous waste. Some states have stricter regulations that require special handling procedures and transportation. According to the Battery Council International (BCI), battery laws usually

FIGURE 2-6 Used antifreeze coolants should be kept separate and stored in a leak-proof container until it can be recycled or disposed of according to federal, state, and local laws. Note that the storage barrel is placed inside another container to catch any coolant that may spill out of the inside barrel. *(Courtesy of James Halderman)*

- prohibit lead–acid battery disposal in landfills or incinerators,
- require batteries to be delivered to a battery retailer, wholesaler, recycling center, or lead smelter, and
- require all retailers of automotive batteries to post a sign that displays the universal recycling symbol and indicates the retailer's specific requirements for accepting used batteries.

CAUTION: **Battery electrolyte contains sulfuric acid, which is a very corrosive substance capable of causing serious personal injury, such as skin burns and eye damage. In addition, the battery plates contain lead, which is highly poisonous. For this reason, disposing of batteries improperly can cause environmental contamination and lead to severe health problems.**

Battery Handling and Storage. Batteries, whether new or used, should be kept indoors. The storage location should be an area specifically designated for battery storage and must be well ventilated. If outdoor storage is the only alternative, a sheltered and secured area with acid-resistant secondary containment is strongly recommended. It is also advisable that acid-resistant secondary containment be used for indoor storage. In addition, batteries should be placed on acid-resistant pallets and never stacked!

Fuel Safety and Storage

Gasoline is very explosive. The expanding vapors are extremely dangerous and are present even in cold temperatures. The vapors that form in many vehicle gasoline tanks are controlled, but vapors from stored gasoline may escape from the can, resulting in a hazardous situation. Therefore, place gasoline storage containers in a well-ventilated space. Although diesel fuel is not as volatile as gasoline, the same basic rules apply.

FIGURE 2-7 This portable gasoline supply is a sealed steel container that is painted red. *(Courtesy of James Halderman)*

- Approved gasoline storage cans have a flash-arresting screen at the outlet. These screens prevent external ignition sources from igniting the gasoline in the can when pouring the gasoline or diesel fuel.
- Technicians must always use approved *red* gasoline containers to allow for proper hazardous substance identification (Figure 2-7).
- Do not fill gasoline containers completely full. Always leave at least 1 inch from the top of the container. This will allow room for the gasoline to expand at higher temperatures. If the containers are completely full, the expanding gasoline will be forced from the can and create a dangerous spill.
- If gasoline or diesel fuel containers must be stored, place them in a designated storage locker or facility.
- Never leave gasoline containers open except while filling or pouring gasoline from the container.
- Never use gasoline as a cleaning agent.

- Always connect a ground strap to containers when filling or transferring fuel or other flammable products from one container to another, in order to prevent static electricity that could result in explosion and fire. These ground wires prevent the buildup of a static electric charge, which could result in a spark and a disastrous explosion.

Air Bag Handling

Air bag modules are pyrometer devices that can be ignited if exposed to an electrical charge or if the front or sides of the vehicle are subjected to a sudden shock. Air bag safety should include the following precautions:

1. Disarm the air bag(s) if you will be working in the area where a discharged bag could make contact with any part of your body. Consult service information for the exact procedure to follow for the vehicle being serviced.
2. Do not expose an air bag to extreme heat or fire.
3. Always carry an air bag pointing away from your body.
4. Place an air bag module facing upward.
5. Always follow the manufacturer's recommended procedure for air bag disposal or recycling, including the proper packaging to use during shipment.
6. Always wash your hands or body well if exposed to a deployed air bag. The chemicals involved can cause skin irritation and a possible rash to develop.
7. Wear protective gloves if handling a deployed air bag.

Used Tire Disposal

Used tires are an environmental concern for several reasons, including:

1. In a landfill, they tend to "float" up through the other trash and rise to the surface.
2. Tires trap and hold rainwater, which is a breeding ground for mosquitoes. Mosquito-borne diseases include encephalitis and dengue fever.
3. Used tires present a fire hazard and when they burn they create a large amount of black smoke that contaminates the air.

Used tires can be reused until the end of their useful life and then should be disposed of in one of the following ways:

1. Tires can be retreaded.
2. Tires can be recycled by shredding for use in asphalt.
3. Tires, removed from the wheel, can be sent to a landfill (most landfill operators will shred the tires because it is illegal in many states to landfill whole tires).
4. Tires can be burned in cement kilns or other power plants where the smoke can be controlled.

Use only a registered scrap tire handler to transport tires for disposal or recycling.

Air-Conditioning Refrigerant Oil Disposal

Air-conditioning refrigerant oil contains dissolved refrigerant and is therefore considered hazardous waste. This oil must be kept separate from other waste oil or the entire amount of oil must be treated as hazardous. Used refrigerant oil must be sent to a licensed hazardous waste disposal company for recycling or disposal (Figure 2-8).

SAFETY TIP

INFECTION CONTROL PRECAUTIONS

Working on a vehicle can result in personal injury, including the possibility of being cut severely enough to cause serious bleeding. Some infections such as hepatitis B and HIV (which can cause acquired immunodeficiency syndrome, [AIDS], hepatitis C virus, plus others) are transmitted in the blood. These infections are commonly called **blood-borne pathogens**. Report any injury that involves blood to your supervisor and take the necessary precautions to avoid coming in contact with blood from another person.

FIGURE 2-8 Used refrigerant oil should be stored in a clearly labeled, secure container. *(Courtesy of James Halderman)*

SUMMARY

1. OSHA enforces workplace health and safety.
2. Hazardous waste includes reactive, corrosive, ignitable, and radioactive substances that are identified for disposal.
3. MSDSs provide information about potentially hazardous materials.
4. Asbestos is a hazardous material that must be handled and disposed of properly as required by federal and local laws and regulations.
5. Some chemicals and components used in motor vehicles service also must be disposed of properly.

REVIEW QUESTIONS

1. OSHA is short for _____ _____ _____ and _____.
2. Hazardous waste materials are _____ or _____ that the shop no longer needs and that pose a danger.
3. EPA is short for _____ _____ _____.
4. A _____ material can burn skin or dissolve metal.
5. MSDS is short for _____ _____ _____ _____.
6. An MSDS contains information about a _____ _____.
7. _____ _____ or _____ _____ might contain asbestos.
8. Asbestos exposure can cause _____.
9. Used engine oil should be _____ so it can be used over and over.
10. Automotive solvents that contain _____ _____ solvents can cause health and environmental problems.
11. Cleaning solvents can strip _____ _____ from skin.
12. Some cleaning solvents have the ability to enter your _____ _____.
13. Technicians should wear _____ _____ and _____ _____.
14. Antifreeze can cause death if _____.
15. _____ is a very explosive liquid.

CHAPTER QUIZ

1. Student A says the Occupational Safety and Health Act was passed in 1970 to protect workers. Student B says that the Environmental Protection Agency publishes a list of hazardous materials. Who is correct?
   - **a.** Student A
   - **b.** Student B
   - **c.** Both A and B
   - **d.** Neither A nor B
2. Hazardous materials include all of the following except _____.
   - **a.** engine oil
   - **b.** asbestos
   - **c.** water
   - **d.** brake cleaner
3. Student A says that employees have a right to know if materials that they are working with are hazardous. Student B says that all employees must be trained about hazardous materials. Who is correct?
   - **a.** Student A
   - **b.** Student B
   - **c.** Both A and B
   - **d.** Neither A nor B
4. Student A says that any technician working on an automotive A/C system must be certified. Student B says that all hazardous materials must be labeled. Who is correct?
   - **a.** Student A
   - **b.** Student B
   - **c.** Both A and B
   - **d.** Neither A nor B

5. To determine if a product or substance being used is hazardous, consult _____.
   a. a dictionary
   b. an MSDS
   c. EPA guidelines
   d. SAE standards

6. Student A says that right-to-know laws state that employees have the right to know when they are working with hazardous materials. Student B says the right-to-know laws state that the employer has the responsibility to train employees about the hazardous wastes they will encounter in their workplace. Who is correct?
   a. Student A
   b. Student B
   c. Both A and B
   d. Neither A nor B

7. Student A says that hazardous waste is material that the shop no longer needs that can pose a danger to people and the environment. Student B says that material safety data sheets (MSDS) must be provided to all employees. Who is correct?
   a. Student A
   b. Student B
   c. Both A and B
   d. Neither A nor B

8. Student A says that exposure to asbestos can cause serious health problems. Student B says that all brake and clutch lining materials should be treated as if they contain asbestos. Who is correct?
   a. Student A
   b. Student B
   c. Both A and B
   d. Neither A nor B

9. Two students are discussing the disposal of used motor oil. Student A says that used motor oil should be recycled. Student B says that 1 gallon of used motor oil will make 1 million gallons of freshwater undrinkable. Who is correct?
   a. Student A
   b. Student B
   c. Both A and B
   d. Neither A nor B

10. Two students are discussing the solvents often used in automotive repair. Student A says that physical contact with solvents should be avoided. Student B says that all solvents should be used in open, well-ventilated areas. Who is correct?
    a. Student A
    b. Student B
    c. Both A and B
    d. Neither A nor B

11. Student A says that used coolant can be recycled or, with a permit, disposed of by pouring it down a drain. Student B says that new or used antifreeze can cause death if it is swallowed. Who is correct?
    a. Student A
    b. Student B
    c. Both A and B
    d. Neither A nor B

12. Student A says that the lead in batteries is toxic and battery acid is corrosive. Student B says that used batteries must be recycled. Who is correct?
    a. Student A
    b. Student B
    c. Both A and B
    d. Neither A nor B

13. Student A says gasoline vapors are very dangerous. Student B says that gasoline should never be used to clean parts. Who is correct?
    a. Student A
    b. Student B
    c. Both A and B
    d. Neither A nor B

14. Two students are discussing how air bags should be handled. Student A says that air bag systems should always be disarmed when working near them. Student B says that air bags should never be exposed to extreme heat or fire. Who is correct?
    a. Student A
    b. Student B
    c. Both A and B
    d. Neither A nor B

15. Two students are discussing used tire disposal. Student A says that recycled tires can be added to asphalt for roads. Student B says that used tires are a fire hazard. Who is correct?
    a. Student A
    b. Student B
    c. Both A and B
    d. Neither A nor B