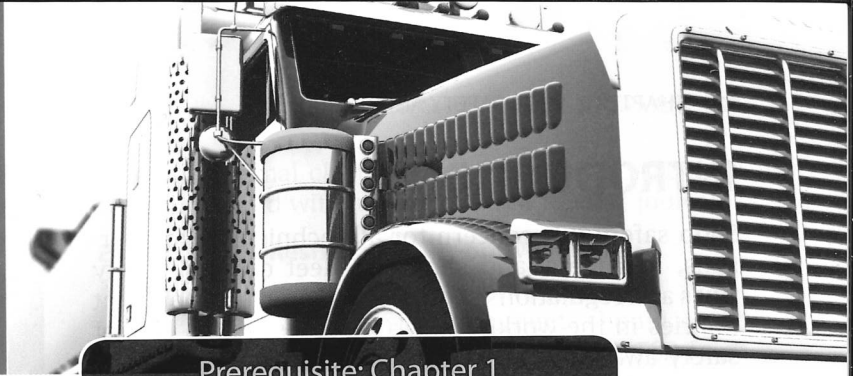


# 2



Prerequisite: Chapter 1

## SHOP SAFETY AND OPERATIONS

### OBJECTIVES

After reading this chapter, you should be able to:

- Explain the special notations in the text labeled SHOP TALK, CAUTION, and WARNING.
- Identify the basic procedures for lifting and carrying heavy objects and materials.
- Explain how to use personal protective equipment (PPE).
- Identify the UL requirements of shop safety boots and ESR footwear.
- Describe safety warnings as they relate to work area safety.
- Identify the different classifications of fires and the proper procedures for extinguishing each.
- Operate the various types of fire extinguishers based on the type of extinguishing agent each uses.
- Identify the four categories of hazardous waste and their respective hazards to health and the environment.
- Explain laws regulating hazardous materials, including both the “Right-to-Know” and employee/employer obligations.
- Identify which types of records are required by law to be maintained on trucks involved in interstate shipping.
- Outline the precautions required to work on hybrid hydraulic, hybrid electric, and gaseous fueled vehicles.
- Explain what hydraulic pinhole injection is and the action required if you suspect it.
- List the safety requirements required to work around high-voltage electrical equipment.
- Identify the precautions required to work safely with oxyacetylene equipment.
- Identify the precautions required to work safely with electric welding stations.
- Discuss the role of computers in the administration, logistics, and maintenance management of transport truck operations.

### KEY TERMS

corrosive  
dispatch sheet  
electric shock resistant (ESR) footwear  
electrocution  
Federal Motor Vehicle Safety Standard (FMVSS)  
flammable  
hazardous materials

material safety data sheet (MSDS)  
mechanic’s gloves  
Occupational Safety and Health Administration (OSHA)  
parts requisition  
personal protective equipment (PPE)  
pinhole injection

reactive  
Resource Conservation and Recovery Act (RCRA)  
Right-to-Know Law  
single-phase main solvents  
spontaneous combustion

static charge  
static discharge  
toxic  
vehicle identification number (VIN)  
Workplace Hazardous Materials Information System (WHMIS)

**FIGURE 2-3** Hearing protection

earplugs are good enough for temporary use. Hearing muffs or earphone-type protectors (**Figure 2-3**) can be worn in constantly noisy environments.

### WARNING

Electronic noise-cancelling headphones or audio headphones should not be worn on the shop floor. It can be dangerous to wear electronic noise-cancelling devices when doing anything but sitting still. These and audio headphones may isolate the wearers from certain noises that they may want to be aware of such as a verbal warning or running machinery.

### HAIR AND JEWELRY

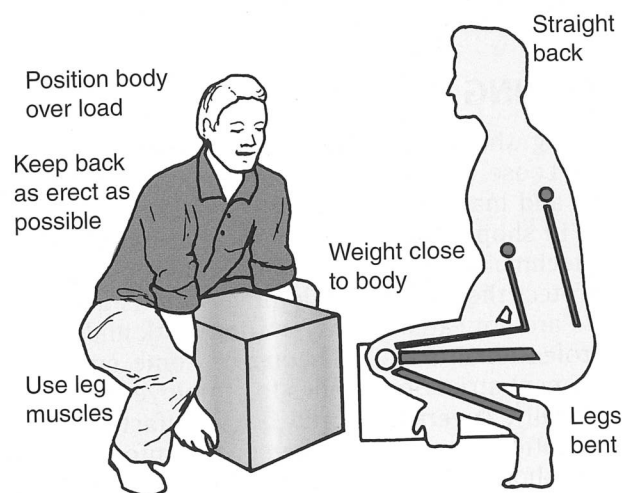
Long hair and hanging jewelry can create the same type of hazard as loose-fitting clothing. They can become caught on moving engine components and machinery.

Tie up long hair securely behind your head or cover it with a cap. Bump caps (similar to construction helmets) are recommended when working in pits or under overhead hoists.

Remove all rings, watches, bracelets, and neck chains. These items can get caught on moving parts, causing serious injury or electrically arc on live circuits.

### LIFTING AND CARRYING

Knowing the proper way to lift heavy materials is important. You should always lift and work within your ability and seek help from others when you are not sure you can handle the size or weight of the material or object. Even small, compact auto parts can be surprisingly heavy or unbalanced. Always examine the lifting task before beginning. When lifting any object, follow these steps:

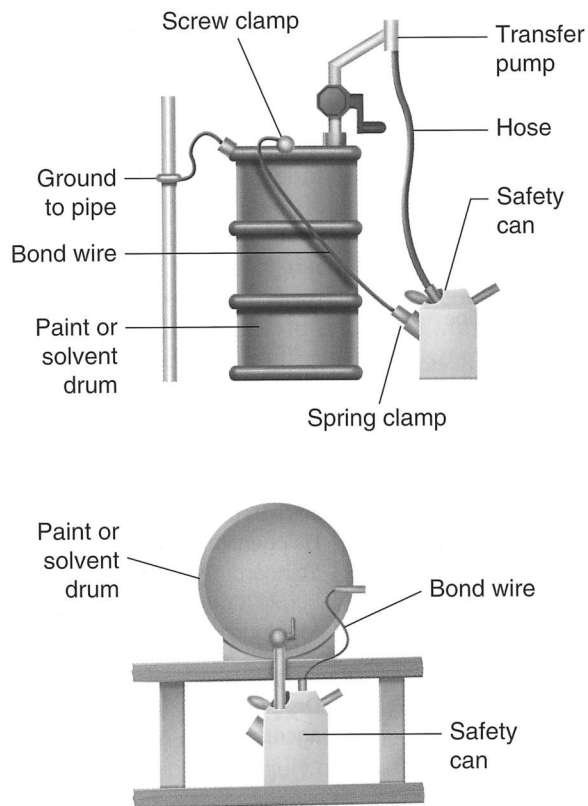
**FIGURE 2-4** Use your leg muscles, never your back, when lifting any heavy load.

1. Place your feet close to the load and properly positioned for balance.
2. Keep your back and elbows as straight as possible. Bend your knees until your hands reach the best place for getting a strong grip on the load (**Figure 2-4**).
3. If a part or component is stored in a cardboard box, be certain that the box is in good condition. Old, damp, or poorly sealed boxes can tear or otherwise fail. A heavy object could rip through the side or bottom of the container, causing injury or damage.
4. Grasp the object close to your body and lift by straightening your legs. Use your leg muscles, not back muscles.
5. When changing direction of travel, do not twist your body. Turn your whole body, including your feet.
6. When placing an object on a shelf or counter, do not bend forward. Place the edge of the load on the surface and slide it forward. Be careful not to pinch your fingers.
7. When lowering a load, bend your knees and keep your back straight. Do not bend forward—this strains the back muscles.
8. Use wood blocks to protect your fingers when picking up or lowering heavy objects to the floor.

### OTHER PERSONAL SAFETY WARNINGS

Never smoke while working on any vehicle or machine in the shop. Tilt cab-over-engine (COE) style cabs and engine compartment hoods with care (**Figure 2-5**). Proper conduct can help prevent accidents. Horseplay is not fun when it sends someone to the hospital. Such things as air nozzle fights, creeper races, or practical jokes have no place in a truck shop.

**FIGURE 2-7** Safe methods of transferring flammable materials from bulk storage.



Where natural gas (NG)-, dimethyl ether (DME)-, and propane-fueled vehicles are serviced, special care must be taken to identify and repair gas leaks. Technicians should take precautions when working in the vicinity of gaseous-fueled vehicles, especially where welding and high-potential electricity is close-by.

## FIRE SAFETY

Familiarize yourself with the location and operation of the firefighting equipment in the work area. All fires are classified in one or more of the following categories.

- **Class A**—Fires in which the burning materials are ordinary combustibles, such as paper, wood, cloth, or trash. Putting out this type of fire requires drowning with water or foam solutions containing a high percentage of water, or a multipurpose dry chemical extinguisher.
- **Class B**—Fires in which the burning material is a liquid, such as gasoline, diesel fuel, oil, grease, or solvents. To extinguish this type of fire requires a smothering action from foam, carbon dioxide, or dry chemical-type extinguisher. *Do not use water on this type of fire.* It can cause the fire to spread.

**FIGURE 2-8** Store combustible materials in approved safety cabinets.



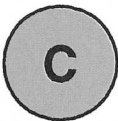



- **Class C**—Fires in which the burning material is “live” electrical equipment such as motors, switches, generators, transformers, or general wiring. To extinguish this type of fire requires a nonconductive smothering action, such as carbon dioxide or dry chemical extinguisher. Do not use water on this type of fire.
- **Class D**—Fires in which the burning materials are combustible metals. Special extinguishing agents are required to put out this type of fire.

The following are some general tips for operating the various types of portable extinguishers based on the type of extinguishing agent they use (**Figure 2-9**):

- **Foam**—Do not spray the jet directly into the burning liquid. Foam works by smothering to allow the foam to fall lightly onto the fire.
- **Carbon dioxide**—Direct discharge as close to the fire as possible, first at the edge of the flames and gradually forward and upward.
- **Soda-acid, gas cartridge**—Direct the stream at the base of the flame.
- **Pump tank**—Place the foot on the footrest and direct the stream at the base of the flame.
- **Dry chemical**—Direct the nozzle at the base of the flames. In the case of Class A fires, follow up by directing the dry chemicals at the remaining material that is burning.

FIGURE 2-9 Guide to fire extinguisher selection

Class of Fire	Description of Fire	Typical Fuel Involved	Type of Extinguisher
Class  Fires	<b>For Ordinary Combustibles</b> Put out a Class A fire by lowering its temperature or by coating the burning combustibles.	Wood Paper Cloth Rubber Plastics Rubbish Upholstery	Water* <sup>1</sup> Foam* Multipurpose dry chemical <sup>4</sup>
Class  Fires	<b>For Flammable Liquids</b> Put out a Class B fire by smothering it. Use an extinguisher that gives a blanketing, flame-interrupting effect; cover whole flaming liquid surface.	Gasoline Oil Grease Paint Lighter fluid	Foam* Carbon dioxide <sup>5</sup> Halogenated agent <sup>6</sup> Standard dry chemical <sup>2</sup> Purple K dry chemical <sup>3</sup> Multipurpose dry chemical <sup>4</sup>
Class  Fires	<b>For Electrical Equipment</b> Put out a Class C fire by shutting off power as quickly as possible and by always using a nonconducting extinguishing agent to prevent electric shock.	Motors Appliances Wiring Fuse boxes Switchboards	Carbon dioxide <sup>5</sup> Halogenated agent <sup>6</sup> Standard dry chemical <sup>2</sup> Purple K dry chemical <sup>3</sup> Multipurpose dry chemical <sup>4</sup>
Class  Fires	<b>For Combustible Metals</b> Put out a Class D fire of metal chips, turnings, or shavings by smothering or coating with a specially designed extinguishing agent.	Aluminum Magnesium Potassium Sodium Titanium Zirconium	Dry powder extinguishers and agents only

\*Cartridge-operated water, foam, and soda-acid types of extinguishers are no longer manufactured. These extinguishers should be removed from service when they become due for their next hydrostatic pressure test.

**Notes:**

- (1) Freezes in low temperatures unless treated with antifreeze solution, usually weighs over 20 pounds (9 kg), and is heavier than any other extinguisher mentioned.
- (2) Also called ordinary or regular dry chemical (sodium bicarbonate).
- (3) Has the greatest initial fire-stopping power of the extinguishers mentioned for Class B fires. Be sure to clean residue immediately after using the extinguisher so sprayed surfaces will not be damaged (potassium bicarbonate).
- (4) The only extinguishers that fight A, B, and C classes of fires. However, they should not be used on fires in liquefied fat or oil of appreciable depth. Be sure to clean residue immediately after using the extinguisher so sprayed surfaces will not be damaged (ammonium phosphates).
- (5) Use with caution in unventilated, confined spaces.
- (6) May cause injury to the operator if the extinguishing agent (a gas) or the gases produced when the agent is applied to a fire is inhaled.

If a fire extinguisher is used, report it to your instructor or service manager so that it can be immediately recharged.

## HYBRID DRIVE AND NG PRECAUTIONS

Although the subject matter of this textbook does not deal with alternative fuels and hybrid drive technology, both hybrid drive and gaseous-fueled (NG, propane, and DME) powertrains are becoming increasingly common in commercial heavy vehicle shops. Specialized training is required to work on the

powertrains or fuel systems of these vehicles. And if you are asked to do a lube job on one, you should clearly understand the potential dangers. That begins with the ability to define them.

### Hybrid Electric

Hybrid-electric drive vehicles have become increasingly common, especially in inner-city transit operations. A hybrid-electric drive vehicle typically uses a diesel- or NG-fueled engine and a generator system to produce high-voltage electricity. Once produced this electricity is stored on chassis in battery and

**FIGURE 2-14** Shop record keeping is made easier by specialty software programs.



- **Vehicle History.** A database that can provide a detailed profile on any vehicle in the fleet.
- **Work Order Generating.** The ability to automatically generate a work order when a vehicle needs servicing.
- **Cost Tracking.** Using databases on parts, vehicle history, PM scheduling, and warranty information to keep track of overall costs.
- **Warranty Information.** A database linked with vehicle history that provides specific information on parts warranty. Helpful in obtaining prompt warranty payments from vendors.
- **Vehicle and Driver Performance Analysis.** Trip data can be wirelessly downloaded during (telematics) or after each trip (microwave transponder).

## SUMMARY

- Personal safety on the job may require eye or ear protection, or both, plus protective clothing and shoes. Long hair and loose jewelry are hazards.
- Lifting and carrying heavy materials the correct way will protect against injury.
- Tilt hoods and COE cabs with care.
- Do not smoke or engage in horseplay in the shop.
- Take care when oxyacetylene cutting or electric welding and always use protective eyewear with the correct filter shades. Avoid contact with hot metal components, and practice caution when working around flammable substances and potentially toxic gases.
- Take care when using a hydraulic press. Use protective eyewear. Make sure you are protected by safety cages or barriers.
- The work area should be kept clean, dry, and organized. Flammable liquids and solvents should be handled and stored carefully.
- Emergency telephone numbers and a first-aid kit should be handy.
- Use firefighting equipment appropriately: water or foam on ordinary combustibles; foam, carbon dioxide, or dry chemicals on burning liquids;

carbon dioxide or dry chemicals on burning "live" electrical equipment; and special extinguishing agents on burning metals.

- Select, store, use, and maintain shop tools properly.
- Hazardous materials used in heavy-duty truck repair include flammable, corrosive, reactive, and toxic materials. Your employer is obligated to inform you of potential hazards in your workplace, and you have a right to protect yourself from them.
- Specific laws govern the disposal of hazardous wastes, including oil, antifreeze/coolants, refrigerants, batteries, battery acids, acids and solvents used for cleaning, and paint and body repair product wastes. Hazardous wastes may be recycled in the shop or removed by a licensed disposal hauler.
- By law, records must be kept by each shop of the repair and maintenance of trucks involved in interstate shipping.
- Computers have become part of the way of life in truck service shops. They are used for diagnostic routines, maintenance tracking, parts inventory control, work order generating, personnel management, and cost tracking.

## REVIEW QUESTIONS

1. In this book, the sections that contain cautions about situations that might result in personal injury are labeled with what special notation?
  - a. SHOP TALK
  - b. SAFETY RULES
  - c. CAUTION
  - d. WARNING
2. The best way to prevent eye injury is to:
  - a. take care during grinding or other operations that throw off particles.
  - b. always wear safety glasses.
  - c. always wear a bump cap.
  - d. make sure a source of running water is available to flush foreign matter out of the eyes.
3. Which of the following describes a safe lifting and carrying practice?
  - a. Twist your body when changing your direction of travel while carrying a heavy object.
  - b. Bend forward to place a heavy object on a shelf or counter.

- c. Lift by bending and then straightening your legs, rather than by using your back.
  - d. Position your feet as far as possible from the load when you begin to lift.
4. Oil on the floor of the work area can be cleaned up using a \_\_\_\_\_.
  5. The exhaust pipe of a diesel engine must be connected to the shop exhaust system to protect against:
    - a. breathing harmful emissions.
    - b. carbon monoxide.
    - c. carbon dioxide.
    - d. fire.
  6. Do NOT attempt to put out a Class B fire using:
    - a. foam.
    - b. carbon dioxide.
    - c. a dry chemical type extinguisher.
    - d. water.
  7. A Class C fire involves:
    - a. ordinary combustibles, such as paper or cloth.
    - b. a flammable liquid.
    - c. live electrical equipment.
    - d. combustible metals.
  8. To use carbon dioxide to extinguish a fire, direct the discharge:
    - a. at the top of the flames.
    - b. first at the edge of the fire, then forward and upward.
    - c. at the base of the flames.
    - d. several feet over the top of the flames.
  9. What are the four types of hazardous wastes?
  10. The "Right-to-Know Law" was passed by the government to:
    - a. require any company that disposes of hazardous materials to inform their community.
    - b. protect employees, customers, or vendors from hazards in the workplace caused by hazardous chemicals.
    - c. require industries to compensate employees injured by contact with hazardous materials.
    - d. require chemical industries to reveal complete information about the chemicals they produce.
  11. Which of the following is covered under the Resource Conservation and Recovery Act?
    - a. waste water
    - b. waste oil
    - c. cleaning solvents
    - d. all of the above
  12. Which of the following is an approved way of disposing of hazardous wastes?
    - a. Washing them down the drain with plenty of water.
    - b. Using them as weed killer.
    - c. Recycling them by reusing them in the shop.
    - d. Placing them in leak-proof containers and disposing of them in an RCRA-approved method.
  13. What record must be kept by the shop on trucks involved in interstate shipping?
    - a. out-of-service times
    - b. names of all drivers
    - c. names of all service technicians
    - d. nature and date of inspections
  14. What information is provided by the first digit of the VIN of a heavy-duty truck?
    - a. model year
    - b. axle configuration
    - c. manufacturer
    - d. gross weight rating
  15. Which of the following is bar coding more likely to be used for in a truck service facility?
    - a. parts inventory control
    - b. tracking preventive maintenance
    - c. profiling specifications on a vehicle
    - d. generating work orders
  16. When shutting down an oxyacetylene torch, which valve should be closed off first?
    - a. oxygen
    - b. acetylene
    - c. time it so they are both shut off together
    - d. neither: immerse torch head in water
  17. When arc welding on a truck, where should the ground clamp be placed on the chassis?
    - a. on the engine ECM
    - b. on the engine cylinder block
    - c. as far from the weld area as possible
    - d. as close to the weld area as possible
  18. Which of the following oxyacetylene conditions is potentially more dangerous?
    - a. oxidizing flame
    - b. flashback
    - c. carburizing flame
    - d. backfire
  19. What footwear should be worn when working on high-voltage vehicle systems?
    - a. flip flops
    - b. UL safety boots
    - c. sturdy leather-soled shoes
    - d. ESR footwear
  20. Technician A says that Right-to-Know legislation requires employers to provide WHMIS training to their employees. Technician B says that WHMIS training teaches employees how to interpret a MSDS. Who is correct?
    - a. Technician A only
    - b. Technician B only
    - c. both A and B
    - d. neither A nor B