

Exploring Woodworking

Eighth Edition

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Introduction

Exploring Woodworking is designed to assist you in learning the fundamentals of working safely and efficiently with hand tools and power tools. In addition, the book acquaints you with the different types of woods and their uses. It also introduces you to the industrial woodworking environment, and describes the technology used today to produce the many wood products

The information included in **Exploring Woodworking** is presented in an easy-to-understand format. New terms are listed at the start of each section and are introduced within that section. This allows you to be introduced to a new term in context, resulting in the best understanding of the material being presented. **Safety is stressed throughout the text and is highlighted using a predominant second color.** This enables you to easily locate important information regarding the care and safe operation of tools and equipment.

Exploring Woodworking emphasizes the important role that wood and wood by-products play in our everyday lives. Wood is also a vital part of our future. Improved technology, conservation, and recycling will be critical to ensuring an adequate supply of wood for the future.

Color is used throughout the book to clarify details and highlight important parts of drawings. Color photographs are used to show you the natural colors of various woods, and to enhance the appearance of new tools and equipment.

The contents of this book are presented in an orderly and organized manner. Information regarding the materials used in woodworking, safety, and product planning presented first. Subsequent chapters focus on hand tools, portable power tools, and power woodworking machines, including information on safety and proper use. Updated information in the areas of project construction, wood finishing, lamination, wood bending, and adhesives also covered. A special chapter provides information and details on incorporating entrepreneurship and manufacturing enterprise into the shop. Chapters presenting information on automated manufacturing, entrepreneurship, and careers are also included in this book. Many operations that occur in an industrial setting are different than those that occur in a woods laboratory. However, the theory and principles of operation remain the same.

The final chapter of **Exploring Woodworking** provides construction details of carefully selected new projects. These projects provide students with exciting, easy, first-time projects to build. A special section also shows simple to complex woodworking projects completed by students.

Exploring Woodworking is intended for students in middle schools, junior high schools, and high school technology education programs. Since this is a beginning level exploratory woodworking book, it could also be used for adult education classes and by the do-it-yourselfer.



About the Authors

Fred W. Zimmerman was Professor Emeritus from Western Illinois University in Macomb, Illinois. Fred earned several degrees, including a bachelor of science degree from Southern Illinois University, a master of science degree from Kent State University, and a doctorate in Industrial Education from Bradley University in Peoria, Illinois. He had extensive experience as both an instructor and woodworker, and was active in the Illinois Vocational Industrial Clubs of America as a judge in the cabinetmaking and millwork areas. Fred was a member of the Illinois Woodworking Teachers Association and a Life Member of the International Industrial Education Association.

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Don L. Blazek received his bachelor of science degree in Industrial Education from Fort Hays State University in Hays, KS and his master of science degree at Pittsburg State University. He taught in the Shawnee Mission School District #512, located in Overland Park, Kansas. He taught an exploratory industrial education program consisting of materials and processes (wood and plastics), visual communication (drafting, graphic arts, photography, and video production) and manufacturing processes. He served on two federally funded development projects for the development of pilot industrial education programs for middle/junior high schools for the State of Kansas. This SET (Secondary Exploration of Technology) helped lead to the development of the modular concept of teaching technology education. Don also taught woodworking adult education classes. Over the span of his teaching career, he was actively involved with the Kansas Industrial Education Association and the American Industrial Arts Association. In 1978 he was selected the Outstanding Industrial Education Teacher for the State of Kansas.



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2

Woodworking Safety

Section 2.1
General Safety

Section 2.2
Hand and Power Tool Safety

Section 2.3
Chemical and Fire Safety

Introduction

This chapter describes general safety precautions that should be taken in the woodshop. After studying this chapter, you will have a basic foundation of safe practices to follow when using tools, equipment, and machines.

Section 2.1

General Safety

Objectives

After studying this section, you will be able to:

- Identify safety color codes.
- Name examples of personal protective equipment.
- Describe how to lift heavy objects safely.
- Follow all general safety rules while working in the woodshop.

Technical Terms

hearing protectors	Occupational
National Institute	Safety and Health
for Occupational	Administration
Safety and Health	(OSHA)
(NIOSH)	personal protective
noise reduction rating	equipment (PPE)
(NRR)	

Reading Prep

Before reading the section, skim the photos and their captions. As you read, determine how these concepts contribute to the ideas presented in the text.

Safety in the woodshop is mostly a matter of using common sense when working with machines, tools, and materials. Machine guards and other safety devices are helpful, but they cannot do your thinking and planning for you. Know and follow safety rules at all times, **Figure 2-1**. Keep your mind on what you are doing. Be considerate of other people's safety as well as your own. Safe work habits acquired now will be useful in this course and in the years to come.

Schools and classrooms are subject to a number of federal, state, and local rules regarding safety. The *Occupational Safety and Health Administration (OSHA)* is a federal agency that

sets and enforces standards for workplace safety. Since schools are workplaces for instructors and administrators, OSHA regulations apply to them.

Safety Color Coding

As you look around the woodshop, you may notice signs, equipment, or machine parts in various colors. Each color has a particular meaning, so the colors are a form of code. The following colors are most often used to identify hazards and safety equipment in the woodshop.

- Red is used for fire protection equipment, such as fire extinguishers, and for safety cans. Red also means stop. Emergency stop buttons, bars, or switches on machinery are painted red.
- Yellow means caution and is used to alert workers to physical hazards, such as places where they might trip.
- Orange is used for warning. Moving parts of equipment, such as belts or pulleys, may be painted orange.
- Green is used for first aid equipment and for other safety equipment (except fire extinguishers).
- Blue is used for information. Equipment that needs repair or is being repaired may have a blue tag on it.



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Figure 2-1. Pay close attention as your instructor demonstrates the safe and correct way to use tools and machines.

Safety Glasses, Goggles, and Face Shields

Personal protective equipment (PPE) is any item that is worn to protect an individual from injury or from exposure to harmful substances. In the woodshop, one of the most important pieces of personal protective equipment is eye protection. Sawdust, flying wood chips, and chemical splashes are common in the woodshop. They can cause serious damage to your eyes.

Common types of eye protection include safety glasses, safety goggles, and face shields, **Figure 2-2**. If you wear regular eyeglasses, you should use either safety goggles or a face shield over your regular glasses, **Figure 2-3**. Make sure the safety glasses, goggles, and face shields you wear are clean and free of scratches that might make it hard for you to see clearly.

Hearing Protection

Many woodworking machines produce loud, high-frequency noises. Constant exposure to these high frequencies can lead to hearing loss. Hearing loss is often gradual and many times will not be noticeable until it is severe and permanent.

Hearing protectors are personal protective equipment that will help screen out high-frequency



Figure 2-2. State and federal laws require the use of eye protection in the shop.



Figure 2-3. A safety face shield can be worn over regular eyeglasses.

noises but still allow you to carry on normal conversation. Three types of hearing protectors are earmuffs, earplugs, and banded earplugs, **Figure 2-4**. These hearing protectors have a **noise reduction rating (NRR)**. The higher the NRR number on the device, the better protection it will provide. For example, earmuffs will usually have a rating of 20. Banded earplugs will be rated 23, and other earplugs, 29. Refer to the NRR number on the product. The rating will vary from one manufacturer to another. Avoid using cotton or wax. They offer very little protection from high frequencies.

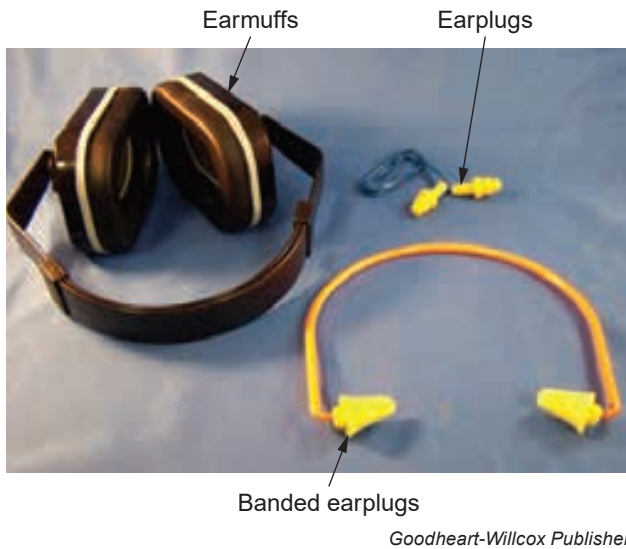


Figure 2-4. Hearing protection is needed because of the high-frequency noises produced by some machines.

Dust and Vapor Protection

Working with wood can produce a large amount of sawdust. Extreme exposure to this sawdust can be harmful if the dust is inhaled. Some species of wood, such as beech, black locust, hemlock, mahogany, red oak, and rosewood, produce dust that is very harmful to the respiratory tract (organs involved in breathing). For a complete list of woods and information on harmful effects, refer to the OSHA website.

Dust collection systems are attached to many woodworking machines to remove dust and wood chips, **Figure 2-5**. A portable dust collection device may be used at various machines and in the finishing area if a large collection system is not available, **Figure 2-6**. If your shop is not equipped with dust collection systems, then your instructor may open the windows and use fans to move dust and fumes to the outside.

Wearing a respirator will reduce the amount of dust and fumes you inhale. The *National Institute for Occupational Safety and Health (NIOSH)* is a federal agency that conducts research and recommends ways to prevent work-related injuries and illnesses. NIOSH has established a rating system for respirators. The respirator pictured in **Figure 2-7**



Figure 2-5. Most woodshops have commercial dust collection systems such as this one.



Figure 2-6. A portable dust collection device may be used if a larger system is not available.

is rated at N-95, which is recommended for most woodshops. It contains cartridges that filter out most dust and fumes.

Simple, disposable dust masks may be worn for general use in the woodshop, **Figure 2-8**. However, they cannot protect against toxic dust and fumes.



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Figure 2-7. This NIOSH-approved respirator should be worn where there are fumes from wood finishing products.



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Figure 2-8. Disposable dust masks can filter out most particles. They are often worn during wood sanding.

Protection for Your Hands

When handling lumber or finishing supplies, you may need to protect your hands from splinters, sharp edges, or chemicals. Work gloves can be worn when you have to carry lumber, plywood, or hand tools with sharp edges. When working with solvents, finishing supplies, or adhesives, it is best

to wear plastic or rubber gloves. These will prevent liquids from penetrating your skin. Be sure to use the right type of glove for the chemicals you will be handling. See **Figure 2-9**.

Lifting and Carrying

While working in the woodshop, you might have to move lumber or plywood or a project. Follow proper lifting and carrying procedures to avoid injuries. Stand close to the load, bend your knees, and hold onto the object firmly. As you lift, straighten your legs and move upward. Do not bend your back. If a load is too heavy or too large for you to maintain complete control without strain, do not lift it alone. Heavy and large loads require multiple people to lift and carry.

General Safety Practices

The woodshop is a great place to learn useful skills, be creative, and practice teamwork. It is also a place with more hazards than a regular classroom. Always think “safety first” as you work on your projects.



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Figure 2-9. Disposable gloves help protect your hands from harmful chemicals

Work Safely

- Get your instructor's permission before you begin work.
- No work should be done when the instructor is not in the room.
- Respect the rights of others and their property.
- Conduct yourself in a positive manner that will contribute to the total safety program in the woodshop. Do not engage in horseplay.
- Look where you are going. Walk, don't run.

Protect Yourself

- Loose clothing can easily get caught in the moving parts of a machine. Wear short sleeves or roll up long sleeves. Keep your shirt tucked in. Do not wear any loose jewelry. Remove rings and watches.
- Wear a dust mask if dusty conditions prevail. The dust mask should be approved by NIOSH. Use a NIOSH-approved respirator with an organic filter if harmful vapors are present.
- Wear appropriate personal protective equipment to protect eyes, ears, and hands.
- When cleaning, avoid blowing or brushing sawdust into your eyes or your classmates' eyes. Do not rub your eyes if sawdust or any other foreign object gets into them. Instead, get immediate assistance. Avoid creating excessive amounts of dust while sanding or during cleanup.
- Ask for help when carrying heavy or bulky objects.
- Exercise caution in the handling of compressed air.
- Use care when handling material with sharp edges.
- Keep your hands dry when handling electric power cords. Water makes skin a better conductor, and an electrical shock could result.

Know the Emergency Procedures

- Be prepared *before* an accident happens. Your instructor will review emergency procedures. Make sure you understand them.
- Report even the slightest injury. Small cuts or other minor injuries may become serious if left unattended.
- Every woodshop should have a basic first aid kit. The kit should include clean, sterile bandages and other supplies to treat minor cuts and nicks. Be sure you know the location of the first aid kit. Follow your shop's rules regarding use of the kit.

Keep the Work Area Safe

- Notify your instructor if you notice any unsafe conditions; for example, dull tools or frayed electrical cords.
- Keep the floor clear of scraps of material and wood shavings.
- When stacking lumber, make sure it will not shift or fall.
- Place clamped stock so it will not fall. Make sure the clamps do not extend into the pathway.
- Place all used rags in a metal fireproof container, **Figure 2-10**.
- Keep the air as clean as possible. Use the dust collection system, if available in your woodshop.
- The exhaust ventilation fan should be turned on for any painting or finishing or whenever any fumes are present in the room.
- Keep the lids on containers of finishes, such as paints or varnish, when they are not in use. Many finishes emit vapors that may be harmful if the area is not properly ventilated.



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Figure 2-10. Rags that are greasy or oily or that were used for wood finishing should be placed in a fireproof container.

Test Your Knowledge

Answer the following questions based on the information provided in this section.

1. In safety coloring coding, which colors signify Stop, Warning, and Caution?
2. *True or False?* If you wear eyeglasses, you should take them off so that safety glasses or goggles will fit better.
3. Hearing protectors should be worn when in areas with _____ noise.
4. *True or False?* In the woodworking shop, the main dangers to your lungs are dust and high humidity.
5. *True or False?* When preparing to lift a heavy object, you should stand close to the item, bend your knees, and hold the object firmly.
6. *True or False?* Minor cuts and splinters need not be reported to the instructor.
7. *True or False?* Used rags should be placed in a metal fireproof container.
8. *True or False?* The dust collection system is a large vacuum that should be operated only at cleanup time.

Section 2.2

Hand and Power Tool Safety

Objectives

After studying this section, you will be able to:

- Name three things to check before operating tools and machines.
- Identify safe procedures for using tools and machines in the woodshop.
- Explain why ground fault circuit interrupters (GFCIs) are important.

Technical Terms

ground fault circuit
interrupter (GFCI)

grounding pin

National Electrical
Code

push stick

Reading Prep

As you read this section, outline the main points. Be sure to include the safety details presented with each topic.

As the name implies, hand tools are held in the hand. They require only your own muscle power to operate. Power tools and machines require electricity or some other power source, such as compressed air.

Hand and power tools and machines allow you to perform many tasks easily and quickly. However, they can be dangerous if not used properly. Your instructor will demonstrate how to operate tools and machines safely. Observe carefully. If you are unsure about anything, ask your instructor to explain.

Preparing to Use Tools and Machines

Carefully think the total process through before beginning an operation. Some procedures may require more than one person. Tell your instructor if you need help. For example, ask for help before beginning a cut on long or heavy pieces, **Figure 2-11**.

Check Yourself

- Wear safe clothing. Make sure you button your shirt and tuck it in. If you are wearing a long-sleeved shirt, roll up the sleeves, **Figure 2-12**. Shoes or sneakers should be worn. Do not go barefoot or wear sandals. Remove any loose-fitting clothing, such as vests or sweaters. Do not wear ties, scarves, or dangling jewelry. If you have long hair, tie it back.
- Wear appropriate personal protective equipment.



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Figure 2-11. If the wood stock is too long for you to support when cutting, have someone help support the end. Make sure both of you stand to the side of the workpiece, not directly behind it.



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Figure 2-12. Long sleeves can get caught in machinery. Roll them up.

Check Equipment and Materials

- Make sure tools and machines are in good working condition. For example, do not use a hammer that has a loose or split handle. Do not use saw blades, drills, or other tools that are bent or twisted. Report any faulty tools or machines immediately to the instructor.
- Make sure all cutting tools are sharp. A dull tool is more dangerous than a sharp one. Test the sharpness of a hand tool on a piece of paper, not on your fingers, **Figure 2-13**.
- Make sure tools and accessories are properly assembled and adjusted before use. Before using any power machine, have the instructor check the setup.



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Figure 2-13. Make sure all cutting tools are sharp before using them.

- Remove the plug from the receptacle, or turn off the disconnect switch, before making any changes to the setup.
- Do not disassemble any tool or machine until the instructor has demonstrated how to do it.
- Do not use power tools or machines that have loose switches or frayed electrical cords, **Figure 2-14**. Occasionally, people remove the **grounding pin** from a grounded (three-prong) plug. This practice is extremely hazardous. Removing the pin



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Figure 2-14. Inform your instructor of any defective electrical cords on machines.

allows for a shorting condition that transfers electricity from the positive (hot) conductor to the housing of the tool and from there to the operator. A serious, possibly fatal, electrical shock can result. *Do not use the tool or machine if the grounding pin has been removed from the plug.*

- Many machines and pieces of power equipment use drive belts. The operator is usually protected from these belts with guards. Since the belts are generally not seen when the equipment is in motion, they are commonly overlooked as a potential hazard. Belts crack and split with age, and they must be replaced.
- Use machine guards, **Figure 2-15**. Get permission first if a special setup requires temporary removal of a guard. Do not leave the machine unattended without the guard.
- Inspect the stock (the workpiece) before beginning a cut. Look for loose knots and twists that might bind the tools. Make sure the stock does not contain nails or other foreign objects.
- Be sure the stock is securely held in place before beginning any cutting operation.



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Figure 2-15. Make sure guards are in place before starting any cutting process. This guard is for a jointer.

Check the Area

- Remove all adjustment wrenches, unneeded tools, and extra material from a power machine table before the power is turned on.
- Be sure everyone is out of the danger zone around a machine before beginning an operation. The danger zone is the area in and around machinery in which there is a risk to health and safety.

Using Hand Tools Safely

- Carry sharp tools with their cutting edges down. Do not carry tools in your pockets. After use, return tools to their storage place, **Figure 2-16**.
- Cut away from your body when using tools with a sharp cutting edge, **Figure 2-17**.
- Do not use a file that does not have the handle securely in place.
- Do not allow vise handles to protrude into the aisles. Do not overtighten them.
- Always store tools in the correct manner. Improper storage can damage the tool and make it dangerous to use.



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Figure 2-16. Store hand tools on a tool rack, not in your pockets.



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Figure 2-17. Cutting tools should be pointed away from the body.

Using Power Tools and Machines Safely

- Never operate any power machine without permission from your instructor. Ask your instructor for permission before using any power tool or machine. Do not help someone else with a power tool or machine unless you are specifically asked to do so by the instructor.
- Stay alert! Keep your mind on the operation of the machine at all times. Do not talk to anyone while operating a machine. Do not operate any power equipment if you do not feel well or are taking certain medications.
- Think through every step of the procedure about to be performed. Is something in the way? Is an outfeed stand needed? Is additional help needed to do the procedure?
- Be sure to work only within the capacity of the machine. Do not attempt operations beyond its limits.
- Turn off the machine before making any adjustments.
- Turn off the equipment after each use.
- Use a *push stick* to cut short or narrow stock, **Figure 2-18**.
- Avoid getting into awkward positions when operating a machine. Keep fingers and hands away from blades and other moving parts of machines.
- Be sure everyone is out of the danger zone around a machine before beginning an operation. The danger zone is the area in and around machinery in which there is a risk to health and safety.
- Never stand in line with a revolving tool or flywheel of a machine.
- Do not feed stock into the machine until it has reached full speed.
- Dress properly. Do not wear loose clothing that could get caught in the moving parts of the machine. Remove jewelry and tie back long hair.
- Wear appropriate personal protective equipment to safeguard your eyes, ears, and breathing. Everyone in the area of the machine should also wear personal protective equipment.
- Inspect the workpiece. It must be free of warp, loose knots, splits, and foreign objects such as nails and staples.



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Figure 2-18. Keep fingers and hands away from cutting blades by using a push stick.

- Do not use the machine in a wet location or where there are explosive vapors.
- Inspect the machine's power cord before starting it. If the cord is frayed, split, or worn, do not use the machine. Do not use the machine if the grounding pin is missing from a three-prong plug.
- When setting up the machine for a job or when making adjustments, always remove the plug from the wall receptacle or switch the electrical disconnect to the OFF position.
- Determine the method of starting and stopping the machine before using it. After finishing a job, do not leave the machine unattended until it has come to a complete stop.
- Remove all adjustment wrenches, unneeded tools, and extra material from a power machine table before the power is turned on.
- Make sure all guards are in place. Special setup jigs and accessories should be properly positioned and secured. If the guard must be removed for a certain procedure, ask the instructor for permission before removing the guard. After you have removed the guard, ask the instructor to check the setup and discuss the procedure. Finally, ask the instructor to assist you in the procedure. Instructors have valuable experience and knowledge of the machines!
- Do not attempt to operate a power machine that has a dull blade. Blades tend to overheat when dull, causing them to warp or break easily without warning. Dull blades also cause the motor to overheat, which may result in permanent damage to the machine. In addition, a dull blade burns the cut surface of the wood. The surface will then need extra sanding, or it will not readily accept glue or a finish.

Electrical Safety

When several tools or machines are in use at the same time, circuits may become overloaded, **Figure 2-19**. Overloads often occur when a number of extension cords have been connected together. The current-carrying capacity of each extension cord is reduced. If a power tool that exceeds this new current-carrying capacity is operated, the cord may overheat, or the power tool will operate with less power than required. The tool itself may overheat, resulting in a loss of efficiency, damage to the tool if operated for any length of time, or possible injury to the operator.

The *National Electrical Code* requires all new wiring in basements, garages, bathrooms, and outdoor locations to have ground fault protection. A ground fault is an unintended electrical path between a power source and a grounded surface. For example, if you are working with a faulty electric tool, your body could become a path to ground for the current. A *ground fault circuit interrupter (GFCI)* senses when a ground fault exists and immediately breaks the circuit. This protects the operator from electrical shock, **Figure 2-20**.



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Figure 2-19. When too many tools or machines are drawing current from the same circuit, the circuit can become overloaded. The result can be a tripped circuit breaker or even a fire.



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Figure 2-20. This receptacle has a built-in ground fault circuit interrupter.

Test Your Knowledge

Answer the following questions based on the information provided in this section.

1. Before operating tools and machinery, you should check yourself, the equipment and materials, and the ____.
2. *True or False?* When working in the woodshop, you should wear loose clothing for freedom of movement.
3. *True or False?* Although using a dull tool may require more effort, it is less likely than a sharp tool to cause an injury.
4. What should you do before making any changes to a machine setup?
5. *True or False?* It is a good idea to remove the grounding pin from all of the three-prong plugs because they are not needed for power machines.
6. *True or False?* After finishing your work, you should remove the machine guard.
7. Carry sharp tools with their cutting edges ____.
8. *True or False?* When cutting with a hand tool, you should cut in a direction away from your body.
9. *True or False?* As long as you are careful, it is safe to use a file without the handle on it.
10. Use a(n) ____ to move short or narrow stock into the circular saw.
11. *True or False?* Feed stock into a machine only when the machine has reached full speed.
12. A(n) ____ is a device that can sense an undesired ground and will immediately break the circuit to prevent electrical shock.

Section 2.3

Chemical and Fire Safety

Objectives

After studying this section, you will be able to:

- Describe safety precautions to use when handling toxic or flammable materials.
- Name the four classes of fire extinguishers and tell which types of fires they are used on.
- Explain what the acronym PASS means.

Technical Terms

ABC-rated fire
extinguisher
flash point

material safety data
sheet (MSDS)
PASS

Reading Prep

As you read this section, make note of the different agencies and organizations involved in chemical and fire safety. How do the agencies and organizations contribute to chemical and fire safety?

Safe Handling of Toxic and Flammable Materials

Many of the materials found in woodshops are toxic (poisonous) and/or flammable. For example, some stains and varnishes can cause headaches, nausea, dizziness, or skin or eye irritation. You have already learned that sawdust can be hazardous to your lungs. It is also flammable and can be explosive.

Workplaces in which chemical hazards are present are required by OSHA to communicate this information to their employees. Containers of hazardous materials must be properly labeled. Detailed information is provided on a form called a *material safety data sheet (MSDS)*. The MSDS lists the characteristics and hazards of the material and tells how to safely store, handle, transport, and dispose of it.

To protect yourself when handling toxic or flammable materials, observe the following safety rules.

- When using chemicals (paint, paint thinners, stains, cleaning solvents, etc.), wear appropriate personal protective equipment, such as gloves and respirators. Make sure the PPE is designated for use with that chemical.
- Chemicals should be kept properly labeled and used only as directed.
- Wash your hands thoroughly with soap and water after handling chemicals.
- Paint, enamel, stain, varnish, lacquer thinner, shellac, alcohol, kerosene, turpentine, machine oil, and other flammable material should be stored in proper containers in an approved metal cabinet, **Figure 2-21**.
- Never incinerate (burn) pressurized paint containers, such as spray cans. Place them in a covered safety can.
- Rags that are greasy, oily, or have been used for wood finishing must be disposed of in a safety can that has a metal lid.
- Do not use flammable material near an open flame.
- Do not use solvents with a low *flash point*, such as gasoline, for cleaning. The flash point is the temperature at which the vapor given off by a substance catches fire when exposed to flame. Even a static electric spark can ignite gasoline vapors.
- Each woodshop should be equipped with an *ABC-rated fire extinguisher*. This type can be used on electrical fires as well as other kinds of fires. The fire extinguisher should be prominently displayed and accessible to everyone working in the woodshop, **Figure 2-22**.

- Examine dust collectors, the area beneath table saws and shapers, and anywhere else sawdust might accumulate. These areas must be cleaned to prevent the buildup of dust and to reduce the potential for fires.
- Make sure you know your shop's fire safety plan. What are you expected to do in case of a fire? When should the room be evacuated, and which exits can be used?

Fire Extinguishers

Different kinds of fires require different extinguishers, **Figure 2-23**. There are four classes of fire:

CLASS A: paper, wood, and other rubbish. This type of fire requires “quenching/cooling.” Most extinguishers for Class A fires contain water.

CLASS B: flammable liquid, such as grease, gasoline, and oil.

CLASS C: Electrical equipment. The type of fire has to be “cooled.” The extinguisher contains carbon dioxide and will cool the fire until it goes out.

CLASS D: Flammable metals. There is not much concern for this type of fire in the woodshop.

The most effective fire extinguishers are the multiclass ones (such as ABC). These shoot a powder that produces a cooling, smothering effect to help stop the fire.

When using any type of fire extinguisher, follow these four steps. Remember the acronym **PASS**:

1. **Pull** the safety pin at the top of the extinguisher.
2. **Aim** the nozzle toward the base of the fire.
3. **Squeeze** the handle to release the extinguishing agent.
4. **Sweep** the nozzle in a back-and-forth motion across the base of the fire.

After the fire has been extinguished, watch to make sure it will not re-ignite.



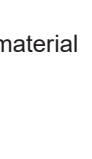
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Figure 2-21. Flammable liquids should be stored in metal, fireproof cabinets.



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Figure 2-22. Fire extinguishers should be kept in an accessible location in the shop. The label shows the types of fires for which the extinguisher can be used.

Fires	Type	Use	Operation						
Class A Fires Ordinary Combustibles (Materials such as wood, paper, textiles.) <i>Requires...cooling-quenching</i> Old New  	Soda-acid Bicarbonate of soda solution and sulfuric acid 	Okay for use on  Not for use on   	Direct stream at base of flame.						
Class B Fires Flammable Liquids (Liquids such as grease, gasoline, oils, and paints.) <i>Requires...blanketing or smothering.</i> Old New  	Pressurized Water Water under pressure 	Okay for use on  Not for use on   	Direct stream at base of flame.						
Class C Fires Electrical Equipment (Motors, switches, etc.) <i>Requires... a nonconducting agent.</i> Old New  	Carbon Dioxide (CO₂) Carbon dioxide (CO ₂) gas under pressure 	Okay for use on   Not for use on  	Direct discharge as close to fire as possible, first at edge of flames and gradually forward and upward.						
Class D Fires Combustible Metals (Flammable metals such as magnesium and lithium.) <i>Requires...blanketing or smothering.</i> 	Foam Solution of aluminum sulfate and bicarbonate of soda 	Okay for use on   Not for use on  	Direct stream into the burning material or liquid. Allow foam to fall lightly on fire.						
	Dry Chemical 	<table><tr><td>Multi-purpose type</td><td>Ordinary BC type</td></tr><tr><td>Okay for  </td><td>Okay for  </td></tr><tr><td>Not okay for  </td><td>Not okay for  </td></tr></table>	Multi-purpose type	Ordinary BC type	Okay for 	Okay for 	Not okay for 	Not okay for 	Direct stream at base of flames. Use rapid left- to-right motion toward flames.
Multi-purpose type	Ordinary BC type								
Okay for 	Okay for 								
Not okay for 	Not okay for 								
	Dry Chemical Granular type material 	Okay for use on  Not for use on   	Smother flames by scooping granular material from bucket onto burning metal.						

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Figure 2-23. Not every fire extinguisher will put out every kind of fire. Check the label on the extinguisher. Using the wrong extinguisher could electrocute you or produce toxic fumes.

Hazardous Waste Disposal

Many finishing supplies, such as paints, solvents, thinners, stains, and clear finishes, are dangerous to humans and to our environment. These hazardous wastes must be stored in Environmental Protection Agency (EPA) approved and properly labeled containers. They should never be poured down the sink drains or dumped outside on the ground.

Career Readiness

As a student and worker, you use technology skills every day to enhance your productivity and knowledge. List some of the common chemicals used in a typical woodworking shop. Use the Internet to search for the most current MSDS for each chemical and identify the proper storage, handling, transport, and disposal of each. Improper and unsafe handling of chemicals is a danger to everyone in the shop and cause for dismissal for your job.

Test Your Knowledge

Answer the following questions based on the information provided in this section.

1. *True or False?* All finishing supplies and other flammable material should be stored in a wood cabinet.
2. Used finishing cloths must be disposed of in a safety can with a(n) _____ lid.
3. Gasoline should not be used for cleaning because it has a low _____.
4. The best fire extinguisher to have in the woodshop is the _____ type.
5. *True or False?* Class A fires usually involve flammable liquid.
6. Electrical fires can be controlled with the Class _____ fire extinguisher.
7. A Class D fire involves flammable _____.
8. What does the acronym PASS mean?
9. _____ wastes are dangerous to humans and the environment.
10. *True or False?* Hazardous waste should be poured onto the ground, away from the woodshop building.

Activities

1. Tour your shop to determine if there are any potential safety hazards. List any hazards you find and determine what should be done to correct the situation.
2. Create a safety training presentation for the class that addresses any safety hazards you identified in the shop, as well as other general shop safety topics.



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A well-organized wood shop contributes to a safe environment.