Here are different readings : you will learn (or revise) vocabulary, acronyms ... You may have a test after this reading homework...

Introduction to Safety

- Introduction
- General Safety Guidelines
- General Clothing for a Machining Environment
- Personal Protective Equipment (PPE)
- Housekeeping
- Guards and Barriers
- Handling and Lifting
- Compressed Air Safety
- Lockout/Tagout
- Hazardous Materials
- SDS
- Fire Safety
- Safety Documentation

GENERAL CLOTHING FOR A MACHINING ENVIRONMENT

Choosing appropriate clothing to wear when working in a machining environment is important.

Wear long pants to protect legs from sharp or hot metal shavings. Shorts, skirts, or dresses are not recommended. Short-sleeved, close-fitting shirts are best. If wearing long sleeves, roll sleeves up past the elbows. Shirts or sweatshirts with hoods or drawstrings should be removed. If a shop coat or apron is worn, it should fit snugly and any ties or strings secured so they do not hang loosely.

Hard, flat-soled work shoes should always be worn because metal shavings, or chips, often fall onto the shop floor and can possibly cut through the soles of other shoes and cause serious cuts. Slip-resistant soles should also be worn because oils and other fluids may spill onto the floor and create slippery conditions. Leather work shoes are preferred, and sometimes safety-toe shoes or even those with metatarsal shields are required. See **Figure 2.1.1** for some examples of appropriate footwear for use in a machining environment.

See **Figure 2.1.2** for securing long hair.

Most machining tasks should be performed without wearing gloves because gloves can also get caught in

FIGURE 2.1.1 Some examples of appropriate footwear for a machining environment. Different heights are available with either (A) soft toes, (B) safety toes, or (C) metatarsal shields, which help to protect the entire foot from heavy objects.

FIGURE 2.1.2 Long hair should be secured safely in a machining environment.

moving parts. Gloves can be worn to perform some specific tasks, as discussed next under the topic heading of Personal Protective Equipment (PPE).

CAUTION

- Avoid any loose-fitting clothing that can get caught in moving machinery.
- Casual shoes, open-toed shoes, sandals, high-heeled shoes, and flip-flops should never be worn.
- Specific types of jewelry should not be worn while machining. Necklaces, dangling earrings, bracelets, watches, and rings can get caught in moving parts of equipment and pull a person into a machine, causing serious injury or even death.
- Long hair should always be secured with a hat, cap, or hairnet so that it does not get caught in moving machinery.
- Never wear gloves when working around running machinery or any moving parts.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

PPE, or **personal protective equipment**, refers to safety equipment that is to be worn to protect a person from potential dangers. Become familiar with PPE requirements for the situations that you will be working in.

CAUTION

Always use the appropriate PPE for every situation.

Eye Protection

Eye protection is the most common type of PPE used in the machining industry. Safety glasses with side shields must always be worn when entering a shop environment, even if just visiting or observing. Always wear safety glasses that meet the standard for protection set by the American National Standards Institute (ANSI), as required by OSHA regulations. The label of *ANSI Z87.1* identifies eyewear that meets this standard. Some situations may also require use of a face shield in addition to standard safety glasses. Ordinary prescription eyeglasses are not adequate protection. Their lenses may shatter when impacted and send lens particles into the

eyes along with the foreign object that broke the lens. For those who wear prescription eyeglasses, there are safety glasses that can be worn over the prescription glasses. Prescription safety glasses are also available. Some operations may also require the additional protection of a face shield. A face shield does not replace standard safety glasses, but provides added protection. **Figure 2.1.3** shows a few of the many different styles of eye and face protection.

If any foreign objects enter the eyes, do not rub the eyes because the particles can cause more damage if moved around. If small particles enter the eye, gently pull the eyelid away from the eye, flush with water as recommended by NIOSH, and see a doctor if irritation persists. If a larger foreign object is stuck in the eye, do not try to remove or flush with water, but seek immediate emergency medical attention.

CAUTION

Always wear safety glasses when in any machining environment.

FIGURE 2.1.3 (A) Safety glasses and goggles come in many different styles. Note that some can be worn over ordinary eyeglasses. Face shields (B) do not take the place of safety glasses, but are worn in addition to them when performing certain operations.

Hearing Protection

Some machining environments may involve high noise levels. OSHA requires some type of noise control or hearing protection if sound levels are above 115 db (decibels) for ¼ hour or over 90 db for 8 hours. Protection is also required if people are exposed for any length of time to a noise level above 140 db. In such situations, hearing protection in the form of earplugs or earmuffs can be used. **Figure 2.1.4** shows some different types of hearing protection.

FIGURE 2.1.4 Some examples of hearing protection.

CAUTION

Personal music players do not provide hearing protection and prevent a worker from hearing machine crashes and people who may be injured. These devices should never be used in a machining environment.

FIGURE 2.1.6 These air-purifying respirators use replaceable filters or cartridges that filter contaminants from the air.

Respirators

Occasionally the air in a machining environment may contain hazardous particles or gases. Fumes are airborne solid particles, while vapors are gases. In some instances, a central ventilation system using hoods or exhaust vents provides protection by removing contaminants from the air. (**See Figure 2.1.5.**)

When hoods or exhaust vents are not strong enough to clean the air, a personal respirator may be required for protection from those contaminants. There are two basic types of respirators: air purifying and atmosphere supplying. Air-purifying respirators use fine mesh or canister-type filters to remove particles or gases from the air so it is safe to breathe. (**See Figure 2.1.6.**) An atmosphere-supplying respirator supplies clean air from a separate source, as shown in **Figure 2.1.7**. Be sure to receive proper training before using any type of respirator.

FIGURE 2.1.7 This worker is wearing an atmosphere-supplying respirator. Note the hose that would be connected to an external oxygen source.

Gloves

There are a few situations in machining where the use of gloves is acceptable. Canvas or leather gloves can be worn to protect hands from cuts when handling raw materials, saw blades, or large cutting tools.

Many chemicals require wearing a specific type of glove while handling. "Rubber gloves" is an everyday term that some people use, but gloves are also made from many other materials such as nitrile, neoprene, latex, or polyvinyl chloride (PVC). They come in various lengths as well. **Figure 2.1.8** shows a few of the many types of gloves available. Always check the chemical manufacturer's recommendation so that the correct type of glove is used. Using the wrong type of glove may provide no protection at all and can lead to exposure and chemical burns.

FIGURE 2.1.8 Different gloves are available for different uses. Note the different lengths. When handling chemicals, always follow the chemical manufacturer's recommendation for the proper type of glove.

CAUTION

Never wear gloves when working around moving parts of running machinery.

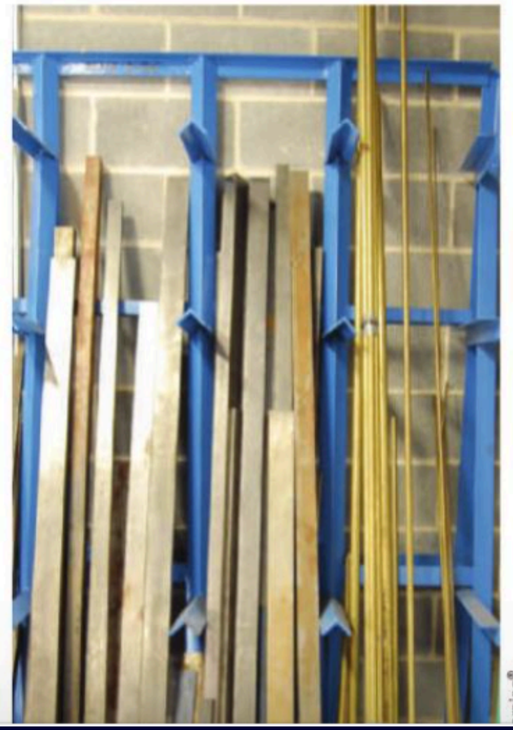
Hard Hats

Some machining environments deal with very large materials and parts. When working in an area where items are stored overhead or moved overhead by hoists or cranes, hard hat usage should be implemented. OSHA regulations require hard hats to be worn whenever there is a danger of head injury from falling items.

HOUSEKEEPING

Housekeeping refers to keeping the working environment clean to prevent dangerous situations. A few simple guidelines can keep a shop clean and safe.

Organizing materials and equipment while working and after job completion is the first step in creating a clean, safe setting. Clutter on benches, on machinery, and in storage areas creates situations where falling items can cause injury, and can damage tools as well. Clean tools and always store them appropriately after use to avoid injury and to keep tools in good condition. Bars of material leaning against walls and machinery can also fall and cause injury. Do not stack round bars of material against walls, because the stack can collapse and roll uncontrollably. Store material in racks like those shown in **Figure 2.1.9**. Items piled on floors can create tripping hazards.



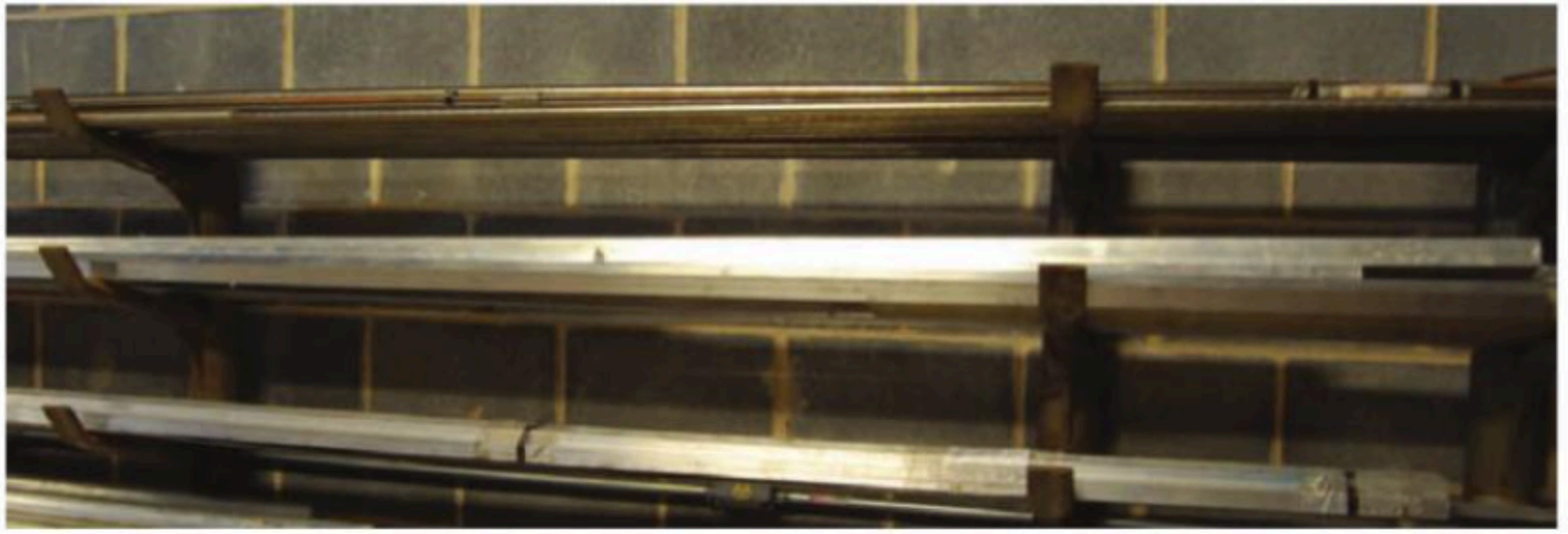


FIGURE 2.1.9 Store material in proper racks like these for safety. Don't stack it on the floor, workbenches, or machinery.

Photo courtesy of Justrite Mfg. Co.

FIGURE 2.1.10 Dispose of oil- and solvent-soaked rags in safety cans like these to avoid spontaneous combustion.

Clear workbenches and machinery of chips with a brush, and use rags to wipe fluids from machinery. Never remove chips or clean machinery while it is running. Place rags soaked with oil or solvents in a safety container like the one shown in **Figure 2.1.10** to avoid spontaneous combustion.

Keeping floors clean of other debris such as metal chips, scraps, oils, and other fluids is also important to create a safe environment. Aisles and walkways also need to be kept clear of obstructions. Do not store materials or equipment in places that can block access to these areas. Daily floor sweeping (or more often if needed) is a good habit to develop. Clean up liquid spills as soon as they occur to minimize the potential of falling hazards from slippery floors. Small liquid spills can often simply be mopped. Large spills can be absorbed with granular absorbents, mats, or rolls like those shown in **Figure 2.1.11**. If using a granular absorbent, sweep up the particles after the liquid has been absorbed. Be sure to properly dispose of the absorbents and mop the area with a quality floor cleaner afterward.

CAUTION

- Always store material, tools, and other equipment in safe locations to prevent tripping and falling hazards.
- Never use your hands to remove chips from equipment.

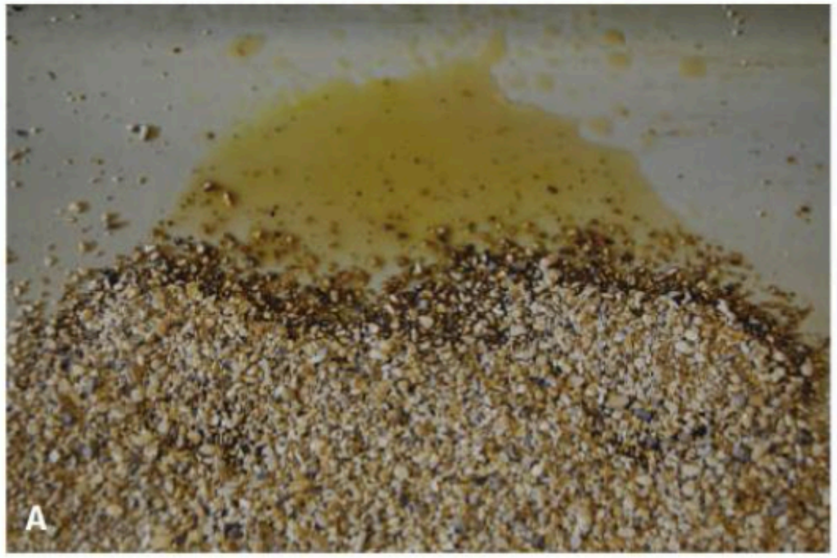


FIGURE 2.1.11 (A) Oil and solvent spills can be absorbed with granular absorbents, then the absorbent can be swept up. (B) Pads or "socks" can also be used to soak up spills.

A well-organized and clutter-free space helps to create a safe work environment.

GUARDS AND BARRIERS

Some environments will contain warning signs or physical barriers to prevent people from entering a danger area. These provide protection during machine operation. Machines frequently have physical guards surrounding cutting tools or other danger areas to prevent hands or fingers from reaching a cutting tool or other moving parts. (**See Figure 2.1.12.**) A switch may keep a machine from operating if a guard is not in its proper place. A light beam may take the place of a physical barrier or guard. If someone crosses into a danger zone and breaks the light beam, the machine is disabled.

CAUTION

Always respect warnings and barriers, and never operate machinery without all safety devices in place. Never attempt to bypass or override any safety device.

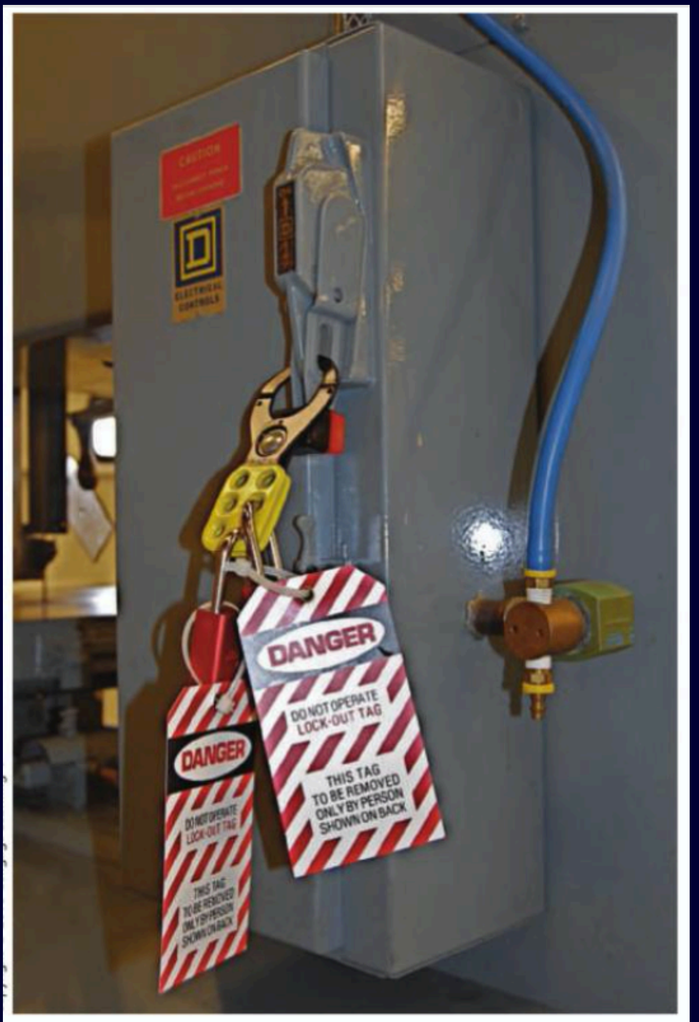


FIGURE 2.1.16 A lockout hasp allows several different people to lock out or tag out a piece of equipment. This machine has been locked out by two different people.

Lockout stations are also often used to provide workers access to lockout devices.

HAZARDOUS MATERIALS

As stated under the topic heading of Personal Protective Equipment (PPE), some machining environments may have exposure to hazardous materials. Hazardous materials can take the form of liquids, solids, or gases. OSHA requires manufacturers of hazardous materials to provide information about these types of materials to users. Employers must also label hazardous materials and provide training to employees who work around them. These activities are referred to as "Right to Know" laws, because OSHA states that workers have a right to know what hazards exist in the workplace and that employers must provide knowledge of those hazards. Companies often conduct special safety meetings or orientations to provide this information to employees.

CAUTION

- When using any product, it is a good idea to check for a hazardous material label.
- If any product is stored in a container other than its original container, an NFPA or HMIS label should always be placed on the new container.

Hazardous Material Labeling

There are two systems of labeling of hazardous materials that are widely used in the machining industry: **NFPA (National Fire Protection Association)** and **HMIS (Hazardous Material Identification System)**. Both offer highly visual systems that serve as warnings of potential dangers.

NFPA

NFPA standard 704 is used to identify specific types of hazards and their levels of danger. The standard uses the multi-colored diamond-shaped symbol shown in **Figure 2.1.17**.

The smaller, different-colored diamonds in an NFPA label show different types of hazards. Numbers ranging from 0 to 4 in each colored diamond rate the hazard level from least to most severe.

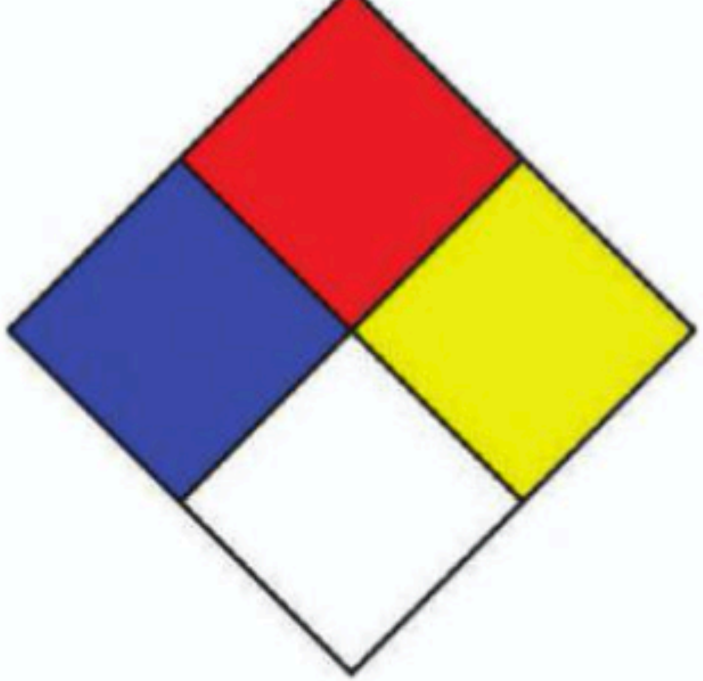


FIGURE 2.1.17 The NFPA (National Fire Protection Association) hazardous material label.

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[1]This reprinted material is not the complete official position of the NFPA on the referenced subject, which is represented solely by the standard of its entirety. The classification of any particular material within this system is the sole responsibility of the user and not the NFPA. NFPA bears no responsibility for any determinations of any values for any particular material classified or represented using this system.

HAZARDOUS MATERIALS CLASSIFICATION

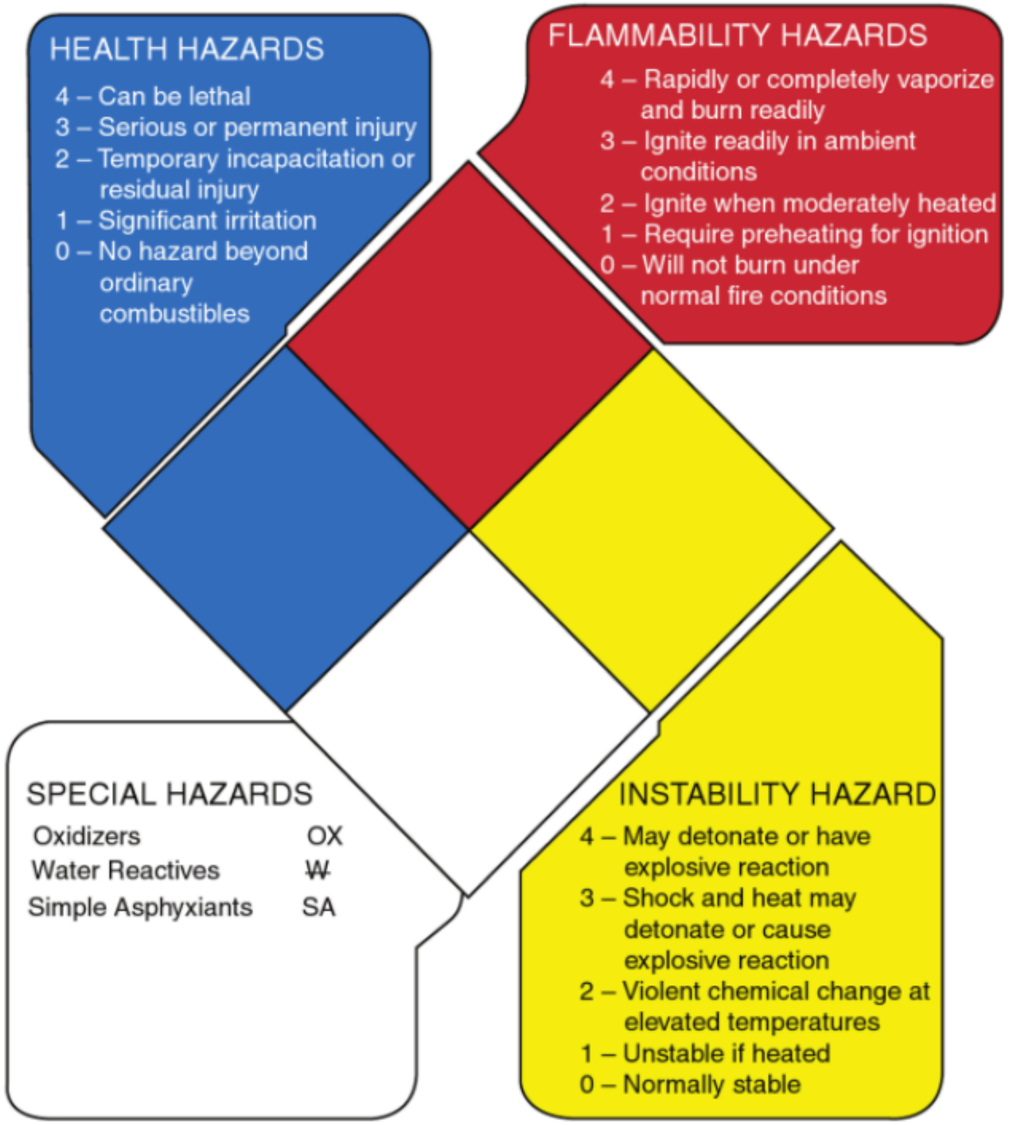

FIGURE 2.1.18 Explanation of the NFPA hazardous material rating system.

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The red diamond rates flammability of a material. The blue diamond rates health hazards. The yellow diamond rates the hazard of instability, or how easily the substance can explode. The white diamond does not use the numbers 0 to 4, but uses symbols to identify special hazards. **Figure 2.1.18** explains the ratings for each type of hazard as well as symbols used to denote special hazards. **Figure 2.1.19** shows the details for two sample NFPA hazard labels.

Additional information can be obtained by visiting the NFPA's website at http://www.nfpa.org

[2]This reprinted material is not the complete official position of the NFPA on the referenced subject, which is represented solely by the standard of its entirety. The classification of any particular material within this system is the sole responsibility of the user and not the NFPA. NFPA bears no responsibility for any determinations of any values for any particular material classified or represented using this system.

[3]We recommend caution when using the HMIS® III and including the following: HMIS® ratings are based on a 0–4 rating scale, with 0 representing minimal hazards or risk, and 4 representing significant hazards or risks. Although HMIS® ratings are not required on MSDSs under 29 CFR 1910.1200, the preparer may choose to provide them. HMIS® ratings are to be used with a fully implemented HMIS® program. HMIS® materials may be purchased exclusively from J. J. Keller at 800-327-6868.

HMIS® III®

HMIS III is the most recent version of the HMIS® method. This system is similar to that of the NFPA but uses colored *bars* and numbers from 0 (minimal hazard) to 4 (severe hazard). An example of an HMIS® III label is shown in **Figure 2.1.20**.

The blue bar at the top in an HMIS® label rates the health hazard of a substance. An asterisk (*) shows that the material has been shown to cause **chronic** (long-term) health hazards. Flammability hazards are rated in the red second bar. The orange third bar rates physical hazards. A white bar at the bottom of the label uses letters and symbols to identify PPE recommended when

HMIS® is a registered mark of the American Coatings Association (ACA).

FIGURE 2.1.20 The HMIS III hazard label.

using the product. Details of the rating system are shown in **Figure 2.1.21**. **Figure 2.1.22** gives details for two sample HMIS® labels.

Additional information about HMIS® can be obtained by visiting the American Coatings Association website at http://www.paint.org/programs/hmis.html.

SDS

NFPA or HMIS labels can quickly identify potential hazards, but OSHA's Hazard Communication Standard (HCS) also requires detailed documentation of hazardous materials used in the workplace. Hazardous material information is contained in a document known as an **SDS**, or **Safety Data Sheet**. Prior to the year 2012, SDS was known as **MSDS** or **Material Safety Data Sheet**, so the term *MSDS* may sometimes still be used. The SDS is another component of *Right to Know*. Companies rely on SDS information to guide training and protect workers. They may have regular safety meetings to discuss hazardous materials and SDS information. It is important to become familiar with interpreting basic information on an SDS to protect yourself and others, and to know what to do in case of an emergency involving a hazardous material. Many manufacturers provide online access to SDSs for their products.

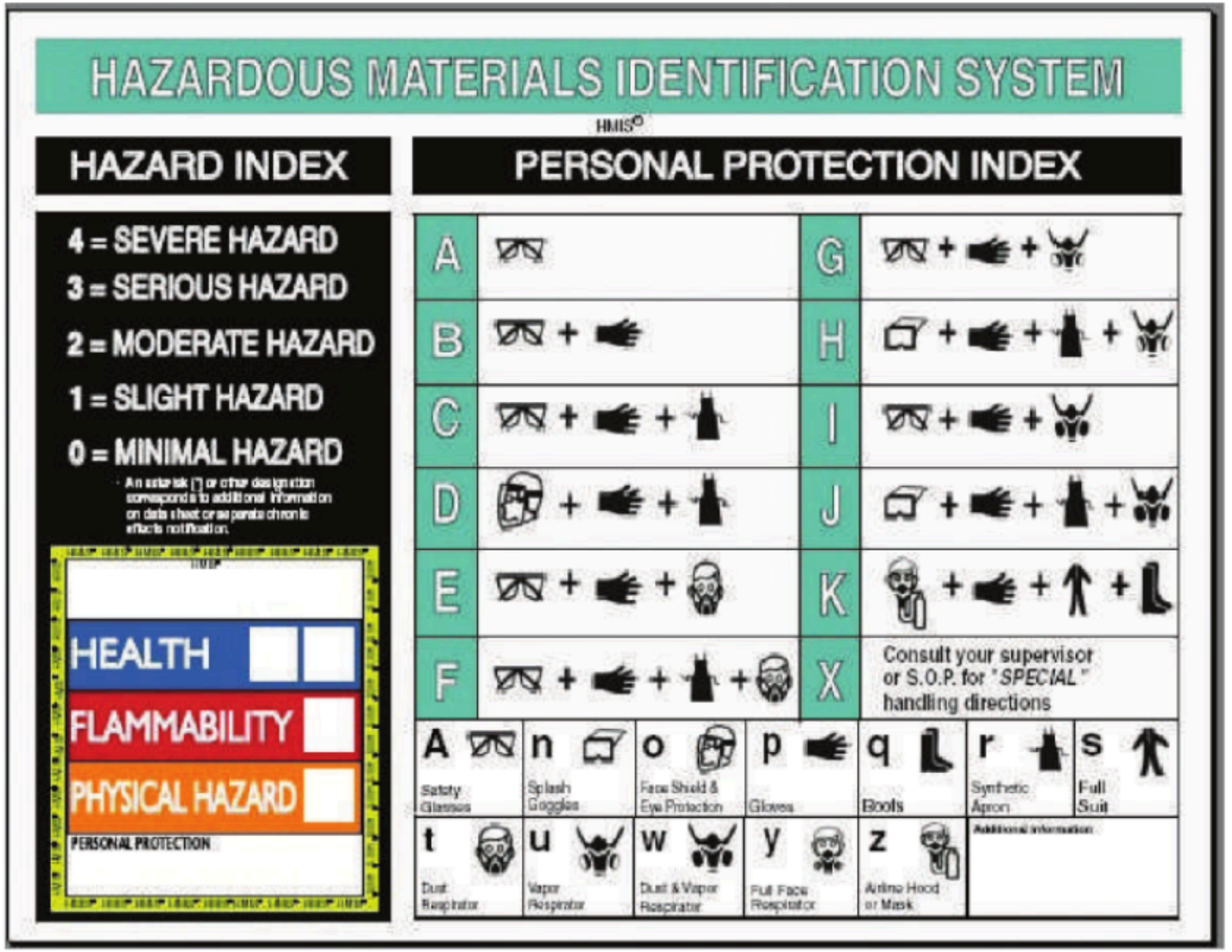

FIGURE 2.1.21 Explanation of the HMIS III rating system.

Slight health hazard from exposure to this material. No long-term hazard.

Material will not burn.

Material is very stable.

Safety glasses required during use.

Severe, possibly deadly hazard.
Long-term health hazard shown by *.

Highly flammable material.

Material is very stable.

Requires use of splash goggles, gloves, protective apron, and vapor respirator during use.

FIGURE 2.1.22 Explanation of two sample HMIS hazard labels.

Next slide

Section 2: Hazard(s) Identification

Section 2 lists all hazards related to the product. Visual symbols called pictograms can be used to show specific types of hazards such as explosives and flammables. **Figure 2.1.23** shows and defines these pictograms.

Corrosion

- Skin Corrosion/Burns
- Eye Damage
- Corrosive to Metals

Exploding Bomb

- Explosives
- Self-Reactives
- Organic Peroxides

Skull and Crossbones

- Acute Toxicity (fatal or toxic)

Flame Over Circle

- Oxidizers

Environment (Non-Mandatory)

- Aquatic Toxicity

Gas Cylinder

- Gases Under Pressure

Health Hazard

- Carcinogen
- Mutagenicity
- Reproductive Toxicity
- Respiratory Sensitizer
- Target Organ Toxicity
- Aspiration Toxicity

Flame

- Flammables
- Pyrophorics
- Self-Heating
- Emits Flammable Gas
- Self-Reactives
- Organic Peroxides

Exclamation Mark

- Irritant (skin and eye)
- Skin Sensitizer
- Acute Toxicity
- Narcotic Effects
- Respiratory Tract Irritant
- Hazardous to Ozone Layer (Non-Mandatory)

FIGURE 2.1.23 HCS (Hazard Communication System) pictograms used to show various types of hazards on an SDS (Safety Data Sheet).

Fire safety

FIRE SAFETY

Fire safety is important in any setting, and a machining environment is no different. The first goal in fire safety is prevention, and conditions where fire hazards exist will be reviewed throughout this text. Knowledge of the factors needed for a fire to burn will help in understanding how to extinguish fires.

The Fire Triangle

The fire triangle shown in **Figure 2.1.24** is a simple symbol that shows the factors needed for a fire. Its sides represent fuel, heat, and oxygen. All three of those elements are needed for a fire to burn.

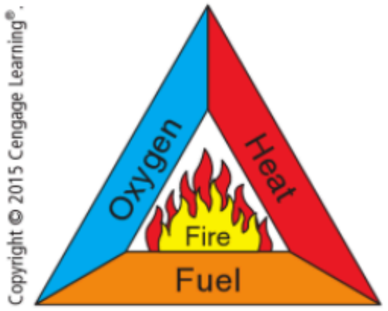

FIGURE 2.1.24 The fire triangle. All three sides must exist for a fire to burn. The job of a fire extinguisher is to remove one of those three elements.

Fire Extinguishers

Fire extinguishers work by cooling the fuel, removing the oxygen, or stopping the reaction. A fire extinguisher sprays a pressurized substance, or media, out of a nozzle. The spray should be aimed at the fuel, which is at the base of a fire, not at the flames.

OSHA identifies five basic types of fires and extinguishers for those particular types of fires. Four may be found in or near a machining setting. Refer to **Figure 2.1.25** for the symbols for these different types while reading their descriptions below. Using the wrong type of extinguisher can fuel a fire and make conditions worse, so be sure to understand the different types and when to use them. Always check fire extinguisher labels to be sure the proper type is available for the given situation.

If a fire is beyond the control of a fire extinguisher, evacuate the area according to an established plan. Notify the proper emergency authorities after safe evacuation.

Class A

Class A fires are what OSHA defines as those involving ordinary combustibles, such as paper, cloth, wood, rubber, and many plastics. Extinguishers labeled for Class A fires use pressurized water as an extinguishing media. Only use a water-based Class A extinguisher on a Class A fire, never on any other type of fire.

Class B

OSHA defines fires in oils, gasoline, some paints, lacquers, grease, solvents, and most other flammable liquids as Class B fires. Class B extinguishers use carbon dioxide (CO_2) as an extinguishing media.

Class C

OSHA defines Class C fires as electrical fires, such as in wiring, fuse boxes, energized electrical equipment, and computers. Class C extinguishers use a dry chemical as an extinguishing media. Class C extinguishers can also use a dry powder or foam media.

Class D

Metal fires are defined as Class D fires by OSHA. They are fires of small particles, such as chips or filings of combustible metals such as magnesium, titanium, potassium, and sodium.

Multipurpose Extinguishers

CO_2 extinguishers may be labeled as usable for both Class B and C fires. Some dry chemical extinguishers may be labeled for use on Class A, B, and C fires. These extinguishers are probably most common in machining because of the possibility of fires of each class or fires fueled by a combination of each class of combustibles.

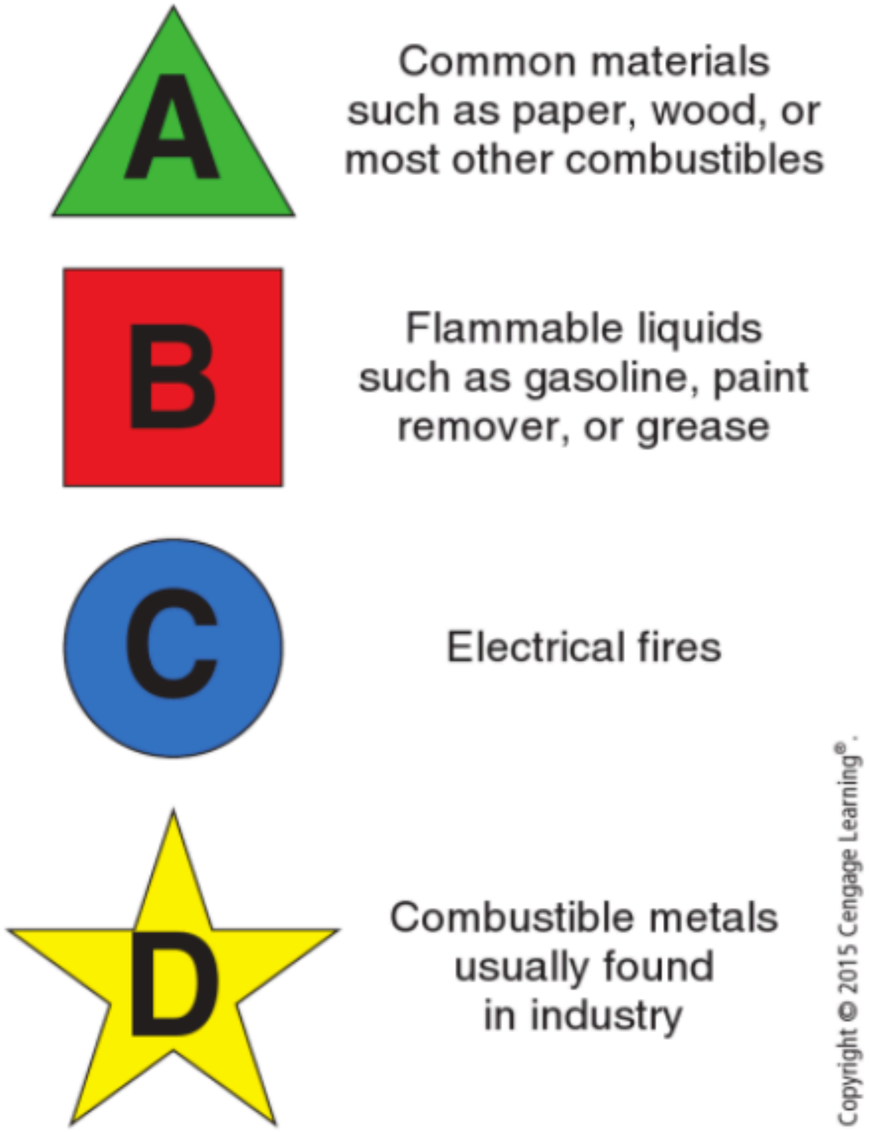

FIGURE 2.1.25 Identification of the different classes of fire extinguishers.

CAUTION

- Be familiar with the location and types of fire extinguishers in your machining area.
- Never use a water-based Class A extinguisher on a Class B fire, as it will splatter the burning liquid and expand the fire, leading to serious injury or death.
- Never use a water-based Class A extinguisher on a Class C fire because the water can increase the risk of electrocution, leading to serious injury or death.
- Never use a water-based Class A extinguisher on a Class D fire because the water can intensify some metal fires.

- Safety barriers or guards are often used to help prevent injuries by restricting access to danger areas. Never cross barriers during machine operation or operate machinery without proper guarding installed.
- Always use proper equipment and methods when lifting to avoid painful injuries.
- Compressed air should not be used to clear debris from machinery or to clean a person's body because debris can become dangerous projectiles and compressed air entering the body can cause severe injuries or even death.
- Use of lockout and tagout procedures prevents machinery from being operated during maintenance or repair to prevent serious injury or death and no one should ever attempt to remove or override someone else's lockout or tagout device.
- Hazardous materials that may be used in a machining setting can be quickly identified by NFPA and HMIS labeling systems. An SDS (or MSDS) shows important detailed information about composition, handling, and dangers of hazardous materials.
- A fire can occur in a machining environment, so be familiar with the location and types of fire extinguishers available in your area and know the fire evacuation plan for any area where you must work.
- Following basic safety guidelines will go a long way in keeping the machining area safe for everyone.

1. Briefly describe what you believe are the two most important actions everyone *should observe* to remain safe in a machining environment.
2. Briefly describe what you believe are the two most important actions that *should never be tolerated* in a machining environment.
3. What should be done in the case of a personal injury emergency?
4. What does OSHA stand for and what is OSHA's purpose?
5. List three specific clothing items that should not be worn in a machining setting.
6. If someone working around machinery has long hair, how should it be worn?
7. Never operate machinery without proper ___ in place.
8. What is PPE?
9. What is the most common and important piece of PPE that should always be used in a machining environment?
10. What does NFPA stand for?
11. What does HMIS stand for?
12. What is the purpose of NFPA and HMIS labeling?
13. What does SDS stand for, and what is the purpose of SDSs?
14. Class A fire extinguishers use ___ as a media to put out fires.
15. What class of fire extinguisher should be used on an electrical fire?
16. What class of fire extinguisher should be used on flammable liquids?