Introduction to Manufacturing, AGE-1320

Ahmed M. El-Sherbeeny, PhD

Fall-2026

Industrial and Workshop Safety

Chapter Outline

1. **Importance of safety**
2. **Hazard types**
3. **Hazard identification**
4. **Risk assessment**
5. **Personal Protective Equipment (PPE)**
6. **Machine safety**
7. **Safety codes and standards**
8. **Workshop safety practices**
9. **Safety culture and behavior**

1. Importance of Safety

Importance of Safety

Why Safety Matters in MFG

- Protects workers from injury and illness
- Improves productivity and quality
- Reduces downtime and equipment damage
- Required by safety regulations and industry standards
- Promotes long-term sustainability and professionalism



2. Hazard Types

Hazard Types

Common Manufacturing Hazards

- Mechanical hazards
  (moving machinery, rotating parts)
- Electrical hazards
  (shock, arc flash)
- Chemical hazards
  (fumes, vapors, spills)
- Fire and explosion hazards
- Noise, vibration, and heat
- Slips, trips, and falls



Electrical Risk



Abrasion & Scrapes



Chemicals Burns



Viral Infections



Impact Risk



Cut Risk



Extreme Temperatures



Musculoskeletal Disorders



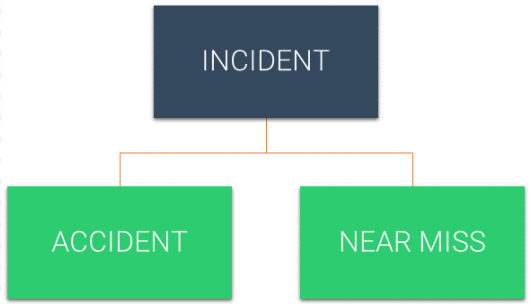
Hazard Types

Hazard vs Risk

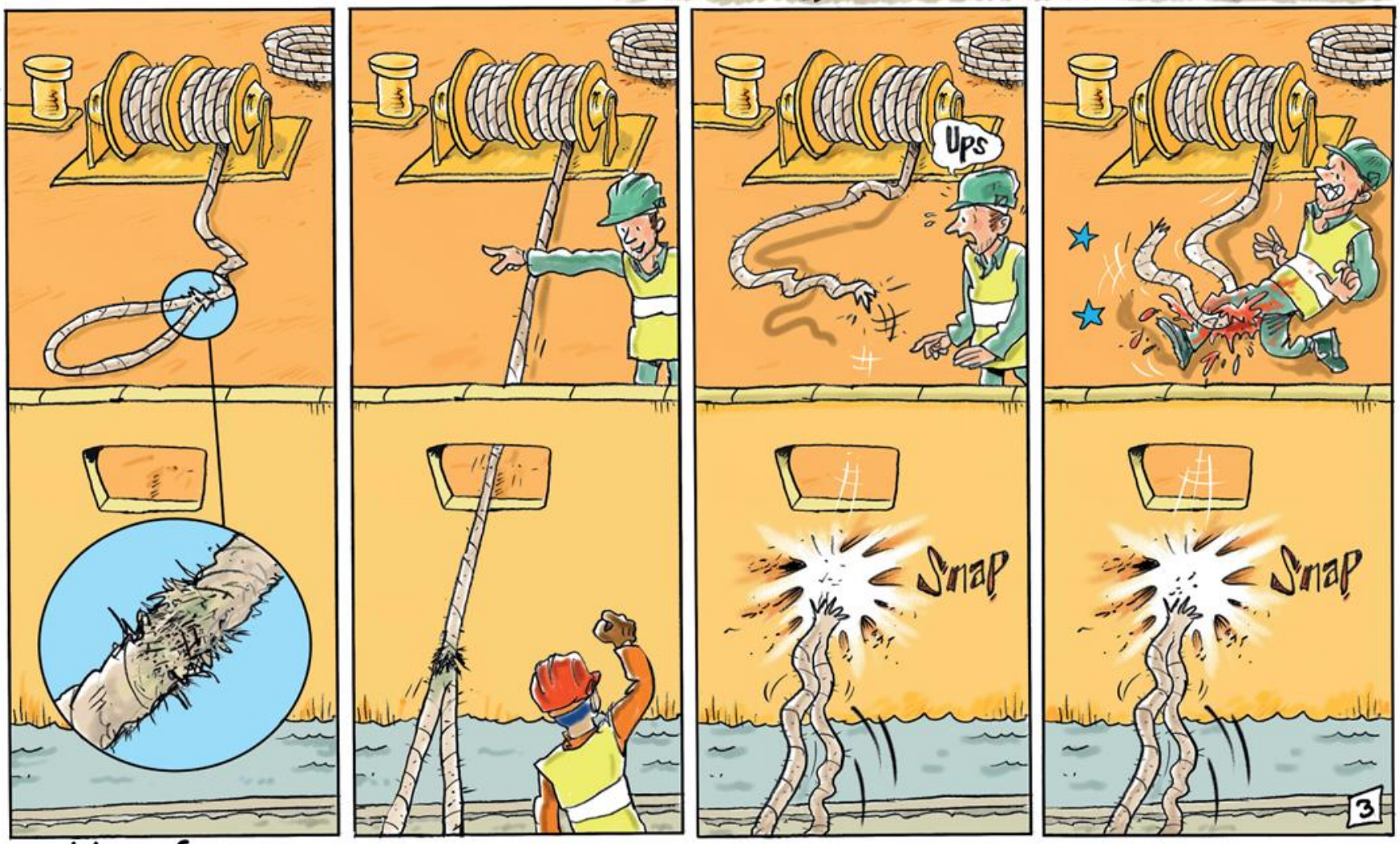
- **Hazard**: a source of potential harm
- **Risk**: the likelihood and severity of harm from a hazard
- **Incident**: Unplanned event that causes loss
- **Near-miss**: Event with no injury but potential for harm







the weak rope



Unsafe condition. • Unsafe act • Near miss • Accident

3. Hazard Identification

Hazard Identification

Hazard Identification Methods

- Regular inspections
- Reviewing past incidents
- Worker feedback
- Safety checklists
- Reviewing Safety Data Sheets (SDS)
- Studying equipment manuals

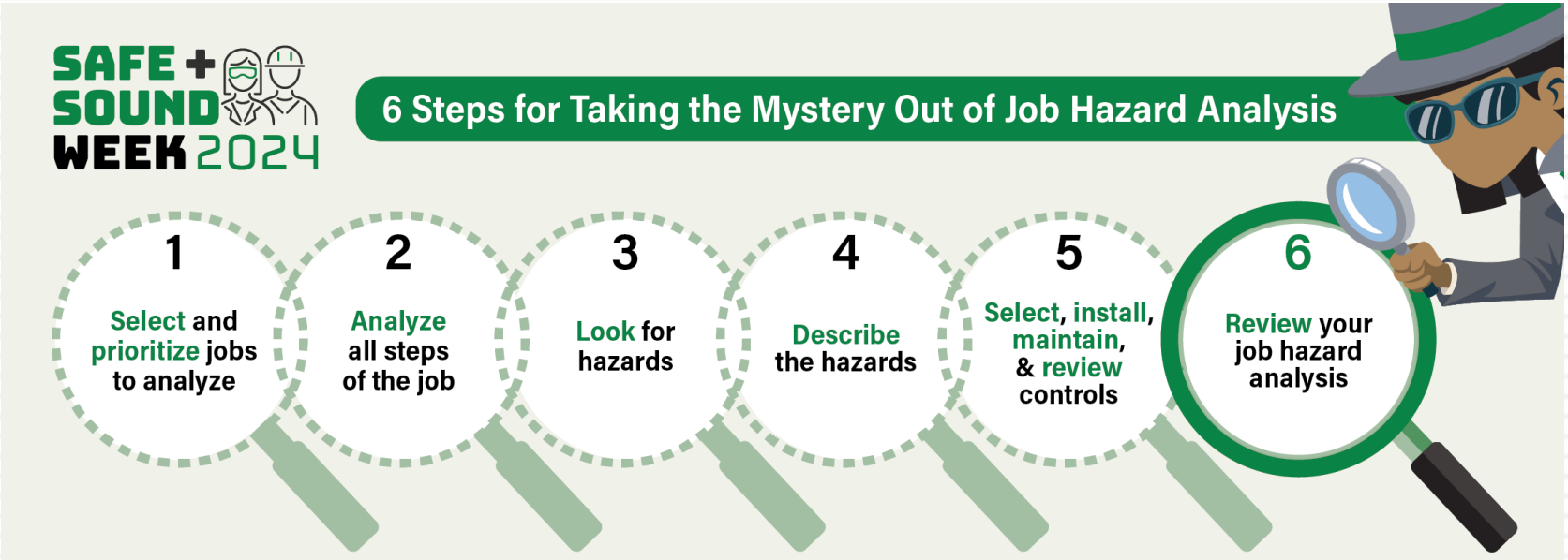




Hazard Identification

Job Hazard Analysis (JHA)

- Break job into steps
- Identify hazards for each step
- Determine **controls**
- Review regularly



4. Risk Assessment

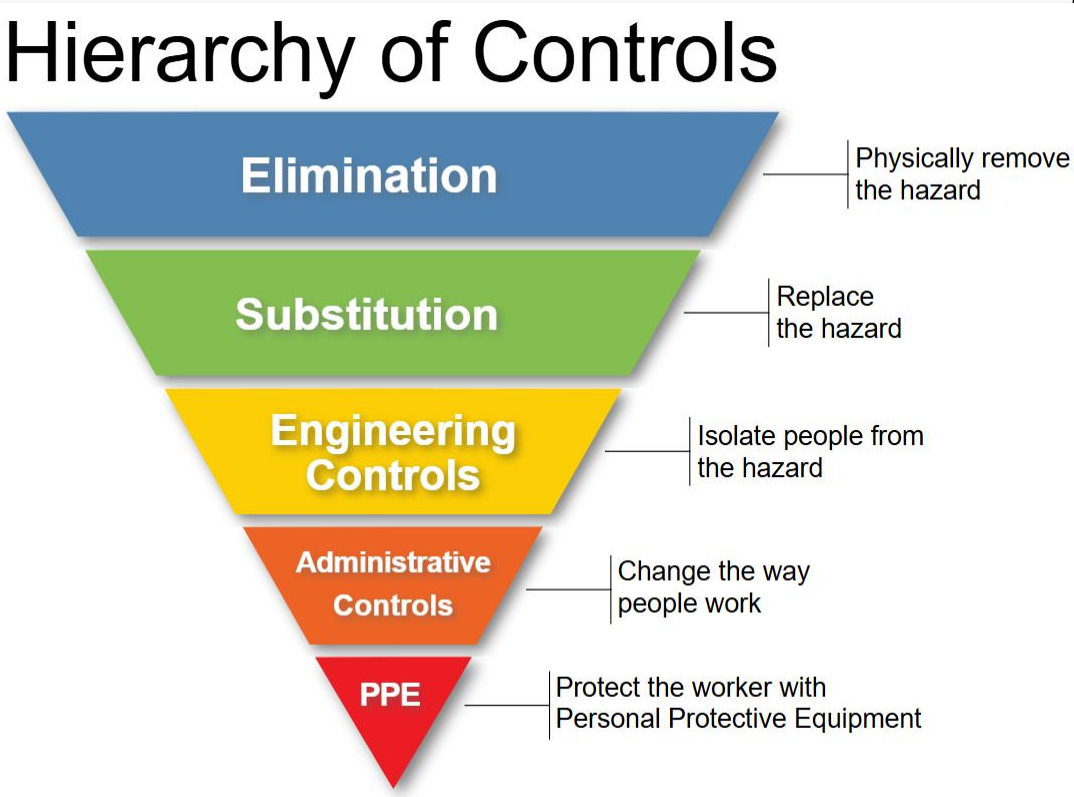
Risk Assessment



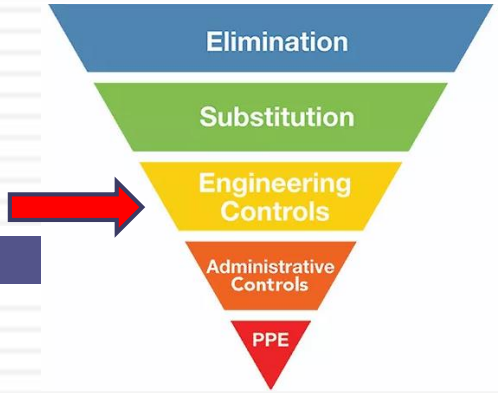
The Hierarchy of Controls

1. Elimination
2. Substitution
3. Engineering controls
4. Administrative controls
5. PPE





Risk Assessment



Engineering Controls in Workshops

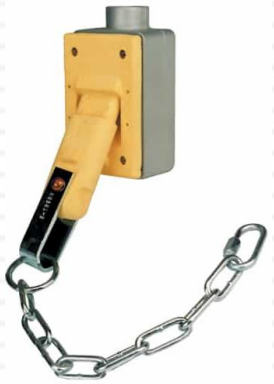
- Machine guards
- Barriers and enclosures
- Ventilation systems
- Noise dampening
- Interlocks



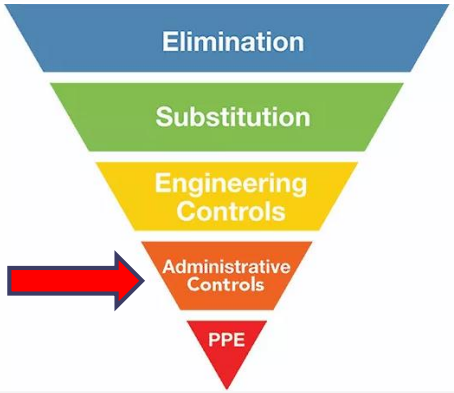








Risk Assessment



Administrative Controls

- Training
- Standard operating procedures
- Warning signs
- Rotating shifts to reduce fatigue
- Limiting access to hazardous areas









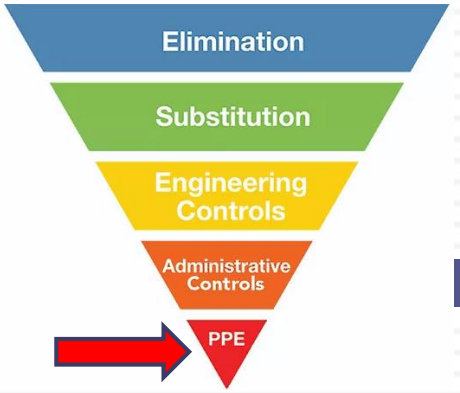






5. Personal Protective Equipment (PPE)

Personal Protective Equipment (PPE)



What is PPE?

- Equipment worn to minimize exposure to hazards
- Used when other controls cannot fully remove risk
- Must be selected based on hazard type



Personal Protective Equipment (PPE)

1. Head and Eye Protection

- Hard hats for falling object protection
- Safety glasses for impact
- Goggles for chemicals
- Face shields for grinding or cutting









Personal Protective Equipment (PPE)

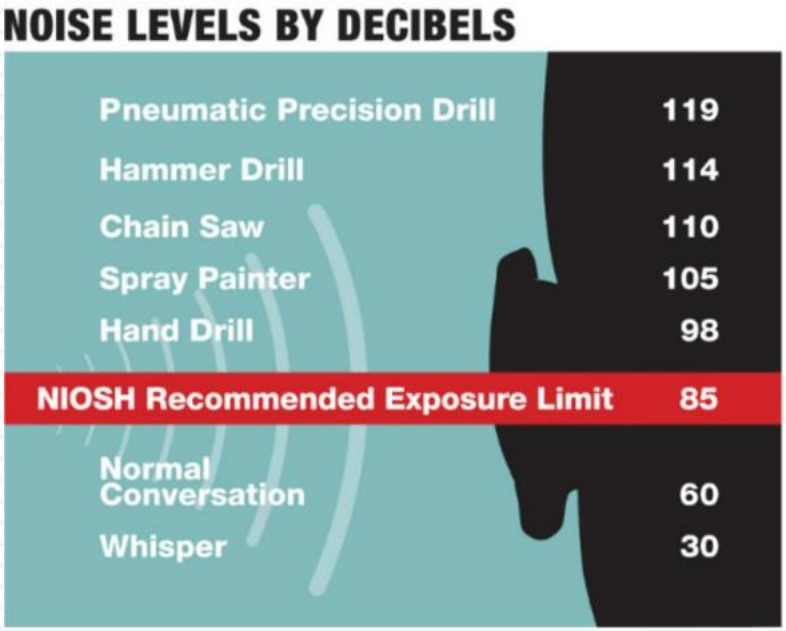


2. Hearing and Respiratory Protection

- Earplugs and earmuffs
- Respirators for dust and fumes
- Fit testing is required for tight-fitting masks







Personal Protective Equipment (PPE)

3. Hand and Body Protection

- Cut-resistant gloves
- Heat-resistant gloves
- Chemical-resistant aprons
- Flame-resistant clothing









Personal Protective Equipment (PPE)



4. Foot Protection and Visibility

- Safety shoes with toe protection
- Slip-resistant soles
- High-visibility vests
- Metatarsal guards







Personal Protective Equipment (PPE)

Proper PPE Use and Limitations

- Must fit properly
- Must be inspected before use
- Must be replaced when damaged
- PPE does not eliminate the hazard



6. Machine Safety

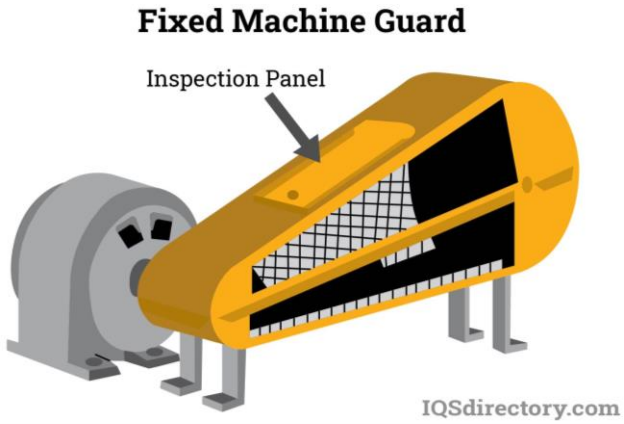
Machine Safety

Machine Safety Principles

- Read machine manuals
- Never bypass guards
- Verify tool condition before use
- Use correct speeds and feeds
- Keep hands and clothing away from moving parts



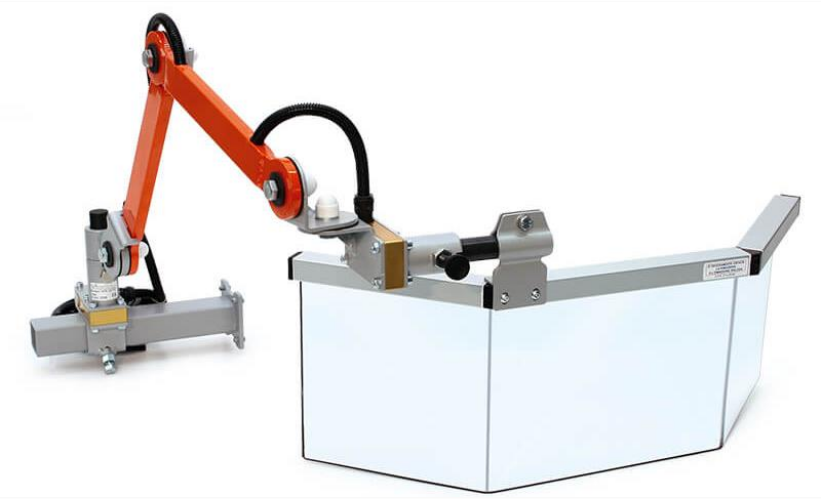
Machine Safety

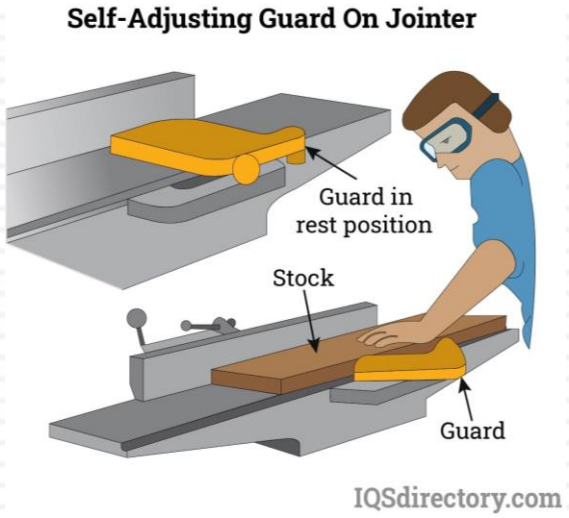


Types of Machine Guards

- Fixed guard
- Interlocked guard
- Adjustable guard
- Self-adjusting guard







Machine Safety

Lockout–Tagout (LOTO)

- Ensures machines cannot be powered during maintenance
- Prevents accidental startup
- Uses locks, tags, and isolation devices

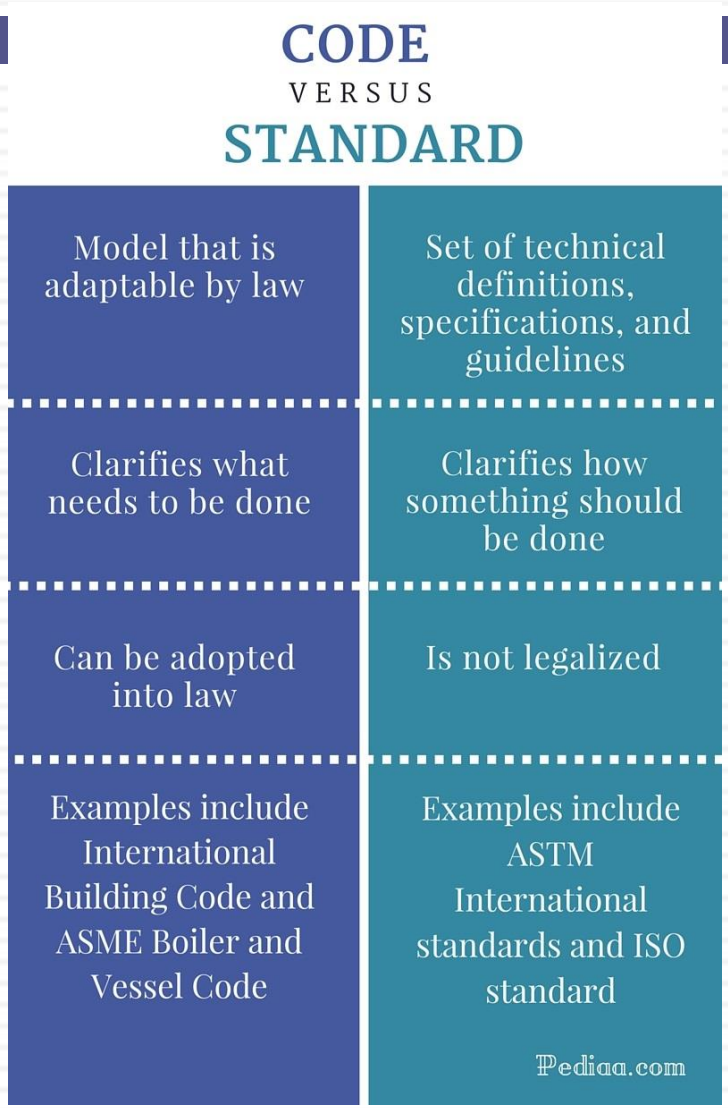


7. Safety Codes and Standards

Safety Codes and Standards

Safety Codes Overview

- Provide guidance on safe work practices
- Define responsibilities of employers and workers
- Used worldwide to ensure consistent safety performance



Safety Codes and Standards

Major International Standards

- OSHA (United States)
- ISO 45001 (Occupational health and safety)
- IEC electrical safety standards
- Fire protection standards (NFPA)

OSHA® Occupational Safety and Health Administration
www.osha.gov

International Organization for Standardization ISO 45001

IEC® International Electrotechnical Commission

NFPA® National Fire Protection Association

Safety Codes and Standards

Employer and Worker Responsibilities

- Employer must:
  - Provide safe workplace
  - Train workers
  - Provide PPE
- Worker must:
  - Follow safety procedures
  - Use PPE correctly
  - Report hazards and incidents



8. Workshop Safety Practices

Workshop Safety Practices

Housekeeping and Organization

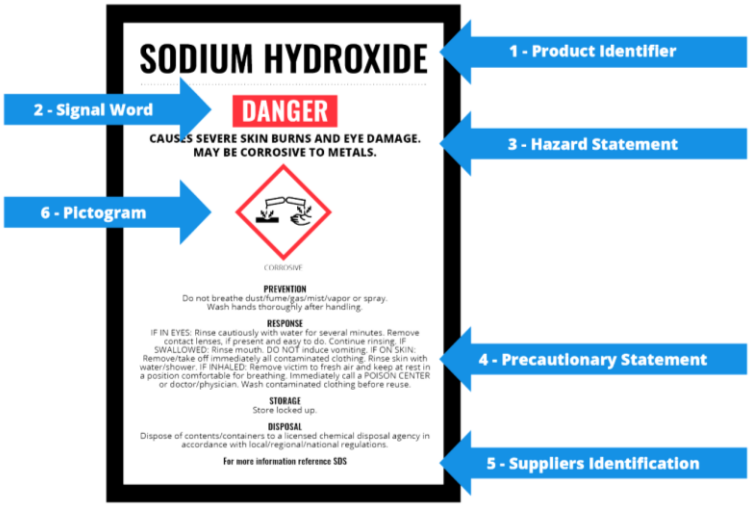
- Keep floors clear
- Store tools properly
- Clean spills immediately
- Maintain clear walkways



Workshop Safety Practices

Chemical Safety

- Use SDS for chemicals
- Store flammable materials properly
- Ensure good ventilation
- Label containers clearly

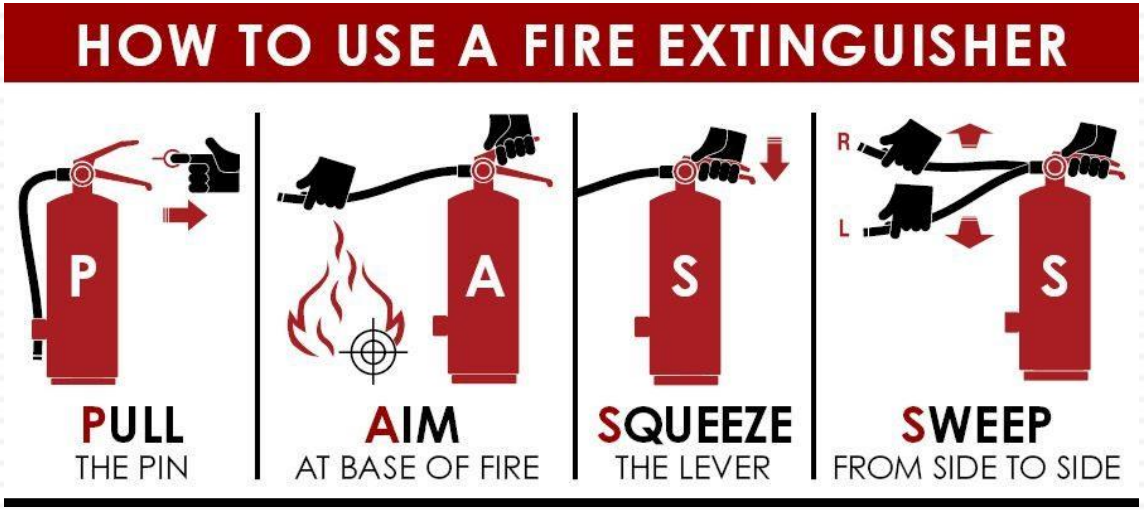




Workshop Safety Practices

Fire Safety

- Know fire extinguisher types
- Keep exits unblocked
- Remove ignition sources
- Proper storage of flammable liquids

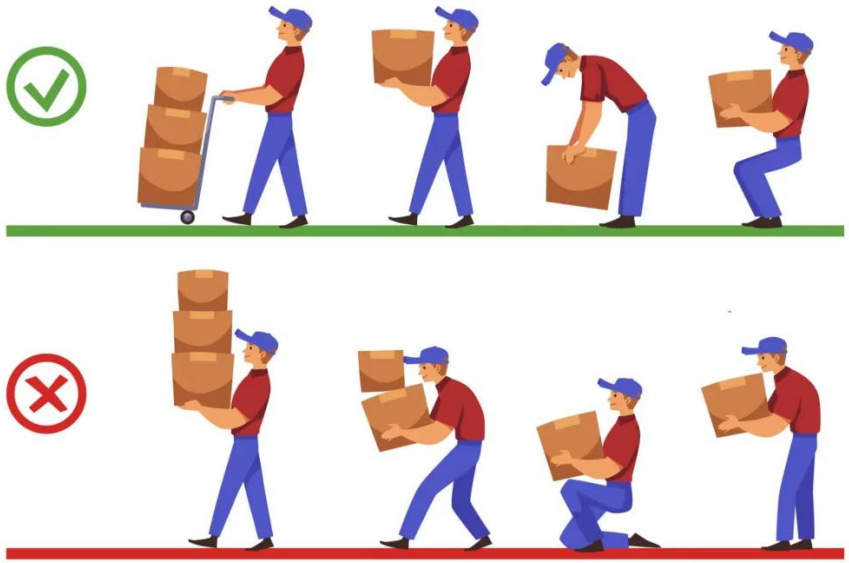




Workshop Safety Practices

Ergonomics and Manual Handling

- Use proper lifting technique
- Avoid awkward postures
- Reduce repetitive motions
- Use lifting aids when available





9. Safety Culture and Behavior

Safety Culture and Behavior

Importance of Safety Culture

- Encourages proactive reporting
- Reduces fear of speaking up
- Builds teamwork and vigilance
- Leads to fewer incidents





Safety Culture and Behavior

Unsafe Behaviors to Avoid

- Removing PPE
- Bypassing safety devices
- Rushing tasks
- Using damaged tools
- Ignoring warning signs



Safety Culture and Behavior

Daily Safety Checklist

- Am I wearing PPE?
- Are tools in good condition?
- Are guards in place?
- Are walkways clear?
- Are emergency exits visible?



Safety Culture and Behavior

Summary

- Safety protects workers, equipment, and productivity
- PPE is the last line of defense
- Hazard identification is ongoing
- Safe behavior is essential
- Hazard activity:



