



Instructor's Guide



Safety and Technology Series **Metalworking Safety**

Introduction

This guide provides information to help you get the most out of the *Metalworking Safety* program of the *Safety and Technology* series. *Metalworking Safety* provides a series of tips for preventing the myriad accidents that can occur in a metalworking environment. Among the topics the video covers are recommended practices for safely using materials, rules for maintaining a safe work setting in a foundry, and ways to carefully negotiate sheet metal and accompanying equipment.

Learning Objectives

After viewing the program, students will be able to:

- Name safety hazards likely to be present in metalworking environments.
- Identify types of accidents/injuries likely to occur in metalworking shops or similar settings.
- Give examples of actions industrial and manufacturing professionals should take in metalworking environments to prevent accidents/injuries.

Educational Standards

This program content correlates with the following Sheet Metal and Ironworking Competency Objectives of the National Center for Construction Education and Research (NCCER).

SHEET METAL

Level One: MODULE 04101-8 — INTRODUCTION TO THE SHEET METAL TRADE

3. List the basic tools and equipment used in the sheet metal trade.
5. Identify shop and field safety considerations specific to the sheet metal trade.

Level One: MODULE 04102-08 — TOOLS OF THE TRADE

1. Identify and describe the proper use of tools commonly used in the sheet metal trade.
2. State general rules for safety when using tools.
3. Describe proper maintenance procedures for tools.
4. Demonstrate how to properly use sheet metal tools.

Level Two: MODULE 04207-08 — SOLDERING

1. Identify soldering tools and materials.
2. Safely and properly use soldering tools and materials in selected tasks.

Level Four: MODULE 04406-03 (MT101) — INTRODUCTORY SKILLS FOR THE CREW LEADER

1. Discuss current issues and organizational structure in the construction industry today.
3. Demonstrate an awareness of safety issues, including the cost of accidents and safety regulations.
4. Identify a supervisor's typical safety responsibilities.

IRONWORKING

Level One: MODULE 30102 — TRADE SAFETY

1. Describe the consequences of on-the-job accidents.
2. Explain the special responsibilities of the Occupational Safety and Health Administration.
3. List potential hazards for the ironworker.
4. Describe safe work practices when near cranes.
5. List major health hazards classified by OSHA.

Level One: MODULE 30104 — TOOLS AND EQUIPMENT OF THE TRADE

1. Identify and explain commonly used safety tools and equipment.
2. Identify and describe the proper use of common ironworking hand tools.
3. Identify the power sources for common ironworking tools.
4. Identify and describe the proper use of common ironworking power tools.

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This program correlates with the National Science Education Standards National Committee on Science Education Standards and Assessment, National Research Council.

Science as Inquiry

Content Standard A: As a result of activities in grades 9-12, all students should develop:

- Abilities necessary to do scientific inquiry
- Understandings about scientific inquiry

Science and Technology

Content Standard E: As a result of their activities in grades 9-12, all students should develop an understanding of:

- Abilities of technological design
- Understanding about science and technology

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The activities in this Teacher's Guide were created in compliance with the following National Standards for the English Language Arts from the National Council of Teachers of English.

- Standard 7: Students conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data from a variety of sources (e.g., print and non-print texts, artifacts, people) to communicate their discoveries in ways that suit their purpose and audience.
- Standard 8: Students use a variety of technological and information resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge.

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The activities in this Teacher's Guide were created in compliance with the following National Education Technology Standards from the National Education Technology Standards Project.

- Standard 3: Research and Information Fluency. Students apply digital tools to gather, evaluate, and use information.
- Standard 4: Critical Thinking, Problem-Solving & Decision-Making. Students use critical thinking skills to plan and conduct research, manage projects, solve problems and make informed decisions using appropriate digital tools and resources.

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Program Overview

Metalworking is a broad field of study that encompasses several large industries. This informative video demonstrates the kind of precautions that should be taken when working with metals. Sheet metal work, soldering, foundry work, and forging are covered, along with handling steel beams at a construction site (the Shedd Aquarium, in Chicago). Footage of accidents reinforces the importance of safety. This video should be viewed by anyone studying technology or any metalworking trade.

Main Topics

Chapter 1: Introduction

In this introductory segment, the viewer learns about the range of metalworking activity that occurs in a variety of industries, and how enjoyable the work can be as long as workers heed safety regulations.

Chapter 2: Material Safety

Here, tips for storing and handling metal underscore the need for safety precautions to guard against the dangers working with metal poses.

Chapter 3: Machining Safety

This section names a series of critical safety actions to take, from where to stand to what to wear, when working with or around dangerous power equipment in a metalworking setting.

Chapter 4: Sheet Metal Safety

As this section reveals, sheet metal, if not worked with properly, can pose numerous hazards that include losing fingers in forming rolls and breathing in toxic soldering fumes.

Chapter 5: Foundry and Forge Safety

This segment offers important safety rules that foundry workers, especially those working with a foundry furnace and/or forge, should follow to avoid serious burns and other equally harmful injuries.

Chapter 6: Metalworking Tool Safety

Carefully working with and maintaining metalworking tools, as viewers learn in this segment, are important to maintaining a safe metalworking workplace.

Chapter 7: Steelworking Safety

This final segment offers several general but important safety tips steelworkers should keep in mind while on the job, such as knowing how to properly handle heavy steel beams.

Fast Facts

- Many steelworkers are killed from just falling off a tall building when working.
- When moving large pieces of sheet metal, it is important to move one sheet at a time.
- When lifting, one should always lift with the legs, not the back.
- A pointed corner of sheet metal could inflict a deep wound, equivalent to a sword.
- Among the important general rules when working in a foundry is dressing to protect against serious burns.
- Molten metal is over 1,000 degrees Fahrenheit.
- Steelworkers must know how to lift, move, set, and fasten steel beams weighing thousands of pounds while working several stories in the air.
- On tall buildings, OSHA (Occupational Safety & Health Administration) approved temporary railing must be constructed out of two by fours to avoid falls when working.
- A steel worker can easily lose a hand or his or her life if crushed by a heavy beam as it moves up and down.

Vocabulary Terms

acid core flux: A chemical agent that helps create a stronger bond between metal bits or plumbing being joined.

air hammer: A hammer driven by compressed air.

alloy: A homogeneous mixture or solid solution of two or more metals.

anvil: A heavy iron or steel block on which metals are hammered during forging.

bar stock: Raw material purchased from metal manufacturers in the form of long bars.

C clamp: A type of clamp device typically used to hold a wood or metal workpiece, and often used in, but not limited to, carpentry and welding.

casting: Forming an object with a mold.

center punch: Make a small hole in something as a guide for a drill.

chain hoist: An electrically powered, remote-controlled winch-type device that uses a chain to pull a load.

chuck: A holding device consisting of adjustable jaws that center a workpiece in a lathe or center a tool in a drill.

coolant: An agent that produces cooling, especially a fluid that draws off heat by circulating through an engine or by bathing a mechanical part.

crucible: The hollow at the bottom of an ore furnace, where the molten metal collects.

drill bit: The cutting part of a drill.

drill press: An upright power-driven machine for drilling holes in metal, wood, or other material.

epoxy: An adhesive composed of two liquids, a resin and a hardener, that when mixed together, harden to form a strong bond.

forge: The hearth that a fire is kept upon, or inside of, for the purpose of heating the iron.

foundry: A factory where metal castings are produced.

grinder: A machine that uses an abrasive to wear away at the surface of a workpiece.

kill switch: A security measure used to shut off a device in an emergency situation in which it cannot be shut down in the usual manner.

laceration: A torn and ragged wound.

magnesium: A lightweight metallic chemical element, one of the alkaline-earth metals.

milling machine: A machine tool used to shape metal and other solid materials.

molten: Reduced to liquid form by heating.

pinch point: Any point at which it is possible for a person or part of a person's body to be caught between moving parts of a machine, or between the moving and stationary parts of a machine, or between material and any part of the machine.

punch: A hard metal rod with a shaped tip at one end and a blunt butt end at the other, which is usually struck by a hammer. Punches are used to drive objects, such as nails, or to form an impression of the tip on a workpiece.

solvent: A substance, usually a liquid, capable of dissolving another substance.

swarf: The fine bits and shavings that accumulate in the grinding or cutting of metal.

tang: A long and slender projecting strip, tongue, or prong forming part of an object, as a chisel, file, or knife, and serving as a means of attachment for another part, as a handle or stock.

torque: Twisting force.

wire wheel: A wire wheel brush for heavy duty cleaning, paint removal, and grinding.

Pre-Program Discussion Questions

1. What is metalworking? Give examples.
2. Which trade professionals are likely to be involved with metalworking?
3. What types of dangers might metalworkers experience on the job?
4. What types of safety errors might metalworkers make?
5. If you were a metalworker, how would you protect yourself from potential injury?

Post-Program Discussion Questions

1. What are the most common types of injuries metalworkers experience?
2. Is there an aspect of metalworking that is more dangerous than others? Explain.
3. Why might trade professionals, even following safety regulations, experience harm while working?
4. How would you promote metalworking safety in the workplace?
5. If you were a metalworking shop supervisor, how would you enforce safety regulations?

Student Projects

Visiting the Shop

Student groups visit different metalworking shops in the community to explore firsthand how safety is practiced in actual work situations. They also inspect the sites to determine whether safety hazards are at play. The groups present their site visit findings — what shop they visited, safety practices in action, and safety hazards they observed — to their peers. Individual groups create a plan that suggests ways shop workers should address the observed safety hazards.

Trade Professionals and Metalworking

Instruct students to research a variety of trade professions that involve metalworking. Each student selects one profession to research to learn in what ways their chosen trade is connected to metalworking and the precautions they take to guard against accidents/injuries. Students write a one-page description (perhaps with guided headers like name of profession, type of work involved, types of work required, safety measures taken, etc.). The class compiles the descriptions to create a vocational handbook on metalwork safety, perhaps for use by people preparing for specific trades.

Face to Face

Students can interview various trade professionals in their community to learn about metalworking tasks and how they guard against injuries, accidents, etc. Students share their interview findings with the class via mixed media, for example, using a visual presentation such as a PowerPoint slide, or an audio recording of the interviewees accompanied by “how to” charts.

Metalworking Safety Quiz

Instruct students to take several online metalworking safety quizzes (links below) to see how much they know about the topic as presented in the film and from their general knowledge. Have them research any topics they are not familiar with. Invite students to create a quiz based on the film topics that trade professionals might take to test their shop metalworking safety knowledge.

- www.lausd.k12.ca.us/vnhs/Tool_Academy/safety/safety.htm
- <http://quiz.thefullwiki.org/Metalworking>

Assessment Questions

- Q1:** Which of the following does *not* pose a danger associated with the handling of metalworking materials?
- a) Face protection
 - b) Lifting
 - c) Scrap metal
 - d) Metal cutoffs
- Q2:** Knowing the location of the _____ is critical when all equipment power must be turned off.
- Q3:** This item prevents sparks and coolant from shifting to a broader shop area.
- a) Chuck
 - b) Drape
 - c) Swarf
 - d) Shield
- Q4:** True or False? If drilling pressure is released before the bit breaks through the bottom of the part being drilled, the drill will dangerously rotate.
- Q5:** Which of the following is *not* a necessary precaution to take when soldering metal?
- a) Wear a respirator
 - b) Wash hands before soldering
 - c) Avoid breathing fumes
 - d) Make sure area is ventilated
- Q6:** True or False? Pressurized cans can explode.
- Q7:** A _____ heats and softens metal.
- Q8:** A guardrail on a tall building should be made from _____.
- Q9:** True or False? A mushroomed chisel edge is desirable.
- Q10:** What can someone do to ensure continuous safety in a metalworking setting?
- a) Report unsafe work practices.
 - b) Be familiar with the shop layout.
 - c) Work with colleagues as a team.
 - d) All of the above

Assessment Questions Answer Key

Q1: Which of the following does *not* pose a danger associated with the handling of metalworking materials?

- a) Face protection b) Lifting c) Scrap metal d) Metal cutoffs

A: a

Feedback: Workers should wear face or eye protection during any task that could be dangerous. This would include using power tools, machining, grinding, and other similar tasks.

Q2: Knowing the location of the _____ is critical when all equipment power must be turned off.

A: kill switch

Feedback: Knowing the location of the kill switch, a device that shuts off power to equipment, is important in a metalworking environment.

Q3: This item prevents sparks and coolant from shifting to a broader shop area.

- a) Chuck b) Drape c) Swarf d) Shield

A: b

Feedback: Metalworkers doing an operation that could affect another shop area, such as grinding, can isolate their work area with a shop drape. The drape will keep sparks or coolant from flying into another area.

Q4: True or False? If drilling pressure is released before the bit breaks through the bottom of the part being drilled, the drill will dangerously rotate.

A: False

Feedback: Releasing drilling pressure right before the bit breaks through the bottom of the part prevents possible injury. A drill bit tends to catch when breaking through. This can cause the drill or part to rotate dangerously.

Q5: Which of the following is *not* a necessary precaution to take when soldering metal?

- a) Wear a respirator b) Wash hands before soldering
c) Avoid breathing fumes d) Make sure area is ventilated

A: b

Feedback: When soldering sheet metal, metalworkers should avoid breathing the fumes. Melted lead fumes and acid core flux fumes can be hazardous if inhaled. Workers should solder in a ventilated area while wearing a respirator. They should wash their hands after soldering so they don't ingest any lead solder or residue. Metalworkers should wear safety glasses to protect themselves from spattering solder and flux. Finally, they should let solder joints cool before touching them, and be sure to shut off the gas valve securely after soldering.

Q6: True or False? Pressurized cans can explode.

A: True

Feedback: If overheated, cans of paint and other pressurized cans can explode.

Q7: A _____ heats and softens metal.

A: forge

Feedback: A forge is used to heat and soften metal so that it can be hammered into a new shape. A foundry heats metal into a liquid so that it can be poured into a mold to produce a metal part.

Q8: A guardrail on a tall building should be made from _____.

A: two by fours

Feedback: On tall buildings, OSHA approved temporary railing must be constructed out of two by fours to avoid falls when working.

Q9: True or False? A mushroomed chisel edge is desirable.

A: False

Feedback: Keep both ends of chisels and punches properly ground or shaped. A chisel cutting edge should be sharp and square. After long hammering, the top of the chisel or punch becomes mushroomed. This is dangerous. Workers should grind off the rough metal to avoid injury to their hands.

Q10: What can someone do to ensure continuous safety in a metalworking setting?

- a) Report unsafe work practices.
- b) Be familiar with the shop layout.
- c) Work with colleagues as a team.
- d) All of the above

A: d

Feedback: Safety is a team effort. Thus, workers should report unsafe work habits to their boss. They might be saving a co-worker's life by helping him or her understand the mistake being made by using unsafe work habits. One must constantly think safety when working with metal. A metalworker must evaluate every job or work technique, to decide whether a particular operation is safe or dangerous, and take action to remedy any safety problems.

Additional Resources

EHS Today

The Magazine for Environment, Health and Safety Leaders
<http://ehstoday.com/>

Fabricating & Metalworking

The Business of Metal Manufacturing
www.fandmmag.com

U.S. National Library of Medicine

National Institutes of Health

Mapping safety interventions in metalworking shops
www.ncbi.nlm.nih.gov/pubmed/17351520

Monthly Labor Review Online

Profiles in safety and health: roofing and sheet metal work
www.bls.gov/opub/mlr/1990/09/art4abs.htm

National Institute for Metalworking Skills

www.nims-skills.org

Sheet Metal Workers International Association

www.smwia.org

Sheet Metal Occupational Health Institute Trust

www.smohit.org

United States Department of Labor: Occupational Safety & Health Administration

Search on "Metalworking Fluids"
www.osha.gov

Additional Video Programs from Films Media Group

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Auto Body Repair Basics

This video introduces basic repair concepts, safety procedures, and NADA service ethics. A wide range of tools is presented, and the metalworking and refinishing areas of a typical shop are shown. A viewable/printable instructor's guide is available online. A Shopware Production. (21 minutes)
© 2005 Order # 32775

Introduction to Gas Metal Arc Welding and Flux Core Welding

There are a lot of similarities between Gas Metal Arc Welding (MIG) and Flux Core Arc Welding, including the use of direct current to provide constant voltage. Viewers will also learn about the different types of electrodes wires used in each outfit. Wire feeders are demonstrated along with the spools that feed them — containing several hundred feet of electrode wire, allowing welders to make long continuous welds. Students see how to position the electrode and how to establish a good weld pool. As in all of the welding videos, safety practices are clearly demonstrated and explained. A Meridian Production. (11 minutes) © 1998 Order # 25479

Safety in the Workshop: Avoiding Accidents and Injuries

Going inside a professional and very busy woodshop, this program shows how to prevent a wide range of carpentry-related hazards. An overview of basic safety measures focuses on the need for face masks, respirators, steel-toed shoes, and eye, ear, and hair protection. Safety zones, proper tool storage, flammable liquid storage, and overall cleanliness and organization are also emphasized. Advice on tool sharpening and maintenance leads to detailed safety demonstrations for various hand tools and power tools, both portable and stationary. Finally, students receive a valuable look at basic first aid and what to do in case of an accident. (22 minutes) © 2009 Order # 41118

Tools of the Trade: Inside the Welder's Toolbox

Welding is part skill, part science, and a whole lot of precautions. This program shows viewers the safe way to work with fire, gas, and molten metal as it profiles the tools used by welders to perform a variety of tasks. Specific tools and equipment for OFW, GMAW, GTAW, and SMAW are spotlighted, along with a variety of general tools and safety items. The video also takes a look at basic welding diagrams and pre-welding treatment of materials. A viewable/printable instructor's guide is available online. Recommended for high school, vocational/technical school, and adult education. A Shopware Production. (23 minutes) © 2008 Order # 37047