IMT 210 – Industrial Safety I - Module # 4

NCCER Module # 00103-09

Introduction to Hand Tools
Introduction to Hand Tools

Goal
The goal of this module is to introduce students to the hand tools used in the construction trade, such as hammers, saws, levels, pullers, and clamps. The module will explain the specific role of each tool, how to properly use it, and the important safety and maintenance issues related to each tool.

Duration of Module
10 hours + lab time

Topics Covered
- Importance of safety when handling hand tools
- Hammers, ripping bars and nail pullers, chisels and punches
- Screwdrivers
- Pliers and wire cutters
- Wrenches, sockets and ratchets, torque wrenches
- Rules and other measuring tools
- Levels, squares, plumb bob
- Utility knives, saws, files and rasps
- Clamps, chain falls and come-alongs
- Shovels and picks
Introduction to Hand Tools

Objectives
Upon completion of this module, students will be able to:

1) Recognize and identify some of the basic hand tools and their proper uses in the construction trade.
2) Visually inspect hand tools to determine if they are safe to use.
3) Safely use hand tools.

Supplemental Resources
NCCER Core Curriculum: Introductory Craft Skills Edition 4

Module 00103-09 Exam
The Annotated Instructor’s Guide for the Core Curriculum: Introductory Craft Skills textbook comes with a test booklet that includes module exams, performance exams, and answer keys. These are paper tests that should be administered to students after completion of each module.

When you see the symbol ◊, click on the associated word to see the definition. Scroll through the flashcards to find the correct term. You can also print the flashcards to keep on hand.

If you would like to turn captions on while viewing the videos in this module, click the captions icon (see below) at the bottom of the video.
Introduction to Hand Tools

Introduction

In the construction trade, it is important to not only know how to use hand tools but to learn how to maintain them and use them safely. This module will highlight the most commonly used hand tools in the construction industry.

Before using any tool, you should always read the manufacturer’s guide for safety tips and procedures. Never use a tool that is in poor condition, worn, or damaged. Always wear the appropriate personal protective equipment (PPE) when using a tool.

Figure 1 – Assorted Hand Tools
(by Shaun Wong, CCY-3.0)
Introduction
There are many different types of hammers used for different types of work. The most common hammers used in the trade are the claw hammer and the ball peen hammer.

Claw Hammer
The claw hammer has a steel head and a handle made of wood, steel, or fiberglass (see figure 1 below). The head of the hammer is used to drive nails and wedges. The claw is used to pull nails out of a material. The face can be either flat or rounded.

![Claw Hammer Diagram](image)

Figure 2 – Claw Hammer (Public Domain)

Click here to watch a video on how to use a claw hammer to drive a nail.
Hammers

**Ball Peen Hammer**

The ball peen hammer is a hammer used for metalworking. The ball peen has both a flat face and a spherical face for rounding off (peening) metal. This hammer is commonly used with a chisel or punch (discussed later). Most ball peen hammers are classified by weight (from 6 ounces up to 2.5 pounds).

![Ball Peen Hammer](Figure 3 – Ball Peen Hammer (Public Domain))

Check for splinters and cracks in the handles of hammers. Check that the handle is set securely in the head of the hammer. Periodically clean the face of the hammer. Avoid hitting with the side of the hammer head. Do not use hammers with damaged heads. Do not strike two hammer heads together.
Sledgehammers
A sledgehammer is a tool that is used to drive posts or stakes and break up concrete or other hard materials. The head is made of high-carbon steel and can weigh up to 20 pounds. Depending on the job, a sledgehammer can have a long or short handle.

Always wear the proper PPE when using a sledgehammer (safety glasses and gloves). Check for cracked, broken, or splintered handles. Keep hands away from the object you are driving.

Figure 4 – Sledgehammer (by peaaru, CCY-3.0)

Figure 5 – Sledgehammer Driving a Stake (Public Domain)
Ripping Bars

Introduction

A ripping bar is used for prying nails and taking apart framing or concrete forms. There are four types of ripping bars: the wrecking bar, flat bar, chisel bar, and cat’s paw (see below).

Always wear the appropriate PPE when using ripping bars (safety glasses, hard hat, and gloves). Always use two hands when using ripping bars. Be sure that the material holding the nail is braced securely before you begin pulling. Keep your footing balanced and a firm grip on the prying tool.
Chisels and Punches

Chisels

A chisel is used for carving or cutting wood, stone, and metal. It has a sharpened, sloped (beveled) edge. There are two types of chisels, wood chisels and cold chisels (see pictures below). Both types of chisels have steel heads and are able to cut anything that is softer than the steel they are made from.

Figure 10 – Wood Chisel (by Wikimedia Commons, CCY-3.0)

Figure 11 – Cold Chisel (by Wikimedia Commons, CCY-3.0)

Figure 12 – Wood Chisel (Public Domain)
Chisels (continued)
Always wear the appropriate PPE (safety glasses and gloves). Periodically sharpen the cutting edge of the chisel. Avoid using a chisel head that has become mushroomed, flattened, or damaged.

Punches
A punch is used to indent metal before a hole is drilled. They are made of steel and are available in various sizes.
Screwdrivers

Introduction
A screwdriver is a tool that is used to tighten or remove screws.

Figure 14 – Screwdriver Bits
(by Don DeBold, CCY-2.0)

There are six common types of screwdrivers used in the construction industry: slotted (a), Phillips (b), Pozidriv (c), Torx® (d), Allen® (e), and Robertson® (f).

Figure 15 – Screwdriver Types
(Public Domain)

Click here to watch a video on how to use a screwdriver.
Screwdrivers

A slotted screwdriver is the most common type of standard screwdriver. It will fit slotted screws. A Phillips head is the most common crosshead screwdriver and will fit Phillips head screws. A Pozidriv screwdriver is an improved version of the Phillips head screwdriver. The Torx® screwdriver has a star-sharped tip that is mostly used in the automobile industry, household appliances, and lawn and garden equipment. The Allen® screwdriver is used on screws that have a hex head. The Robertson® screwdriver has a square head that will provide torque power.

Keep the screwdriver clean. Only use the screwdriver for its intended purpose. Never use it as a chisel or punch. Never use a screwdriver near live electrical wires. Check the handle of the screwdriver, and replace it if the handle is worn or broken. Keep the blade of the screwdriver pointed away from you or another person.

Click here for a review of hammers, ripping bars, chisels, punches, and screwdrivers.
Answer the following questions about important concepts presented so far. Answers can be found at the end of the module.

**Learning Activity 1**
What is the difference between a claw hammer and a ball peen hammer? Which hammer has the capability to pull nails out of an object?

**Learning Activity 2**
Why should screwdrivers never be used near live wires?

**Learning Activity 3**
Which tool has a beveled edge, and what is it used for? What does the word “bevel” mean?

**Learning Activity 4**
What are the different types of screwdrivers shown below?

At this time, visit your LMS to take the graded quiz “Introduction to Hand Tools Quiz # 1”. The quiz located in this text is a practice quiz and will NOT count toward your grade. You must take the quiz in your LMS for credit.
Pliers and Wire Cutters

Introduction

Pliers are scissor-shaped tools with jaws that have teeth that help grip objects. The two legs (or handles) move on a pivot to allow for adjustment of gripping size. Pliers are used to hold, cut, or bend material. There are five common types of pliers used in the construction industry: slip-joint, long-nose, lineman, tongue-and-groove, and locking pliers.

Figure 16 – Slip-Joint Pliers
(by Wikimedia Commons, CCY-3.0)

Figure 17 – Long-Nose Pliers
(Public Domain)

Figure 18 – Lineman Pliers
(by Wikimedia Commons, CCY-3.0)

Figure 19 – Locking Pliers
(by Wikimedia Commons, CCY-3.0)

Figure 20 – Tongue-and-Groove Pliers
(Public Domain)
Pliers and Wire Cutters

**Slip-Joint Pliers**
These pliers are most commonly used for holding and bending wire and for gripping objects. The jaws are usually adjustable.

**Long-Nose (Needle-Nose) Pliers**
These pliers are used to get into tight places, grip small objects, and bend wire. These pliers can come with an adjustable spring between the handles to help keep them apart.

**Lineman Pliers**
These pliers have wide jaws to cut heavy wire and to help grip objects.

**Tongue-and-Groove Pliers**
These pliers have jagged or serrated teeth that help to grip flat, hexagonal, or round objects. There are five adjustable positions on the pliers.

**Locking Pliers**
These pliers operate similar to a vice. They have an adjustable knob that controls the width and tension of the jaws.

[Click here](#) to watch a video on how to slip-joint pliers.
Wrenches

Introduction
The purpose of a wrench is to turn and hold screws, nuts, bolts, and even pipes. There are two main categories of wrenches: nonadjustable and adjustable.

Nonadjustable Wrenches
There are four main types of nonadjustable wrenches: open-end, box-end, hex key, and combination.
Wrenches

Open-End Wrenches
This wrench has an opening on each end. Each end is a specific size, and they measure the distance between flats of the wrench. Typical sizes are $\frac{7}{16}$-inch and $\frac{1}{2}$-inch.

Box-End Wrenches
This wrench forms a circle around the head of a fastener. The ends come in different sizes, including $\frac{3}{18}$-inch and $\frac{15}{16}$-inch. These wrenches have a firmer grip than open-end wrenches.

Hex Key Wrench
This wrench is L-shaped and hexagonal. The wrench is usually made of steel, and both ends will fit the socket of a screw or bolt.

Combination Wrenches
This wrench is a combination of the open-end wrench and the box-end wrench.
Wrenches

Adjustable Wrenches
Adjustable wrenches have one moveable jaw and one fixed jaw. There are two types of adjustable wrenches most commonly used in the construction industry: the pipe wrench and the adjustable end wrench.

Pipe Wrench
This wrench is used to tighten and loosen pipes. Both the moveable jaw and the fixed jaw have serrated teeth used to grip pipe.

Adjustable End Wrench
This wrench has smooth jaws that are used for turning nuts, bolts, and pipe fittings.
Introduction
The socket wrench has a socket that grips the nut or bolt and a ratchet (handle) that is used to turn the socket.

The end of the socket that fits into the ratchet is usually square. The other end of the socket will have either 6 or 12 gripping points. The ratchet handle has a small lever that allows you to change the turning direction.

Click here to watch a video on how use a socket wrench.
Introduction
The torque wrench measures the resistance to turning and is used when you are installing fasteners that have to be tightened without distorting the object. Usually, a specific torque setting is required for specific bolts or fasteners and is measured in **inch-pounds** or **foot-pounds**. Be sure to hold the head of the wrench with one hand to support the bolt, and make sure it is properly aligned. There are two common types of torque wrenches: manual and digital.

Figure 28 – Manual Torque Wrench
(by Wikimedia Commons, CCY-3.0)

Figure 29 – Digital Torque Wrench
(Public Domain)

Click here to watch a video on how use a torque wrench.
Measuring Tools

Introduction
There are four common types of measuring tools: flat steel rule, tape measure, wooden folding rule, and laser measuring tool.

Flat Steel Rule
These rules come in 6-inch, 12-inch, 18-inch, or 24-inch lengths. They can either be flexible or non-flexible. These rulers are read like the standard rulers (English or Metric) discussed in the Introduction to Construction Math Module (Module 3).

Tape Measure
The standard tape measure should have both English (\(\frac{1}{2}\)-inch, \(\frac{1}{4}\)-inch, \(\frac{1}{8}\)-inch, \(\frac{1}{16}\)-inch) and Metric (centimeters and millimeters) measurements. The tape is usually concave in shape. This provides stability when measuring.
Measuring Tools

Wooden Folding Rule
This rule comes in either 6-foot or 8-foot lengths and is marked in sixteenths of an inch. The folding rule is a stiff ruler that is used for measuring vertical distances. Unlike a tape measure, it can easily be held up vertically.

Laser Measuring Tool
This ruler is an electronic version of a tape measure. You point the tool at a specific object, and a laser shoots out at the object and a reading is sent back to the tool. The measurement is then displayed on the screen. This tool can measure in English or Metric units.
Levels

Introduction
This tool is used to determine how level a surface is and how plumb a surface is. A level surface describes a perfectly horizontal surface. A plumb surface describes a perfectly vertical surface. The most commonly used level in the construction industry is the spirit level.

Spirit Level
A spirit level is made of tough metals and has three alcohol-filled vials. The center vial is used for checking for level. The two on either end are used for checking for plumb. When the bubble in the vial is centered between the lines, the object is either level or plumb.

Click here to watch a video on how to use a level.
Introduction

Squares are tools used for marking or measuring, depending on the job they are being used for. This square is L-shaped and used to square up wall studs and sole plates and to lay out stairs. To square up means to ensure objects are at right angles.
Introduction
A plumb bob uses the force of gravity to make a line hang plumb. The plumb bob is a pointed weight attached to a string and comes in different weights. A plumb bob can be used to make sure a wall is vertical or to help install a doorjamb. Make sure the line is attached to the center of the plumb bob, and hang the plumb bob from a horizontal member. When the weight is hanging freely and stops swinging, the string is considered plumb (vertical).

Click here for a review of pliers, wrenches, sockets and ratchets, torque wrenches, levels, squares, and plumb bobs.

Click here to watch a video on how use a plumb bob.
Learning Activity

Answer the following questions about important concepts presented so far. Answers can be found at the end of the module.

**Learning Activity 5**
Can you identify the different types of pliers below?

![Images of pliers]

**Learning Activity 6**
What is the difference between nonadjustable and adjustable wrenches?

**Learning Activity 7**
What units do we measure torque in with a torque wrench?
Learning Activity 8
Out of the four types of measuring tools mentioned, which one would be best for measuring vertical heights, such as the height of a wall?

Learning Activity 9
What is a perfectly horizontal surface called?

Learning Activity 10
What is a perfectly vertical surface called?

Learning Activity 11
What is a plumb bob, and how is it used?

At this time, visit your LMS to take the graded quiz “Introduction to Hand Tools Quiz # 2”. The quiz located in this text is a practice quiz and will NOT count toward your grade. You must take the quiz in your LMS for credit.
Introduction

A chalk line is a piece of string coated with chalk. When the line is stretched between two points and then snapped, it leaves a chalky line on the surface. A mechanical self-chalking line chalks the string as it is pulled out of the box. Some chalk line boxes have a point on the end so that it can be used as a plumb bob.

Click here to watch a video on how use a chalk line.
Utility Knives

Introduction
A utility knife is a multi-purpose tool used for cutting and trimming. It has a replaceable razor blade. The handle is usually made of cast-iron or plastic. Most models come with a retractable blade, and they are considered the safest type of utility knife. When using the utility knife, be sure to place a scrap piece of wood under the object you are cutting to protect the surface you are cutting on. Be sure to retract the blade after using the knife.

Figure 41 – Utility Knife
(by Wikimedia Commons, CCY-3.0)
Saws

Introduction
There are many different types of saws used for different purposes. The main differences are in the number, shape, and size of their teeth. The fewer the teeth per inch, the coarser and faster the cut. The more teeth per inch, the slower and smoother the cut.

Backsaw
The backsaw has a flat blade with a reinforced back edge. It is used for cutting joints.

Compass Saw
The compass saw is used for cutting curves in wood or wall board quickly and for cutting holes for large-diameter pipes.
Saws

Coping Saw
The coping saw has a narrow and flexible blade attached to a U-shaped frame. The holders on either end can be adjusted so you can cut at different angles. This saw is used for making moldings fit together.

Hacksaw
The hacksaw is used for cutting through metals, like nails. Hacksaws are designed to cut on the push stroke. The hacksaw will not cut on the pull stroke.
Handsaw
The handsaw is made of tempered steel to give it strength. The teeth are set at an angle that is slightly wider than the thickness of the blade. There are two types of handsaws: the crosscut saw and the ripsaw. The crosscut saw should be used to cut against the grain of wood. Most crosscut saws have 8 to 17 teeth per inch. The ripsaw should be used to cut with the grain. Most ripsaws have 5 to 9 teeth per inch. You should always brace yourself on the last stroke when you are sawing, so you are not thrown off balance.

Figure 46 – Handsaw
(by Wikimedia Commons, CCY-3.0)

Click here to watch a video on how to use a handsaw.
Files and Rasps

A file or rasp is used to cut, smooth, or shape parts, usually metal. It can also be used to sharpen other tools. Files have slanting rows of teeth. Rasps have individual teeth. There is a specific type of file that is used for different metals. Usually they are classified by their teeth. Sharp and wide-spaced teeth files are used for soft metals. Less sharp and close teeth files are used for harder metals. Files and rasps do not usually come with a handle, therefore you should put a handle on the file before using it. After using a file or rasp, be sure to brush the filings and debris from the teeth with a file card (see below).

Figure 47 – Files and Rasps
(by Wikimedia Commons, CCY-3.0)

Figure 48 – File Card
(Public Domain)
Learning Activity

Answer the following questions about important concepts presented so far. Answers can be found at the end of the module.

Learning Activity 12
Describe how a chalk line works.

Learning Activity 13
Which of the following saws would be best for cutting curves in wood or wall board quickly?

a)  

b)  

Learning Activity 14
Which of the following saws would be best for cutting moldings at different angles?

a)  

b)  

Learning Activity 15
What is the difference between a file and a rasp?
Clamps

Introduction
Clamps are used to hold objects or work pieces. Clamps are sized by their opening and the throat (depth of the clamp). There are many types of clamps, each classified by their shape and their capacity (what they can hold).

C-Clamp
This clamp has a C-shaped frame and a T-bar that is used to tighten the clamp to hold the material between the jaw and the shoe.

Spring Clamp
This clamp has a spring that allows you to open the clamp by squeezing the handle with your hand. When the handle is released, the spring will hold the clamp firmly shut.
Clamps

Bar Clamp
This clamp has one fixed jaw and one moveable jaw. A piece of steel or aluminum is the spine between the jaws. The fixed jaw should be positioned against the object you want to hold, and then the moveable jaw should slide into place.

When clamping soft materials, like wood, be sure to place padding between the work and the clamp to prevent damage to the work. Discard any clamps that have broken or bent frames. Check the shoe and T-bar often for damage. Do not over-tighten a clamp. This could cause damage to your work and the clamp.

Click here to watch a video on how to use a clamp.
Chain Falls

**Introduction**

A chain fall is used to move a heavy load. It is a tackle device that is fitted with chain to hoist loads by hand and is suspended from an overhead track. The chain fall has a brake that will hold the load after it is lifted. The brake will hold the load until the lowering chain is pulled. There are manual chain falls (by hand) and electrical chain falls (electrical control box). The suspension hook is made from steel and is used to hang the chain fall. The suspension hook should be one size larger than the load hook at the bottom. The load hook has a safety latch that will prevent the load from slipping. The gear box holds the gears that will provide the lift. The hand chain is an endless loop of chain used to operate the gear box.

[Click here](#) to watch a video on how to use a chain fall and how it works.

*Figure 53 – Chain Fall (Public Domain)*
Introduction
The come-along is a tool that uses a ratchet handle to move heavy loads horizontally, usually over short distances. The ratchet handle is used to take up the chain. When the ratchet is released, it allows the chain to be pulled out. A come-along should not be used to move vertical loads.

Always follow the manufacturer’s instructions for use and maintenance, such as lubricating the chains. Avoid getting lubricant on the clutches. Always try a chain fall or come-along on small loads first. Never stand under a load or put your hands where they could be pinched.
**Shovels**

**Introduction**

Shovels are used by many different types of construction trades, including electricians, masons, carpenters, plumbers, and welders. Shovels can have wooden or fiberglass handles. There are two common lengths of shovels.

A long-length handle is usually 48 inches long. A short-length handle is usually 27 inches long. There are three main types of shovel blades: round, square, and spade.

**Round Shovel**
Round shovels are used to dig holes or remove soil.

**Square Shovel**
Square shovels are used to move gravel or to help clean up debris.

**Spade Shovel**
A spade shovel is used to move large amounts of dirt and dig trenches with straight sides.

*Figure 55 – Types of Shovels (by Wikimedia Commons, CCY-3.0)*
Shovels (continued)
Always check the handle for cracks and splinters before using a shovel. Be sure to wear appropriate PPE (steel-toed boots, gloves, and hard hat). Rinse off the blade after use.

Figure 56 – Shoveling
(Public Domain)

Click here to watch a video on how to use a shovel.
Introduction
A pick is a tool used to break hardened soil, chop tree roots, break up stones and concrete, or even dig a hole. A pick can have a handle that is between 36 and 45 inches in length. Long-handled picks can be used for actions that require a normal amount of swing, such as digging a hole. A short-handled pick should be used to create a maximum amount of swing force for tasks such as breaking concrete. A pick should be selected based on your height and strength.

Always check the handle for cracks and splinters. The head should be fixed firmly to the handle of the pick. Proper PPE should be worn at all times (eye protection, gloves, and hard hat).

Click here for a review of utility knives, saws, files, rasps, clamps, chain falls, come-alongs, shovels, and picks.

Figure 57 – Pickaxe
(Public Domain)
Learning Activity

Answer the following questions about important concepts presented so far. Answers can be found at the end of the module.

Learning Activity 16
Can you identify the different types of clamps pictured below?

Learning Activity 17
What are the differences between a chain fall and a come-along?

Learning Activity 18
True or False: The round shovel is used dig trenches.

Learning Activity 19
True or False: The square shovel is used to move gravel.

Learning Activity 20
True or False: The spade and round shovel are used to move large amounts of soil.

At this time, visit your LMS to take the graded quiz “Introduction to Hand Tools Quiz # 3”. The quiz located in this text is a practice quiz and will NOT count toward your grade. You must take the quiz in your LMS for credit.
Within the construction industry, and as a professional, the tools you use are essential to your success in the field. Through this module, you were taught how to identify the many different hand tools and how to properly use and maintain them. Even though you may not use all the tools mentioned in this module, you still need to be aware of them. By learning how to use and maintain tools properly now will keep you safe and save you and your employer time and money in the long run.
**Glossary**

**Bevel**
Cut on a slant at an angle that is NOT a right angle.

**Fastener**
Bolt, clasp, hook or lock that is used to attach materials.

**Flats**
Straight sides or jaws of a wrench opening.

**Foot-pounds**
Unit that measures torque or pressure needed to tighten an object.

**Inch-pounds**
Unit that measures torque or pressure needed to tighten an object.

**Level**
Perfectly horizontal or flat; tool used to determine if an object is level.

**Plumb**
Perfectly vertical.

**Square**
Exactly cut to be rectangular with equal dimensions on all sides; tool used to determine if something is square.

**Tempered**
Item treated with heat to create or restore hardness in steel.

**Torque**
Turning or twisting force and measure in foot-pounds or inch-pounds.
Learning Activity 1
The head of the claw hammer is used to drive nails and wedges. The claw is used to pull nails out of a material. The face can be either flat or rounded. The ball peen hammer has a flat face and a spherical face for rounding off (peening) metal.

The claw hammer has the capability to pull nails out of an object.

Learning Activity 2
A screwdriver is made of metal that will conduct electricity if near live wires. This can cause electrical shock.

Learning Activity 3
Chisels are used for carving or cutting wood, stone, and metal. Bevel means “slope.”

Learning Activity 4
a = slotted, b = Phillips, c = Pozidriv, d = Torx®, e = Allen®, f = Robertson®

Learning Activity 5
Starting from the left: slip-joint, long-nose, lineman, tongue-and-groove, and locking pliers.
Answers to Learning Activities

Learning Activity 6
Adjustable wrenches have a moveable jaw and a fixed jaw. Nonadjustable wrenches do not have the ability to adjust size.

Learning Activity 7
Inch-pounds or foot-pounds.

Learning Activity 8
The wooden folding rule would be best for measuring vertical heights.

Learning Activity 9
A perfectly horizontal surface is called level.

Learning Activity 10
A perfectly vertical surface is called plumb.

Learning Activity 11
A plumb bob uses the force of gravity to make a line hang plumb. Make sure the line is attached to the center of the plumb bob and hang the plumb bob from a horizontal member. When the weight is hanging freely and stops swinging, the string is considered plumb (vertical).
Learning Activity 12
When the line is stretched between two points and snapped, it leaves a chalky line on the surface.

Learning Activity 13
The compass saw (b) would be best for cutting curves in wood or wall board quickly.

Learning Activity 14
The coping saw (a) would be best for cutting moldings at different angles.

Learning Activity 15
Files have slanting rows of teeth. Rasps have individual teeth.

Learning Activity 16
Bar clamp (a), Spring Clamp (b), C-Clamp (c).

Learning Activity 17
A chain fall is a tackle device that is fitted with a chain to hoist loads by hand and is suspended from an overhead track. The chain fall has a brake that will hold the load after it is lifted. The come-along uses a ratchet handle to move heavy loads horizontally, usually over short distances.
Learning Activity 18
False. The spade shovel is used to dig trenches. The round shovel is used to dig holes or remove large amounts of soil.

Learning Activity 19
True

Learning Activity 20
True