

# Training Guide: Hand Tools and Fixturing

## INTRODUCTION:

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Hand tools are held in the hand during use and require some degree of strength and control for their proper use. Some tools rely completely on manpower and others have a power source such as a battery or power cord. Additionally, the material being worked upon must be secured to avoid injury as well as to promote proper care of the work piece and tools. This is referred to as fixturing and often involves the use of vises and clamps.

Hand tools and their associated fixturing devices are used in many applications and can often replace the need for power tools. Whether manual or electric powered, hand tools help give makers a personal connection with the parts they are creating and help them develop fine motor skills and a sense of craftsmanship.

## AFTER COMPLETING THIS TRAINING, STUDENTS WILL BE ABLE TO:

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- Identify proper tool to use based on task at hand
- Inspect tool prior to use to make sure it is working properly
- Determine appropriate fixturing method for given application
- Set up work piece and secure part for safe use of the tool and protection of the part
- Safely operate basic hand tools including screwdrivers, hammers, wrenches, pliers, drills, hand saws, etc.
- Clean tools and fixturing devices and return to storage

## COMMON TYPES OF HAND TOOLS AND HOW TO USE:

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**Screwdrivers** come in a variety of types and sizes, and have uses outside of driving screws in or out of a material. Common head types are slotted and Phillips, but Torx and tamper-resistant versions are becoming more common. The variety of styles are intended to give users better control and greater ability to transfer torque. There are a range of sizes for, both head and body length, and choosing the correct size will allow users to get the job done without stripping screws or damaging materials.



**Hammers** come in many shapes and sizes and head types.

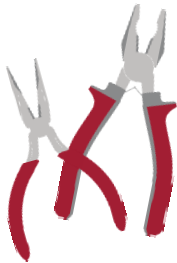
Flat metal heads are used to drive nails. Round or ball metal heads are used to shape metal. Metal claws are used for prying and to pull out nails.

Mallets (or other hammers with plastic or rubber heads) are useful for tapping and aligning pieces without damaging the surface.



**Electric Power drills** are powered by re-chargeable batteries or a power cord. There are a variety of bits available, including: standard drill bits, hole saws, masonry bits, and screwdriver heads. Important concerns for drilling:

- Choose the correct drill bit for the material
- Secure the piece being drilled, using sacrificial material as needed
- Hold the drill carefully and align the bit with the intended hole direction
- Drill large holes in steps, using a series of drills or a special drill called a step drill
- When driving or removing screws control the drill speed carefully. The drill can typically provide great torque at slow speeds, which is ideal for driving screws. Excessive speed will likely result in damaged screw heads, material, or drill bits.



**Pliers** come in many different shapes and sizes and have many uses. In addition to gripping material for bending or holding, some pliers also have cutting edges. Common types are needle-nose, slip-joint, lineman's, crimpers, vise grips. When choosing pliers to hold or bend or cut material, take note of the gripping surface and make sure it will not damage the material. Longer handles will allow users to exert more force at the gripping surface. Plastic coating on the handles make the pliers more comfortable and provide insulation when used in electrical applications.



**Wrenches** are a metal tool that are typically used to tighten and loosen nuts, bolts, screws and pipes. The wide variety of wrenches includes adjustable and fixed size flat wrenches as well as ratcheting socket wrenches. Nut drivers combine a screwdriver handle with a socket head, and are convenient tools for turning nuts and bolts

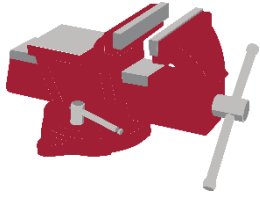


**Hand saws** come in a range of sizes and styles. There are many different kinds of tooth used for different types of cuts and materials. In general, small teeth are used for metal, large teeth for wood. Important concerns for drilling:

- Choose the correct saw and tooth style for the material
- Secure the piece being sawed, with room for the blade to move
- Hold the saw carefully and align it with the intended cut
- Cut with long strokes, using the entire length of the blade
- Have a helper around to hold the material as it is being cut off

## COMMON TYPES OF FIXTURES AND HOW TO USE:

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**Vises** are used to keep parts in place while being worked on; they should be secured to a worktable or other stable item. Vises have two parallel jaws: one that is fixed and the other that is adjusted to secure or remove parts. Material in a clamp should be oriented such that it does not slip out when being worked on. Some vises have a notch in the jaws to hold round parts. Once you are sure it can hold the workpiece, check the clamping surface and determine if it will damage the material being clamped. Often other pieces of material (such as wood or rubber) are used in the clamp to prevent damage.



**Clamps** are portable device used to position parts while fixing them together. Clamps have two parallel surfaces to secure to part, and often one or both surfaces have angles that pivot or rotate to fit the surfaces of the part. Common types are C-clamps and bar clamps. Bar clamps are lighter, easy to use, and have a greater clamping range, and come in a large variety of sizes.

## SAFETY GUIDELINES FOR FIXTURING WORK PIECE AND OPERATING HAND TOOLS:

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- Choose the proper tool for the given application
- Set up the vise or clamps that will be used to hold the work piece
- Secure the work piece in the fixture such that it cannot move and is not crushed or damaged:
  - Use materials such as electrical tape, felt, or rubber to protect the work piece
- Check that the tool is in good working condition:
  - Look for loose parts
  - Confirm that the points of contact are not dull or damaged
- Operate the tool safely
  - Grip material with pliers/vise grip rather than by hand
  - Point and move the tool away from any body part
  - Ensure that pieces being removed will fall or move towards a safe place

## PRACTICE APPLICATIONS FOR STUDENTS:

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- Sawing a piece of wood
- Drilling a hole into a piece of material with a power drill
- Driving a screw into wood with power drill
- Bending metal sheet or rod