6 Hand Tools

Objective

The learner will be able to:

- Identify basic hand tools
- Describe applications of hand tools
- Identify safety guidelines for using hand tools
- List types of abrasives its purposes

Orienting Questions

- ✓ What is the role of hand tools in machining?
- ✓ Is there are proper way of using hand tools?
- ✓ What is the purpose of abrasives in machining?

Helpful Tips

- ✓ You can select the **HIGHLIGHTED TERMS** to read more about it.
- ✓ If needed, there are **CLOSED CAPTION** buttons CC on the YouTube videos that will enable you to read along while you watch. The Closed Caption buttons are located bottom right of the video screen.
- ✓ Take time and explore about the subject by selecting the **EXPLORE** links in each section of this module.

INTRODUCTION

Hand tools and work holding devices are essential in every mechanical trade. Machinists should be able to identify and use each hand tool and work holding device properly. Abrasives provide a manual way of removing small amounts of material. A machinist will become proficient in the uses of abrasives with experience and diligence.

SCREWDRIVERS

The two types of screwdrivers that are the most common are the standard (flathead) and Phillips. Both types come in various styles and sizes. When using the standard style, it is important to use the right width and shape of blade **(Figure 1)**. If the tip is badly worn or an incorrect size it can damage the head of the screw by slipping out of the slot. Never use a screwdriver as a chisel, punch, or pry bar. These tools are only meant for what their name describes.

EXPLORE: Gallery of Screw Drives

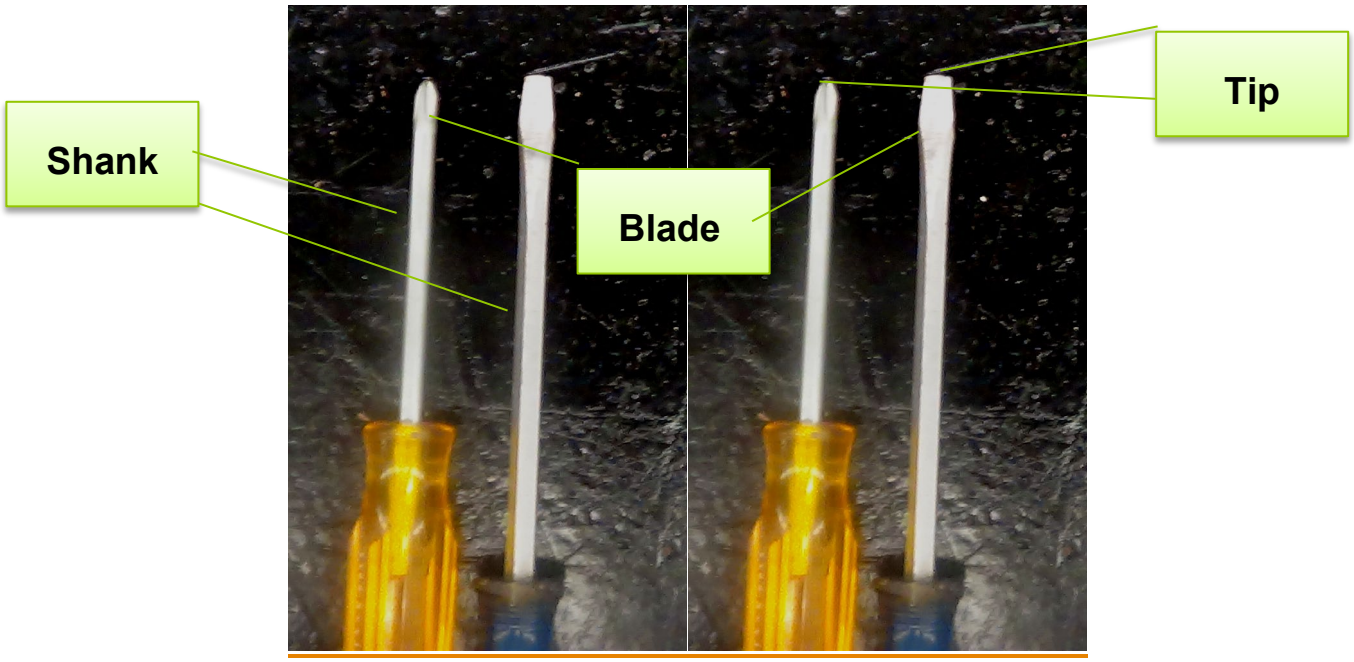

Figure 1: Diagram of a Screwdriver (Image provided by Ladell Humphries, 2013)

What You Need to Know: TECHNIQUE - PHILLIPS SCREWDRIVER

TECHNIQUE – SLOT HEAD SCREWDRIVER

PLIERS

Pliers are available with different types of jaw action and come in several shapes **(Figure 2)**. Combination or slip-joint pliers will do most jobs where they are required. The slip-joint allows the jaws to expand and hold larger pieces. They are measured by their length. Interlocking joint pliers or Channel-locks® were made to tighten nuts on water pumps of automobiles but can be very useful in a variety of jobs.

Needle nose pliers are used for holding small and delicate work. Diagonal are used traditionally for wire cutting but have been very useful in cutting thin material. The vise-grip® wrench is a locking type with an adjustment screw in the end to adjust for tension. It is important to remember that these types of pliers and wrenches should never be used to remove or install nuts. These tools can damage nuts beyond repair.

EXPLORE: Gallery of Pliers

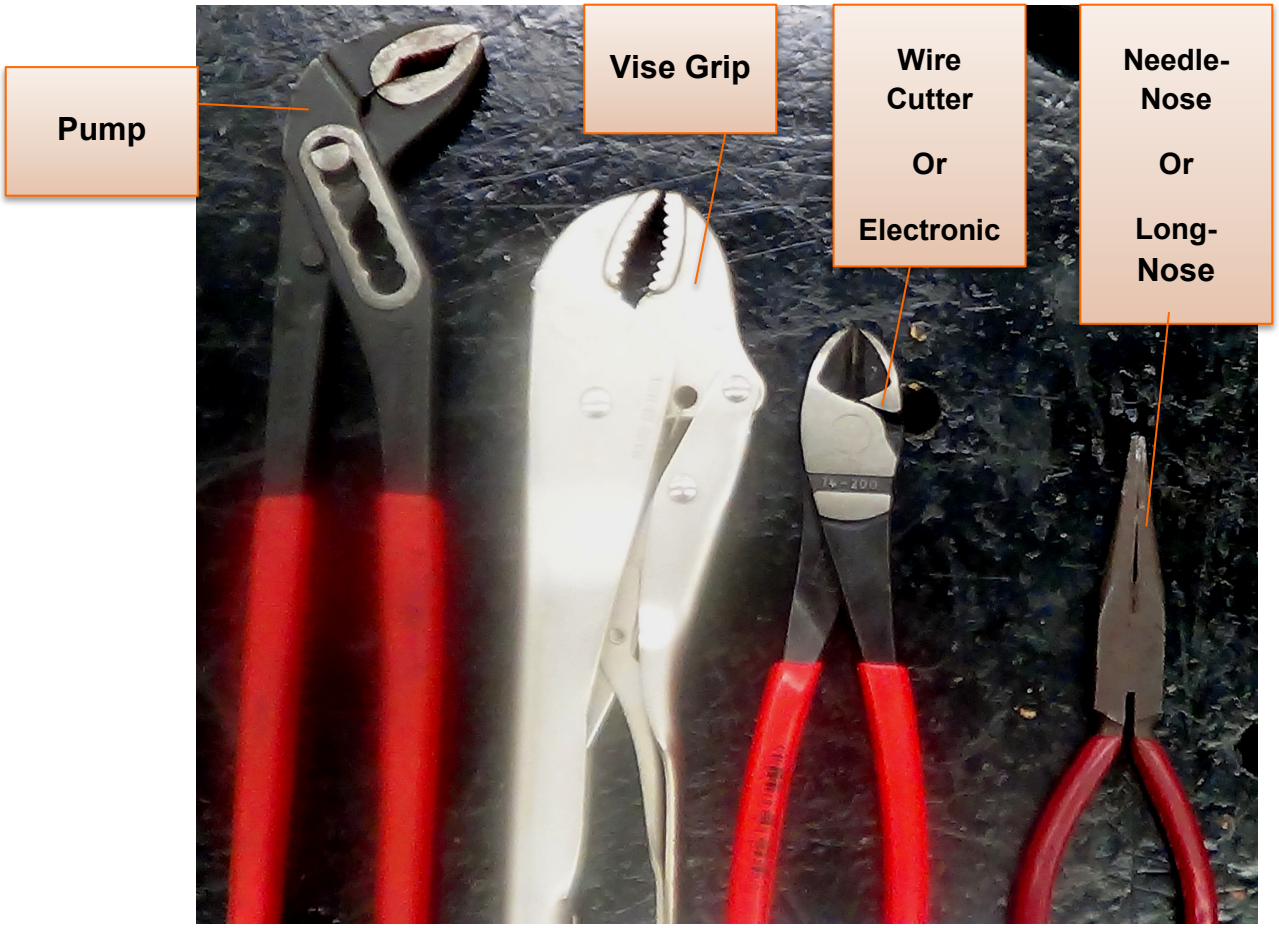

Figure 2: Types of Pliers (Image provided by Ladell Humphries, 2013)

What You Need to Know: TECHNIQUE - PLIERS

WRENCHES

A large variety of **wrenches** are made for different tasks such as installing and removing nuts and bolts. The **most common type** of wrench that is found in industry is the **adjustable wrench**. They come with a fixed jaw that is integrated into the handle. The movable jaw is the part that makes it useful for a variety of sizes of nuts and bolts. These wrenches cannot be used were space is an issue. They are often

misused and it should be noted that the tightening force should always be against the unmovable jaw.

We used to have both open end wrenches and box end wrenches. They were able to combine these wrenches into a combination wrench. These types of wrenches come in both metric and standard sizes. These can be invaluable to someone working in the mechanical trades. These wrenches are used when precise fit is required and space is limited.

Explore: Gallery of Wrenches

What You Need to Know: TECHNIQUE - WRENCHES

HAMMERS

Hammers can be classified as hard or soft. They come in various sizes which is dependent upon weight. The hammer that is most frequently used is the ball peen hammer **(Figure 3)**. It has a two sided head. One end is rounded, which is used to deforming or riveting metal. The other end is the striking face. These hammers range in size from 2oz to 3lbs. Anything smaller than 10oz is used for layout work.

Soft hammers are made from several types of material. They can be made from plastic, brass, lead, copper, or rawhide. They are used to position work pieces that have a finish to protect. A hard hammer could damage these surfaces. The smartest choice would be a dead blow hammer. There are fewer tendencies for these types of hammers to bounce back causing injury.

Explore: Ball Peen Hammer

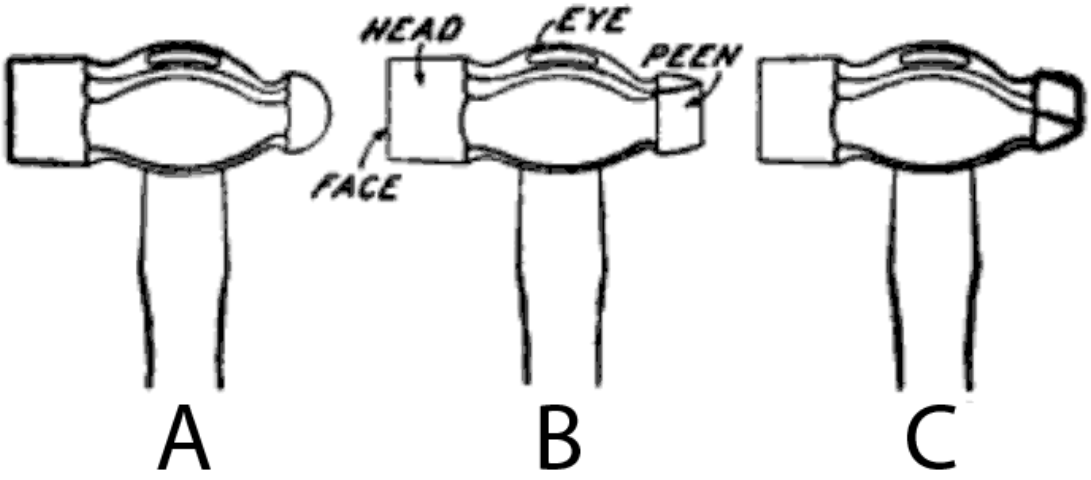

Figure 3: Diagram of a Ball Peen Hammer (Wikipedia.com, 2013)

What You Need to Know: **TECHNIQUE - HAMMERING**

TECHNIQUE – CHOOSING A HAMMER

ACTIVITY 1

Complete the sentence by filling in the blank.

1. The two types of screwdrivers that are most common are _____ and _____.
2. Soft faced hammers can be made from several types of materials such as _____, _____, _____, _____, and _____.
3. _____ are used for holding small and delicate work.
4. _____ pliers allow the jaws to expand and hold larger pieces.
5. The most common type of wrench found in industry is the _____.
6. A _____ is used when space is limited and a more precise fit is needed.
7. _____ were developed to tighten water pumps on automobiles.
8. A _____ is the most frequently used hammer in industry.

WORKHOLDING TOOLS

Clamps and **vises** **(Figures 4, 5 & 6)** are the work holding tools of the machining industry. Most manual operations, which are performed by hand, are done while the parts are being held by one of these tools. They are simple in design but provide stability and some repeatability for the machinist when trying to hold parts.

EXPLORE: **Gallery of Clamps**

What You Need to Know: TECHNIQUE – DIFFERENT CLAMPS

Explore: **Gallery of Vises**

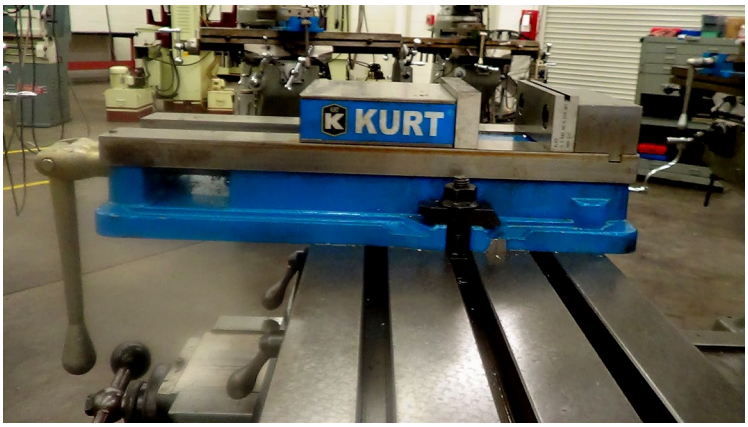

Figure 4: Standard shop vise (Image provided by Ladell Humphries, 2013)

Figure 5: Standard Table-Top shop vise (Image provided by Ladell Humphries, 2013)

Figure 6: Standard shop vise fixed in a Lathe machine (Image provided by Ladell Humphries, 2013)

What You Need to Know: A MACHINE VISE

BENCH VISE

There are all different types of vises being used by machinists and other mechanical trades. Some have solid bases while others have a swivel base. The swivel base will enable the machinist to rotate the work 360°. Solid bases remain stationary. It is important to mount the solid base bench vise in a manner that long work can be held vertical alongside the bench.

Bench vises have hardened jaws with serrated teeth. Because these teeth can damage parts, soft jaws can be created fairly easy. Soft jaws can be made from copper, aluminum, and other soft metals. Vises are used for holding work, filing, hack sawing, light bending of metals, and assembly and disassembly. A proper height of a mounted vise will place the vise jaws at elbow height.

Explore: **Technique – Indicate the vise on a milling machine**

(Creative Commons License, Aluminum soft jaw shown holding five parts at a time in a CNC milling machine, Wikipedia.com, 2013)

What You Need to Know: **TECHNIQUE – CNC BENCH VISES**

TECHNIQUE – METALWORKING VISES

HOW TO SET UP VISE ON CNC MACHINE

CLAMPING

C-Clamps are used to hold work pieces together or even aid in the machining of parts. Heavy duty C-clamps are used by machinists specifically to hold steel plates together for drilling and further machining operations. Parallel clamps are used to hold delicate work. They don't have the same clamping power as c-clamps. Precision measuring set-ups can be held in place with parallel clamps. The size of the clamp is determined by the largest opening of its jaws **(Figure 7)**.

Explore: **Gallery of C-Clamps**

Fixed Jaw

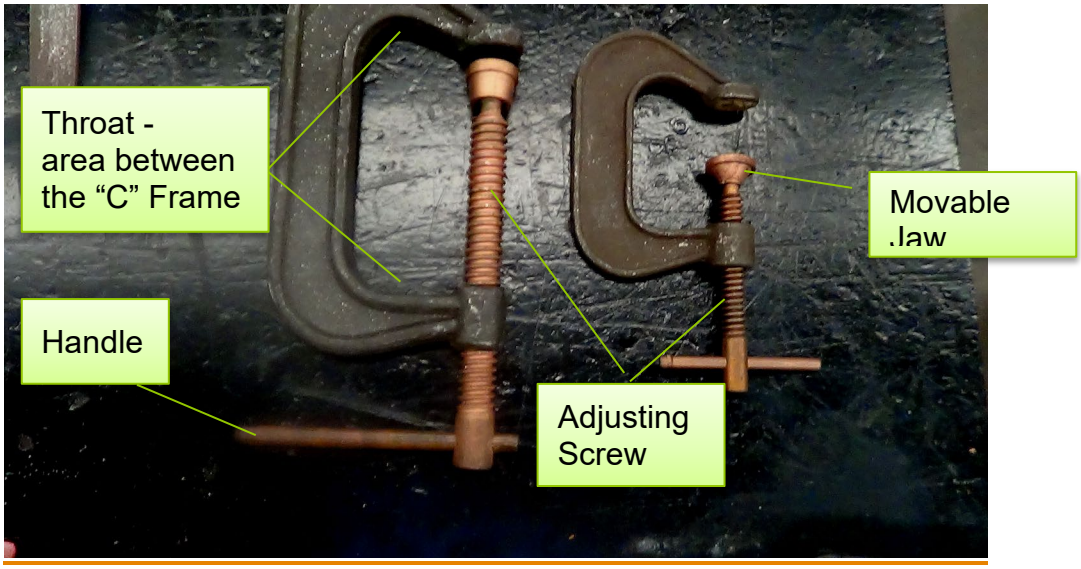

Figure 7: Standard C-Clamps (Image provided by Ladell Humphries, 2013)

What You Need to Know: CLAMP FORCE

DEBURRING

As machinists we want our finished product to be free from burrs. Burrs are the raw material and sharp edges that are left after machining **(Figure 8)**. To correct these problems, further finishing procedures should be followed. You would never want a customer to receive a final product and cut themselves during inspection.

EXPLORE: Deburring

More About Deburring

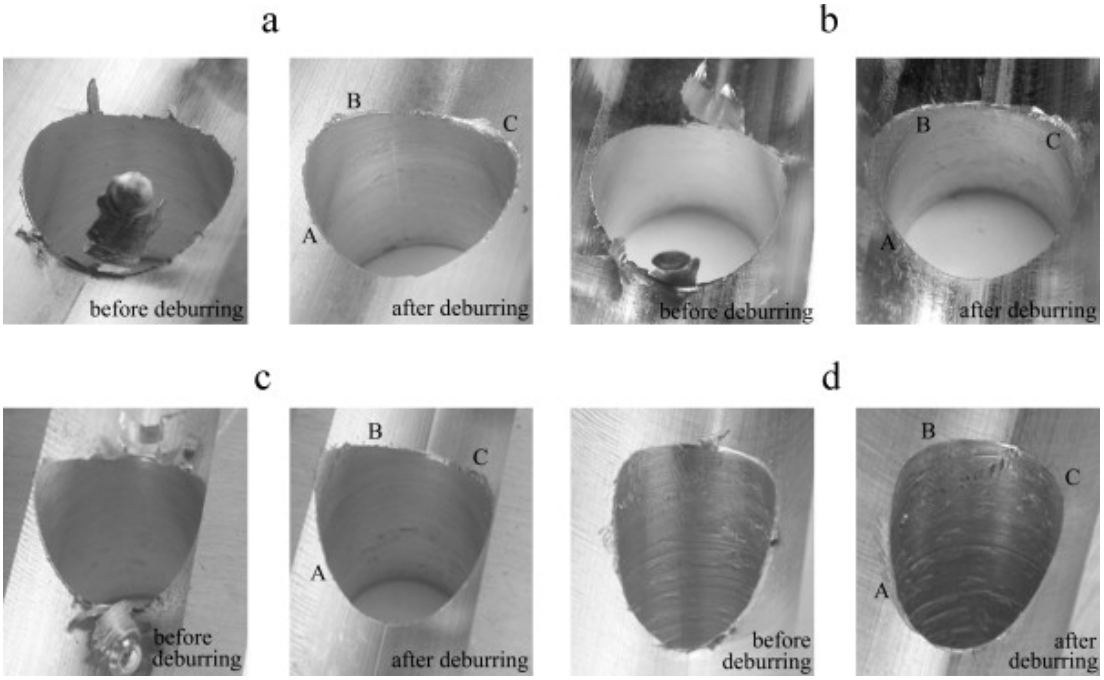

Figure 8: Burr and Deburr (Science Direct.com, 2013, http://www.sciencedirect.com/science/article/pii/S0924013612000064#fig0050)

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What You Need to Know: TECHNIQUE – DEBURRING A PART

Activity 2

Watch the video on **Deburring Tool** and list the features that can be deburred by using the tool in the video.

Link: **Video**

FILES

Files come in many shapes and are defined by tooth patterns and coarseness **(Figure 9 and 10)**. They can be specifically used to put the finishing touches on a machined workpiece. Skilled workers can even use files to produce intricate shapes. Most files have a concave and convex side. The concave side will leave a file cutting the sides and not the middle. The convex side cuts more in the middle of the file as opposed to just the sides.

A file handle should always be used. Especially when using a file for further machining. In the case of running an engine lathe, it is extremely dangerous without a file handle. The tang **(Figure 9)** that is part of the file on one end is very jagged and dull but when propelled can even prove dangerous. A file card is used to clean pinning, material left behind in the file, out of the file.

A file can only be used to remove burrs by moving the file over the edges with a rolling type motion. The file can only cut in one direction. This process will remove the burr rather than pushing it back and forth.

Explore: **Files**

More Files

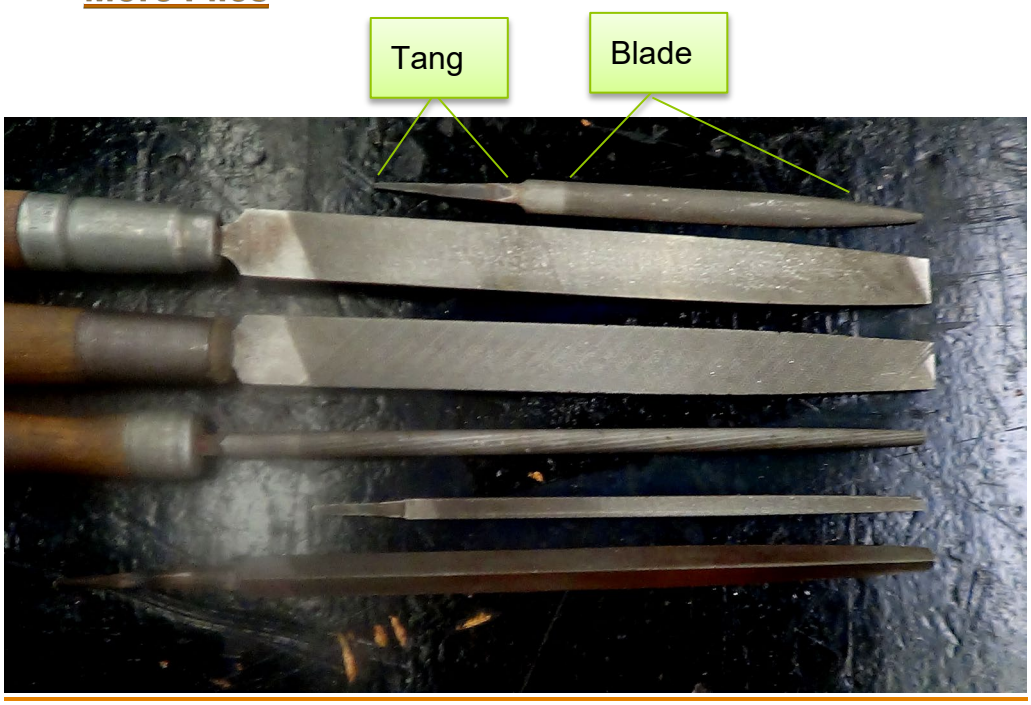

Figure 9: Types of Files (Image provided by Ladell Humphries, 2013)

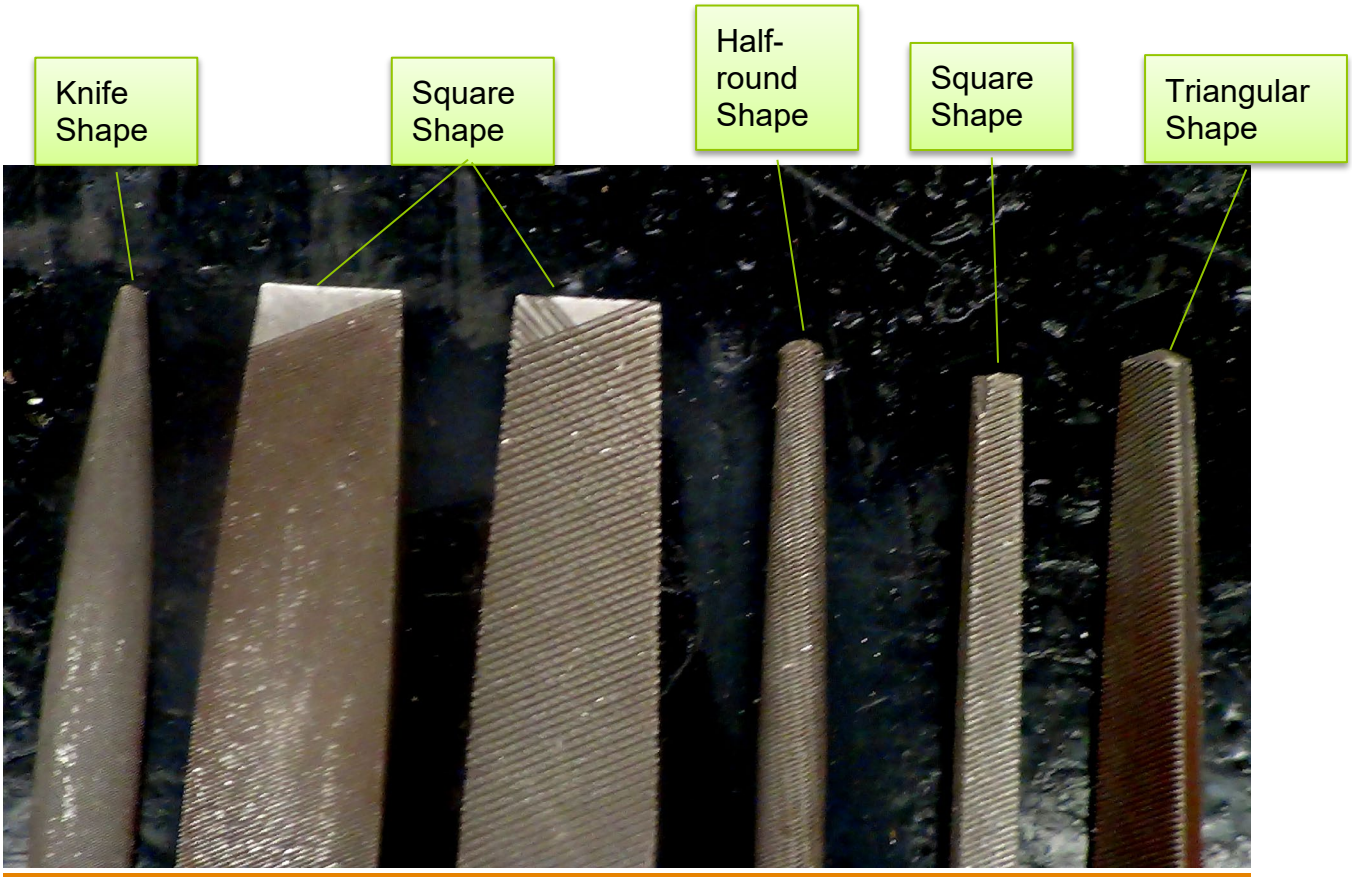

Figure 10: File shapes (Image provided by Ladell Humphries, 2013)

What You Need to Know: TECHNIQUE - FILING

ABRASIVES

Unlike files, **abrasives** **(Figure 11a – 15b)** are able to cut in any direction. Abrasives are anything natural or man-made that can erode away material to produce smoother surfaces and remove burrs. **Sandpaper** is considered one type of abrasive. It is coded by the coarseness of the grit. **Grit** is the size of the abrasive grains. The lower the number, the courser the paper. Finer grits will produce smoother finishes but material removal is very minimal.

Some stones are used to polish and remove material. Stones have abrasives that are bonded together in a solid state. They come in many shapes and sizes for all types of applications.

EXPLORE: **How It's Made – Abrasive Grain**

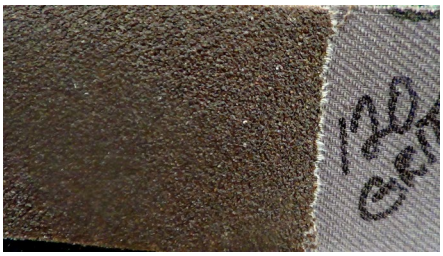

Figure 11a: 120 grit sandpaper

Figure 11b: Close-up of a 120 grit

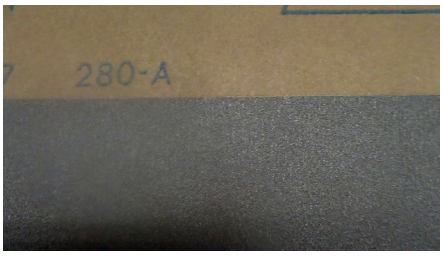

Figure 12a: 280 grit sandpaper

Figure 12b: Close-up of a 280 grit

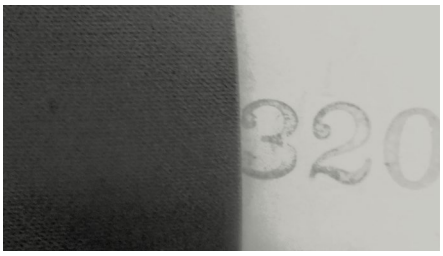

Figure 13a: 320 grit sandpaper

Figure 13b: Close-up of a 320 grit

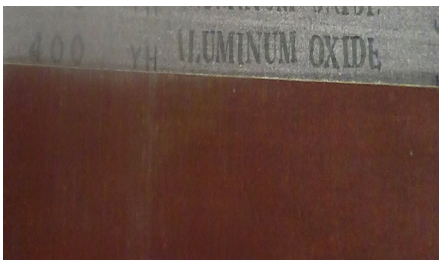

Figure 14a: 400 grit sandpaper

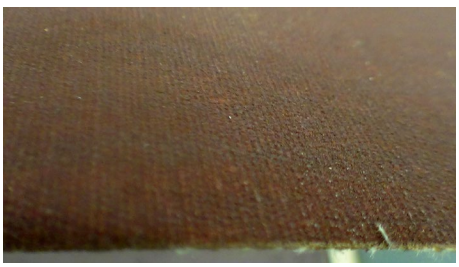

Figure 14b: Close-up of a 400 grit

Figure 15a: Cut-of-Wheel

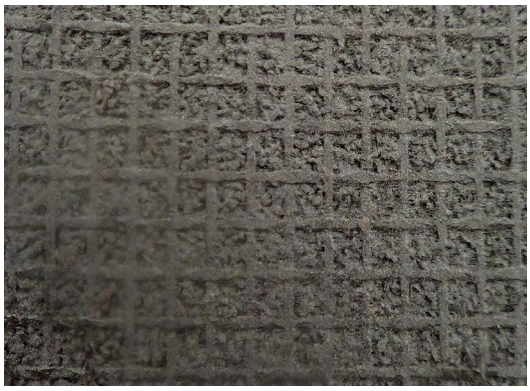

Figure 15b: Close-up of a Cut-of-Wheel

Figure 11a–15b: Types of Sandpaper (Images provided by Ladell Humphries, 2013)

What You Need to Know: HOW ABRASIVES WORK

KEY CONCEPTS

- Machinists use hand tools just like any other mechanical trade. Machinists should be able to use and identify hand tools. These tools are used for setting up machines for operations and repairing them when needed. They are also used where disassembly is required.

- There is a proper and improper way to use hand tools. For instance, a slotted screwdriver comes in many different sizes and widths. It is important to choose the right size slotted screwdriver so that the screw head is not damaged during assembly or disassembly.
- Abrasives are used for deburring purposes but can used for removal of small amounts of material. Abrasives can also be used for polishing purposes. The most common type of abrasive used is sandpaper. In the machining field, sandpaper is used to remove material as small as .001” (one-thousandth of an inch) to .0005” (one-ten thousandth of an inch). This requires great patience and can easily result in a scrapped part if great care is not taken.

KEY TERMS

HAND TOOLS

SCREWDRIVERS

PLIERS

WRENCHES

BALL PEEN HAMMER

C-CLAMPS

FILES

ABRASIVES

VISES

MODULE REINFORCEMENT

True or False: Read the following questions and determine whether the statement is true or false.

1. Files can cut in any direction.
2. Any slotted screwdriver can be used when installing or removing screws of the same type.
3. C-clamps are used to hold work pieces during machining.
4. A swivel base vise can only rotate 180°.
5. The “peen” of a ball peen hammer is used for deforming metal.
6. A screwdriver is a good substitute for a chisel or pry bar.
7. Slip-joint pliers are used to tighten nuts on water pumps of automobiles.
8. Bench vises have hardened jaws with serrated teeth.
9. Parallel clamps have the same clamping power as C-clamps.
10. Box-end and open-end wrenches were combined into a combination wrench.

Multiple Choice: Read the following questions or statements and select the best answer.

1. The _____ pliers allow the jaws to expand and hold larger pieces.
   a. Slip-notch
   b. Slip-joint
   c. Locking lever
   d. Needle-nose
2. A _____ is used to clean pinning, material left behind in the file, out of the file.
   a. File card
   b. Steel brush
   c. File brush
   d. Stiff brush
3. _____ are the raw material and sharp edges that are left after machining.
   a. Filings
   b. Pinning
   c. Burrs
   d. Razors
4. The most common type of wrench that is found in industry is the _____.
   a. Box-end wrench
   b. Allen wrench
   c. Spanner wrench
   d. Adjustable wrench
5. Any ball peen hammer smaller than _____ is used for layout work.
   a. 10oz.
   b. 12oz.
   c. 11oz.
   d. 1lbs.
6. Soft face hammers are made from several types of material including _____.
   a. Brass
   b. Rubber
   c. Aluminum
   d. Magnesium
7. A swivel base vise will rotate the work _____.
   a. 90°
   b. 45°
   c. 180°

d. 360°

8. Files are classified by _____ and coarseness.
   a. Tooth patterns
   b. Grit
   c. Convex
   d. Angle
9. A _____ should always be used with a file when filing on a machine.
   a. File card
   b. Face shield
   c. Gloves
   d. File handle
10. Wrenches with fixed jaws, like a combination wrench, are used where a _____ is required.
   a. Tight fit
   b. Precise fit
   c. Loose fit
   d. Close fit

Answer Key

True or False	Multiple Choice
1. F 2. F 3. T 4. F 5. T 6. F 7. F 8. T 9. F 10. T	1. B 2. A 3. C 4. D 5. A 6. A 7. D 8. A 9. D 10. B

ANSWER KEYS TO ACTIVITIES

ANSWER TO ACTIVITY #1

Answers:

1. **Phillips, Standard**
2. **Plastic, Rawhide, Brass, Lead, Copper**
3. **Needle-nosed Pliers**
4. **Slip-joint**
5. **Adjustable Wrench**
6. **Combination Wrench**
7. **Interlocking-joint Pliers**

ANSWER TO ACTIVITY #2

Answers:

1. Hole Edge 2. Outer Edge 3. Straight Edge 4. Cross-Hole Both Edges

5. Double-Edged Sheets 6. Hole Inner Surface 7. Slot Keyways

8. Hole Back Edge

DISCUSSION PROMPTS

DISCUSSION PROMPT TITLE #1

What are the needs for abrasives at home? Explain your answer and list examples where you used an abrasive at home.

DISCUSSION PROMPT TITLE #2

Explain the purpose for using the proper sized screwdrivers when installing screws. Give examples of instances where you used the improper size and damaged a screw.

CRITICAL THINKING

COMPARE AND CONTRAST KEY CONCEPTS

	Adjustable Wrench	Combination Wrench
Describe each tool.		
Explain the proper use of each tool.		
Explain how each tool is different from the other.		
	Screwdriver (Flathead)	**Screwdriver (Phillips)**
Describe each tool.		
Explain the proper use of each tool.		
Explain how each tool is different from the other.		
	Vise Grips	**Needle Nose Pliers**
Describe each tool.		
Explain the proper use of each tool.		
Explain how each tool is different from the other.		

PUTTING NEW KNOWLEDGE TO WORK

Job Description # 1	Immediate Supervisor	Task	Result of Task
You are a Machinist…	…your immediate supervisor, Mr. Humphries,...	…has asked you to… Inventory the hand tools that are used in the machine shop.	…this will enable you to recognize hand tools that are used in a machine shop.

Student Instructions:

1. Record the hand tool names that have been discussed in this module.
2. Using the machine tool lab's tool room, locate those tools, and sketch the shape of each tool from that list.
3. Label each sketch you made with the proper name of that hand tool.
4. Turn the sketches in when you come to lab.
5. SMILE 

…You have completed the task.

Grading Rubric for Instructors:

	Comprehensive coverage (25 points)	Contains most key information (24-20 points)	Contains key information, but with gaps (19-15 points)	Contains some information (14-10 points)	Missing most or all information (9-0 points)
1. Student recorded the					

names of the hand tools					
2. Student located the tools from that list and sketched each tool.					
3. Student labeled each tool correctly					
Total					

ATTRIBUTION TABLE

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