NJIT | Makerspace

Welcome to the NJIT Makerspace!

“What is a makerspace???”

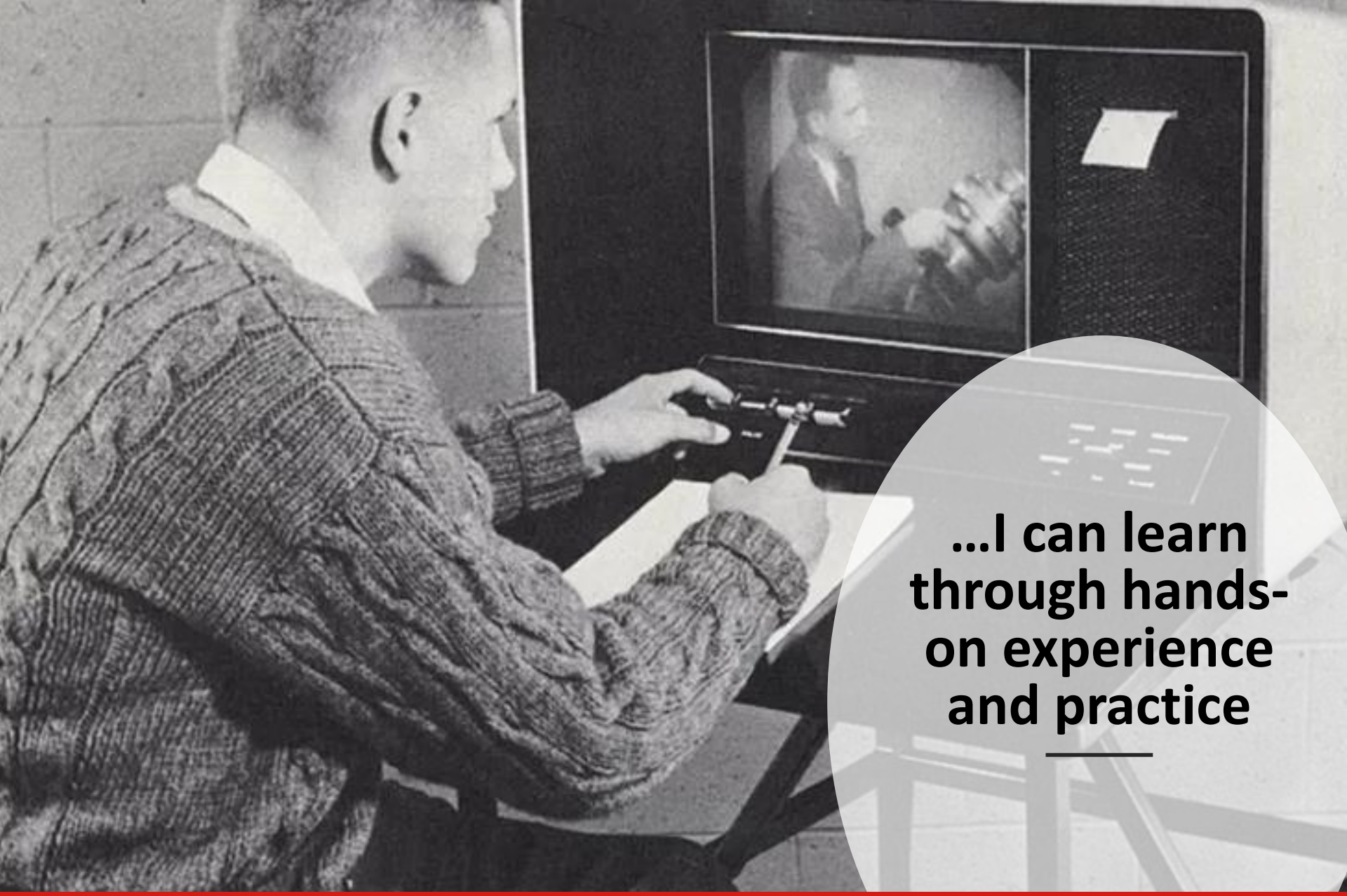
A Makerspace is…

"…a gathering point where communities of new and experienced makers connect to work on real and personally meaningful projects, informed by helpful mentors and expertise, using new technologies and traditional tools"

Be a Part of the Culture!

Makers believe that…


…If I can imagine it, I can make it



…I can learn through hands-on experience and practice

…A "culture of safety" protects us all from unnecessary harm

…a clean & safe workspace promotes safety for everyone


…If I don’t know the equipment I want to use, I’ll ask for help

…Even if it's not perfect, it's worth making

…We're all in this together

But what can I even make here…?

- RC Drone
- Toothbrush holder
- Lawnmower motor-powered off-road vehicle


6
NJIT

- RC Drone
- Toothbrush holder
- Lawnmower motor-powered off-road vehicle
- 3D printed pinball machine


GlobalFSD
ALLOY
PLA
PET
FLEX
HIPS
WOOD
PVA
CLAY
0|0|5|7|0

- RC Drone
- Toothbrush holder
- Lawnmower motor-powered off-road vehicle
- 3D printed pinball machine
- Desk with built-in wireless charging
- Protective laptop sleeve
- Radio controlled airplane

- RC Drone
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- Desk with built-in wireless charging
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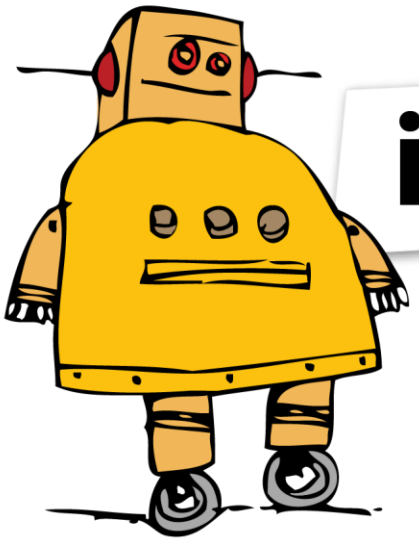
- Laser engraved meat & cheese board


Baxter
EST. 10.24.2016



instructables

Make:

Thingiverse

We Encourage you to Work On…

- **NJIT Coursework**
- **Team/Group Projects**
- **Research Projects**
- **Personal Projects & Hobby Work**
- **Entrepreneurial Projects and Prototypes**

However, do not make…

- **Weapons of any kind**
- **Drug Paraphernalia**
- **Commercial products for sale**
  - **(There can be certain exceptions)**
- **Political items**
- **Anything that makes other members feel uncomfortable**

Some of the Makerspace Equipment

- **3D Printers (multiple varieties)**
- **CO2 Laser Cutters/Engravers**
- **CNC Mills, Lathes and Routers**
- **CNC Water Jet**
- **Wire EDM**
- **Vacuum Former**
- **Band Saws**
- **Polishing units**
- **UV Printer**
- **Metrology Equipment**
- **And more!**

Makerspace Equipment Classifications

Hand Tools

- Operational
- Hazard Class 1
- Standard Access

- Every machine in the Makerspace has a **machine status, hazard class** and **access class** that can be found on our website

Machine Status

Hazard Class

Access Class

Machine Status

- Operational
  - The machine is operational and ready for use
- Service Advisory
  - The machine is either semi-operational or in need of repairs
- Temporarily Unavailable
  - Equipment has not been setup and commissioned. Planned to be available by November 2018.

Hazard Class

- Hazard Class 1

Hazards: Minor injuries that can be resolved with first aid kit or ice pack
Power: Less than 0.25 HP, 2-4 amps, 120 VAC or up to 18V DC
Examples: Lower power hand tools and small bench tools. Drills, glue guns, soldering tools, heat guns, 3D printers, 3D scanner
Access Requirements: Members must attend a training session and pass written and hands-on exams. Improper use will be punished with a verbal warning.
Supervision Requirements: The Makerspace must be open and a makerspace staff member must be present in the facility.

Hazard Class

- Hazard Class 2

Hazards: Minor injuries that can be resolved with first aid kit or ice pack, but potentially requiring additional medical assistance
Power: 0.25-0.5 HP, less than 10 amps, 120 VAC, 18-24V DC, specialized/enclosed CNC machines
Examples: Low to medium power tools. Mid-range powered hand tools, laser cutters, self-standing manual tools (arbor press), desktop CNC mills, routers and lathes (interlocked/enclosed), thermal formers
Access Requirements: Members must attend a training session and pass written and hands-on exams. Improper use will be punished with a verbal warning and a note in the members file and mandatory retraining.
Supervision Requirements: The Makerspace must be open and a makerspace staff member must be present in the facility.

Hazard Class

Hazard Class 3

Hazards: Minor injuries that can be resolved with first aid kit or ice pack, but potential for serious lacerations and minor amputations that require medical attention

Power: Greater than 0.5 HP, greater than 10-amp, 120 VAC, greater than 24V DC

Examples: Powerful portable tools and light industrial tools. 3D printers/processes with toxic/corrosive wash steps

Access Requirements: Members must attend a training session and pass written and hands-on exams. Improper use will be punished with a verbal warning, a note in the members file, mandatory retraining, and potential loss of access to the space.

Supervision Requirements: The Makerspace must be open and a Makerspace staff member must approve use of the equipment each time it is used. Staff may deny access or place additional restrictions on the use of this equipment on a per-use or per-person basis.

Hazard Class

- Hazard Class 3

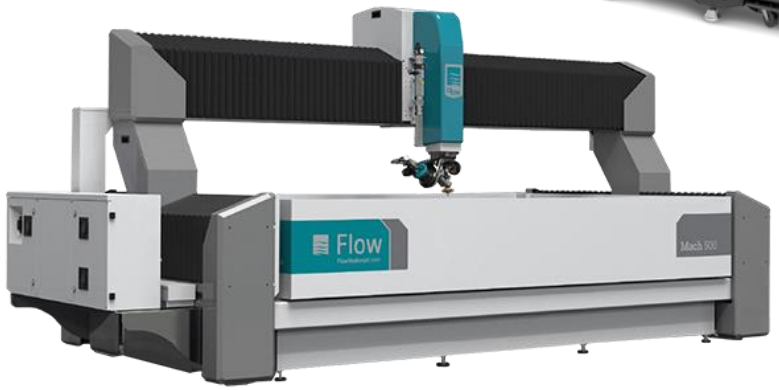
Hazard Class

- Hazard Class 4

Hazards: As above, but potential for serious amputations and life-threatening injuries
Power: As above, but self-standing and 3 phase power
Examples: Powder actuated tools, table saws, manual mills and lathes, CNC mills and lathes, waterjet
Access Requirements: Members must attend a training session and pass written and hands-on exams. Improper use will be punished with a verbal warning, a note in the members file, mandatory retraining, and potential loss of access to the space.
Supervision Requirements: The Makerspace must be open and a dedicated staff member must supervise use of this equipment for the entirety of its operation. Staff may deny access or place additional restrictions on use of this equipment on a per-use or per-person basis.

Hazard Class

- Hazard Class 4



Access Class

Standard Access

- Trained Makers are allowed to use the machine

Assisted Use Only

- Trained Makers are allowed to use the machine when a staff member is with them to assist

Staff Use Only

- Only staff members may use the machine

Basic Guidelines & Safety Rules!

Operating Hours (Fall):
12PM – 9PM

- **NJIT undergraduates, graduate students, faculty and staff, part-time and full-time**, are all eligible to use the NJIT Makerspace
- Access to the Makerspace during open hours is granted once this introductory course is completed!
- Access to the Makerspace **may be revoked at any time** at the discretion of Makerspace personnel

Basic Guidelines & Safety Rules!

Operating Hours (Fall):
12PM – 9PM

- **If you are questioning the safety of an activity, STOP what you are doing and consult Makerspace staff!**
- Only use equipment that you have been properly trained on
- Please do not tamper with machine safety devices or 3D printer control access systems
- Try to avoid working alone!

Basic Guidelines & Safety Rules!

Operating Hours (Fall):

12PM – 9PM

- **Smile! You are on camera at all times!**
- **Please find additional information regarding rules and guidelines on our website:**

NJITmakerspace.com

- **Also, please find additional information from NJIT's Environmental Health & Safety website:**

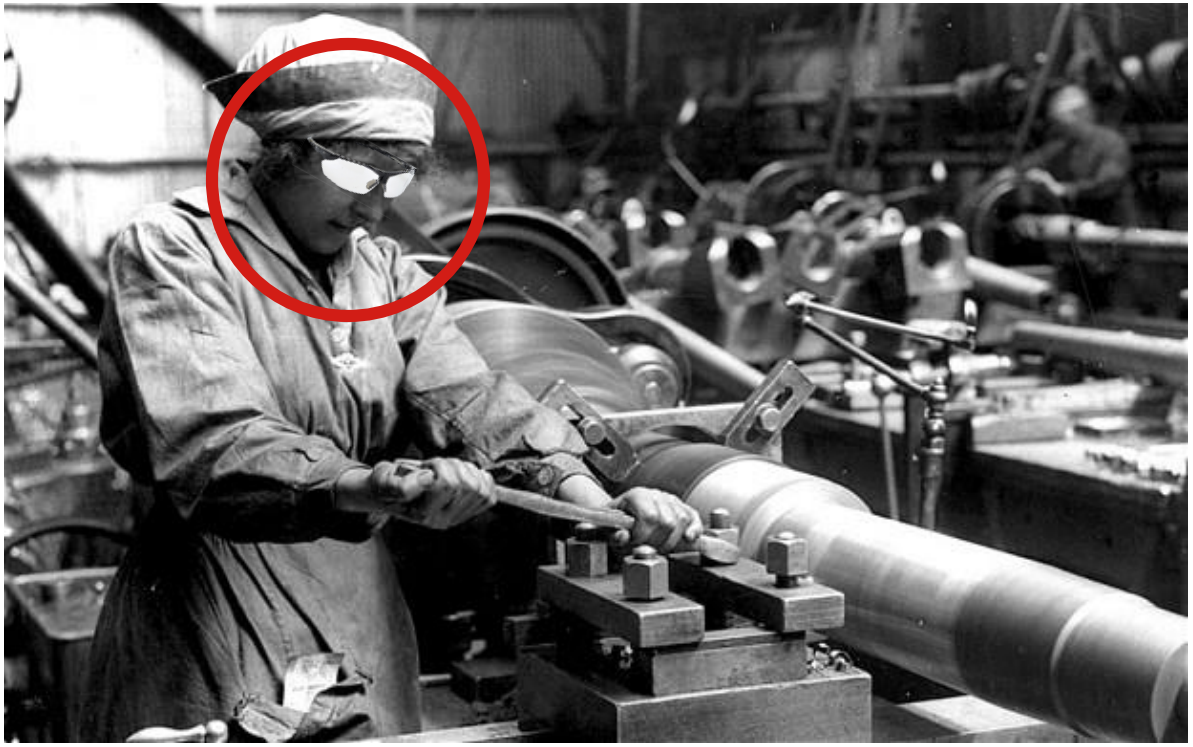
njit.edu/environmentalsafety

Proper Attire

- **No loose fitting clothing or jewelry**
- **No open-toed footwear**
- **Long hair must be tied up and out of the way of machinery**

Personal Protective Equipment (PPE)

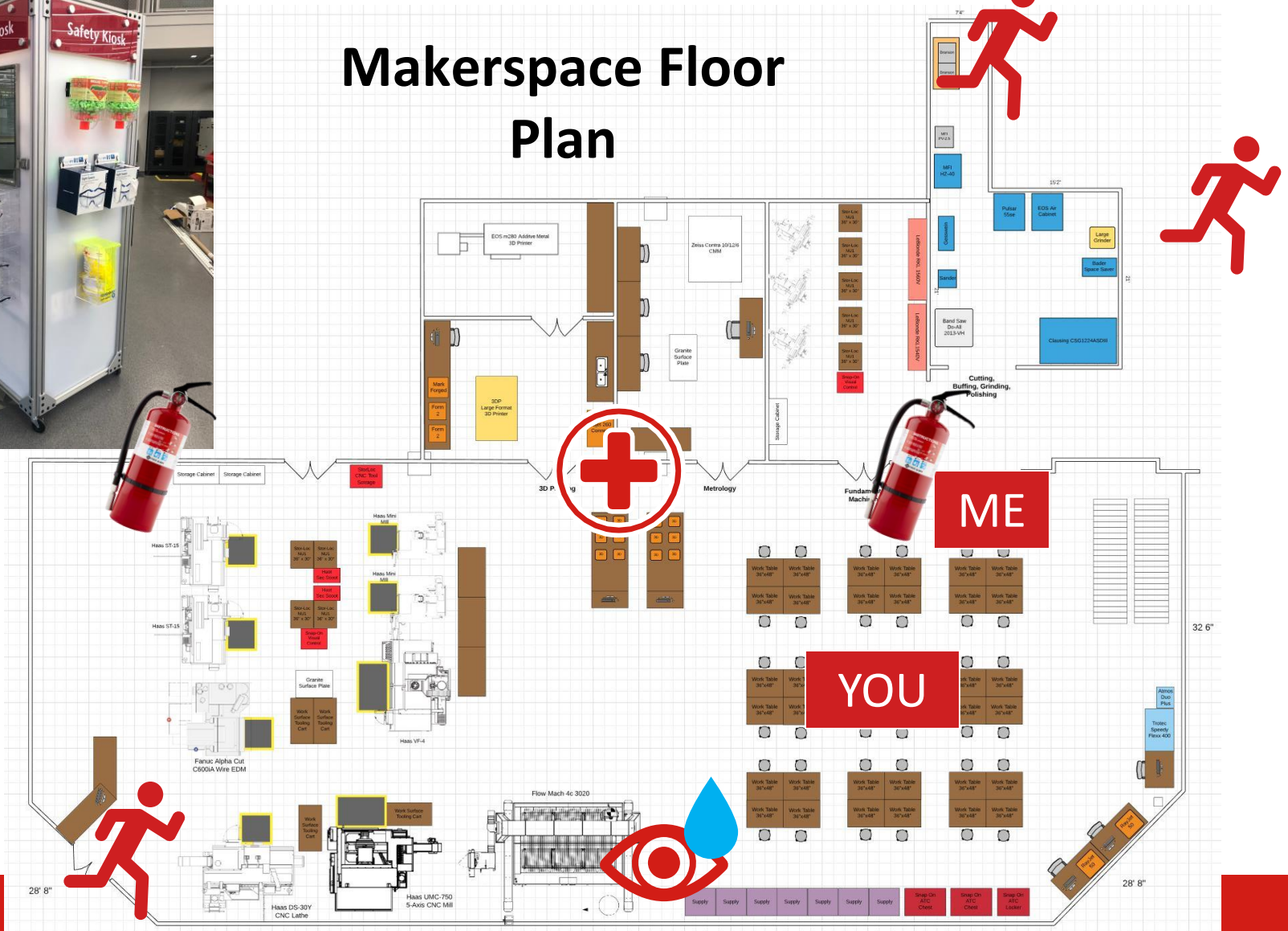
What PPE is missing in the photo from the last slide?



- **All Makers must wear appropriate PPE for the task at hand**
- **Eye protection must <u>always</u> be worn when in the workbench area**

Fire Exits & First Aid

Makerspace Floor Plan



In Case of an Emergency

Call 911

NJIT Public Safety Non-Emergency
(973) 596-3111

- **Make sure that the 911 operator knows you are on NJIT campus!**
- **Alert Makerspace staff**
- **Provide assistance if there is an injured party until emergency response team arrives**

In Case of a Fire

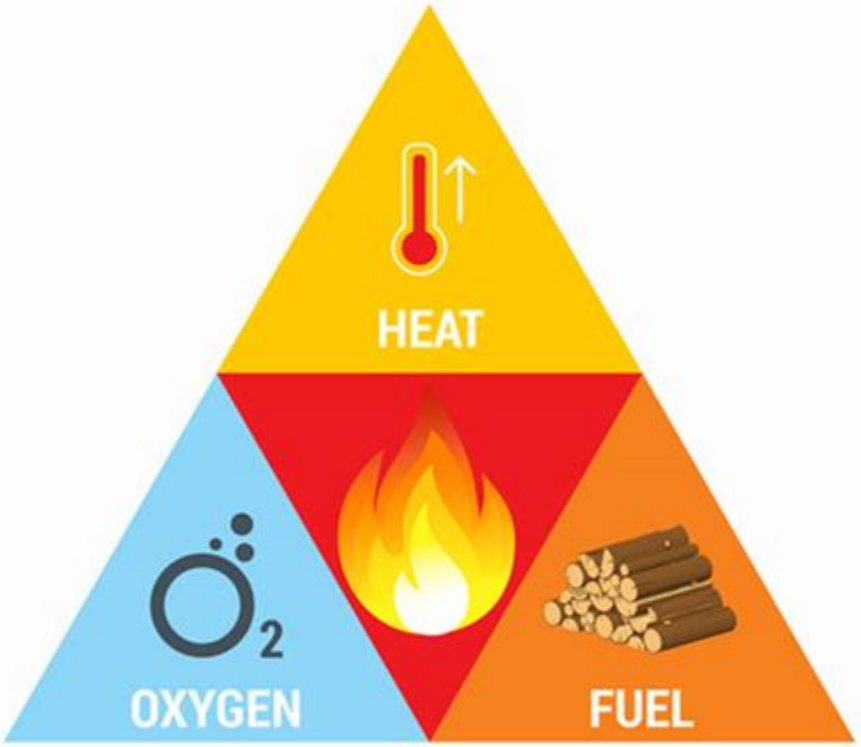
- Activate the building fire alarm
- Evacuate the Makerspace and the building
  - Assist those who need it
  - Leave your belongings behind

Call 911

(Let them know you're on NJIT Campus)

- Once you're outside, don't leave the area! You will need to be accounted for

Fire Safety



Remove one ingredient → Fire stops

Fire Safety

If the fire is small (Ultimaker 3 size)……

Do not endanger yourself to put out a fire!!!

EHS Shop Safety Training
(In Brief)

- **Everyone in the Makerspace has a right to know all physical and health hazards pertaining to the Makerspace**
- **Everyone in the Makerspace will have access to standard operating procedures (SOP) and Action Plans pertaining to the Makerspace**
- **Each and every chemical present in the Makerspace has a Safety Data Sheet (SDS) that can be found in a binder near the first aid station**
- **No eating or drinking within the Makerspace**
- **Please return damaged PPE to Makerspace staff**
- **Do not remove any PPE from the Makerspace!**
- **Inform Makerspace staff if you need to dispose of chemical/ hazardous waste**

Basic Hand Tool Training

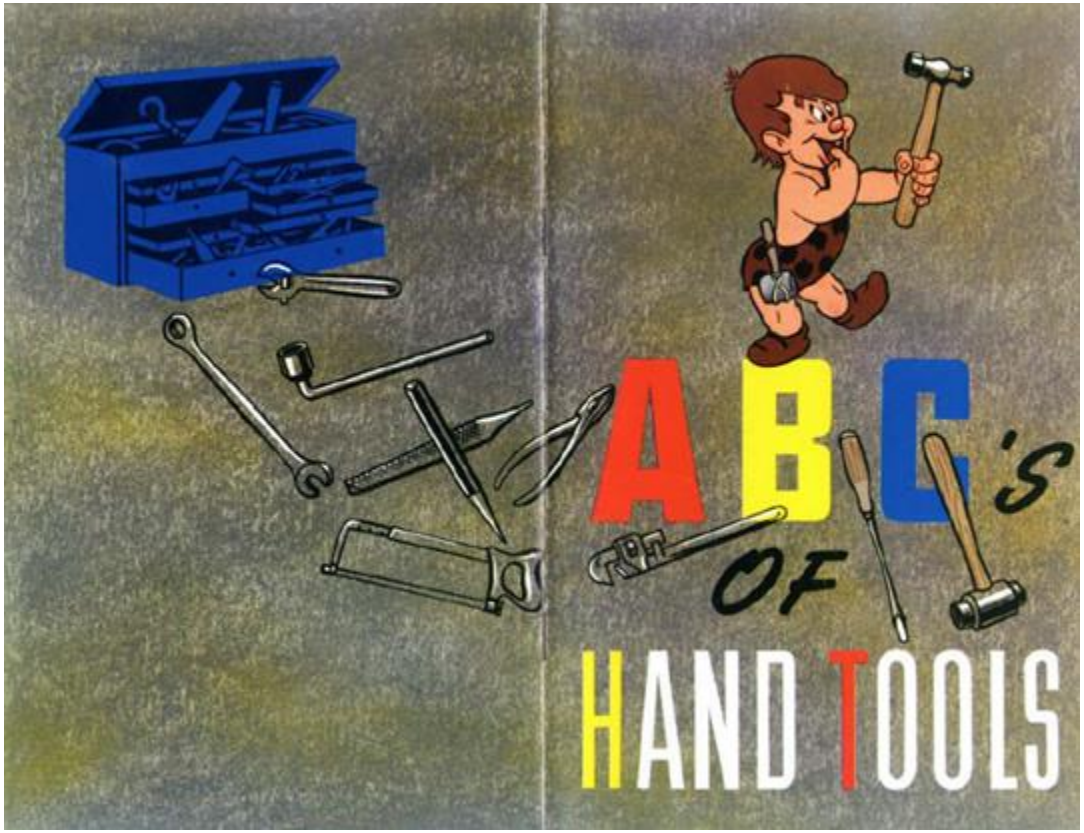
5 Basic Hand Tool Safety Rules

1. Keep all tools in good condition via regular maintenance
2. Use the right tool for the job
3. Examine tools for damage before use & do not use damaged tools
4. Operate tools according to the manufacturer's instructions
5. Use the proper personal protective equipment for the job

Basic Hand Tool Use

You will notice that some of the following images look like they're from a 1950's cartoon…

They are.

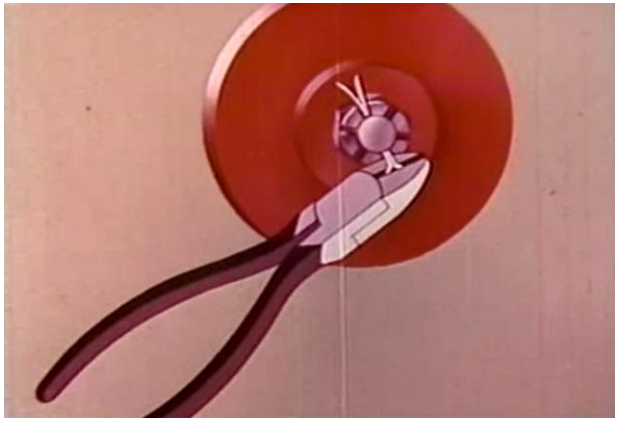


Basic hand tool operations have not changed since the inception of these tools, because they were all designed with a very specific purpose! The following are the safest and most effective uses of basic hand tools that you will have access to in the Makerspace!

Basic Categories of Hand Tools

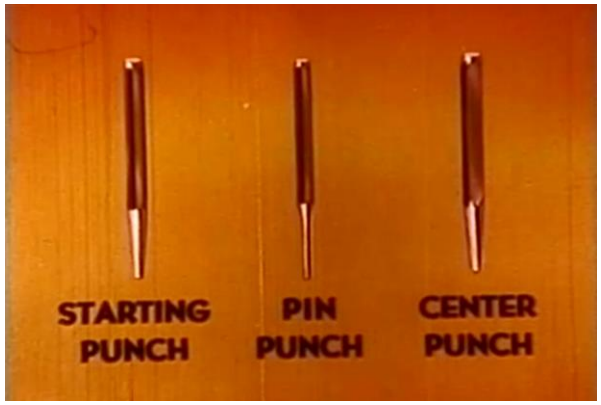
Hammers
- Claw
- Ball-peen
- Non-marring

Drivers
- Screwdriver
- Hex keys
- Wrenches



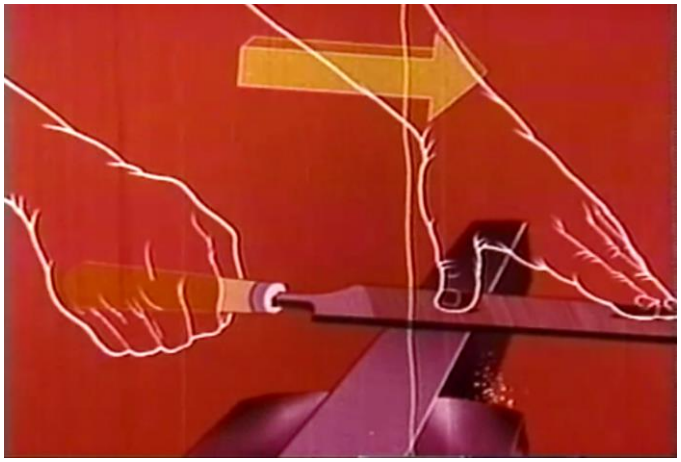
Pliers
- Diagonal
- Slip joint
- Duckbill
- Needle-nose
- Locking

Basic Categories of Hand Tools

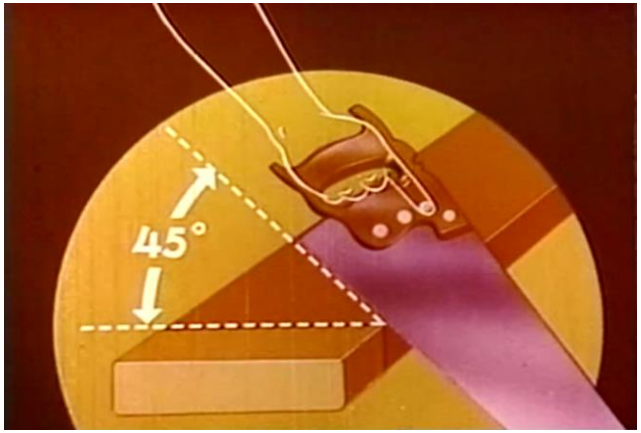


Chisels & Punches

- Starting punch
- Pin punch
- Center punch



Files

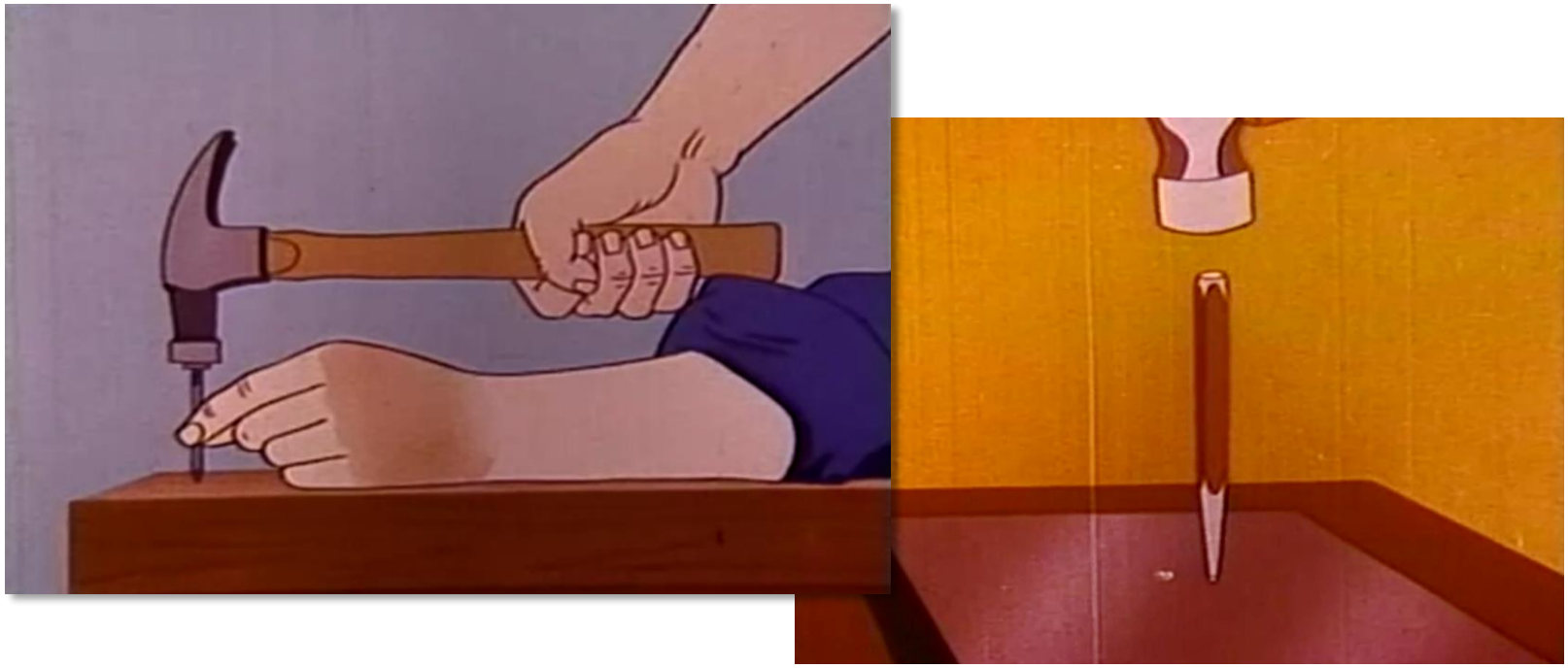


Saws

- Rip saw
- Cross cut saw
- Hack saw

Hammers

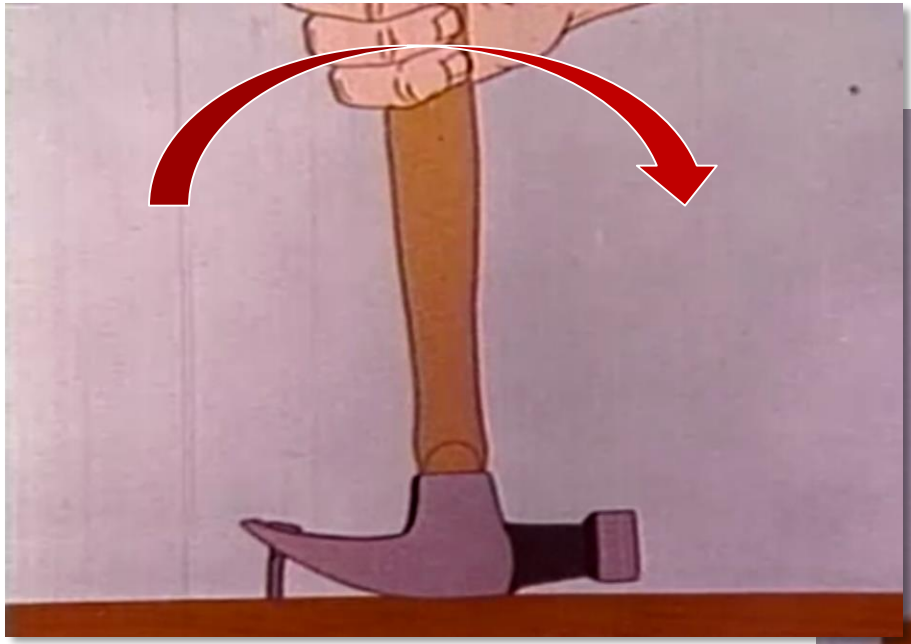
Hammers impart impact force to a nail, punch, chisel or directly to a workpiece via swinging motion



Notice the proper arm and hand placement in the above image. The gripping hand holds the handle at its end. The forearm gripping the fastener, in this case, a nail, is resting flat on the workpiece. The hammer head's face will make impact perpendicular to the nail.

Types of Hammers

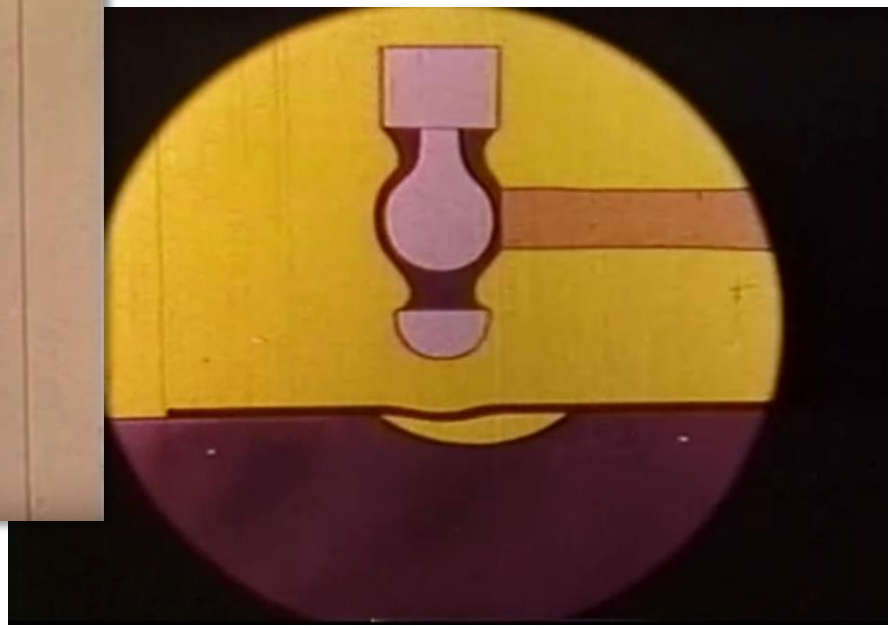
Claw Hammer



- Claw hammers are excellent for driving and removing nails.
- For removing nails, the nail head is aligned between the split in the claw. The hammer handle is then rocked towards the user's body.
- The curvature of the claw provides leverage for removing nails

Types of Hammers

Ball Peen Hammer



- Ball peen hammers are used for directly striking metal workpieces, either to shape or “peen” them
- Also excellent for working with chisels or punches, or for installing rivets

Types of Hammers

CAUTION

- Be careful NOT to strike your workpiece with the edge of the hammer's face
- This can potentially damage the hammer!

Types of Hammers

Non-Marring Hammer

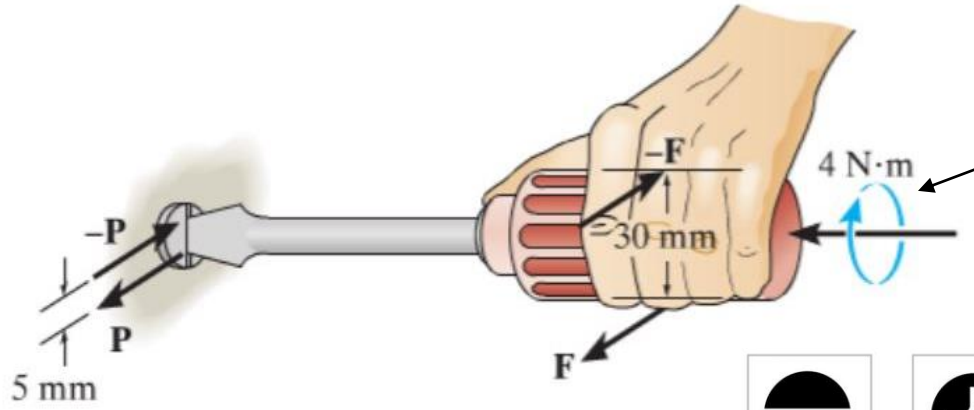
- Non-marring hammers have both a plastic and a rubber tip for imparting force on a workpiece without affecting its finish
- The plastic side of the head has less “give” than the rubber side, allowing for more force to be sent to the workpiece but with greater potential for marring its surface. You could potentially damage the hammer or mar your workpiece so be careful!

Drivers

Drivers move a fastener axially using a turning motion, which propels the threads of the fastener through the workpiece

Considerations for Drivers

- There are 2 forces required when using a driver:
  - Axial force to maintain connection with driver and fastener
  - Torque (rotational force) to rotate the fastener, which propels it along its axis
- Driver size! Make sure the end of your driver matches the fastener, both in shape and dimension!!

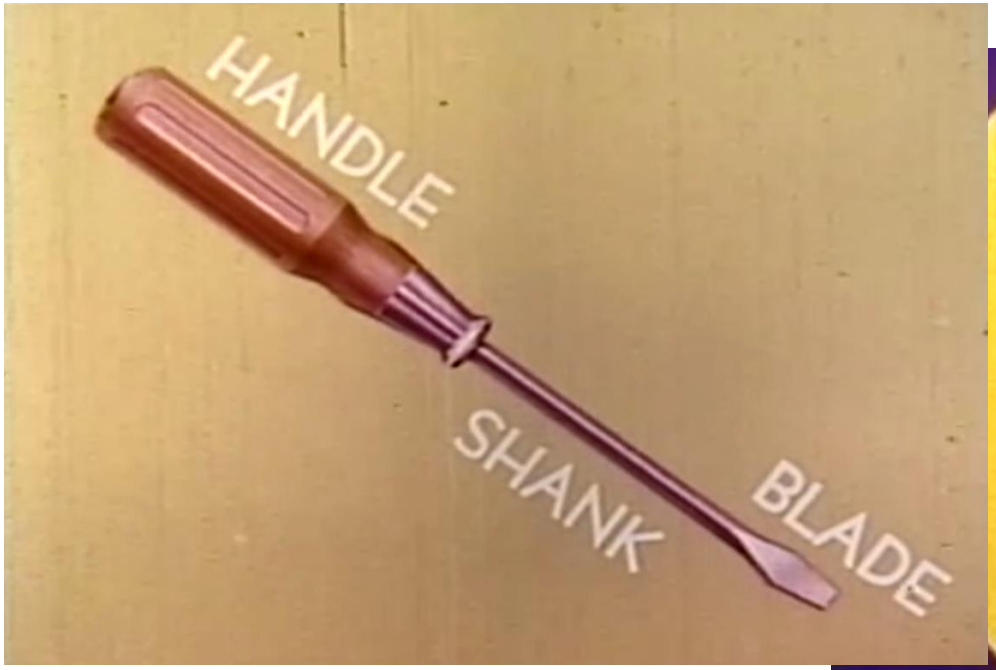


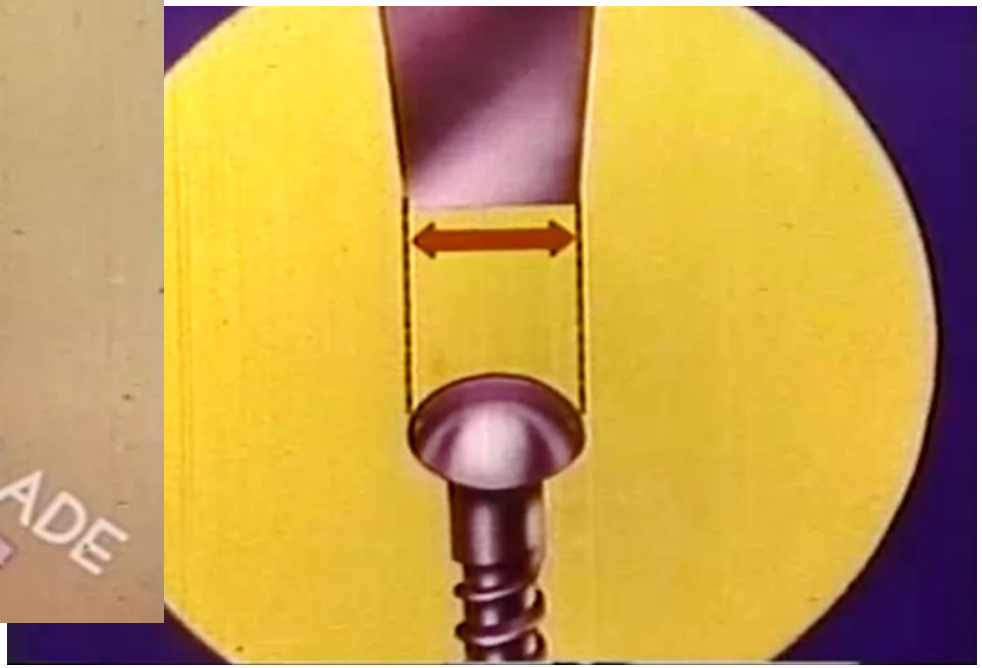
Torque

Axial Force

Types of Drivers

Screw Driver

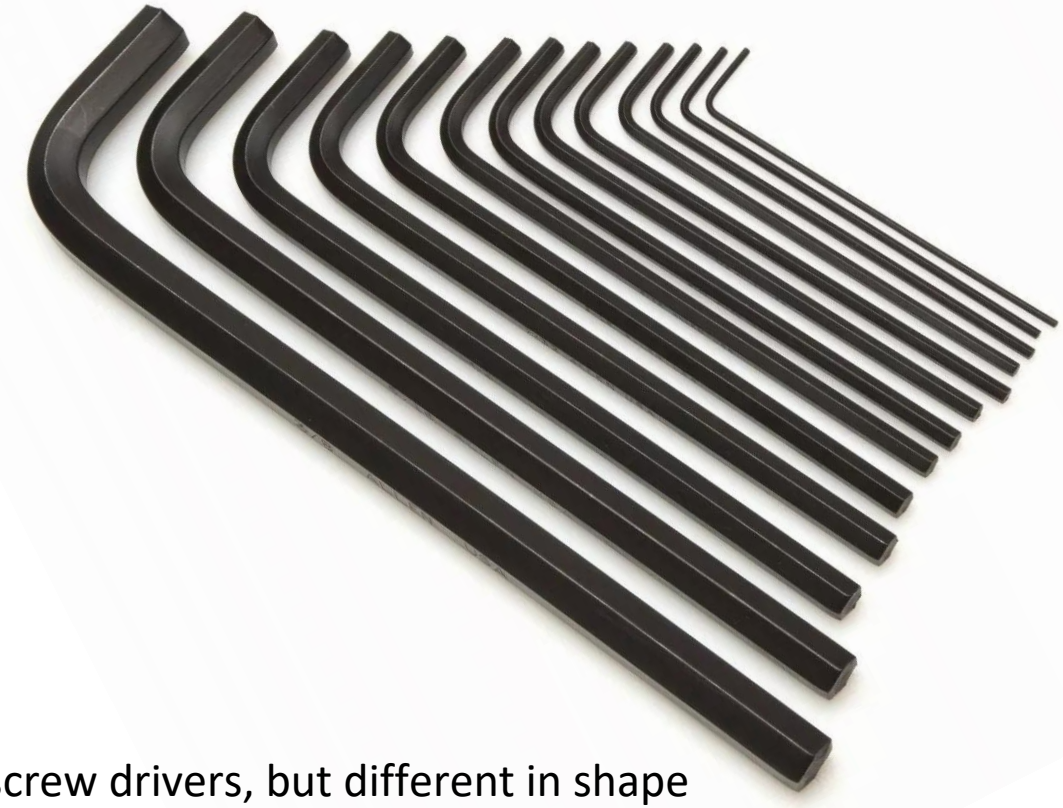




- For driving screws of various head shapes, including phillips, flat or spline (torx)
- Ensure that the blade of the screw driver fits snug with the head of the fastener being driven, both in terms of width and thickness
  - Failure to do so could result in “stripping” the fastener

Types of Drivers

Hex Keys



- Similar to screw drivers, but different in shape
- Specifically for driving hex head fasteners
- Use the long end to locate and initially drive the fastener
- Use the short end to fully torque the fastener

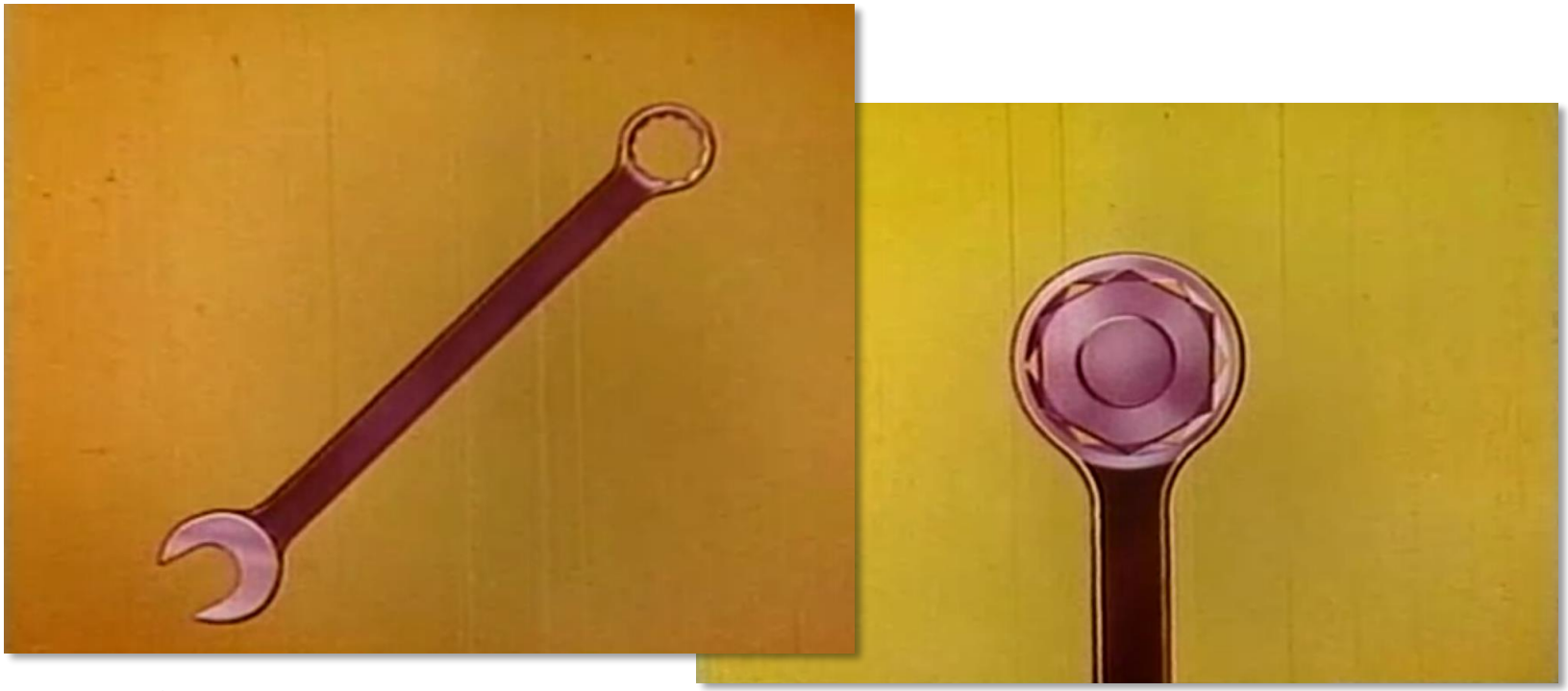
Types of Drivers

Wrenches

- Used for driving hex head bolts, nuts or pipe by engaging perpendicularly to the driving axis
- Different types for different applications
- **Pull**, don't push!

Types of Drivers

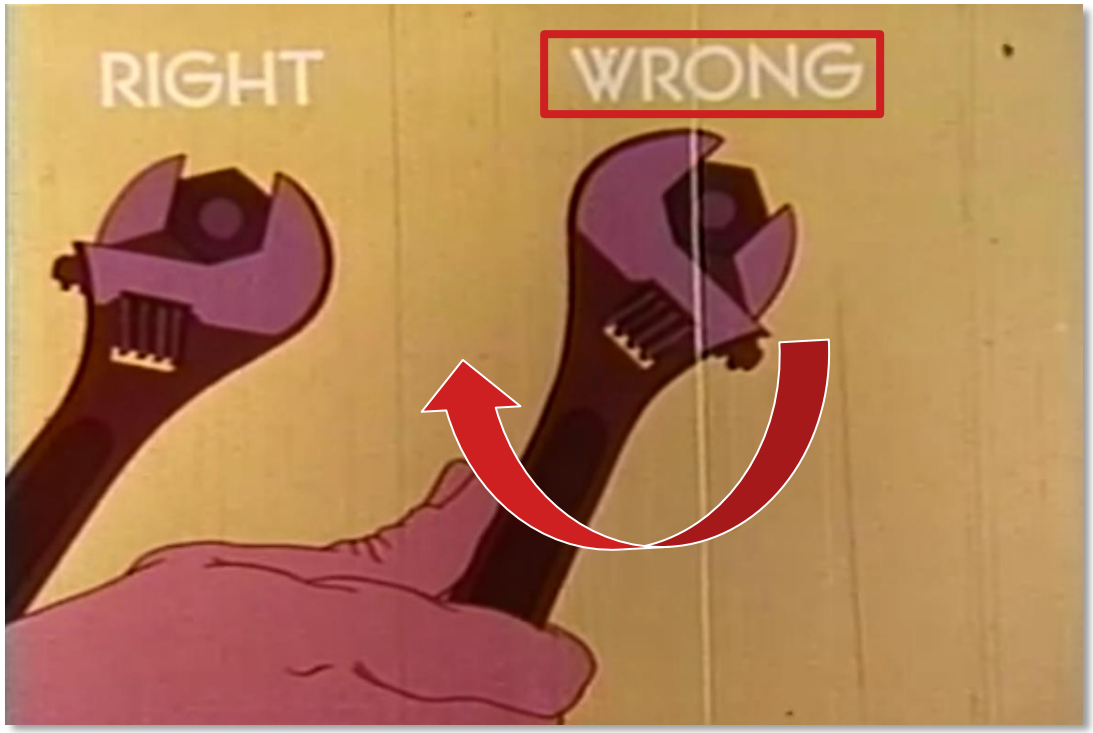
Open & Closed/Combo Wrench



- Excellent for high-torque applications!
- Open and closed ends for different situations
  - Open end is useful for tight entryways: the wrench can be flipped over to allow for a fuller turning motion
  - Closed, 12-point contact excellent for high-torque applications

Types of Drivers

Adjustable Wrench



- Excellent for low-torque, variable fastener size applications
- Always turn wrench in a direction away from the non-adjustable jaw
  - This is the strongest part of the wrench!

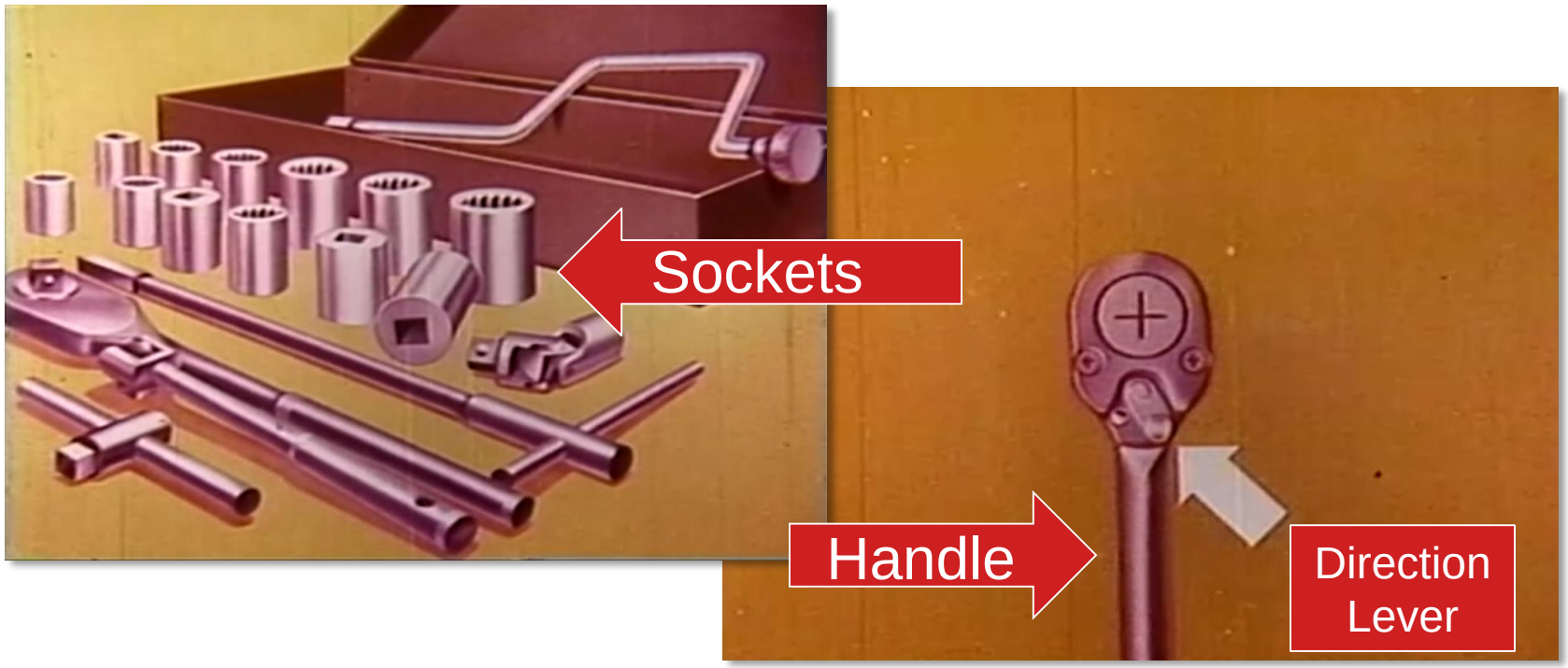
Types of Drivers

Pipe/Plumber Wrench

- Useful for turning pipe of various radii
- Serrated teeth are useful for gripping pipe to be turned
- Wrench is adjusted by turning the silver ring indicated in photo
- As with the adjustable wrench, always turn away from “thickest” portion of jaws
  - Pipe could slip out of plumber wrench if turned in wrong direction

Types of Drivers

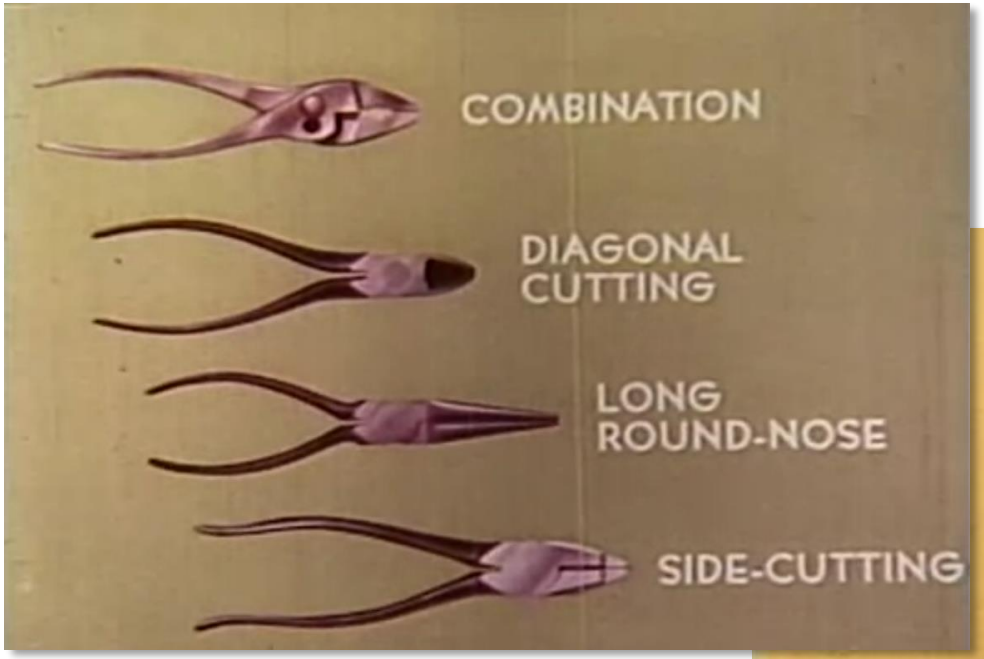
Ratcheting Socket Wrench

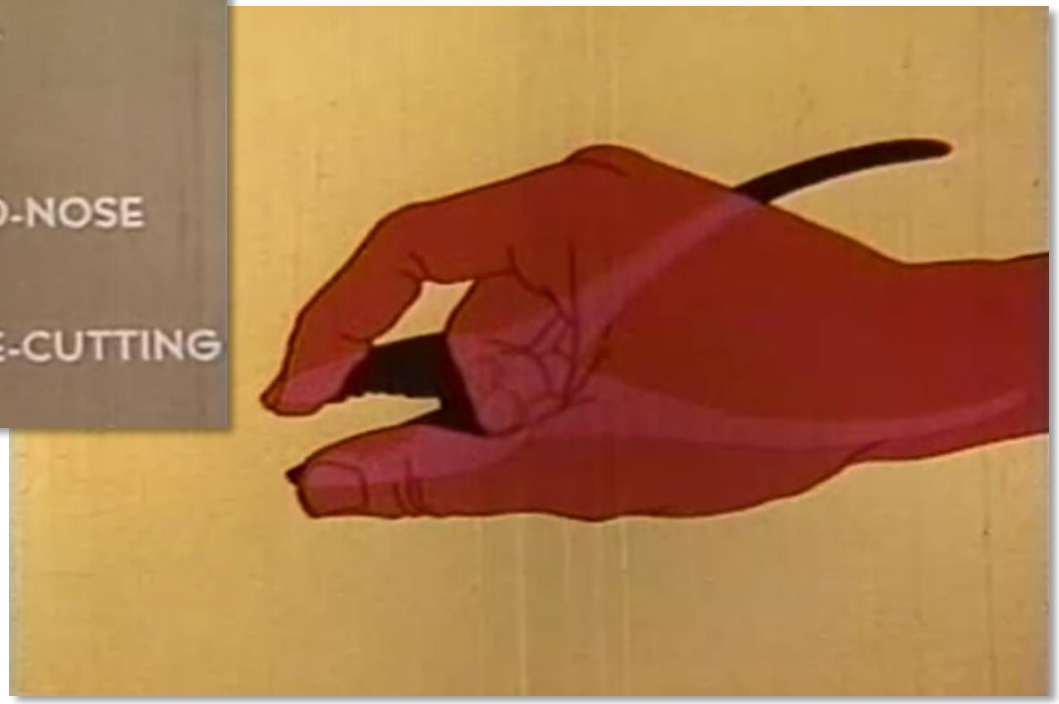


- For high-torque applications and/or hard to reach fasteners
- Socket fits around fastener, handle mounts to socket
- The ratcheting mechanism allows for torque to be applied in one turning direction only
  - This allows for rapid torqueing of the fastener

Pliers

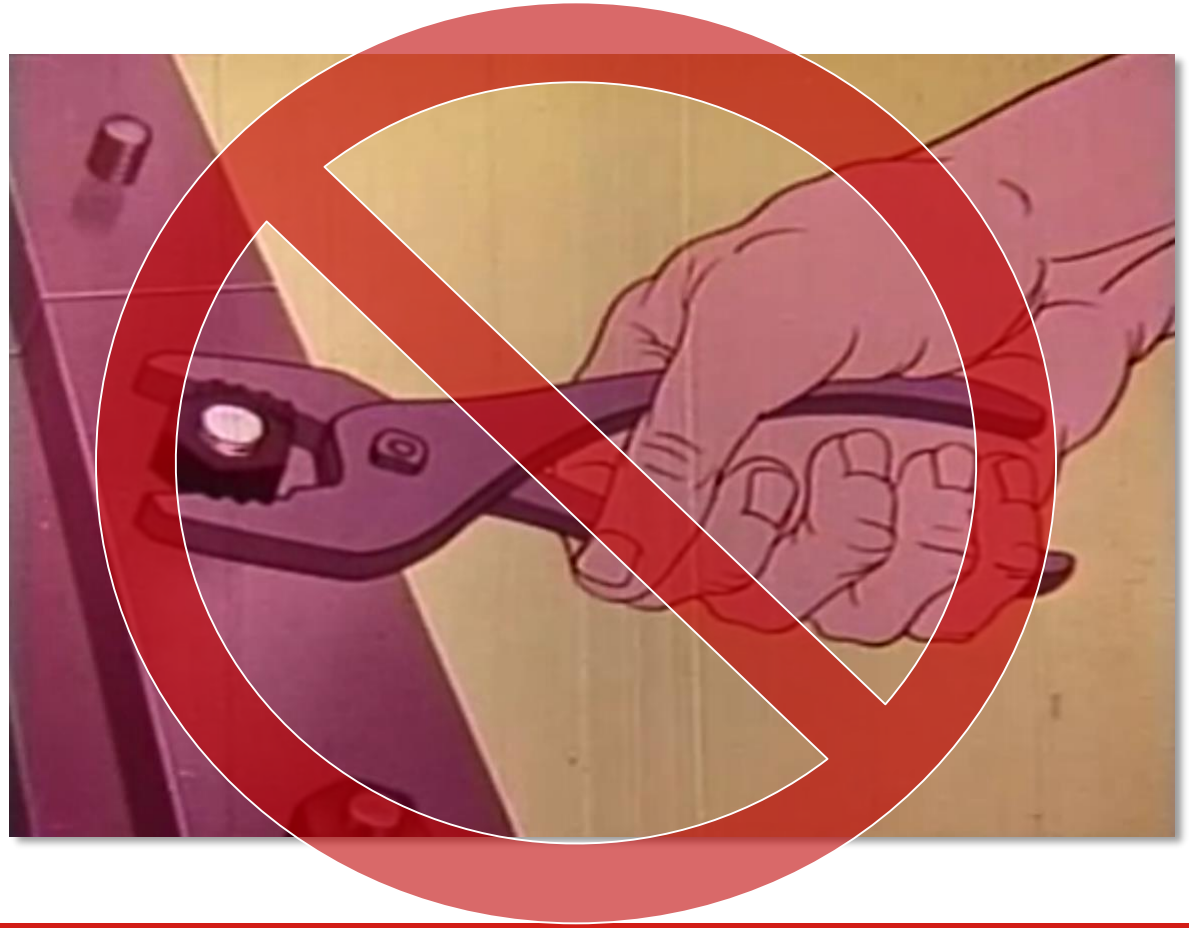
Pliers are used for gripping, bending and cutting workpieces. As pictured below, think of pliers as an extension of your fingers, just more powerful!





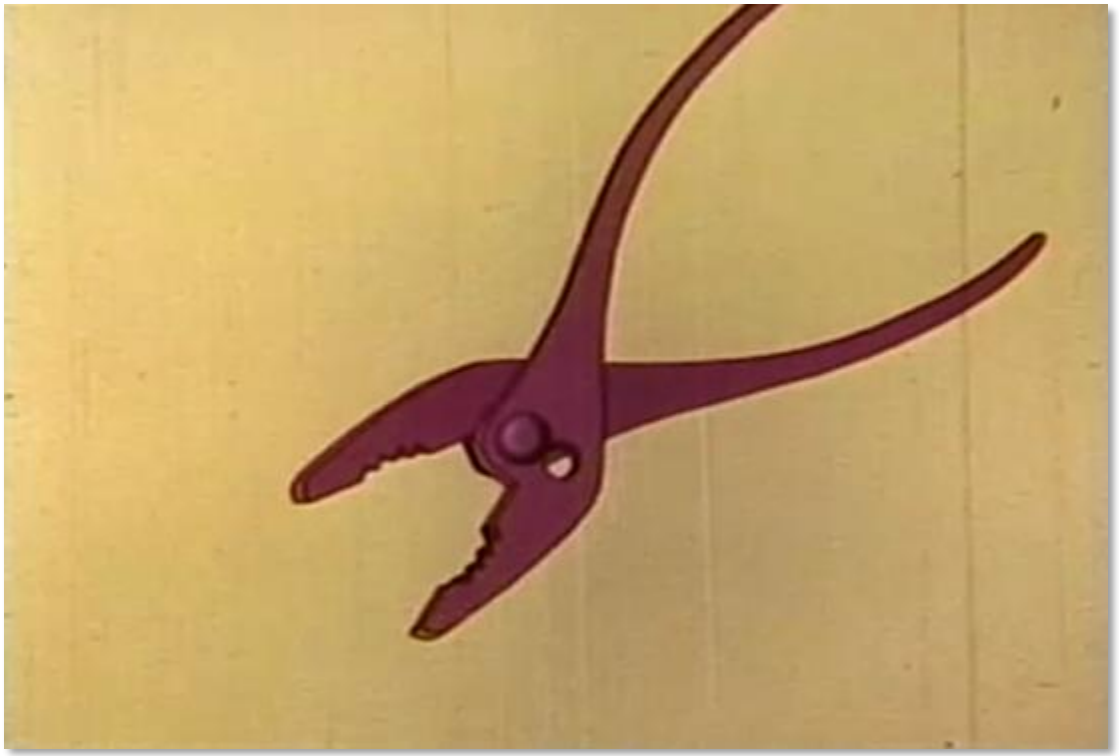
How NOT to Use Pliers

- Pliers are not for torqueing fasteners or gripping fasteners while the other end is torqued!
- Most pliers have serated teeth on their jaws that will damage fasteners!



Types of Pliers

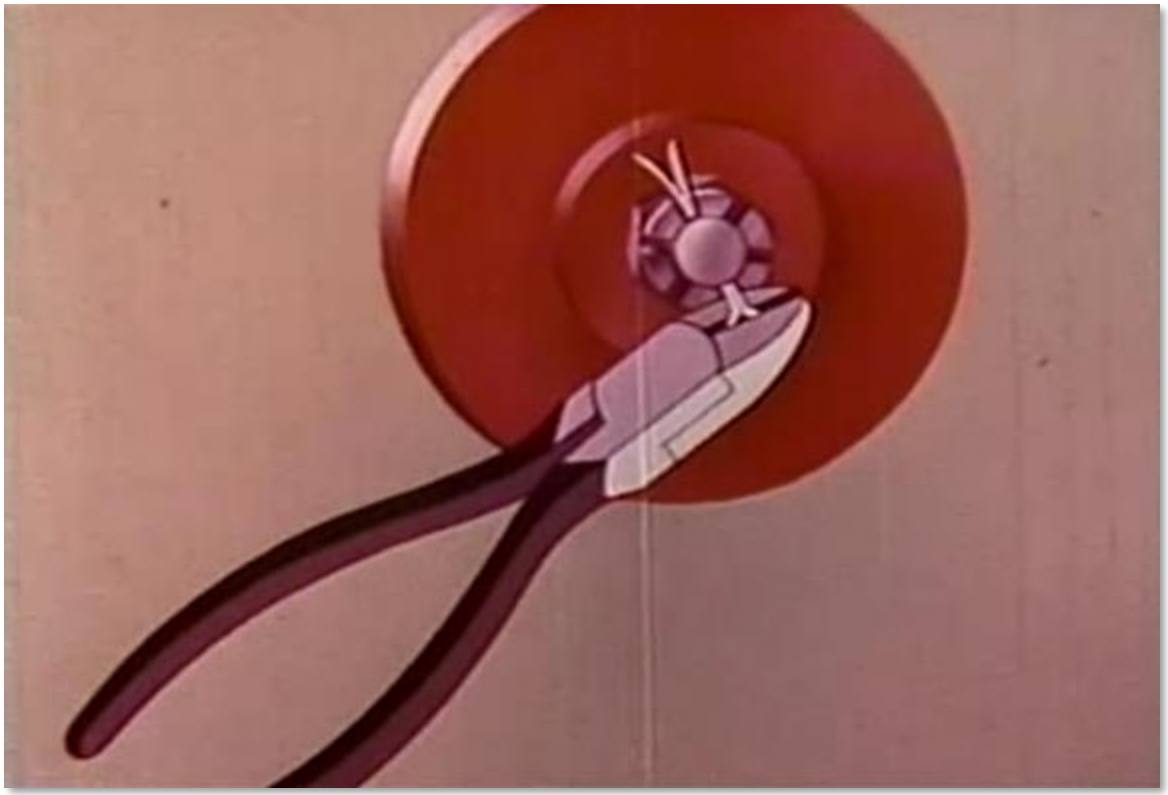
Combination/Slip Joint Pliers



- Pliers with an adjustable fulcrum to allow for gripping larger objects

Types of Pliers

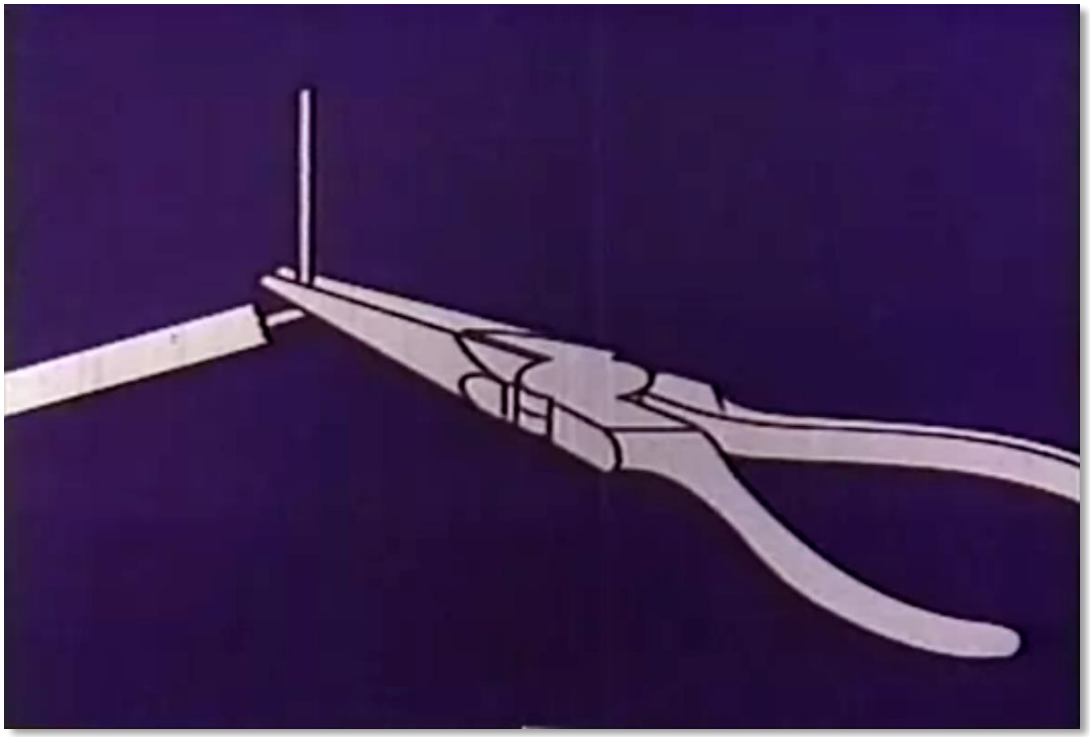
Diagonal Cutting Pliers



- Pliers with a sharp edge on their jaws, excellent for cutting wire or pulling cotter pins

Types of Pliers

Needle-Nose Pliers



- Used in gripping, bending, repositioning and cutting wire
- Bends are made via gripping wire and turning the pliers, bending the wire around the jaws
- The variable radius on the jaws allows for different radius wire bends

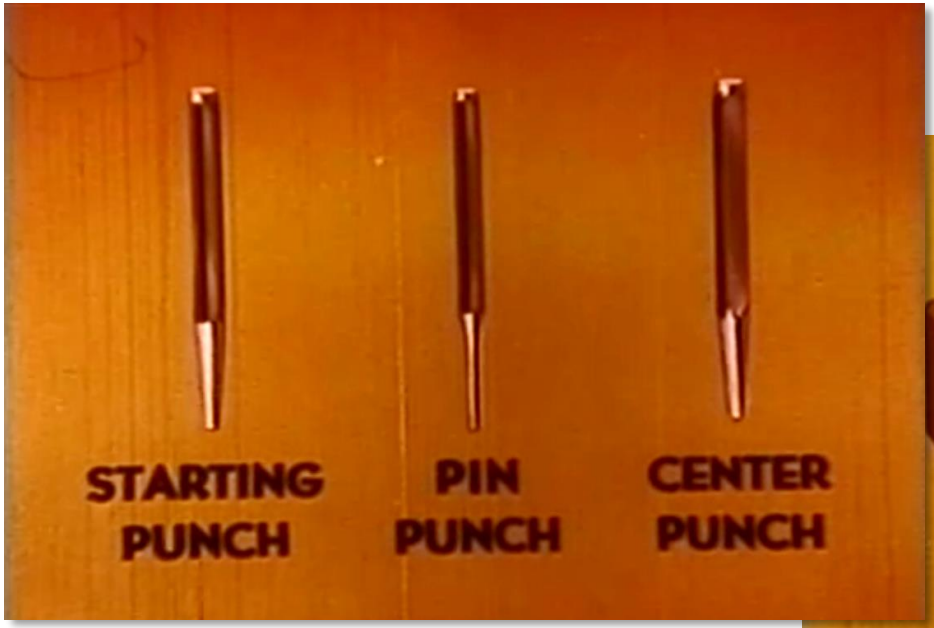
Types of Pliers

Locking Pliers

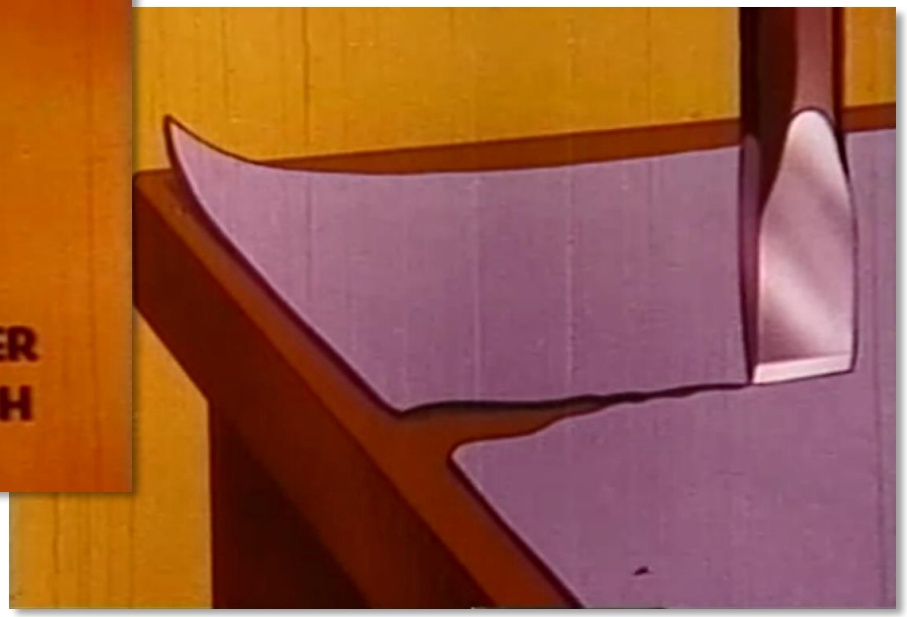
- Pliers that can be locked into a closed position
- A great, precise, and controllable amount of gripping force can be achieved with these pliers

Chisels & Punches

Both chisels and punches are tools that are struck by a hammer to impart force to a workpiece in a defined pattern.

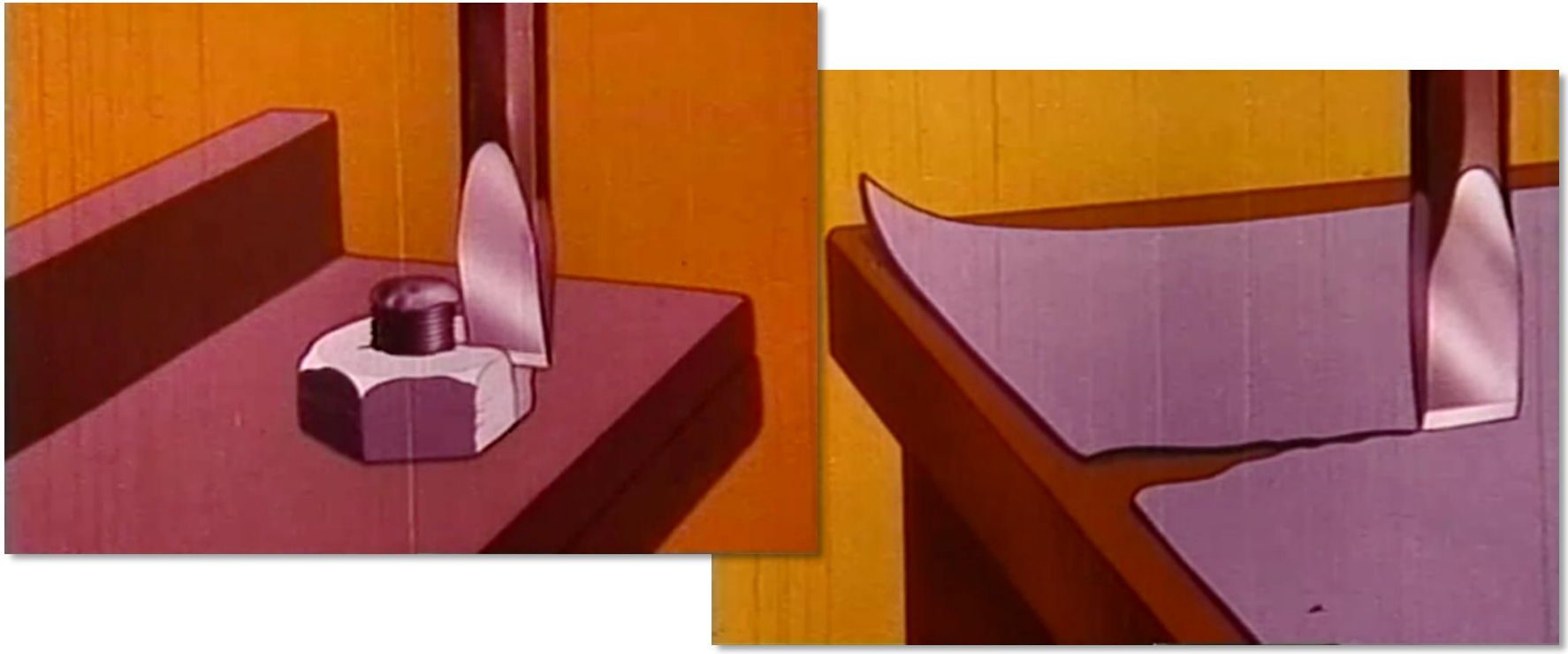


Punches have a circular or cone tip



Chisels have a sharp edge at their tip

Chisels

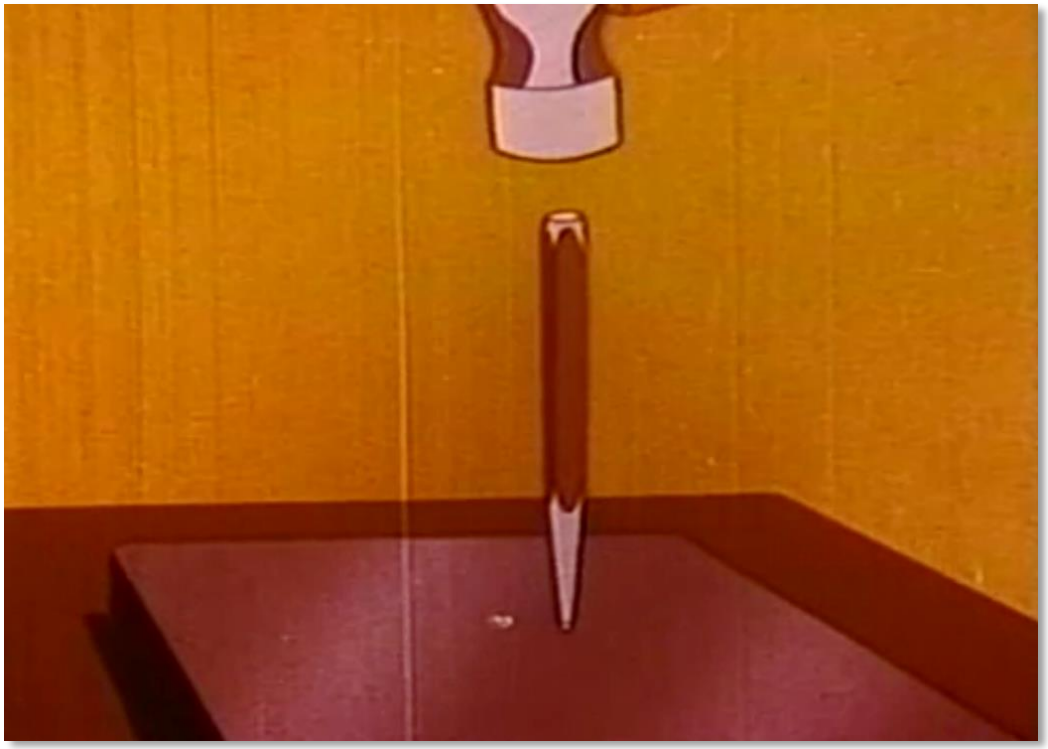


- “Cold” chisels, for metalworking, can be used to remove nuts that cannot be torqued
- Chisels can also be used to make rough cuts in thin sheet metal

How NOT to Use Chisels

- Chisels are NOT for prying up nails, turning screws, or opening paint cans!

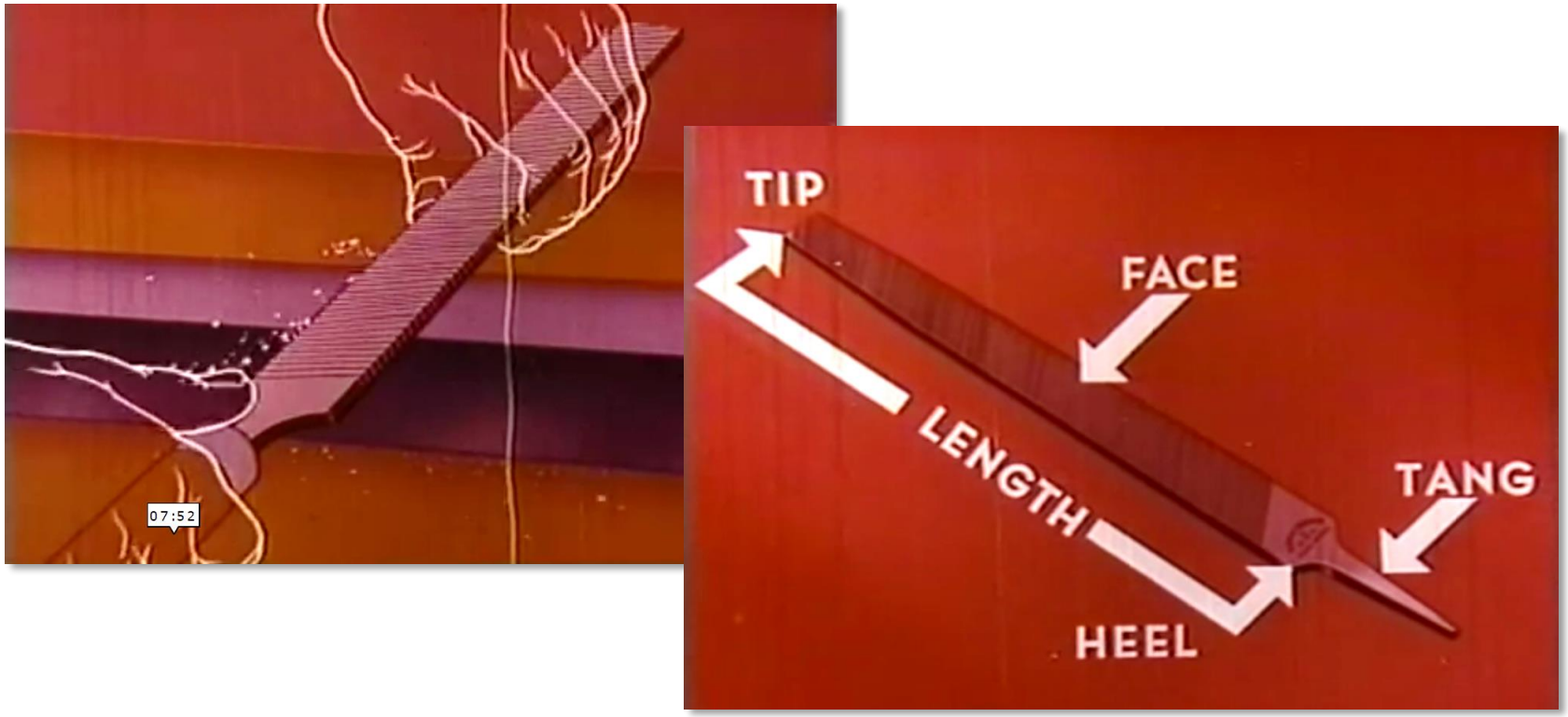
Punches



- "Starting" and "pin" punches have a flat, circular tip used for pushing pins through holes
  - The starting punch gets the pin moving, and the pin punch chases it through the hole
- A center punch is crucial for marking the center of a hole that is to be drilled
  - As shown above, the center punch creates a guide "dimple" for a drill bit so that the bit will not wander when spun on the workpiece, which could damage the bit

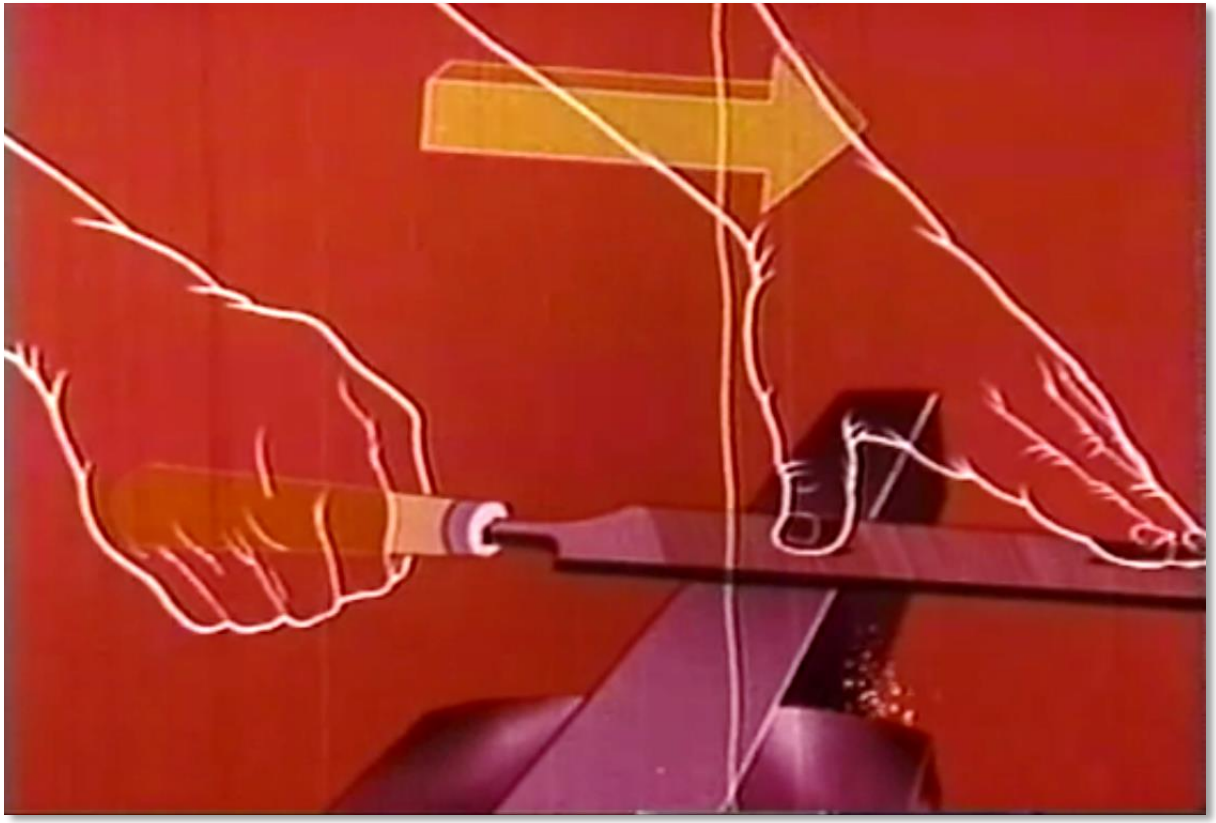
Files

- Files are used to remove small amounts of material from workpieces by rubbing against the workpiece
- This makes them excellent for rounding sharp edges on metal workpieces



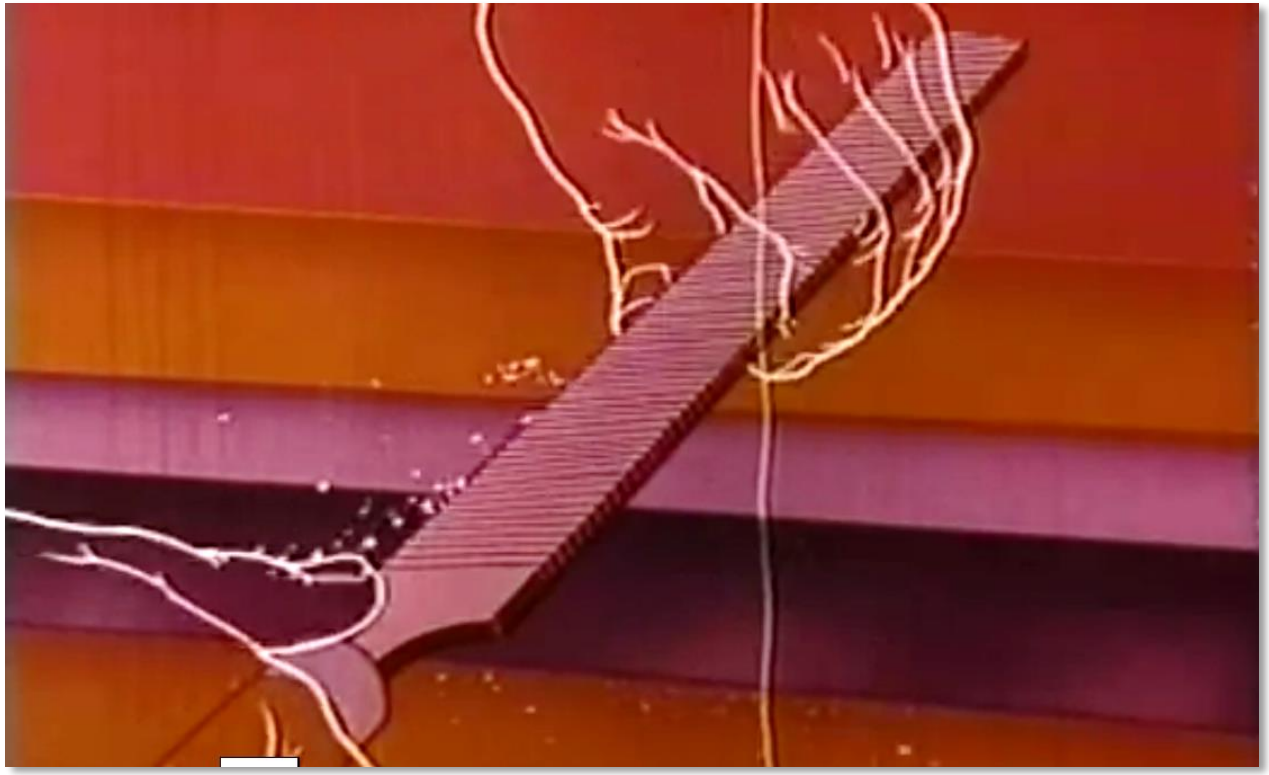
The size, tooth coarseness and tooth pattern all determine how much material will be removed

File Use



- File teeth are meant to cut only on the forward stroke
- Therefore, lift the file off the workpiece when resetting for the next stroke

File Use



- The above photo shows the **draw filing process,** which is used to create an even, flat surface
- Here, the file can be applied to the workpiece on both forward and backward strokes

Saws

Saws are best used for making straight cuts through workpieces. There are various size saws and tooth shapes for different materials

- Always ensure that there are at least 2 teeth in contact with the workpiece when cutting
  - If not, select a saw blade with more teeth per inch!

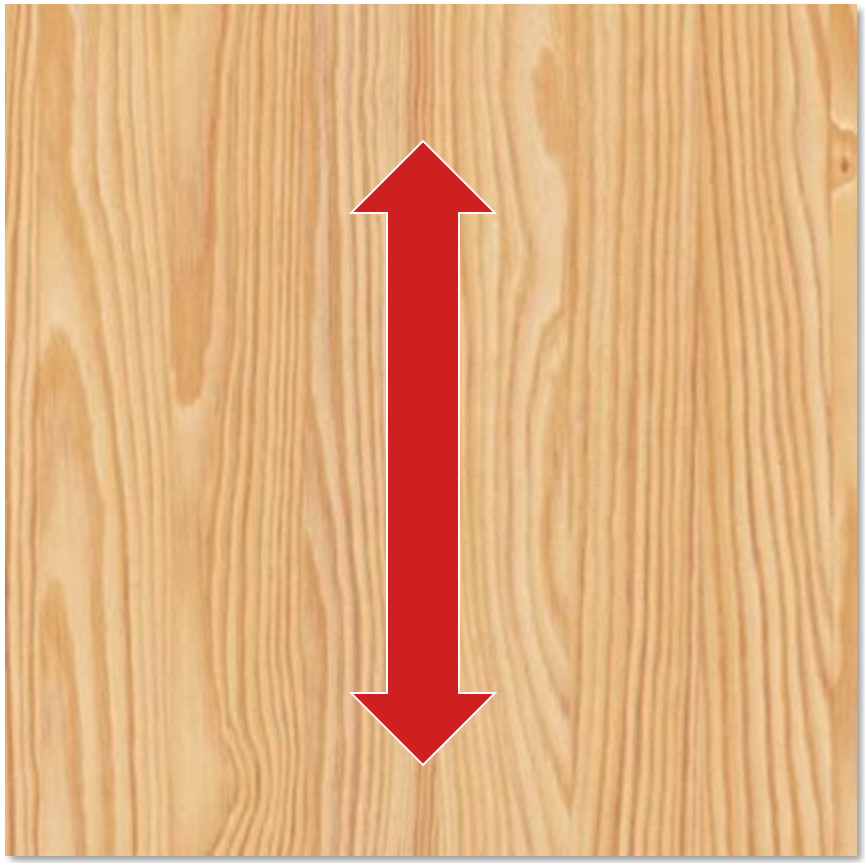
Types of Saws

- Cross-cut saws are for cutting perpendicular to the wood's grain
- Teeth are smaller and there are more per inch

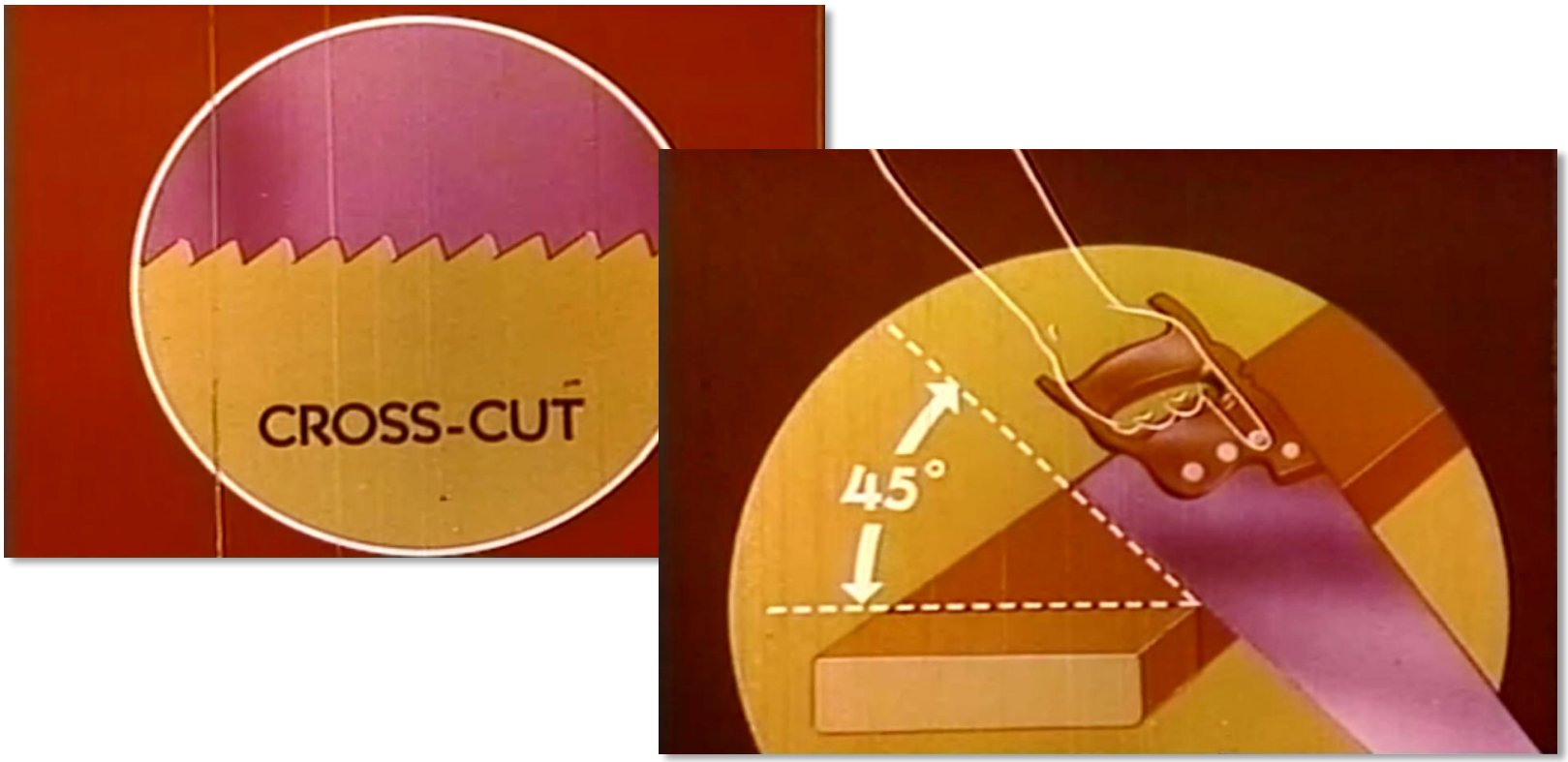
- Rip saws are for cutting parallel to the wood's grain
- Teeth are larger and there are fewer per inch

Wood Grain

All wood has a grain direction, shown below. The direction of the cut in relation to the wood's grain will determine the correct saw blade

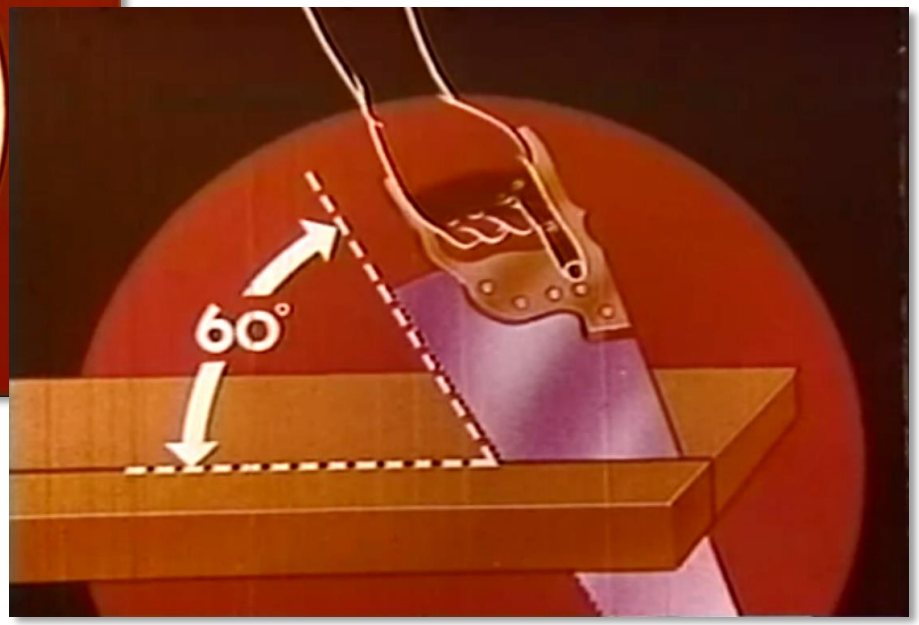


Types of Saws



- Cross-cut saws should be held at a 45-degree angle from the cutting surface while cutting

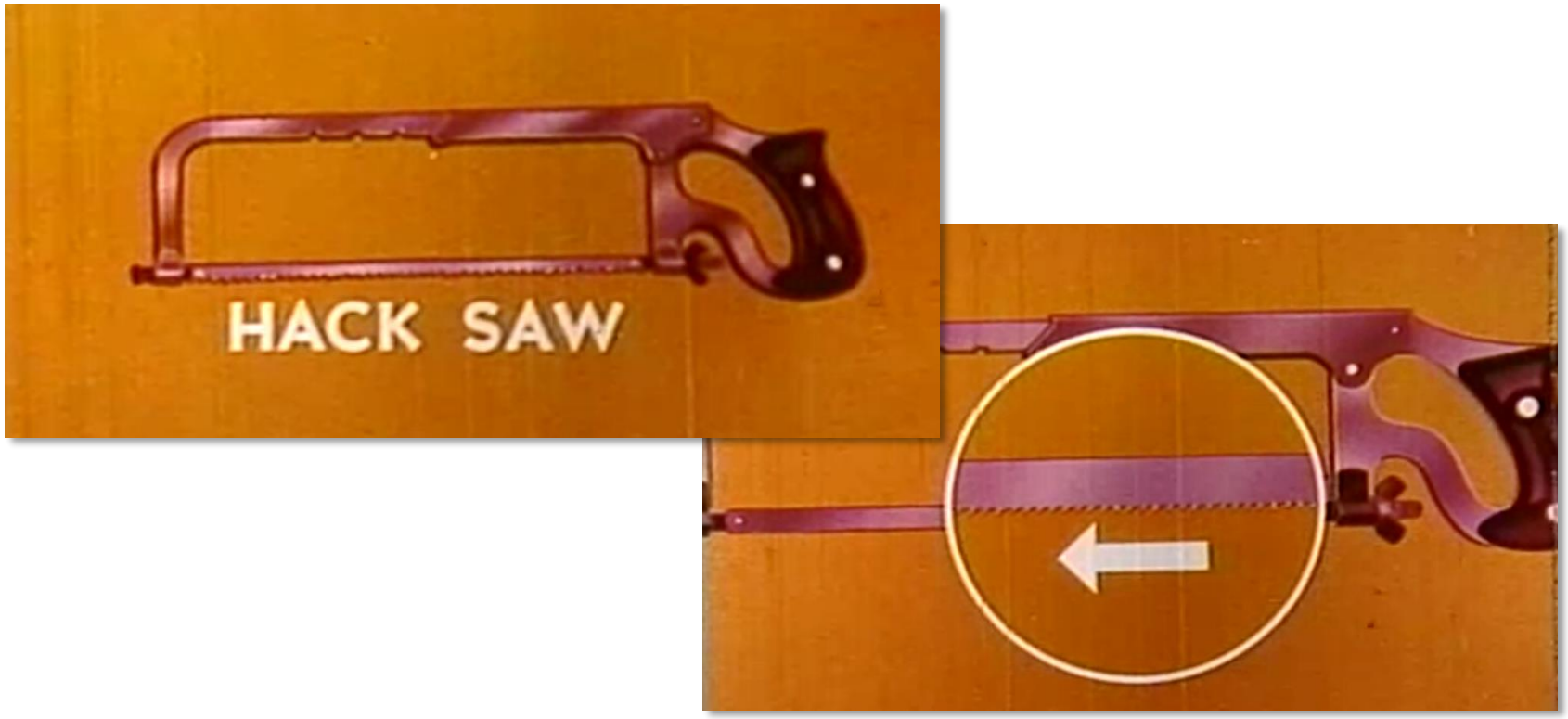
Types of Saws



- Rip saws should be held at a 60-degree angle from the cutting surface while cutting

Types of Saws

Hack Saw



- Hack saws are for cutting metal pipe and thin metals
- Make sure the points of the teeth are facing away from the handle

Power Tools

- The Makerspace has a variety of electric and pneumatic hand tools that are excellent for jobs that require a great amount of force or torque, and/or repetitive jobs

- In the interest of safety and accountability, pneumatic hand tool safety training will be offered in the **Make 201** training class.

Basic Power Tool Training

Why Use Power Tools?

- For jobs requiring:
  - Repetitive motion that could cause fatigue
  - Increased speed/efficiency
  - Power
  - Greater Accuracy

Basic Power Tool Safety

- **Always use the proper P.P.E.!!!**
- **ALWAYS be aware of your surroundings (people & hazards)**
- **Never** carry a power tool by the power cord
- Keep power cords away from heat, oil and sharp edges
- Ensure that no parts of the tool are damaged and that moving parts are properly secured before use (e.g. securing a bit in a chuck)
- **ALWAYS** disconnect the tool from its power source when servicing, cleaning or changing accessories!
- **ALWAYS** disconnect the tool from its power source when you walk away from the tool!

Basic Power Tool Safety

- Secure your workpiece with clamps or a vise
- Maintain good footing and balance while operating power tools
- Follow the manufacturer's instructions for proper tool operation
- Clean all power tools and related components after use

General Power Tool Tips

1. **Stay Focused!**
2. Friction + repetitive contact = **HEAT**
3. Understand the movement of the power tool before using it
4. Understand what the power tool would do to your workpiece if it were NOT secured
5. Do you have enough space to complete your tool's motion?
6. Will the tool be locked in the "on" position when I turn it on?
7. **Slow** is **smooth** and **smooth** is **fast**

CHARGE YOUR BATTERY WHEN YOU'RE DONE!

Basic Power Tool Use

Terminology

Bit (drill or fastener) – Tool that is inserted into the chuck of the drill. The bit will be spun via power delivered to the chuck. Drill bits remove material in a cylindrical shape (create holes)

Terminology

Chuck – Part of drill that securely holds the bit that will be spun.

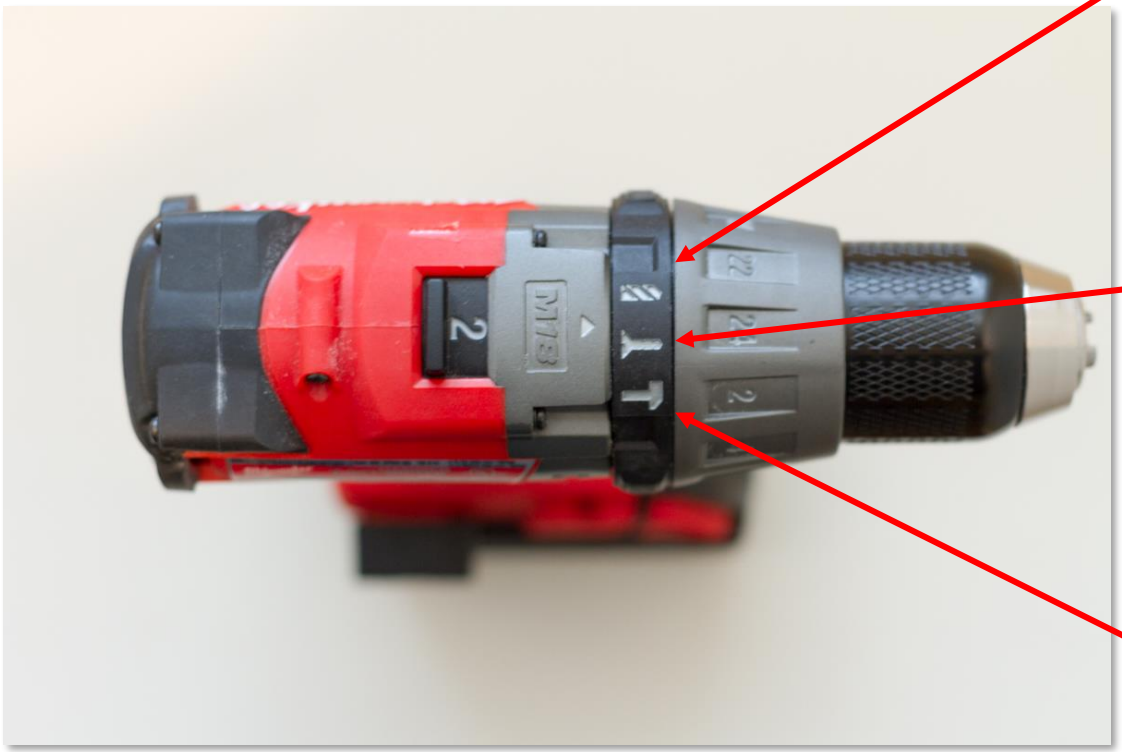
Keyless Chuck – 3 jaws grip the bit. Tightened or loosened by twisting the collar.

Hex Chuck – Hex patterned bits can be inserted and locked into place. Remove by lifting chuck towards open end

Terminology

Adjustable Clutch – Located at the base of the chuck. Allows for adjustment of the drill's maximum torque, which will determine how deep a fastener is sunk into the workpiece. The higher the number, the greater the torque applied to the spinning bit before slipping is allowed.

Selecting a Clutch Setting



Drilling – Used for drilling, unaffected by clutch setting

Fastener Setting – Used for driving fasteners. Adjusting clutch will set torque

Hammer Drill – Used for drilling through very hard materials. Sends impact force through the drill bit

14.4 ¼” Drive Cordless Ratchet

- For driving hex head fasteners
- Sockets are attached to ¼” drive platform
- 35 ft-lb torque output

14.4 V Hex Cordless Screwdriver

- Primarily for driving fasteners
- Do not use for drilling
- 150 in-lb torque output
- Hex chuck holds hexagonal bits
- 2-speed operation

14.4 V 3/8" MicroLithium Cordless Drill

- For driving fasteners and drilling applications
- Adjustable keyless chuck
- 150 in-lb torque output
- 2-speed switch and adjustable 9-position clutch

1/2" 18 V Cordless Hammer Drill

- Primarily for heavy-duty drilling applications
- Adjustable keyless chuck with carbide jaws
- 450 ft-lb torque output
- 2-speed switch and adjustable 22-position clutch
- Hammer drill setting for drilling into especially hard materials

18 V Cordless Reciprocating Saw

- Saw blade is loaded by pressing the shank of the blade into the spring-loaded collet
- Twist collet to remove blade

- Primarily for cutting wood, tubing or plastics, some thin metals
- Blade rapidly moves forward and backward much like a manual saw

18 V Cordless Grinder

- Uses a rotating disc to saw, grind or even polish a workpiece, depending on what wheel is loaded into the tool
- Take note of what wheel is loaded before use
- 8,000 RPM
- Takes 4 ½” to 5” wheels
- Battery attachment can rotate to be kept out of the way

18 V Cordless Grinder

Grinding

Cutting

- There are different discs for different angle grinder operations.
  - **Make sure you are using the correct disc for the operation!**
- Grinding should be done at a 10 degree angle between disc and workpiece
- Cutting should be done perpendicular to the work surface

Checking out Tools

- Now that you have completed this presentation, you will be given card access to the Makerspace, the Snap-On locker and the tool chests!

- Tap your card on the black RFID sensor on the front of the chest to unlock the drawers
- Tools removed from the chest will be linked to your ID
- When returning tools, place them back in the drawers exactly where you found them!

Available Training Sessions

After this intro training, consider attending…

- **Intro to 3D Printing**
- **Intro to CO2 Laser Cutting & Engraving**

We look forward
to seeing your creations!

NJIT | Makerspace