

# Protohaven

CLASS NOTES

## Forge 101: Basic Smithy

CLEARANCES

Forge



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# Welcome

Welcome to the Basic Smithy class at Protohaven!

## Shop Rules

### Be Safe

- Get safety clearances
- Wear protective equipment
- Watch and reset equipment after use
- Never use equipment that is red-tagged

### Take Care of Each Other

- Be aware of your surroundings
- Don't use a tool if it poses a danger to someone else

### Take Care of the Tools

- Get tool clearances
- Do not alter or use equipment beyond limits
- Notify staff when maintenance is needed

### Keep the Shop Clean

- Clean up after yourself
- Return tools to their original locations

## Tool Status Tags

Every tool at Protohaven has a status to let you know if the tool is safe to use: green, yellow, or red.

If the tool status is *green*, the tool is safe to use. All features should be expected to work, and no extra care should need to be taken while using the tool. There are no tags for tools with green status.

If the tool status is *yellow*, the tool may still be used, but with extra caution. Tools with yellow status should have a physical tag on the machine. The information on the physical tag or in the online maintenance history will indicate what special care needs to be taken while using the tool. If the physical tag and the maintenance log disagree, alert a tech.



If the tool status is *red*: **DO NOT USE THE TOOL**. The tool is not safe to use. Tools with red status should have a physical tag on the machine. The information on the physical tag or in the online maintenance history will indicate what fixes are pending, and when a repair is expected.



If you are in doubt about the status of a tool with no visible tag, check the tool status by following the link in the QR code attached to the tool, or check the Protohaven website for the tool status page:

<https://www.protohaven.org/equipment/>

## Filing a Tool Report

If you are using a tool, and the tool becomes unsafe, damaged, or is not working properly, you must notify a tech. The tech may instruct you to submit a tool report:

<https://airtable.com/appbI0RlmbIxNU1L/shrluff2WSzy8c3xd>

Notifying the tech will help us keep signage up to date, and make sure the users who come in after you have all the information they need to use the tool safely, even if they don't use discord.



# Class Safety

**Wear PPE in the smithy.** Make sure you have eye and hearing protection, and are not wearing any clothing that could melt and stick to your skin.

**Assume worked metal is too hot to touch with bare skin.** Be very careful picking up metal in the forge, unless you know it has been cooled in the quench tub.

**Be aware of your surroundings.** When working alone in the smithy, set up the workspace so that everything you need is in easy reach. When working with others in the smithy, make sure you do not put them in danger.

If you feel unsure of something, feel free to ask!

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# Introduction

In the smithy, several tools are used together to work mild steel into useful shapes.

We use the forge to heat the material, the anvil or the vise as shaping platforms, and various tongs and hammers to work the metal by flattening, bending, or twisting.

## Learning Objectives

- Start the forge.
- Manipulate heated metal with hand tools.
- Shutdown the forge.

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# Tools

## Smithy

The smithy is a collection of very simple tools. The work is learning forging is practice:

- trying things
- figuring things out
- refining technique

Something something make ourselves better smiths.

## Notes

### Safety

When forging, always wear appropriate safety gear:

- Leather apron
- Eye protection
- Hearing protection

Always wear well-fitted clothing made of natural fibers (cotton, denim, wool) in the forge. Do not wear clothing made of plastic: if the clothing gets too hot, it will melt into your skin, causing severe burns.

Always wear closed-toed shoes in the forge. Boots are recommended. Wear shoes or boots made of natural materials (leather or canvas).

**Assume all objects on the large forge table are hot.** Always use tongs to pick up or manipulate objects on the large forge table.

Never leave the forge unattended while lit.

### Common Hazards

Do not use tongs that fit loosely to your workpiece; this may cause a heated workpiece to move unexpectedly in the tongs or fall out, possibly resulting in injury.

### Tooling

Protohaven has a good range of common smithing tools available for use in the tool crib. You are welcome to bring (or make!) your own tools for use in the smithy.

### Materials

Materials approved for use in the forge:

- carbon steel (unpainted, uncoated, ungalvanized)

Materials prohibited for use in the forge:

- painted metal

- coated metal
- galvanized metal
- brass
- bronze
- chromium steel
- stainless steel

A small selection of steel rod suitable for smithing is available at the Protohaven shop.

## Parts of the Forge

### Propane Tank

The **tank isolation valve** controls the flow of propane from the tank into the hose line.



Figure 1: An annotated view of the large propane tank.

Do not adjust the propane regulator. If you think the flow rate is low, tell a tech on duty.

### Forge

The **forge isolation valve** controls the flow of propane from the hose line into the forge.

Press the **ignition switch** to ignite the forge.



Figure 2: An annotated view of the parts of the forge.

The firebrick inside the forge protects the refractory material from damage.

## Anvil

The anvil is a work surface for many forging tasks.



Figure 3: An annotated view of the parts of the anvil.

**Face.** The face is the flat area at the top of the anvil. The top of the face is used to flatten and shape material. The edge of the face can be used to bend material. Face edges can be sharp or rounded to achieve different kinds of bends.

**Step.** The step (also known as the cutting table) is a small area between the face and the horn. The step is slightly lower than the face. The metal of the step is softer than the face for better absorbing chisel blows during cutting operations.

**Horn.** The horn is the rounded, tapered end of the anvil. The horn is used to bend material into curves. Different parts of the horn can be used to shape the material into various curves.

**Hardie hole.** The pritchel hole is a square hole at the rear of the face, extending clear through the body of the anvil. The hardie hole accepts hardie tools, which rest in the hole without rotating.

**Pritchel hole.** The pritchel hole is a round hole at the rear of the face, extending clear through the body of the anvil. The pritchel hole provides clearance for punching tools. It can also be used to hold tools that have round shanks, such as the hold fasts.

## Quench Tub

The quench tub filled with water is on the floor of the forge.



Figure 4: The quench tub on the floor of the smithy.

The quench tub is used to quickly cool tools and forged workpieces.

### Large Forge Table

the large forge table is by the the gas bottles, and holds the primary working forge in the smithy.



Figure 5: An annotated view of the large forge table.

The large forge table can be used to rest heated workpieces and tools.

The large forge table as an attached leg vise, and a drawer for hand tools.

### Leg Vise

The leg vise is attached to the forge table.

The leg vise can be used to hold workpieces for hand bending and twisting. Workpieces should not be forged in the vise.

### Garage Door

The garage door must be opened for ventilation while a forge is lit.

### Tool Crib

The smithy tool crib holds various hand tools.





Figure 6: The tool crib holds hand tools: hammers, tongs, brushes, punches, etc.

## Hand Tools

### Hammers

The smithy tool crib holds forging hammers of various sizes.



Figure 7: A sledge hammer (left) and a cross peen hammer (right).

### Tongs

The smithy tool crib holds tongs of various shapes and sizes.



Figure 8: Flat-jaw tongs (left), v-bit tongs (center), and scrolling tongs (right).

Always choose tongs that will have strong, positive contact with the workpiece.

### Brushes

The smithy tool crib holds various wire brushes.



Figure 9: Various brushes for removing scale and cleaning surfaces.

Brushes are used to clean the scale off of forged material.

### Punches

The smithy tool crib holds various punches for cutting material, making holes, and manipulating surfaces.





Figure 10: A square punch (left), a round punch (center), a flat punch (right).

**Cutting.** Various chisels can be used to cut material.

**Making holes.** Various punches and drifts can be used to make square or round holes in material. For through holes, use the pritchel hole for clearance underneath the workpiece.

**Manipulating surfaces.** Chisels can be used to mark material prior to forging. The shop also has several sets of letter and number punches, for embossing the surface of a workpiece with text.

### Hardie Tools

The drawer in the metal forge table holds hardie tools. These tools are meant to be used with the hardie hole on an anvil.



Figure 11: Two cutting tools. Note the square profile of the stems.

Only use a hardie tool if it fits **loosely** in the hardie hole of an anvil. You may need to use a different anvil for a particular tool.

Do not leave hardie tools in the anvil when the hardie tools are no longer in use.

**Cut-off hardie.** The cut-off hardie is an edged tool that presents a cutting edge. Fixing the cutting edge lets you use your hands to manipulate the material and the hammer while cutting, for an easier cut.

## Pritchel Tools

The metal forge table also holds tools for use with the pritchel hole on an anvil.



Figure 12: A pritchel cut-off tool (left), and a holdfast (right).

Holdfasts are hung from the large forge table. Holdfasts can be used in pritchel holes to hold a workpiece to the anvil.

## Basic Operation

### Setting Up

1. Make sure that all of the materials and tools you will need for forging your workpieces are available and within easy reach.  
*If you need to get something from outside the smithy and the forge is lit, turn off the forge. Never leave a lit forge unattended.*
2. Check both the tank isolation valve and the forge isolation valve to make sure they are closed. *When checking valve positions, always turn the valve towards the closed position (clockwise).*
3. Turn on the vent fan.
4. Open the garage door.

## Workholding

Always use tongs that have a snug and secure fit to your workpiece.

Use the leg vise to hold pieces for bending or twisting.

Use holdfasts to clamp a workpiece to the anvil.

## Lighting the Forge

1. Open the tank isolation valve to allow gas to flow from the tank.
2. Open the forge isolation valve and immediately press the ignition switch. Press the button repeatedly until the gas ignites, as needed.

**If the gas does not ignite within three seconds, shut off the forge isolation valve immediately.** Let the smithy ventilate for a minute before next attempting to start the forge.

**Do not adjust the regulator.** If you believe the regulator is faulty, alert the tech on duty.

## Forging

1. Heat your material by placing it in the lit forge on the firebrick.
2. Let the material soak until the area you want to forge is glowing yellow.
3. Use tongs to transfer the material to the anvil or leg vise for working.
4. Work the material as needed.

If the material cools too much to continue working, repeat the above steps. Material will be too cool to work when it reaches a dull red, sometimes noted as "medium cherry red" (1400°F).

Clean the anvil off between heats. If scale is left on the anvil, forging a workpiece on top of the scale will pound the scale into the anvil, damaging the face.

## Quenching

The quench tub has multiple uses in the smithy.

Use the quench tub to cool areas of your workpiece that you do not want to bend while you are working the heated areas.

If the material no longer needs to be worked, cool it in the quench tub until it can be safely handled.

When you pull material out of the water, note how quickly it dries. If the material dries immediately, it is still too hot to handle with bare hands. If the material stays wet, it *might* be safe to touch: proceed with caution.

## Cleaning Up

1. Close the tank isolation valve.
2. Close the forge isolation valve.
3. Turn off the vent fan.

4. Close the garage door.
5. Return all tools to their places in the tool drib or the large forge table.
6. Sweep the smithy floor for any slag and debris and discard.
7. Recycle any waste by placing it in the scrap metal bins

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# Resources

<https://workingtheflame.com/blacksmith-beginner-projects/>

<https://blacksmithu.com/blacksmith-techniques-shape-mould-metal/>

<https://www.iforgeiron.com/>

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