



## PCTA Trail Skills College Curriculum Instructor Planning Guide



# Course 107. Hand Tool Field Maintenance

We rely on hand tools to lop branches, dig drain dips, remove slough and berm, construct waterbars and check steps, and much more. As a result, hand tools receive a great deal of wear and tear. Learn about the most common tool problems that are encountered during trail work and how to address them in the field including dull blades and loose heads. This is designed to be a 4-hour class.

### STUDENT SKILL OUTCOMES:

- Understand the uses of common trail work tools
- Be able to assess tool conditions and recognize unsafe tools
- Know how to address common tool maintenance problems in the field
- Be able to sharpen an Pulaski/axe and loppers

### KEY TERMS:

sharpening, rehandling, bastard file, bevel, sheath, fastening or grady wedge

### TRAIL MAXIMS:

“A dull tool is a dangerous tool.” “Use the right tool for the right job.”

### TOOLS NEEDED (PER 8 STUDENTS):

8 loppers in need of sharpening; 8 axes or Pulaskis in need of sharpening; 1 axe/Pulaski with loose head; 1 each: McLeod, shovel, hoe (Terra, Rogue, Hazel or other grubbing hoe), reinhart, mattock, sledge; single or double Jack

### MATERIALS NEEDED:

Digital projector and “Handtools for Trail Work Video Part 2” (<https://www.youtube.com/watch?v=p-wXYgwjcw>); 10 handled bastard files, 5 hand tool sharpening gauges; 3 wedges;

### BACKGROUND

Good tools are essential for doing all types of trail work. We rely on hand tools to lop branches, dig drain dips, remove slough and berm, construct waterbars and check steps, and much more. Since we rely so heavily on hand tools in the field, they receive a great deal of wear and tear. It turns out that sticks and stones are pretty strong.

### Tool Safety - “A dull tool is a dangerous tool... So is a sharp one.”

Which is more dangerous- a dull axe or a sharp axe? A sharp axe requires great attention. The blade, when sharpened correctly, can dry shave hair off of skin. The utmost care must be used when transporting, swinging and storing an axe or Pulaski. A dull axe on the other hand might give a false

variety of tool sheaths; 5 nails; 2 crescent wrenches

### WORK SITE REQUIREMENTS:

An indoor or outdoor location that can accommodate course participants with enough room to safely spread out into safe tool sharpening distances.

### KEY CONCEPTS:

- 1) Safety Documents and Concerns: Personal Protective Equipment (PPE), Job Hazard Analysis (JHA)
- 2) Types of Hand Tools: Uses, strengths & precautions
  - Understand the proper use of each tool
  - Use the right tool for the right job
- 3) Tool Carrying and Storage: Sharp side down, sheathed, not over the shoulder except rock bar or crosscut saw, downhill side
- 4) Common Problems in the Field
  - Loose heads
    - Soaking method
    - Fastening wedge method
  - Dulling
- 5) Sharpening
  - Pulaskis/axes
  - Loppers
  - Difficult to sharpen in the field- shovels, Reinharts, mattocks, hoes, mcleods
- 6) Broken and Unsafe Tools
  - How to treat broken or unsafe tools

sense of safety. It requires much more work when swinging and more work translates into fatigue. More fatigue means a greater likelihood of injury. A dull axe dulls one's focus on the task at hand. Sharp and dull tools each have their own hazards. Know what they are and how to prevent injuries!

Discuss the following important safety information:

- Need to wear gloves, long sleeves, leather boots and eye protection while sharpening tools.
- Files **MUST** have a handle and a knuckle guard.
- Always be conscious of the location of sharp blades during tool maintenance and make sure to have plenty of space to work
- Keep blades in a protected covering (sheath) whenever possible including during tool transport, storage and when not in use

## Types of Tools - “The right tool for the right job”

The likelihood of dulled or broken tools in the field is greatly reduced if each tool's intended uses are well understood. For example, a shovel should not be used for prying out a rock and the chopping edge of a Pulaski should not be used to cut roots in the dirt.

Tool	Uses	Strengths	Precautions
Pulaski	Chopping logs, limbing, grubbing, loosening soil	Moderate weight, forceful for swinging, versatile; can be field sharpened	Do not use for prying; Roots, dirt & rocks will quickly dull the cutting edge
Single-bit Axe	Chopping, wedging	Light weight	Take care to keep cutting edge sharp; Be careful for kickback when banging wedges
Double-bit Axe	Limbing, chopping	Accurate and powerful	Dangerous exposed blades; take care to keep cutting edges sharp
Loppers	Brushing, limbing	Lightweight and easy to use; can be field sharpened	Cannot cut anything larger than 1/2"; Do not twist while lopping; Must be kept sharp
McLeod	Grubbing, removing slough & berm, shaping, spreading, finishing tread, tamping, scraping	Versatile, large head is good for spreading dirt and leveling	Relatively heavy; difficult to rehandle in the field
Shovel	Excavating, grubbing, removing slough & berm, scraping	Very versatile, good for moving large amounts of soil	Do not use for prying; best used for loose soil; difficult to rehandle in the field
Hoes (Grub, Hazel, Rogue, Terra, etc.)	Grubbing, excavating, cutting roots, spreading, shaping, scraping, removing slough & berm	Moderate weight, forceful for chopping roots	Heads can be loose; not meant for heavy prying
Reinhart	Grubbing, moving soil, scraping, removing slough & berm	Versatile, good for moving large amounts of soil	Do not use for prying; difficult to rehandle in the field
Pick Mattock	Prying, excavating, cutting roots	Very good for rocky soil; strong prying leverage; removable head	Heavy; pick end can bend or break if hit too much on solid rock
Cutter Mattock	Cutting roots, excavating	Very good for soil with lots of roots; removable head	Heavy; keep cutting edges sharp for maximum utility
Rock Bar	Prying, moving rocks, tamping	Great leverage; comes in varying sizes/weights	Heavy

## Tool Transportation and Storage in the Field

All hand tools should have a **sheath** on them whenever they are being transported, stored or not in use. Sheaths can be made out of rigid plastic, fire hose, wood, leather, or any other material that will keep tool blades from being exposed. By keeping tools in sheaths, workers are protected from injury and tools are kept sharp. Make sure that sheaths fit snugly on tool heads and are clearly marked (they are easy to misplace in the field).

Care should be taken while transporting tools in vehicles. Tools should be sheathed and outside of the main compartment of the vehicle (e.g. in a truck bed or roof rack).

Carrying tools in the field should be done in a way that minimizes the potential of injury to yourself or others on the trail. Spacing between people should be wide enough that if a person in front of you was to stop abruptly, there would be more than enough room to stop without coming near their tool. Personal preference for many Forest Service employees is to space out at minimum triple the tool length.

Carry tools with the most dangerous blade pointed away from your body on the downhill side of the trail. This is done so the tool can be gotten rid of downhill in case of a stumble or fall.

**NEVER CARRY TOOLS ON SHOULDERS.** It is very dangerous! There are two exceptions, however. Due to the absence of a sharp edge, rock bars may be carried on ones shoulder. This requires extra precaution in keeping large spacing between people. It is encouraged that a person shouldering a rock bar be at the end of the crew.

The second exception is the crosscut saw. When carrying a saw, lay it flat across one shoulder with the teeth guarded and facing away from the neck. Carry the saw on the downhill shoulder. Grasp the front handle from under the blade. Remove the rear handle to prevent snagging on overhanging limbs. Transport saws at the rear of a line of workers.

Storing tools properly will help create a safe work environment and will keep tools in better condition. During breaks, store tools in an easily located spot off of the trail. If laying flat on the ground, make sure sharp edges are face down. For overnight tool storage at the worksite or in camp, tools should be clean, oiled, out of the elements, and in a safe location away from people. Long-term field storage of tools is discouraged. Weather is damaging to tools and there is a safety risk to leaving tools unaccompanied.

## Common Tool Problems in the Field

Remember: The best way to prevent broken or dull tools is to use the right tool for the right job!

**Loose Heads:** Loose tool heads are the most common problem that arises while working in the field. This can result from improperly hung tool heads, percussion/vibrations from tool use, using tools in a way they are not meant to be used, and changing weather conditions (especially humidity). Field solutions to loose tool heads are a form of triage — they can make the tool safe for using the rest of the day and/or project but are not permanent solutions. The only way to have a tool head safely secured after it has been loose is to rehandle it. Rehandling tools is generally not accomplished in the field since it requires special tools.

There are two common methods for securing loose axe/Pulaski heads in the field, both of which have their drawbacks:

- 1) Soak the tool head in water- place the tool head in a stream, lake or other water source overnight. This will make the wood swell into the tool head.

Drawbacks: There are some who think that tool heads should never be soaked in water and others who think it is just fine. Soaking tool heads in water can contribute to further swelling, shrinking and cracking of the wood and is bad for the long-term health of steel tool heads. Also the wood can dry

out during the workday and become loose and unsafe.

- 2) Use a steel ***fastening wedge***. These are small steel wedges that are easy to use and can be stowed away in a pack. They should be driven into the wood eye at the top of the tool head at a diagonal to the wooden wedge keeping the tool head in place. If necessary, two may be driven into one tool head but should be spaced evenly (rather than side-by-side).

Drawbacks: Driving a steel fastening wedge is discouraged by some people familiar with tool maintenance since it contributes to long-term cracking of the wood in the eye of the tool head. There is a possibility that the percussion of driving the fastening wedge will further loosen the tool head, so accuracy and technique is very important. Additionally, steel fastening wedges are easiest to insert in the field, but they make the handle harder to remove by drilling.



**Figure 1. Fastening wedge.**  
(IMAGE COURTESY OF PCTA)

**Remember that these solutions are temporary, so a tool head that has been soaked in water or had a fastening wedge added should be taken out of service and flagged after the project so it can be rehandled.**

Loose heads on Reinharts, shovels, and certain grubbing hoes generally cannot be fixed in the field, unless the issue is a loose nut or screw. Bring a wrench and/or screwdriver in case of such issues. A crescent wrench can tighten loose loppers.

Heads on mattocks and most grubbing hoes are held on by centripetal force (swinging the tool) rather than compression of the wood into the tool head. It is important that these tool heads are thick enough that they will hold the tool head snugly with no risk of the tool head coming off of the top. The head of the tool can be secured temporarily with a nail if the tool head slides down the handle towards one's hands.

***Dull Tools:*** Dull tools are the other most common tool maintenance problem that arise while working in the field. A dull tool can be more dangerous than a sharp one and requires the trail worker to exert more energy than necessary. Dulling of tool blades occurs naturally during use, though it can be minimized by using the right tool for the right job.

Some hand tools should not be sharpened in the field because it is impractical, they require more advanced sharpening equipment, or the value of getting the tool slightly sharper may not be worth the time and effort in the field. Tools that fall into this category include Reinharts, shovels, grubbing hoes, and McLeods.

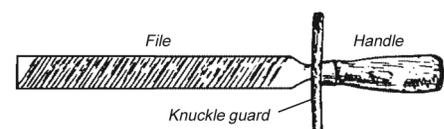
Axes, Pulaskis and loppers are all good candidates for field sharpening- they are relatively easy to sharpen and there is a very high value of having sharp blades (in terms of easier and safer work).

## Field Sharpening

Having people sharpen tools increases their awareness of the amount of labor required to keep tools sharp and encourages proper tool usage.

A bastard file is the tool of choice for sharpening hand tools in the field. All files must be fitted with a handle and knuckle guard to protect one's hands while sharpening tools. Files come in different lengths. Longer files, while heavier, allow for longer strokes while sharpening. A 10-inch file is the best for all-around tool sharpening.

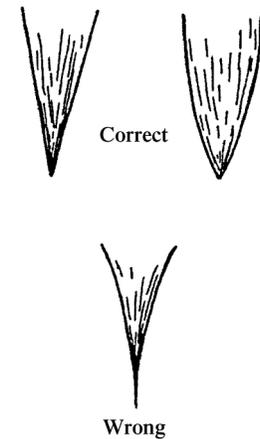
**Figure 2. Bastard file.**  
(IMAGE COURTESY OF THE USFS)



This file has a knuckle guard made from old linen hose.

Keep in mind that field sharpening will not fully restore the cutting edge of a tool to its ideal condition. This has to be done in a shop with files, whetstones, and/or grinders. Field sharpening will not be able to remove large nicks in the blade nor fully restore the correct blade **bevel**. Field sharpening is a type of triage and is just meant to hone the cutting blade so the tool functions better in the field.

Figure 3. Blade bevel. (IMAGE COURTESY OF THE USFS)



There are three main things to consider while sharpening a tool in the field:

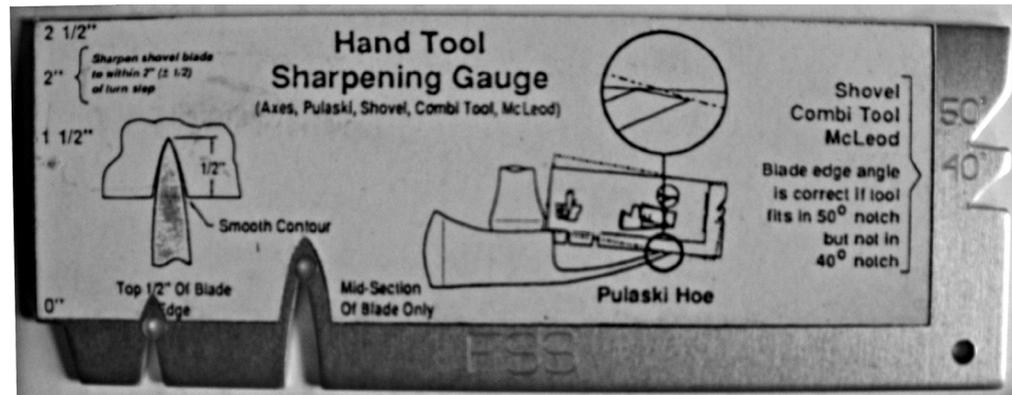
1. Shielding yourself from injury
2. Protecting the file from damage
3. Sharpening edges appropriate for their uses

A long sleeve shirt and leather gloves on both hands are required PPE for tool sharpening.

Tools must be held motionless while being sharpened. While a vise can easily accommodate this in the shop, it can be more difficult in the field. Tools that can not be held motionless pose a hazard. Axes and Pulaskis can be secured by driving them into a stump while the free edge is sharpened. When this is impractical, caution should be taken to secure the tool as best as possible. If necessary, use a partner to help brace the tool against a log or stump.

To sharpen blades on axes, Pulaskis and loppers, file into the edge of the tool, using long, even strokes. Apply even pressure (enough to lightly cut into the steel) on the push stroke, lift the file off the tool, and repeat. Filing away from the blade can bend the blade's edge and leave a burr. **DO NOT GO IN A BACK AND FORTH MOTION.** After every few passes, tap the file on a log or block of wood to clear the metal flakes from the file's teeth.

Figure 4. Sharpening gauge. (IMAGE COURTESY OF PCTA)



The adze end of the Pulaski head does not require field sharpening, though it can be done if desired. When sharpening the adze, sharpen the

bevel side only (the side of the adze blade facing the handle). This same technique can be used in the field to sharpen Reinharts and grubbing hoes, but keep in mind that these tools do not require the same level of sharpness to be safe and useful in the field.

Some people like to carry a U.S. Forest Service hand tool sharpening gauge. It is helpful in making sure that cutting edges have the correct bevel and angle. It can be ordered from Monarch Tool Company (phone number: 406-777-5931).

Loppers are sharpened in the same manner as axes/Pulaskis. Only the inside face of the lopper's cutting blade needs to be sharpened for standard bypass loppers. (Both are sharpened on anvil type loppers.)

## Broken and Unsafe Tools

It is important for trail workers to know when a tool is unsafe to use anymore. If the safety of a tool is in question, it is better to play it safe and treat it like it was completely broken. All broken and unsafe tools should be treated the same way- cover all sharp edges, set the tool aside, and flag it. When the tools are brought back to the cache, make sure broken and unsafe tools are kept separate and are flagged.

After work projects, all tools should be cleaned off of any caked dirt, sharpened and stored in a dry place for their next use.

## TEACHING TIPS & TECHNIQUES

---

Group discussion questions:

- You are building a 50 foot section of trail through a wooded area (duff, roots, maybe a few rocks). What tools do you want to bring with you and why?
- You are building a 50 foot section of trail through a rocky, open area. What tools do you want to bring with you and why?
- What are the dangers of carrying a tool on the uphill side of the trail? Are there dangers with carrying the tool on the downhill side and if so, what are they?
- When carrying a Pulaski, should the axe or adze end be facing down? How about a McLeod?
- Sheaths are notorious for getting lost. What would you do if you lost the sheath out in the Wilderness and needed to protect your tool?
- Is it better to have the adze end or the axe end of a Pulaski closer to the back of your head when you carry it over your shoulder? Trick question!
- Which tools can you carry on your shoulder?
- Which do you think is better to secure a loose tool head- soaking it overnight or adding fastening wedges? Also sort of a trick question. Neither secures it for good.

Teaching activities:

- Assign each student a bastard file, a dull Pulaski or single-bit axe, and loppers. Demonstrate safe sharpening of the axe/Pulaski and loppers then have each student sharpen their tools. Give tips as students work on their tools.
- Using an axe or Pulaski with a loose head, demonstrate the correct way to add one or two fastening wedges.
- “An Axe to Grind” is a wonderful resource on tools and tool maintenance. Consider showing one or more of the segments during the course.

## TRAIL FUN

---

For a fun wrap-up do a fast-paced “Jeopardy”-style quiz based on the KEY CONCEPTS.

## REFERENCES

---

*An Ax to Grind: A Practical Ax Manual.* 1999. Bernie Weisgerber and Brian Vachowski. Missoula, MT: USDA Forest Service. Can be viewed in entirety at <http://www.fhwa.dot.gov/environment/fspubs/99232823/lc99232823.htm>

*Handtools for Trail Work.* 2005. Richard Hallman. Missoula, MT: USDA Forest Service. Can be viewed in entirety at <http://www.fhwa.dot.gov/environment/fspubs/05232810/lc05232810.htm>

*Lightly on the Land: The SCA Trail Building and Maintenance Manual.* 2005. Robert Birkby. Seattle, WA: The Student Conservation Association and Mountaineers Books. See Chapter 6: “Tools”, pp. 75-102.

*Trail Construction and Maintenance Notebook.* 2007. Woody Hesselbarth. Missoula, MT: USDA Forest Service. See “Tools” section, pp. 141-157. This can be viewed in entirety at <http://www.fhwa.dot.gov/environment/fspubs/07232806/index.htm> A free copy can be ordered at: <http://www.fhwa.dot.gov/environment/rectrails/trailpub.htm>

*Trail Training DVD Series.* 2008. Disc 1 includes: “Handtools for Trail Work” and “An Ax to Grind”. A free copy can be ordered at <http://www.fhwa.dot.gov/environment/rectrails/trailpub.htm>



# PCTA Trail Skills College Curriculum Field Reference



## Course 107. Hand Tool Field Maintenance

### STUDENT SKILL OUTCOMES:

- Understand the uses of common trail work tools
- Be able to assess tool conditions and recognize unsafe tools
- Know how to address common tool maintenance problems in the field
- Be able to sharpen an Pulaski/axe and loppers

### KEY TERMS:

sharpening, rehandling, bastard file, bevel, sheath, fastening or grady wedge

### KEY CONCEPTS:

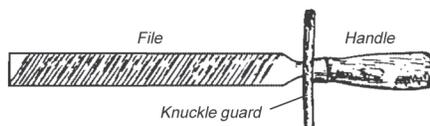
- 1) Safety Documents and Concerns: Personal Protective Equipment (PPE), Job Hazard Analysis (JHA)

- 2) Types of Hand Tools: Uses, strengths & precautions
  - Understand the proper use of each tool
  - Use the right tool for the right job
- 3) Tool Carrying and Storage: Sharp side down, sheathed, not over the shoulder except rock bar or crosscut saw, downhill side
- 4) Common Problems in the Field
  - Loose heads
  - Soaking method
  - Fastening wedge method
  - Dulling
- 5) Sharpening
  - Pulaskis/axes
  - Loppers
  - Difficult to sharpen in the field- shovels, Reinharts, mattocks, hoes, mcleods
- 6) Broken and Unsafe Tools
  - How to treat broken or unsafe tools



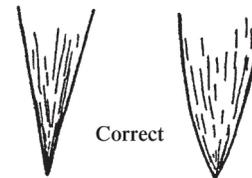
Figure 1. Fastening wedge.  
(IMAGE COURTESY OF PCTA)

Figure 2. Bastard file.  
(IMAGE COURTESY OF THE USFS)



This file has a knuckle guard made from old linen hose.

Figure 3. Blade bevel.  
(IMAGE COURTESY OF THE USFS)



Correct



Wrong

Tool	Uses	Strengths	Precautions
Pulaski	Chopping logs, limbing, grubbing, loosening soil	Moderate weight, forceful for swinging, versatile; can be field sharpened	Do not use for prying; Roots, dirt & rocks will quickly dull the cutting edge
Single-bit Axe	Chopping, wedging	Light weight	Take care to keep cutting edge sharp; Be careful for kickback when banging wedges
Double-bit Axe	Limbing, chopping	Accurate and powerful	Dangerous exposed blades; take care to keep cutting edges sharp
Loppers	Brushing, limbing	Lightweight and easy to use; can be field sharpened	Cannot cut anything larger than 1/2"; Do not twist while lopping; Must be kept sharp
McLeod	Grubbing, removing slough & berm, shaping, spreading, finishing tread, tamping, scraping	Versatile, large head is good for spreading dirt and leveling	Relatively heavy; difficult to rehandle in the field
Shovel	Excavating, grubbing, removing slough & berm, scraping	Very versatile, good for moving large amounts of soil	Do not use for prying; best used for loose soil; difficult to rehandle in the field
Hoes (Grub, Hazel, Rogue, Terra, etc.)	Grubbing, excavating, cutting roots, spreading, shaping, scraping, removing slough & berm	Moderate weight, forceful for chopping roots	Heads can be loose; not meant for heavy prying
Reinhart	Grubbing, moving soil, scraping, removing slough & berm	Versatile, good for moving large amounts of soil	Do not use for prying; difficult to rehandle in the field
Pick Mattock	Prying, excavating, cutting roots	Very good for rocky soil; strong prying leverage; removable head	Heavy; pick end can bend or break if hit too much on solid rock
Cutter Mattock	Cutting roots, excavating	Very good for soil with lots of roots; removable head	Heavy; keep cutting edges sharp for maximum utility
Rock Bar	Prying, moving rocks, tamping	Great leverage; comes in varying sizes/weights	Heavy

Figure 4. Sharpening gauge. (IMAGE COURTESY OF PCTA)

