

Trail Hand Tool Maintenance

Objectives: 1. Learn **why** maintaining tools is important; 2. **Inspect** and **identify** tools to 3. **Determine when** to maintain tools; 4. **Practice** how to safely **conduct** tool maintenance and 5. **Produce** sharp tools

Trail tool proverbs: Keep it clean, and keen | Be cool, use the right tool

Vocabulary: hone, sharpen, apex, bevel, tool names, whetstone, whet, hone, sharpen, edge lead, edge trail, feather/wire edge or burr, file anatomy, file card, file cut grades and types, draw file, grit, spindle lock, flap disc

Materials: mattocks, rouge hoes, loppers, hand pruners, shovels, files, grinding stones and wheel, electric grinder, flap wheel, vice, clamps, file card or brush, linseed/flax oil, motor oil, rags, gloves, glasses, face shield, first aid kit

WHY SHARPEN?

Dull tools	Sharp tools
bounce or glance off targets damage/tear plants increase user effort, and perhaps frustration extra effort could result in bent or broken tools, and strain can lead to nicks, cracks, and tool failure	cut, not bludgeon aid plant repair/recovery reduced effort, and perhaps frustration decrease time for task- increase productivity tool love = tool longevity

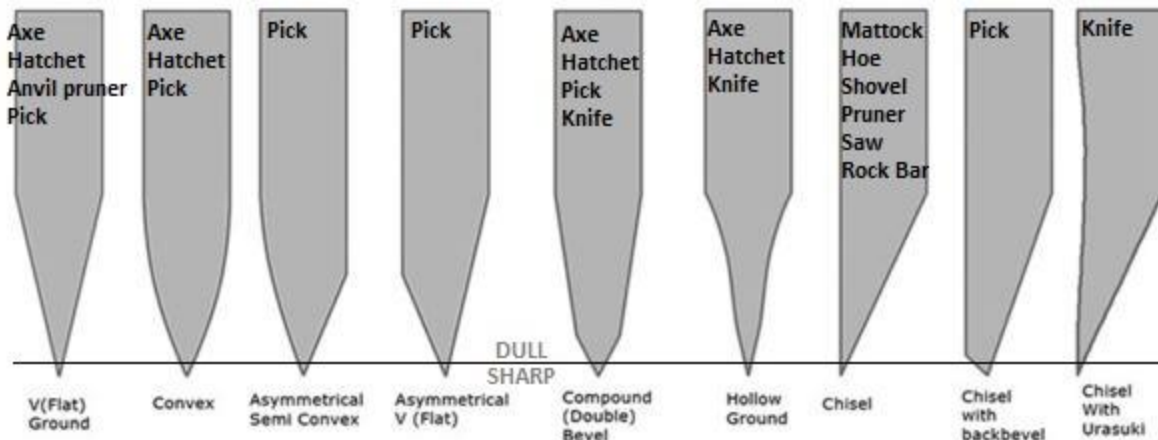
WHEN TO SHARPEN

Trail tools that kiss dirt and rock need “sharpening” as they take a licking. Pruners that never see soil for root cutting may be “honed,” but will eventually need “sharpening.”

- **Honing**— bends microscopic damage and waviness back into a straight line without removing metal. However, most “honing” rods do have abrasive surfaces via grooves and may be covered with diamonds that “sharpen.”
- **Sharpening**— grinds away metal

Determine the sharpening need by looking at the apex (tip) of the bevel (edge). Do the two planes come to a fine point, or has it given way to flatness and/or roundness? Does the edge reflect light or come to a sharp invisible point/apex?

Bevel Types:

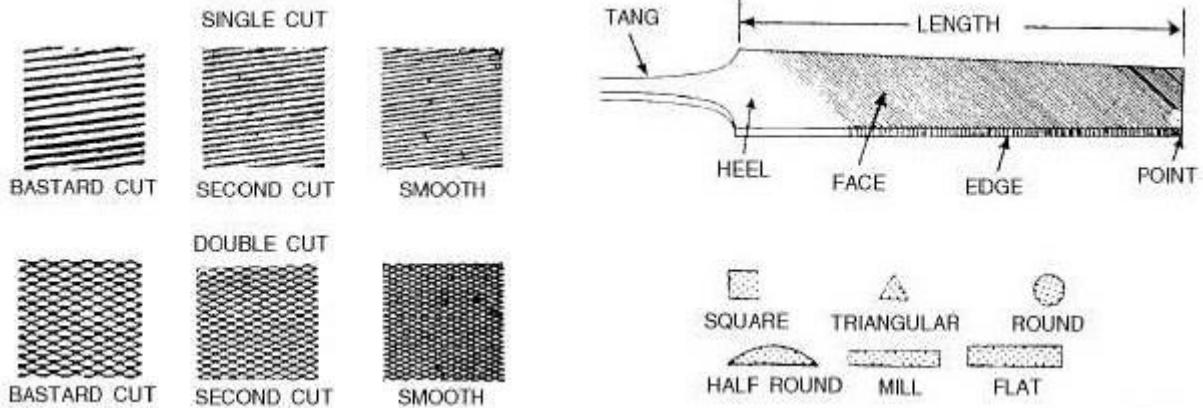


If there are no nicks, and the tool still has an “edgy” appearance— do nothing, or use a whetstone or file to whet (sharpen) the edge. Upkeep is easier than full-blown sharpening. Sharpening frequency varies with soil, rock, and root concentrations. Monitor your tool hours and resultant edge dulling and nick accrual to find the best sharpening/honing frequency for your needs (sharpening methods explained throughout and at the end).

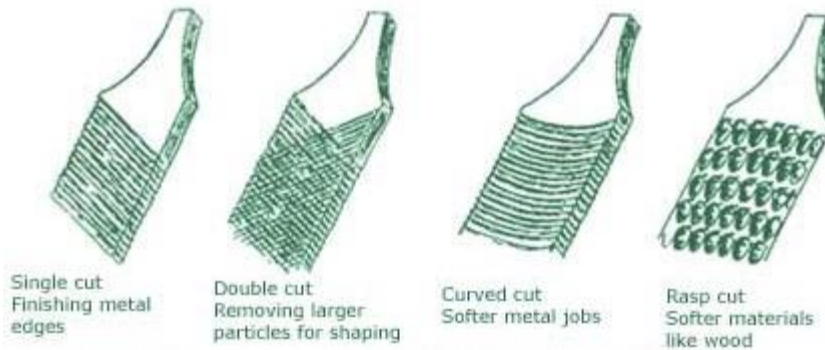
Remove nicks, and a reflective edge with coarse grinding tools to reshape worn bevels and remove nicks. As explained below, use hand files, course whetstone (or 240 grit for knives), or electric grinders with abrasive wheels or abrasive sandpaper flap discs (around 36 grit for sharpening).

SHARPENING TOOLS

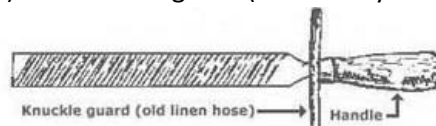
FILES



1. Three cut types:
 - a. Single Cut: parallel teeth 60° to 80° from the edge; sharpening or smooth finish; example: mill
 - b. Double/Cross (not Second) Cut: two series of parallel teeth set at a 45° angle to each other to form diamond-shaped teeth; rapid removal; examples: flat, half round, round
 - c. Rasp: large individually formed teeth; generally used for wood; examples: half round, flat, round
2. Six cut grades (course to fine): rough, middle, bastard, second cut, smooth, and dead smooth
 - a. coarseness or fineness are comparable only when files of the same length and shape are compared
 - b. coarseness of a file increases as the length from tip to heel increases (remembering same length/shape)
3. Various shapes for different applications: square, triangular, round, half round, mill, flat...



4. **Typical trail tool files:** 10-12 inch (point to heel) **mill** (single cut) **bastard** (liberal removal) **or** long-angled lathe file, flat bastard, Home and Garden file by Nicholson, as well as Axe and Handy files
 - a. Mill files are always single cut. Used for smoothing, draw-filing, and fine precision work. Mill bastards or long-angle lathe files will provide a true shearing or shaving action and scoring is avoided.
 - b. Flat files are general purpose files where metal is to be removed rapidly or in comparatively large amounts. Flat bastards cut for rough work, and second cut or smooth for smooth finishing, followed with a mill file.
 - c. For harder carbon steels in cutter knives, shears etc. use a double cut or mill smooth
5. Do NOT use oil or water, as it will help clog the file. Apply chalk to slow down clogging
6. Follow teeth angle to clean. Use a soft wire brush (some prefer brass), tooth brush, or hardwood, or file card
7. Secure the tool (with a vice) so both hands are free for filing, and vibrations don't occur to break file teeth
8. Always wear gloves on both hands
9. Fit the file with a handle (optional) and knuckle guard (mandatory for edge lead sharpening)



10. Store or transport files so they are not thrown together. Shield them from other tools. Protect them by wrapping in paper or cloth.

STONES

SHARPENING STONES						
Stone	Natural	Synthetic	Size (inches)	Cost (dollars)	Use	Sharpening Speed
Black hard Arkansas	X		8x2x1	50 to 60	Edge polishing	Very slow
Hard white Arkansas	X		8x2x1	30 to 40	Edge finishing	Slow
Soft Arkansas	X		8x2x1	15 to 20	Sharpening	Medium
Washita	X		8x2x1	25 to 30	Shaping-roughing	Fast
Silicon carbide		X	8x2x1	8 to 10	Roughing to sharpening	Fast to medium
India		X	8x2x1	8 to 10	Roughing to sharpening	Fast to medium
Crystolon		X	8x2x1	8 to 10	Roughing to sharpening	Fast to medium
Diamond-nickel		X	6x2x ¹ / ₁₆	25 to 30	Sharpening hard steels	Medium
Silicarbide-rubber		X	8x2x1	8 to 10	Deburring	Fast

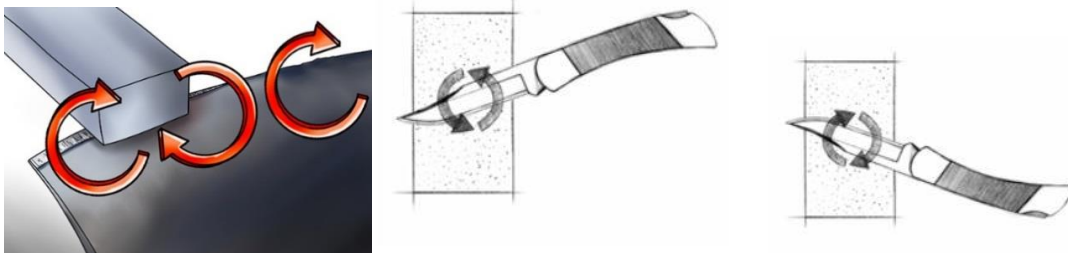
Oil, water, or dry stones? Dry honing/sharpening produces a sharper longer-lasting edge and stone (depending on who you ask)

HOW TO SHARPEN

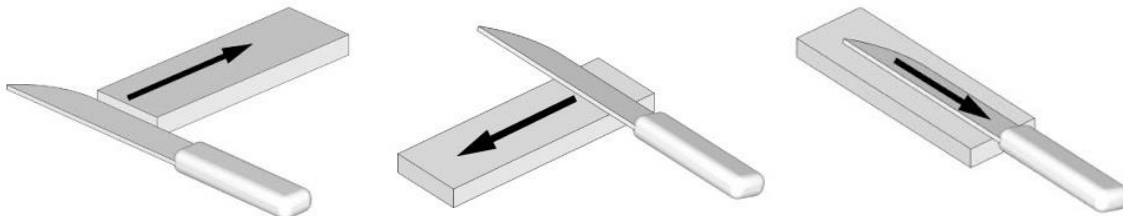
CIRCULAR OR STRAIGHT?

1. Stones

- a. **Circular** or “cabinet maker’s sharpening method”- sharpening in circles (some would say this is a pun)
 - i. Can help keep a steady angle while honing freehand



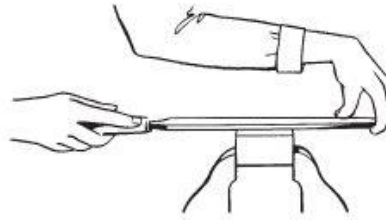
b. Straight



- i. Edge leading- sharpening towards sharp edge (some would say this is a pun)
 - 1. Lead with Silicon Carbide (Carborundum) stones for establishing apex, i.e. to get an edge
 - 2. Diamond sharpeners for edge leading
 - ii. Edge trailing- sharpening away from sharp edge (some would say this is a pun)
 - 1. Trail with Carborundum type stones for keeping apex, i.e. to keep and not ruin an edge
 - iii. Parallel trailing- sharpening away along the edge (another pun?) The Corona pruner manufacture markets this method and a carbide file tool.
- c. To keep a stone’s shape, use the entire stone surface and rotate. If the surface becomes uneven, it may be reshaped by rubbing it over a sheet of glass sprinkled with carborundum powder or on a sheet of coarse sandpaper. Keep stone surfaces wet while reshaping them.

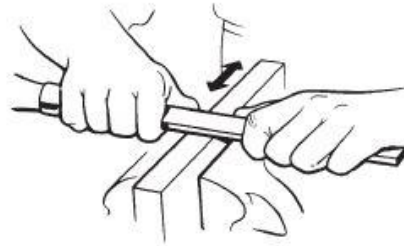
2. Files

- a. Only file in **one direction and the FORWARD direction** (two direction sideways drawing is acceptable)
- b. Dragging on the return or backstroke dulls the file, eventually ruining it
- c. File forward in a straight line
 - i. Apply even pressure in slow, deliberate, strokes on the push stroke, then lift the file up and off the tool while returning for another pass.
 - ii. Too much pressure can clog or shell off teeth. Apply just enough pressure to keep cutting.
 - iii. If allowed to slide over harder metals the teeth of the file rapidly become dull.
- d. **Straight-forward filing:** In this operation the file is pushed straight ahead across the work.
 - i. Trail tools may be filed **leading/towards (starting) or trailing/away (finishing)** from the edge



→ Filing direction →

- e. **Draw-filing:** In this operation the file is grasped at each end, and with an even pressure alternately pulled and pushed over the work. The file remains perpendicular to the direction of motion.
 - i. Draw-filing is used where a smooth level surface on planes or edges of the work is desired.



ELECTRIC GRINDERS

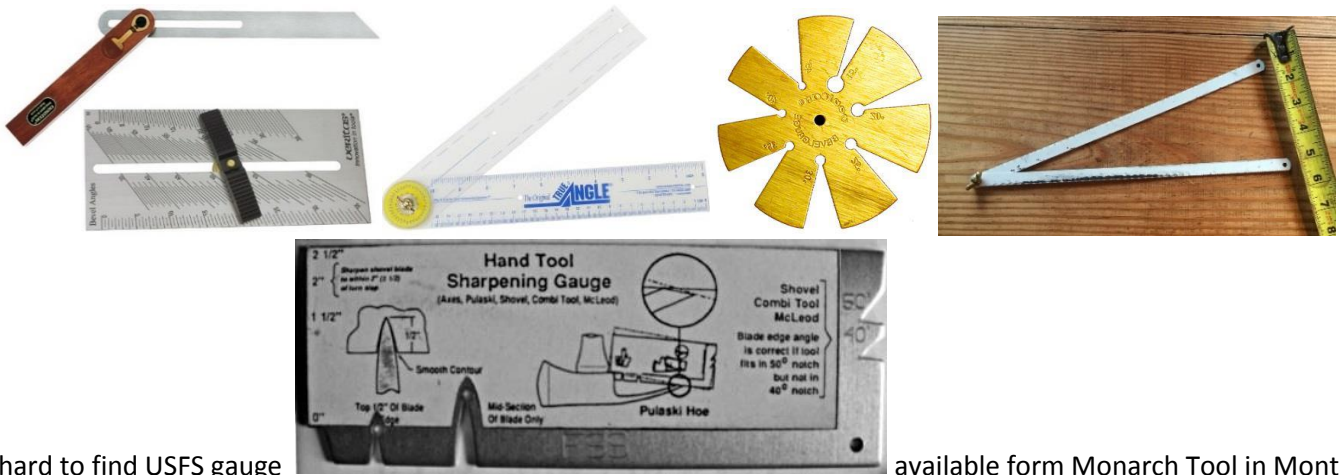
- Firmly secure the hand tool to be sharpened with a vise or clamps to prevent tool movement while grinding
- Wear appropriate PPE such as face shield, safety glasses, dust mask, long sleeves/pants, and shoes
- Ensure that the grinder guard and the abrasive disk are properly installed
- Set variable speed grinders to the appropriate speed, not to exceed the disc manufacturer's maximum rating
- Move the grinder quickly and evenly across the surface at the appropriate angle
 - moving too slowly **may change the temper** (evidenced by discoloration), i.e. the strength
 - heavy pressure may gouge and/or temper the tool
 - allow a few (~5) seconds between passes to allow cooling
- Clean up the tool edge by filing with a 10-12 inch mill bastard
- Changing Abrasive Discs
 - Disconnect the grinder from its power supply
 - Press the grinder's spindle lock to prevent the spindle from turning, remove retaining nut, and disc
 - Mount the replacement disc, abrasive surface facing away from the power tool
 - Hand-tighten the retaining nut on the spindle
 - Press the grinder's spindle lock and tighten the nut with the appropriate wrench

SHARPENING ANGLES

Tool	Recommended Angle*	Tool	Recommended Angle*
Axe		Hand pruner- bypass	0/squared-40, hook is flat
Optional secondary/double bevel	15-22	Hand pruners- anvil	30-60, anvil is flat
Felling (1/64-1/4 inch bevel)	7-15	Pruning shears	10-25 for concave face
Grubbing end of double bit	>25	Grass whip	25
Average	Straight/flat V 45	Hedge trimmer	15
Heavy duty splitting	Convex 50-60	Cutter Mattock- cutter	Straight/V 25-45
Peeling	Hollow Grind 15	Mattock	35-50
Sculpting	Concave 10	Rouge Hoe	25-50
Hatchet- slimmer than an axe	20-30	Pulaski mattock end	30-50
Drawknife	25-35	McLeod	40-50
Hand Saw		Shovel- round/square	35-50/60
Chainsaw		Rock Bar	
Knives	13-16-30		

*or manufactured angle. Some manufactured angles are not intended for cutting. See manufacture's literature for a suggested angle. Tools used for heavy-duty chores that dull the blades quickly should have bigger angles with a relatively short bevel. In contrast, knives, pruning shears, and axes need finer edges: blades sharpened at low angles with a relatively wide bevel.

Bevel Gauges: traditional, True Angle, Veritas, DIY Hacksaw (joined by screw and wing-nut)



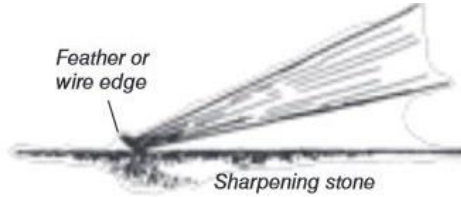
The hard to find USFS gauge

available form Monarch Tool in Montana

DIY Hacksaw Blade Bevel Gauge				
>blade length = 12 inches along straight edge (excludes rounded end portions); total end-to-end (includes rounded end portions) = 12 5/16 inches				
>hole-to-hole blade length (center-to-center) = 11 27/32 inches				
sharpening angle degrees (vertex of isosceles)	hole-to-hole center-to-center ⁺ inches (isosceles triangle base distance) right triangle base x 2	right triangle base distance (aka side opposite) sin(1/2 sharp angle)hypotenuse ⁺⁺	blade hole-to-hole distance (aka hypotenuse)	1/2 of sharpening angle (split isosceles triangle to make two right triangles)
7	1 7/16	47/65	11 27/32	3.5
10	2 1/16	1 1/31	11 27/32	5
15	3 1/16	1 6/11	11 27/32	7.5
20	4 1/8	2 3/53	11 27/32	10
25	5 1/8	2 40/71	11 27/32	12.5
30	6 1/8	3 3/46	11 27/32	15
35	7 1/8	3 32/57	11 27/32	17.5
40	8 1/8	4 3/59	11 27/32	20
45	9 1/16	4 41/77	11 27/32	22.5
50	10	5	11 27/32	25
55	10 15/16	5 15/32	11 27/32	27.5
60	11 13/16	5 59/64	11 27/32	30
	⁺ rounded to 8ths or 16ths	⁺⁺ Excel formula: SIN(RADIANS(1/2 sharp angle))*hypotenuse		

SHARPENING PROCESS

As seen above, the sharpening methods vary according to the sharpening implement (stone, file, paper), not to mention legend and lore. *Four* practices unite sharpening methods: *consistent* and *symmetrical* stroke *angle* and *pressure* (and a fifth: *number* in the case of two bevels). The objective, whether whetting with a stone or file as described above (circular, edge lead, edge trail, or parallel), whet until there is a feather/wire edge or burr. Once a burr is raised to show the bevel has reached a definite point of intersection, flip the tool to remove the fine burr, and repeat. The goal is an apex that comes to a sharp invisible point, sometimes beginning with a coarse grind, always finishing to finer.



A wire edge is removed by honing the opposite edge.

SAND PAPER

Aluminum Oxide (most common), Silicon Carbide (wet/dry, usually black/grey in color), and other sand papers can be used to sharpen as well, but the paper does not last as long as well cared for files and stones. It's cheap in the short run, but more expensive in the long run. The "Scary Sharp" method uses sand paper from courser grits* (60, 80, 220) to finer grits (600, 800, 1000, 2000) depending on tool needs. This method is used primarily for woodworking tools like chisels, but could be employed to sharpen knives, axes, and trail tools. The *grits refer to particle number, distribution, and/or size. Less aggressive open-coated sandpaper leaves 30% or more room for dust build up to reduce clogging. Wet paper, and "stearated" (dry powdered soap impregnated) papers act as lubricants to reduce clogging.

WOOD CRACKS and METAL RUSTS

Wipe wooden handles down with linseed oil (flax- *Linum usitatissimum*) to stop handles from denting, drying and cracking. Wipe metal with motor oil or WD-40 to slow rust. 80-100 grit will suffice for rust removal on trail tools. Remove Rust without scratches with a medium-fine (150-grit). Varying grades of steel wool can be used as well. The frequency of metal and wood conditioning with oil varies with weather, tool storage conditions, and use frequency. DISPOSE oily rags or store in a fire-safe container.

Resources

1. An Axe to Grind- A Practical Manual by Bernie Weisgerber (also on YouTube)
2. The Crosscut Saw Manual by Warren Miller (Tech. Rep. 7771-2508-MTDC, rev. 2003)
3. Saws That Sing: A Guide to Using Crosscut Saws (Tech.Rep. 0423-2822P-MTDC) by David Michael. Copies are available from MTDC.
4. Trail Construction and Maintenance Notebook-Tool section:
http://www.fhwa.dot.gov/environment/recreational_trails/publications/fs_publications/00232839/page13.cfm
5. Handtools for Trail Work: <http://www.fs.fed.us/td/pubs/pdfpubs/pdf05232810/pdf05232810dpi72.pdf>
6. American Trails: Tool info: <http://www.americantrails.org/resources/info/tools1.html>
7. Saveedge.com
8. Buckknives.com
9. Saw and Tool Sharpening Guidebook, Skog Company, 1982 by Roman Dicaire and Ronald A. Skoglund
10. How to Sharpen Anything by Don Geary
11. Modified Belt Sander Sharpens Axes and Pulaskis by David E. Michael, and Mary Ann Davies:
<http://www.fs.fed.us/t-d/pubs/htmlpubs/htm08232327/>
12. Flap Cup Grinder Disc by Lois Sicking: <http://www.fs.fed.us/eng/pubs/html/02511305/02511305.html>
13. <http://toolmakingart.com/2012/04/09/is-there-one-bevel-gauge-to-rule-them-all/>
14. Arvika Axe grind: <http://www.bladeforums.com/forums/showthread.php/1026125-Arvika-grind>
15. Razor Sharp System- Popular Science Feb 1977: <http://sharpeningmadeeasy.com/Juranitch1977Feb.htm>
16. Sharpening Axes: <http://blueandwhitecrew.org/resources/tips/sharpeningaxes.php#measuringbevelangles>

Tool Use

Proper use begins with a good grip. Wet or muddy gloves may cause a tool to slip from your hands, striking you or someone near you.

Watch out for people around you. When chopping or brushing, be aware of any people in the surrounding area. The combined length of your arm and tool could reach a person working near you. Also, be aware of trail users. Often a user may try to pass right into your back swing. If you see someone coming, stop work, notify your coworkers and wait for them to pass.

Make sure you have a clear area in which to swing. Watch out for overhead or side hazards. A hazard is anything that could interfere with the complete swing of your tool, and knock it from your hands or down onto any part of your body.

Keep your tool in front of you at all times. You should never need to swing your tool over your head.

Be alert for hazardous footing. Make sure you have a firm, balanced and comfortable stance before starting your work.

Clear limbs, sticks, loose rocks, or other debris from your footing area. Particularly with striking tools, make sure your feet are spaced well away from your target area.

Carry the tool properly. Always carry tools in your hands and down at your side on the downhill side of the trail. Use blade guards whenever possible. Never carry tools over your shoulder.

Travel safely. Stay at least 10 feet apart on the hike in and out from the work site space yourself along the trail.

Have the right personal protective devices. Along with wearing long pants, long-sleeve shirts, and work boots, crew members should have available hard hats, gloves, and safety glasses.