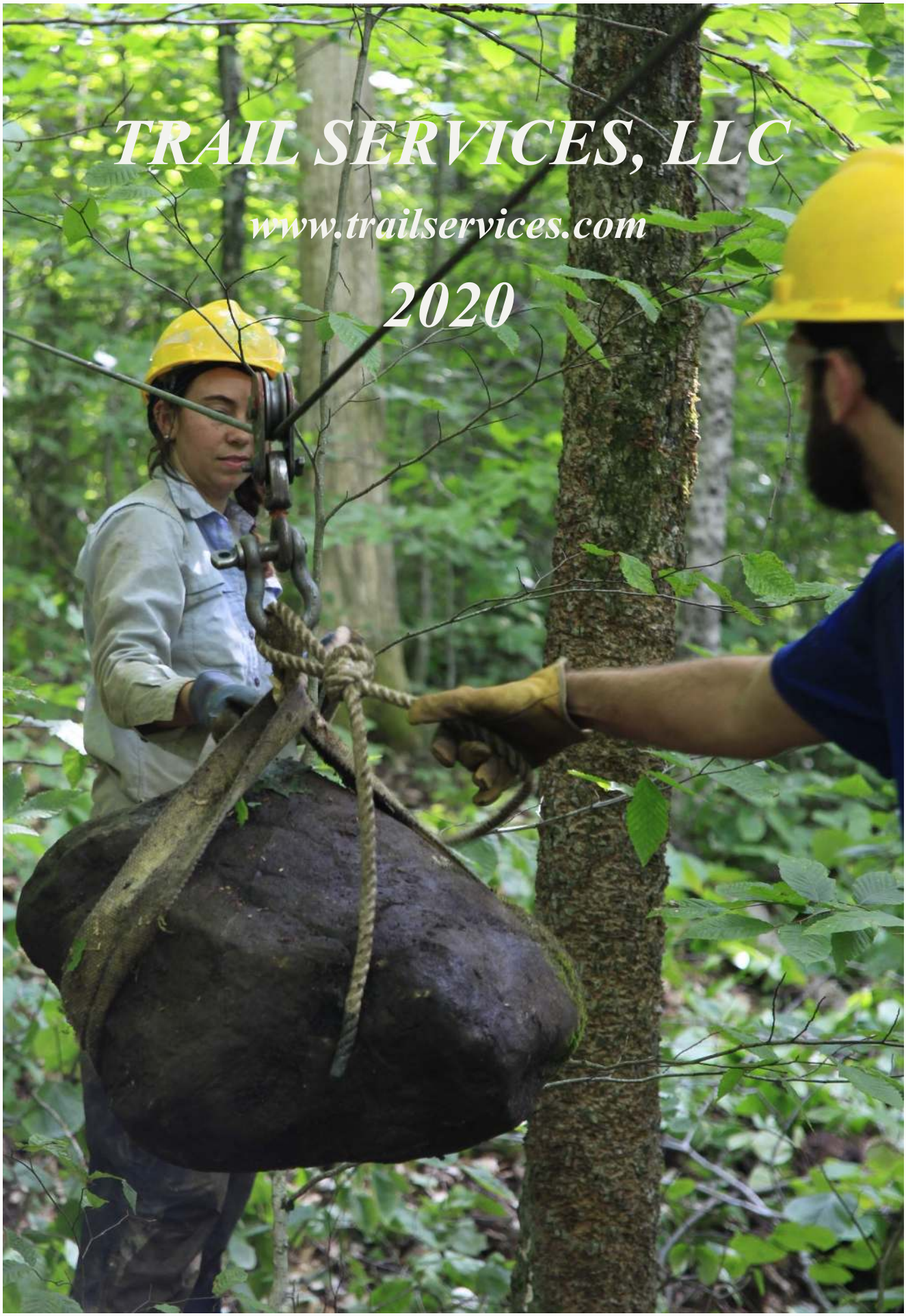
TRAIL SERVICES, LLC
www.trailservices.com
2020

TRAIL SERVICES, LLC

499 Broadway #169
Bangor Maine 04401

Griphoist® Products
Stone Tools
Rock Drilling Equipment
Trail Tools

Trail Services has been providing quality, hard-to-find products for building trails for 27 years.

Trail Services specializes in Griphoist® equipment, rigging, stone cutting and shaping tools, and has a full selection of hand tools and specialty tools for nearly all trail building applications. This catalog has informative articles that share knowledge and techniques.

I welcome calls for further information about tools and techniques. Trail Services promotes good information and good tools for good trails.

Working smarter, not stronger,

Lester C. Kenway - Trail Services

Rebuilt section of the Hunt Trail - Baxter State Park - 2012 - Photo by L.C. Kenway

On the Cover: Highlining stone with the Maine Appalachian Trail Club on the Appalachian Trail in Club—Photo by Jodi Dunn

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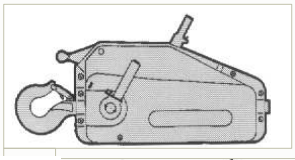
Highlining stone - West Peak of White Cap Mt. 2011 - Photo by Matt Coughlan

HOISTS & ACCESSORIES

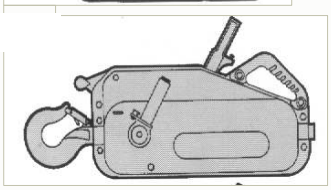
GRIPHOIST® LIFTING AND PULLING MACHINES WITH UNLIMITED WIRE ROPE

Griphoist lifting and pulling machines have found applications in trail work throughout the United States. These hand powered winches utilize a pair of wire rope grips to pull any length of wire rope through the hoist. All hoists come with standard lengths of either 30 ft. or 60 ft. of wire rope. Longer lengths of wire rope can be used for applications such as high lines or where blocks are used to build up the mechanical advantage.

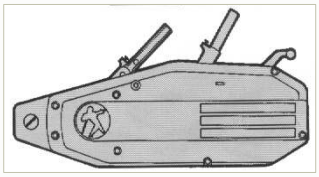
HEAVY DUTY HOISTS



GRIPHOIST® TU-17
2000 lb. capacity • 5/16" wire rope • telescoping handle • frequently chosen unit • 18.5 lb., lightweight wire rope, and robust construction make this a good choice for trail projects.

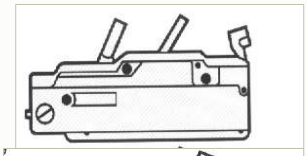


GRIPHOIST® TU-28
4000 lb. capacity • 7/16" wire rope • telescoping handle • 41 lb. • convenient carrying handle • rugged tool that is powerful and effective in situations where weight is not a main concern.

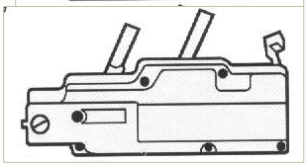


GRIPHOIST® TU-32
8000 lb. capacity • 5/8" wire rope • telescoping handle • 59.5 lb. • applications for moving huge boulders or entire structures.

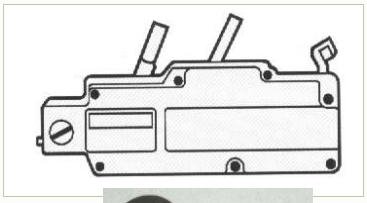
INDUSTRIAL DUTY HOISTS



GRIPHOIST® T-508
2000 lb. capacity • 5/16" wire rope • 14.5 lb. • telescoping handle • small and less expensive • many applications.



GRIPHOIST® T-516
4000 lb. capacity • 7/16" wire rope • 30 lb. • telescoping handle • suitable for most trail work applications



GRIPHOIST® T-532
8000 lb. capacity • 5/8" wire rope • 51 lb. • telescoping handle • applications include lifting bridges for abutment repair.

GRIPHOIST® SWIVEL HOOKS
T-508, T-516, T-532, and TU-32 can be fitted with a swivel hook.

#21851 for T-508 • 1.3 lb.
#21861 for T-516 • 3.3 lb.
#21877 for T-532 • 5.4 lb.
#SWVHK for TU-32 • 5.4 lb.

GRIPHOIST® REPLACEMENT HANDLES
#11338 for T-508 • 2 lb.
#11348 for T-516 and T-532 • 5 lb.
#508 for TU-17 • 2 lb.
#18 for TU-28 and TU-32 • 5 lb.

SHEAR PINS:
#29506 for T-508 (10 pak)
#29516 for T-516 (10 pak)
#6866 for T-532 (10 pak)
#8836 for TU-17 & TU-28 (30 pak)
#6866 for TU-32 (10 pak)
#0434817 for Super Pull-All (10 pak)

HOISTS & ACCESSORIES

GRIPHOIST® REPLACEMENT HANDLES

#11338 for T-508 • 2 lb.
#11348 for T-516 and T-532 • 5 lb.
#508 for TU-17 • 2 lb.
#18 for TU-28 and TU-32 • 5 lb.

GRIPHOIST® WIRE ROPE

Typical wire rope

Replacement or additional wire rope is available in any length for all models of hoists. Standard assemblies include hook and swaged thimble as well as tapered welded point.

GRIPHOIST® WIRE ROPE REELS

Available in four sizes, these reels are convenient for storing or transporting wire rope.

MAASDAM POW'R-ROPE PULLER

Ratchet style come-along uses a v-groove sheave to grip fiber rope • 1000 lb. capacity • no drum! • unit uses 1/2" Polypropylene rope (4200 lb. breaking strength) • excellent for securing loads on vehicles • many applications • 8-3/4 lb. with

SNATCH BLOCK FOR LIGHT DUTY HOISTS

2-3/4" diameter pulley for use with 3/16" - 1/4" wire rope. • allows multi-part pulls and

CROSBY/McKISSICK DROP SIDE SNATCH BLOCKS

Captive bolt allows side plate to open to accept wire rope • bronze bushing • hook swivel allows full rotation .

#108038 #418 hook w/out gate latch • 3" sheave fits 5/16" - 3/8" diameter wire rope • WLL 4000 lb. • 3 lb.
#108065 #418 hook w/out gate latch 4-1/2" sheave fits 7/16"-1/2" diameter wire rope • WLL 8000 lb. • 13 lb.

#109037 #419 swivel eye (1-1/4" ID) 3" sheave fits 5/16"-3/8" diameter wire rope • WLL 4000 lb. • 3 lb.
#109064 #419 shackle swivel eye • 4-1/2" sheave fits 7/16"-1/2"

GATE LATCHES

Notch and cotter pin style for newer hooks.
1096421 - S-4320 latch kit for 1-1/2 Ton Carbon Steel Hook
1096468 - S-4320 latch kit for HA/HC ID Hook
1096515 - S-4320 latch kit for 3 Ton Carbon Steel Hook
Smooth tip gate for older hooks.
1090081 - SS-4055 latch kit for 3 Ton Carbon Steel Hook

BLACK RAT ® SNATCH BLOCK

#003-201 Simple twin plate style block • attach to load with shackle • steel bushing • remove cotter pin to service sheave • 5" sheave fits up to 7/16" wire rope • WLL = 3,520 lbs • 8 lb.
Not Rated for Lifting.

SWIVEL HOOK FOR BLACK RAT® SNATCH BLOCK

#395-2515 Alloy swivel hook with gate latch attaches to Black Rat block with shackle • WLL = 6,000 lbs • 3lb.

Picking the Right Snatch Block

A *snatch block* can be opened on one side to accept a line or wire rope. On "*Drop Side*" snatch blocks, theside plate rotates to create an opening. "*Steel Plate*" blocks have a hinged link that can be opened . All snatch blocks have a grooved wheel called a

Three factors when choosing a snatch block:
1. **What size & type of wire rope will be used?**
2. **What function will the snatch block serve?**

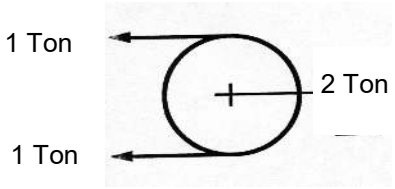
1. What size and type of wire rope will be used with the snatch block?

The wire rope and snatch block must be carefully matched, to prevent damage and accelerated wear.

"Undersize sheaves are probably responsible for more rope failures than any other single cause" - W. E. Rossnagel - Handbook of Rigging

Running wire rope over too small a sheave results in displacement of the strands of the rope and overstresses the wires. For 4x26 Griphoist wire rope, the minimum sheave diameter is 16 times the diameter of the wire

For 5/16" 4 x 26 Wire Rope = 5"
For 7/16" 4 x 26 Wire Rope = 7"



For 6x19 IWR (commonly available) wire rope, the minimum sheave diameter is 18 to 20 times the diameter of the wire rope.

If the diameter of the sheave's groove is too small, the wire rope will bridge across the groove, causing the wire rope to damage the sheave. If the groove is larger than the diameter of the wire rope, the wire rope will be flattened, as it rolls

2. What function will the snatch block serve?
- **-Double the line for a 2:1 advantage?**
- **-Support a high line?**
- **-Roll loads along a cable?**
- **-Provide a change in direction?**

The sheave diameter of a snatch block used

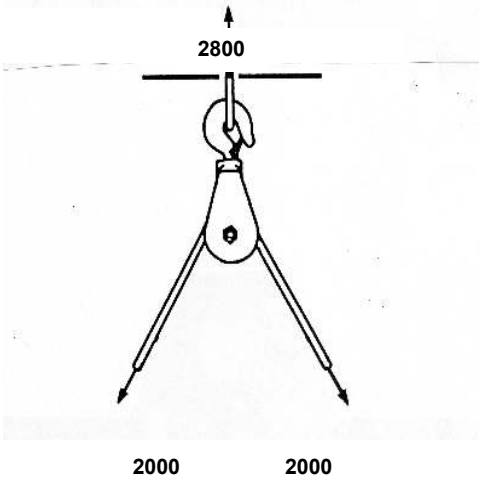
Note: Deep corrugated grooves, worn into the sheave over time can cut into wires and damage the wire rope. Be sure to replace the sheave when corrugations are pronounced, or when it is time to replace the wire rope with a new one.

Smaller blocks used for high anchors, that roll along tight wire ropes, or that provide changes of direction greater than 90º may often be employed with no harm to the wire rope, thereby reducing expense and weight carried by the crew. If smaller diameter snatch blocks are to be used, they still should have the proper diameter groove, to avoid damage to the

3. What loads will the block be subject to?

Snatch blocks are generally rated at 1-1/2 to 2 times the safe working load of the wire rope. A snatch block used to lift loads on a highline will be subject to a load equal to the weight being lifted.

A snatch block used as a high anchor will be subject to loads greater than the line tension.
For example, if a skyline cable passes through a high anchor at a 45º angle, the snatch block will be subjected to a force 140% of the line tension. A 2000 LB tension applied through the angle will apply a downward force of about 2800 lb. on the



SNATCH BLOCKS

CAMPBELL® DROP SIDE SNATCH BLOCKS

Rugged, long lasting, all galvanized block suitable for outdoor or marine settings • bronze bushings • side plate will swing open for wire rope • bolt cannot be lost • hook swivels. Working Load Limits are rated at a safety factor of 5.

#733-9764 Hook with 4-1/2" sheave fits 7/16"-1/2" wire rope •WLL 8000 lb. • 12 lb.

SNATCH BLOCKS WITH SHACKLE

Gate latches are often damaged when lines are used to move snatch blocks along high lines. Swivel eyes allow the use of one or more shackles to make attachments to the block.

#733-9752 With shackle swivel eye
3" sheave fits 5/16" - 3/8" wire rope • WLL 4000 lb. • 5 lb.
#733-9762 with shackle swivel eye

GATE LATCHES

The hooks on CAMPBELL® blocks will accept a spring loaded latch that will keep attachments secured inside the hook • very sturdy latch • will fit other brands.
#399-1403 for 3" blocks **750-6495** for 3" blocks
#399-1405 for 4-1/2" blocks **750-6695** for 4-1/2" blocks

ROCK ANCHORS

Expanding rock anchor fits into 1-7/8" diameter hole • anchor is expanded by turning the threaded rod and then pulled • anchor can be temporary or permanent • ***placements in granite observed to fail above 12,000 lb.*** • nominal SWL = 4,000 lb. • suitable for anchoring Griphoist® or lifting boulders out of hard to reach places • furnished complete with 3/4" rod - 15" long • Wt. = 5 lb.
#HPS R315 3/4" rod by 15" AB Chance Rock Anchor

Sometimes simple
is better.
Maine Trail Crew
Appalachian Trail;
West Peak of WhiteCap

SNATCH BLOCKS

SKOOKUM® BLOCKS
Skookum has been supplying blocks and rigging supplies to industrial, logging and marine operations since 1890.
When Griphoist wire rope is 7/16" diameter (TU-28 and T-516) and is used in a 2:1 pull, the sheave diameter must be a minimum of 8 inches. A 5/8" wire rope (TU-32 and T-532) must have

HALF SIDE BLOCK

HALF SIDE BLOCKS - BRONZE BEARING
A-8 8" diam 1/2-5/8" sheave 29 lb. 16,000 lb. SWL
A-10 10" diam 5/8-3/4" sheave 35 lb. 16,000 lb. SWL

FULL SIDE BLOCK

FULL SIDE BLOCKS - BRONZE BEARING
A-8T 8" diam 1/2-5/8" sheave 29 lb. 16,000 lb. SWL

COOPER SWIVEL HOIST HOOKS
395-2615 3 ton swivel hoist hook with Gate Latch
395-2915 7 ton swivel hoist hook with Gate Latch

A Boulder in Bondage, Hunt Trail Katahdin 2012

SHACKLES & WIRE ROPE CLIPS

SHACKLES

Shackles can also be used to make sling connections, extensions, and load hangers. A single shackle can gather several slings together for a single anchor point.

CAMPBELL® SCREW PIN ANCHOR SHACKLE

Quality forged at a competitive price • galvanized • load rated • size equals diameter of screw pin.

#541-0835 - 1/2" with WLL = 4,000 lb. - wt. = 0.7 lb.,
#541-1035 - 5/8" with WLL = 6,500 lb. - wt. = 1.3 lb.
#541-1235 - 3/4" with WLL = 9,500 lb. - wt. = 2.0 lb.
#541-1435 - 7/8" with WLL = 13,000 lb. - wt. = 3.3 lb.
#541-1635 - 1" with WLL = 17,000 lb. - wt. = 5.0 lb.
#541-2035 - 1-1/4" with WLL = 24,000 lb. - wt. = 10.0 lb.

CROSBY® SCREW PIN ANCHOR SHACKLES

Galvanized • load rated • size equals diameter of screw pin.

#8473 - 5/8" with WLL = 6,500 lb. - weight = 0.63 lb.
#8491 - 3/4" with WLL = 9,500 lb. - weight = 1.38 lb.
#8516 - 7/8" with WLL = 13,000 lb. - weight = 2.25 lb.

CROSBY® FIST GRIP (DOUBLE SADDLE TYPE)

#499 For 5/16" wire rope
#514 For 3/8" wire rope
#532 For 7/16" - 1/2" wire rope

CROSBY® WIRE ROPE CLIPS (U TYPE)

#1010079 For 5/16" wire rope
#1010097 For 3/8" wire rope
#1010113 For 7/16" wire rope

CAMPBELL® WIRE ROPE CLIPS (U TYPE)

#699-0534 For 5/16" wire rope
#699-0634 For 3/8" wire rope
#699-0734 For 7/16" wire rope
#699-0834 For 1/2" wire rope
#699-0934 For 9/16" wire rope

CAMPBELL® HEAVY DUTY WIRE ROPE THIMBLES

Whenever an eye is formed in the end of a wire rope, a thimble should be used to protect the rope from damage.

#626-0202 For 5/16" wire rope
#626-0203 For 3/8" wire rope
#626-0204 For 7/16" wire rope
#626-0205 For 1/2" to 9/16" wire rope

HIGHLINES

WORKING SAFELY WITH GRIPHOIST® POWERED SYSTEMS

by Lester C. Kenway - Illustrated by Julian Wiggins

Many trail crews roll heavy loads along cables tensioned by Griphoist® winches. Described as "slack lines", "high lines", "high wires", or "sky lines", these systems can be used to lift 400 pound step stones 100 feet up a steep slope to a new staircase on the trail.

These systems contain 4 basic components:

1. 1 or more Griphoist® winches with wire rope.
2. Towers or trees for vertical supports.
3. Anchors - usually trees, stumps, or boulders.
4. Accessories - slings, blocks, shackles, etc.

In order for any of these "high line" systems to work well, and to *prevent the failure* of any of these four components, several safe practices must be maintained.

1. Use wire rope in good condition that meets specifications for the Griphoist® machine being used.

The wire rope provided with Griphoist® machines has a breaking strength that is 5 times the rating of the winch. The shear pins will release at 150% capacity. On a 2000 lb. winch, the pins break at 3,000 lb., well below the 10,000 pounds needed to break the wire rope. The following could lead to breaking a wire rope:

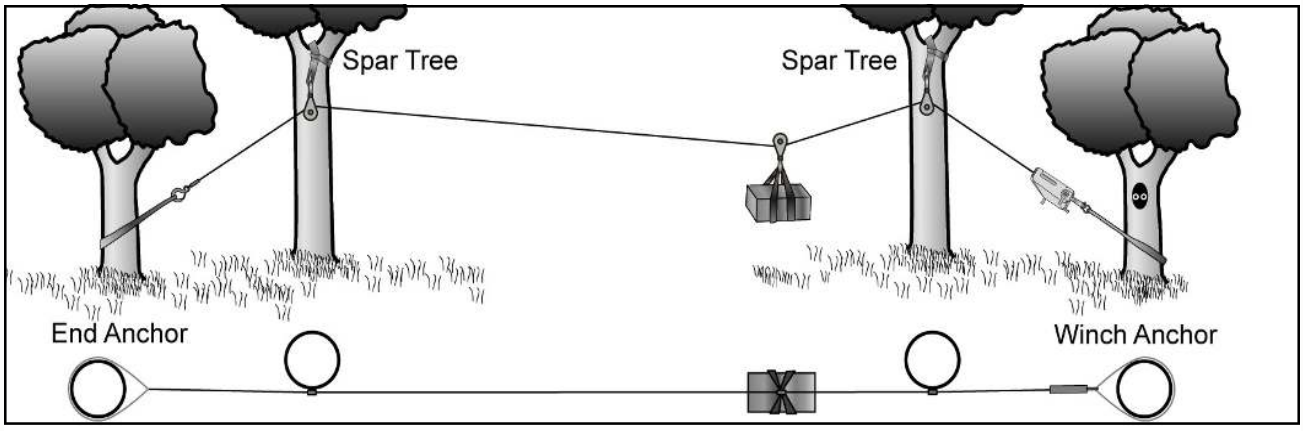
- Disabling the safety shear pins in order to use a longer handle
- Using damaged, or inferior wire rope
- Shock loading - such as pulling a rock off a cliff while it was attached to a tight high line.

The danger of breaking a wire rope is minimized when properly maintained winches are matched with the appropriate wire rope.

2. When using trees as vertical supports, always analyze the forces being put on the tree and use appropriate guy lines to prevent toppling or breaking the tree.

It can take 2000 pounds of tension to lift a 300 pound load in a typical 100 foot long high line system. If this horizontal force were to be applied to a tree 12 to 16 feet off the ground, it could pull the tree over. The simplest way to prevent excessive sideways force on the "Spar" tree is to layout the system in a near linear fashion.

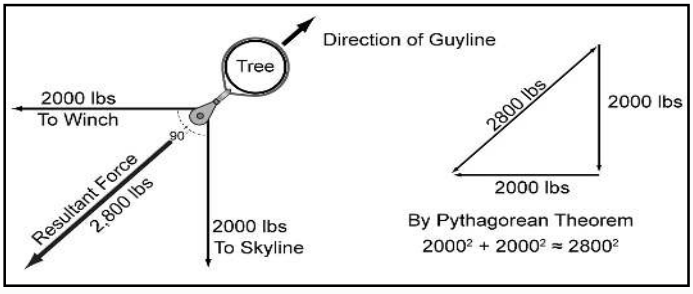
With a linear arrangement, the force on the spar trees by the line is matched by the tension from the

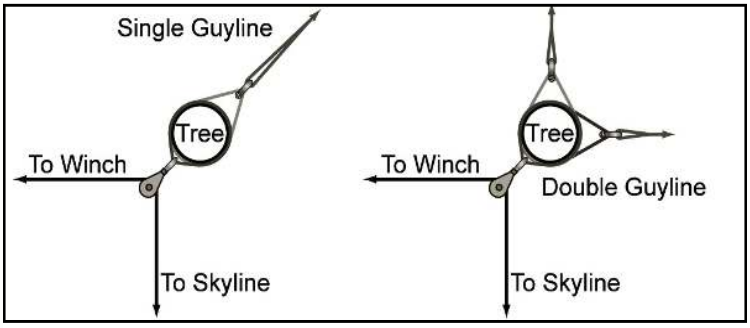


Griphoist and end anchor. With this set-up, the spar trees experience only a downward force.

When spar trees are the focus of a horizontal change in direction of the cable, the angles must be studied and a guy line(s) or backstay(s) applied that will oppose the **resultant** force that will be applied to the tree by the angled cable.

A line running through a 90 degree angle will create a resultant force that is 40% greater than the line tension! ———->

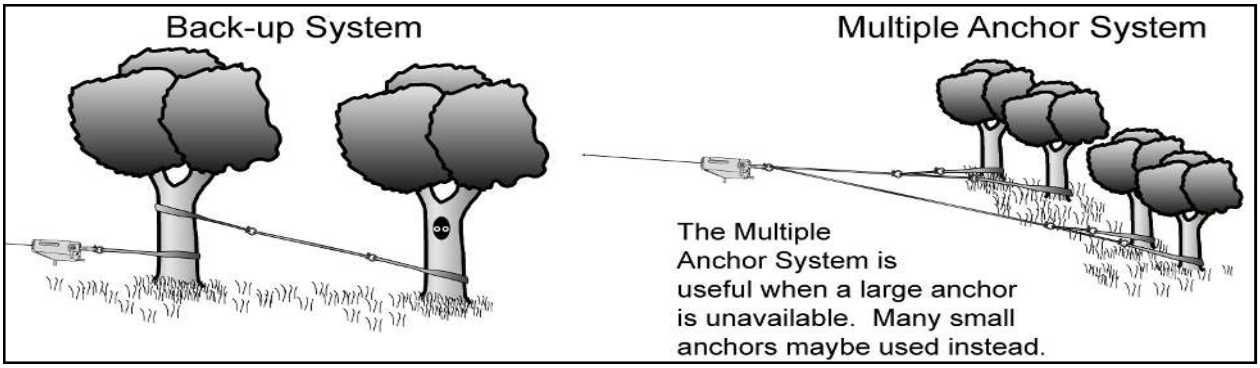




Since an angled cable multiplies the resultant force experienced by the spar tree, at least one guy line made from lifting slings, chain or wire rope may be needed. If it is difficult to estimate the direction of the resultant force, two guy lines can be used, each one directly opposite of the two cable directions.

3. Pick solid anchors, and monitor them for changes. Use multiple anchors when in doubt.
The most common anchors are stout trees or large boulders. Even smaller trees can serve well as anchors if the lines are attached at ground level. Things to monitor:
1. Excessive *tilting* of trees or movement of boulders.
2. Evidence of impending tree fracture (*cracking noises*).
3. Slings *creeping* up the anchor - provoked by too steep an angle towards a spar tree.
4. Progressive *abrasion damage* or cutting of slings by rough edges on the anchor.

When the available anchor points appear to be small or questionable, use multiple anchor points:
Good, (as climbers say - "*Bombproof*") anchors are the foundation of these systems. It pays to do the best job possible with the anchors. ***Winch anchor failure is likely to hurt someone.***



4. Maintain a safety factor of 5 when applying all accessories and hardware to a system.
Quite simply put this means "Use the right tool for the job". Only "load rated" components should be used in these systems, and attention should be paid to avoid exceeding these limits. (Note: the WLL "Working Load Limit" marked on many products is 1/5 of the breaking strength of the part.) The safety factor of 5 is standard throughout much of the rigging industry. Examples:

- A Griphoist® machine that produces 2000 pounds of tension needs an anchor sling rated at 2000 pounds WLL (breaking strength of 10,000 pounds)
- A 4000 pound WLL snatch block (breaking strength of 20,000 pounds) is certainly OK for lifting a 500 pound boulder.

Griphoist powered rigging systems can help trail crews move rock, wood, and other materials to work sites, up steep slopes, and across many barriers. They are tools that can empower people of many ages and abilities to do impressive things. It is important for those who work these machines to be attentive to safe work principles. It pays to learn as much as we can about safe ways to use this equipment. As with many endeavors in life - ***knowledge is safety.***

Drawings by Julian Wiggins

CHAIN

CHAIN for rough service - dragging and lifting freshly cut stone • many applications with heavy equipment •

CAMPBELL® GRADE 3 CHAIN
General purpose chain • frequently used for tow chains, binding chains, and logging chains • available in self colored (SC) or Hot Galvanized (HG) • sized according to diameter of steel wire used to forge each link.
#5/16PC 5/16" SC • WLL = 1,900 lb. • 10 ft. weighs 8.3 lb.
#5/16PC GALV 5/16" HG • WLL = 1,900 lb. • 10 ft. 8.3 lb.
#3/8PC 3/8" SC • WLL = 2,650 lb. • 10 ft. weighs 14.2 lb.
#3/8PC GALV 3/8" HG • WLL = 2,650 lb. • 10 ft. 14.2 lb.

CAMPBELL® GRADE 10 ALLOY CHAIN
Specifically recommended for overhead lifting • alloy steel • heat treated • shot peened finish • high strength to weight ratio • smaller chain can be used when equipment will be backpacked to remote sites.

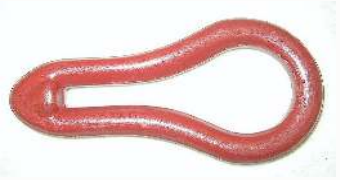
#3/8A-10 3/8" • WLL = 7,100 lb. • 10 ft. weighs 14.2 lb.
#9/32 A-10 9/32" • WLL = 4,300 lb. • 10 ft. weighs 8.3 LB

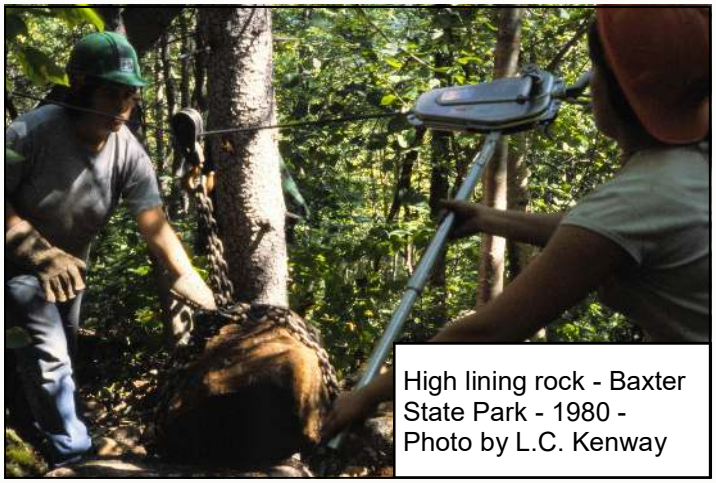
Figure 8 Wrap

CHAIN HOOKS - CARBON STEEL - CLEVIS STYLE (G3)
#440-0504 5/16" slip hook **#450-0505** 5/16" grab hook
#440-0604 3/8" slip hook **#450-0605** 3/8" grab hook

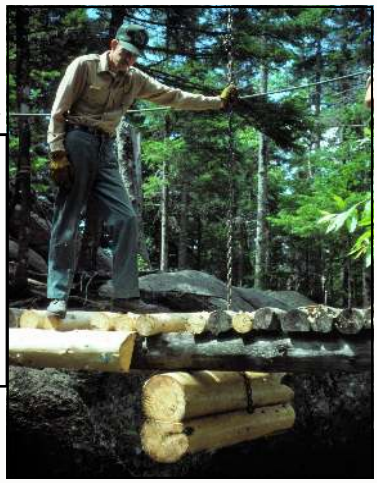
CHAIN HOOKS - ALLOY STEEL - CLEVIS STYLE (G10)
#574-6495 9/32" slip hook #572-4415" 9/32"grab hook
#440-3515 3/8" slip hook #450-3515 3/8" grab hook

DIXIE™ CHAIN SADDLE GRAB LINK
Often called a "keyhole ring", will provide a lifting ring at any point along a 3/8" chain • chain slides through the large part of





High lining rock - Baxter State Park - 1980 - Photo by L.C. Kenway



Installing Needle beam - Katahdin Falls Baxter State Park - 1985 - Photo - L.C. Kenway

PORT-A-WRAP by Buckingham Manufacturing Company

For most rigging situations, good friction systems can be built using shackles anchored to trees and boulders with lifting slings. For high load and difficult situations, we can take a page from the Arborist book and utilize Port-a wrap lowering devices. These tools are available in steel or aluminum models. The units

MINI PORT-A-WRAP, 601MN, 2 LB, 5.5" LONG, ROPE UP TO 1/2", WLL 1,000 @ 7:1, NICKEL PLATED

PORT-A-WRAP , 601L, 7 LB, 9" LONG, ROPE UP TO 3/4", WLL 2,000 LB @ 6:1, POWDER COATED

PORT-A-WRAP, 601, 4 LB, 7.25" LONG, ROPE UP TO 5/8", WLL 2,000 @ 6:1, POWDER COATED

PORT-A-WRAP III, 601N, 4 LB, 7.25" LONG, ROPE UP TO 5/8", WLL 2,000 @ 6:1, NICKEL PLATED

PORT-A-WRAP III, 601LN, 7 LB, 9" LONG, ROPE UP TO 5/8", WLL 2,000 LB @ 6:1, NICKEL PLATED

PORT-A-WRAP, 601XN, 18 LB, 13" LONG, ROPE UP TO 7/8", WLL 6,000 LB @ 10:1,NICKEL PLATED

Grand Teton National Park

Maine Trail Crew
Photo by Jodi Dunn

Escalante, Utah

LIFTING SLINGS

LIFTALL®
NYLON WEB SLINGS

Nylon lifting slings are the anchor and lift system of choice for many trail crews. Wide "eye and eye" slings can be used to anchor Griphoist® machines to trees. Endless loops work well for cinching rocks and logs for transport. Much lighter and stronger than chain, they are much favored for packing to remote sites.

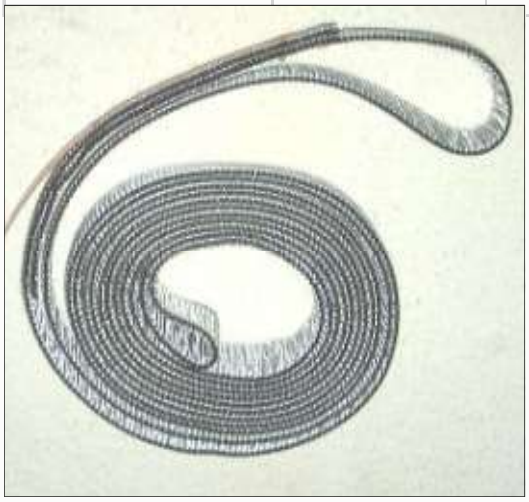
EYE & EYE WEBMASTER 1600 SLINGS			LOAD RATING IN POUNDS		
CODE	WIDTH	LENGTH	VERTICAL	CHOKER	BASKET
#EE-1-802X4T&T	2 IN	4 FT	3,200	2,500	6,400
#EE-1-802X6T&T	2 IN	6 FT	3,200	2,500	6,400
#EE-1-802X8T&T	2 IN	8 FT	3,200	2,500	6,400
#EE1-802X10T&T	2 IN	10 FT	3,200	2,500	6,400
#EE1-802X12T&T	2 IN	12 FT	3,200	2,500	6,400
#EE-1-803X4T&T	3 IN	4 FT	4,800	3,800	9,600
#EE-1-803X5T&T	3 IN	5 FT	4,800	3,800	9,600
#EE-1-803X6T&T	3 IN	6 FT	4,800	3,800	9,600
#EE-1-803X8T&T	3 IN	8 FT	4,800	3,800	9,600
#EE-1-803X10T&T	3 IN	10 FT	4,800	3,800	9,600
#EE-1-803X12T&T	3 IN	12 FT	4,800	3,800	9,600
#EE-1-803X20T&T	3 IN	20FT	4,800	3,800	9,600
#EE-1-803X30T&T	3 IN	30 FT	4,800	3,800	9,600
#EE-1-804X4T&T	4 IN	4 FT	6,400	5,000	12,800
#EE-1-804X6T&T	4 IN	6 FT	6,400	5,000	12,800
#EE-1-804X8T&T	4 IN	8 FT	6,400	5,000	12,800
#EE-1-804X10T&T	4 IN	10 FT	6,400	5,000	12,800
#EE-1-804X12T&T	4 IN	12 FT	6,400	5,000	12,800

Ready to lift a step stone, Long Pond Stream, Maine Trail Crew 2013

Multiple Boulder Anchors—Finger Lakes Trail—LCK

LIFTING SLINGS

ENDLESS LOOP SLINGS		LOAD RATING IN POUNDS			
CODE	WIDTH	LENGTH	VERTICAL	CHOKER	BASKET
EN-1-802X4	2 IN	4 FT	6,400	5,000	12,800
EN-1-802X5	2 IN	5 FT	6,400	5,000	12,800
EN-1-802X6	2 IN	6 FT	6,400	5,000	12,800
EN-1-802X7	2 IN	7 FT	6,400	5,000	12,800
EN-1-802X8	2 IN	8 FT	6,400	5,000	12,800
EN-1-802X10	2 IN	10 FT	6,400	5,000	12,800
EN-1-802X12	2 IN	12 FT	6,400	5,000	12,800
EN-1-802X20	2 IN	20 FT	6,400	5,000	12,800
EN-1-803X4	3 IN	4 FT	11,500	9,200	17,200
EN-1-803X6	3 IN	6 FT	11,500	9,200	17,200
EN-1-803X8	3 IN	8 FT	11,500	9,200	17,200
EN-1-803X12	3 IN	12 FT	11,500	9,200	17,200



3 inch wide Eye and Eye sling anchors TU-17 Griphoist on the Hunt Trail, Katahdin, Maine Trail Crew 2012 →

SAMPSON AMSTEEL BLUE HIGH STRENGTH POLYETHYLENE ROPE

12 strand single braid construction • 100% Dyneema SK-75 fiber with Samthane coating • size for size, same strength as steel • extremely low stretch • lightweight • floats • superior wear and flex fatigue • similar elastic elongation to wire rope • 1/7th the weight of wire rope ▪ can be ordered with spliced tubular steel "Blue Line" thimbles each end ▪ end terminations can also be made with "Port-a-wrap device ▪ sheave size must be 8 times diameter of line ▪ sheave groove diameter must be no less than 10% greater than rope diameter.

Diameter Inches	Weight of 100 feet Pounds	Sampson Avg Strength Pounds	Sampson Min Strength Pounds	SWL Safety Factor 5	Min Sheave Diameter Inches	Min Groove Diameter Inches
5/16	2.7	13,700	12,300	2,740	3	3/8
3/8	3.6	19,600	17,600	3,920	3	1/2
7/16	4.2	23,900	21,500	4,780	4-1/2	1/2
1/2	6.4	34,000	30,600	6,800	4-1/2	5/8
9/16	7.9	40,500	36,500	8,100	4-1/2	5/8

Sheave and Groove Diameters are translated into standard block sizes

LIFTING SLINGS

BOULDER SLINGS

For lifting or lowering boulders in steep or difficult terrain • good for dragging rocks in water • effective for lifting smooth, round or pyramid shaped rocks, sometimes 4 or 5 at a time • sewn from WEBMASTER® 1600 nylon •

#B1 18" x 9 ft. 2" web with steel oval rings • tie straps at 10" spacing • WLL 12,000 lb.
#B2 18" x 9 ft. 2" web • tie straps at 10" spacing • WLL 12,800 lb.
#B3 18" x 9 ft. 1" web • tie straps at 10" spacing • WLL 6,400 lb.
#B4 9" x 8 ft. 2" web • tie straps at 9" spacing • WLL 12,800 lb.
#B5 9" x 6 ft. 2" web • tie straps at 9" spacing • WLL 12,800 lb.
#B6 9" x 6 ft. 1" web • tie straps at 9" spacing • WLL 6,400 lb.

B6 BOULDER SLING

4 boulders in a B4 custom sling.

HAND CARRY SLINGS

Net style sling can be carried by 2 to 8 people • available in 3 ft, 4 ft. and 5-1/2 ft sizes. • can also be lifted by a highline • good for short distances or where a highline would not be worth the effort • SWL 5,000 lb.

#B7 5-1/2 ft x 5-1/2 ft x 2" hand carry sling
#B8 3 ft x 3 ft x 2" hand carry sling
#B9 4 ft x 4 ft x 2" hand carry sling

B9 Hand Carry Sling in use, Rainbow Deadwater Maine - Photo by Hilary Dees – 2 014

TUFLEX POLYESTER ROUNDSLINGS

Endless loop slings • continuous loop of polyester yarns surrounded by a cordura nylon jacket • high strength with low weight • no loss of strength from abrasion to cover • low stretch (about 3% at rated

TUFLEX ENDLESS ROUNDSLINGS				CAPACITY - LBS.	
ITEM NO	COLOR	DIAM	VERTICAL	CHOKER	BASKET
EN30 X 4 FT	PURPLE	5/8"	2600	2100	5200
EN30 X 6 FT	PURPLE	5/8"	2600	2100	5200
EN30 X 8 FT	PURPLE	5/8"	2600	2100	5200
EN30 X 10 FT	PURPLE	5/8"	2600	2100	5200
EN60 X 4 FT	GREEN	7/8"	5300	4200	10600
EN60 X 6 FT	GREEN	7/8"	5300	4200	10600
EN60 X 8 FT	GREEN	7/8"	5300	4200	10600
EN60 X 10 FT	GREEN	7/8"	5300	4200	10600
EN90 X 6 FT	YELLOW	1-1/8"	8400	6700	16800
EN90 X 8 FT	YELLOW	1-1/8"	8400	6700	16800
EN90 X 10 FT	YELLOW	1-1/8"	8400	6700	16800

HAND TOOLS

AMES/TRUE TEMPER® SHOVELS - Parkersburg West Virginia and Camp Hill Pennsylvania since 1774

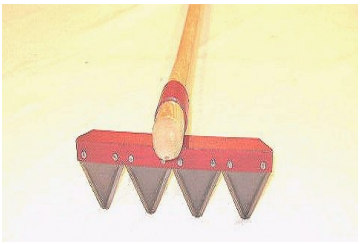
ROUND POINT SHOVELS
#12-375 "Forest Fire" beveled edge, 41" handle • 4 lb.
#13-096 "Kodiak" 30" Armor D-handle • 5 lb.
#SFGDR "Stinger" 24" D wood/plastic handle • 4 lb.
#13-300 "Viper" 47" Fiberglass handle • 5 lb.
#15-583 "Kodiak" 48" Fiberglass handle • 5.5 lb.
#15-740 "Landscaper" 48" ash handle • 4 lb.
#19-411 "Ideal" with 48" ash hanadle • 4 lb.

COUNCIL TOOLS - Lake Waccamaw, North Carolina. Forged tools made in America since 1886

#MT48 McCLEOD FIRE TOOL
9"x9-1/4" blade • 6 teeth • 48" handle • Classic fire line tool • moves gravel, grades soil and slopes, tamps fill.

#20-374 MCLEOD HANDLE - WOOD ONLY

#LW12-60 FIRE RAKE
Four "mowing machine" teeth on a 12" blade • 60" handle • wide teeth will not plug up with leaves • aggressive tool good for clearing duff and soil.



PINCH POINT CROWBARS
The tool of choice for prying and levering rock • chisel shape tip provides leverage in small places • very little flex under heavy load • made in USA.
#120PP - 1-1/8" x 51" 12 lb. crowbar

#180PP - 1-1/4" x 60" 18 lb. crowbar

WARWOOD TOOLS - Wheeling, West Virginia, Forged Steel Tools since 1854

#00061 FOREST ADZE HOE
Also called a hazel hoe • 6-1/4" blade • 4-3/4 lb. head • 34" hickory handle • square eye

MATTOCKS
Several USA tool makers have stopped producing 5 lb pick mattocks. The search continues to find a quality replacement.

#11-435 Fiberglass Mattock Handle (By Ames)
PAH1 - Ash handle for 5 lb. mattocks (by Peavey)

CROWBARS
Warwood crowbars are high quality, and robust.
#16070 18 lb. Pinch Point Crowbar
#16080 22 lb. Pinch Point Crowbar
#16090 26 lb. Pinch Point Crowbar

HAND TOOLS

BAHCO TOOLS South Yorkshire, S66 1YY, United Kingdom since 1862

BOW SAWS

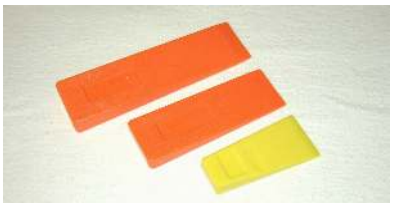
Strong tubular frame keeps high tension on blade • quality steel blades • hand guard • 5 sizes.
#331 21" bow saw with pointed nose - 1.4 lb
#9-21 21" bow saw - 1.4 lb.
#9-24 24" bow saw - 1.6 lb.
#9-30 30" bow saw - 1.8 lb.
#9-36 36" bow saw - 2.1 lb.

Replacement blades are available

PLASTIC WEDGES

High impact plastic • slender ramp at tip • very helpful for directional felling or bucking large logs • 3 sizes.

#1055 - 5-1/2" wedge • 0.3 lb.
#1080 - 8" wedge • 0.5 lb.
#1100 - 10" wedge • 0.7 lb.



#PG-72 FOLDING SAW

7-1/2" teflon coated blade locks in open and closed positions • light and easy to use • can be

LOPPERS

#P16-50-F 1-1/4" capacity • 20 inch handle • 33 oz • bypass loppers

#P16-60-F 1-1/4" capacity • 24 inch handle • 36 oz • bypass loppers

#P19-80-F 2" capacity • 31-1/2 inch chrome handle • 63 oz • bypass loppers

#P116- capacity chrome ▪ bypass

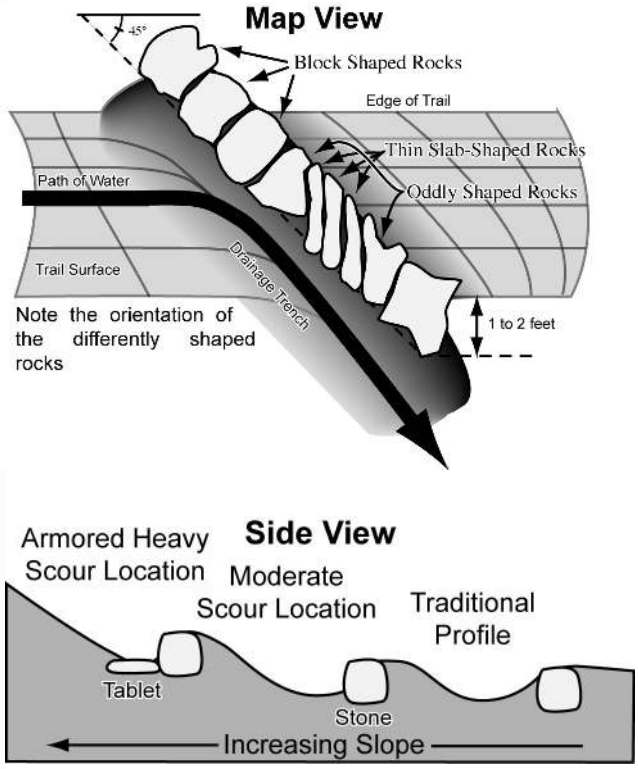
SL- 40 1-1/4" ▪ 15-3/4 inch handle ▪ 24 oz loppers

#P116- 1/4" capacity 19-3/4 chrome 26 oz ▪ bypass loppers

SL- 50 1- inch handle ▪

THE DIAGONAL STACK WATERBAR

With New England's high rainfall and historically steep trails (sometimes 45% slope) our trail crews spend a significant portion of their time installing drainage on existing trails. While at Baxter State Park in the early nineties, Lester Kenway developed this diagonal stack technique of building rock waterbars. It is easy to teach to new staff or volunteers, it allows for fast construction using any rock with two parallel flat faces, and results in a solid product able to withstand heavy scouring.



Drainage structures should be built when the grade of trail is greater than 10% slope or when there is evidence of erosion. As shown in the side view figure, the greater the slope, the more resistant to scouring the structure must be.

Traditionally waterbars are constructed using either long thin slabs (toast) or thick rectangular blocks (cake). The diagonal stack technique allows both to be used in the same waterbar. As shown in the map view figure even oddly shaped pieces may be used.

Directions for construction:

1st: Choose the location for the waterbar. An area where the water will quickly flow away from the trail is desirable.

2nd: Mark the location of the waterbar trench. It should be at least a 45 deg angle to the trail.

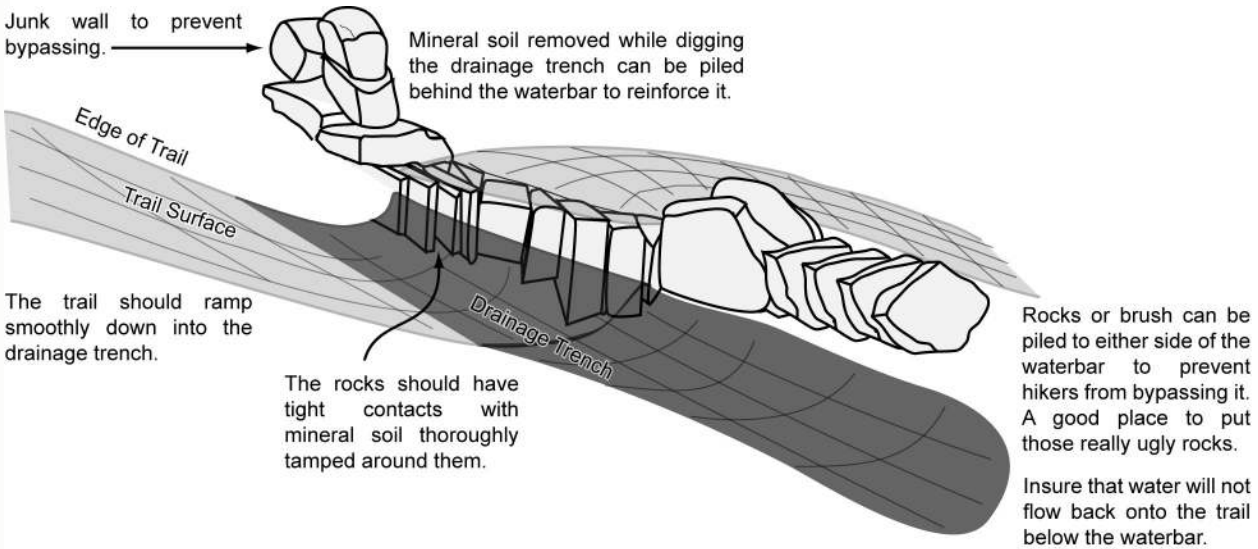
3rd: Quarry the rocks.

4th: Dig a trench for the rocks just down slope from the location of the drainage trench. A trench solely for setting the rocks should be dug and filled with the rocks before the drainage trench for the water is shaped. The trench should be deep enough to allow the rocks to be set completely below grade. The top of the rocks should be level with the trail surface on the down slope side.

5th: Set the rocks so that they have tight contacts. Tamp the soil thoroughly to create a watertight seal around the rocks. The rocks in a waterbar only prevent scouring; the soil is the watertight seal.

6th: Dig the drainage trench in front of the rocks insuring adequate drainage directing water away from the trail.

This article was written and illustrated



by Julian Wiggins
julianwiggins@gmail.com

WOODS TOOLS

SNOW & NEALLEY AXES
Quality steel that will take and keep an edge • a good choice for those areas where the power tools must be left behind • beautifully made, and a pleasure to use. Each axe is provided with a full grain leather sheath.

#012S "Our Best" Single Bit 1-3/4" lb. axe ▪ 24" handle ▪ leather guard

#016S "Our Best" Single Bit 2-1/4 lb. axe • 28" handle • leather guard

#026S "Our Best" Single Bit 3-1/2 lb. axe • 30" handle • leather guard

COUNCIL TOOLS - AXES

#38PE36 PULASKI
3.75 lb. head • 36" straight handle • Classic fire line tool and favored for trail work.
#70-013 Replacement wood handle for Pulaski

#35-2MR MICHIGAN DOUBLE BIT AXE
3.5 lb. head • 36" straight handle •

#38PE136FG PULASKI W/ FIBERGLASS HANDLE
3.75 lb head • 36" straight fiberglass handle.

#40DR36S 4 lb. DAYTON AXE

4 lb. single bit axe with 36" straight handle • good for pounding felling wedges ▪ works plumbing leans as well.

Elevated bog bridge, Appalachian Trail, Monson, Maine— photo by MATC—2014

PEAVEY MANUFACTURING CO. LOGGING TOOLS
EAST EDDINGTON, MAINE

Peavey Mfg. has been catering to the needs of people working with wood ever since Joseph Peavey conceived of the original "Peavey" that he developed in 1857 for driving logs on the Penobscot River.

BANGOR PEAVEY - One piece forged steel socket and pick fitted with a hardwood handle and Duck Bill hook • particularly helpful for rolling, turning, prying, and positioning logs used in rustic bridge or log home construction.

#0011 4 ft. handle - 7.0 lb.
#0018 4-1/2 ft. handle - 7.5 lb.
#0019 5 ft. handle - 6.0 lb.

STANDARD PEAVEY - Forged steel socket and driven pick with hardwood handle and Duck Bill hook.

#0122 4 ft. handle - 7.0 lb.
#0123 4-1/2 ft. handle - 7.5 lb.
#0124 5 ft. Handle - 8.0 lb.
#0125 5-1/2 ft. handle - 8.5 lb.

SWIVEL TIMBER CARRIER - Allows 2 or more people to share the load in a comfortable standing position.

#0421 4 ft. handle - 6.5 lb.
#0422 4-1/2 ft. handle - 7.0 lb.
#0423 5 ft. Handle- 7.5 lb.

BARK SPUD - The easier way to peel bark - when the sap is running • 18” handle • 1.5 lb.
#018SPUD

PULP HOOKS - For handling pulp & boltwood • provides a portable handle when moving logs or timbers.

#0606 Favorite 606 - 1.4 lb.
#0601 International - 1.3 lb.
#0608 Canadian pattern - 1.8 lb.
#0609 12 in. Bentley - 1.8 lb.
#0610 Canadian w/ replaceable tip - 1.8 lb.
#0611 Replaceable tip

DRAW SHAVES
For cutting off bark and shaping wood pieces

#10-DS10 10” Drawshave - 2 lb.
#13-DS10 13” Drawshave - 2.5 lb.
#16-DS10 16” Drawshave - 3.0 lb.

SHINGLE FRO Heavy steel blade with in-line handle is designed for splitting wood into shakes or other thin pieces.
#FRO - 3 lb.

COBRA COMBI

COBRA COMBI TOOLS.

3083-3228-00	14" UC MOIL POINT
3083-3229-00	19" UC MOIL POINT
3083-3231-00	1-3/4 X 9-1/2" UC NARROW CHISEL
3083-3230-00	1-3/4" x 14" UC NARROW CHISEL
3083-4071-00	1-3/4" X 18" UC NARROW CHISEL
3083-4072-00	3" X 11" UC WIDE CHISEL
3083-3232-00	3" x 15" UC WIDE CHISEL
3083-3233-00	3" X 14" UC DIGGING CHISEL
3083-3234-00	4-3/4" X 11" UC DIGGING SPADE
3083-3235-00	5" X 13" UC CLAY SPADE
9245-2812-90	5" X 18" UC ASPHALT CUTTER

DETACHABLE H-THREAD BITS

3083 4223 00	1-3/8" DETACHABLE BIT 'H' THREAD
3083 4223 10	1-1/2" DETACHABLE BIT 'H' THREAD
3083 4223 20	1-5/8" DETACHABLE BIT 'H' THREAD
3083 4223 30	1-3/4" DETACHABLE BIT 'H' THREAD
3083 4223 40	1-7/8" DETACHABLE BIT 'H' THREAD

H-THREAD RODS

3083 4220 00	12" UC DRILL ROD H THREAD
3083 4220 10	18" UC DRILL ROD H THREAD
3083 4220 20	24" UC DRILL ROD H THREAD
3083 4220 30	30" UC DRILL ROD H THREAD
3083 4220 40	36" UC DRILL ROD H-THREAD

Lifting blocks of granite drilled with Cobra Combi and then cut with feathers and wedges - Hunt Trail - Katahdin

COBRA COMBI

Drill/ Breaker similar to the Pionjar 120 • cleaner emissions, less noise and lower vibrations • 50:1 gas/oil mix • 55 lb. • **uses same tools as Pionjar** • 2600 BPM • Maximum drilling depth of 6.5 ft. • Drills 12 in/min with 1-3/8" bit in granite.
#8318 0800 03 COBRA COMBI GAS POWERED DRILL/BREAKER

BRUNNER AND LAY SRINGDALE ARKANSAS SINCE 1882.
DIGGING AND BREAKING TOOLS
7/8" X 4-1/4" HEX SHANKS FOR COBRA COMBI

A01014	14" UC MOIL POINT
A01018	18" UC MOIL POINT
A02014	14" UC NARROW CHISEL
A02018	18" UC NARROW CHISEL
A03014	14" UC 2-1/2" DIGGING CHISEL
A03018	18" UC 2-1/2" DIGGING CHISEL
B00300	14" UC CLAY SPADE
B00500	11" UC 5" ASPHALT CUTTER

CARBIDE TIPPED DRILL BITS

TAMCO DRILL STEELS (H-THREAD)
7/8" X 4-1/4" HEX FOR PIONJAR AND COBRA COMBI drill steels with H-thread connection for detachable drill bits • lengths 1ft. to 6 ft.

#44-01450H	12" HOLLOW DRILL STEEL, H-THREAD
#44-01451H	18" HOLLOW DRILL STEEL, H-THREAD
#44-01452H	24" HOLLOW DRILL STEEL, H-THREAD
#44-01455H	30" HOLLOW DRILL STEEL, H-THREAD
#44-01452H	36" HOLLOW DRILL STEEL, H-THREAD

TAMCO CARBIDE INTEGRAL DRILLS 7/8" X 4-1/4" HEX FOR PIONJAR AND COBRA COMBI

One piece drills ▪ single carbide cutting edge ▪ shank is sized for hex chuck in Pionjar or Cobra Combi gas powered drills

TAMCO CARBIDE BITS (H-THREAD)
Cross pattern 4-cutter threaded bits • economical, only bit needs to be retired when worn out.

#HTI-137H	1-3/8" (35MM) H-THREAD MULTI-USE BIT
#HTI-150H	1-1/2" (38MM) H-THREAD MULTI-USE BIT
#HTI-162H	1-5/8" (41MM) H-THREAD MULTI-USE BIT
#HTI-175H	1-3/4" (45MM) H-THREAD MULTI-USE BIT
#HTI-187H	1-7/8" (48MM) H-THREAD MULTI-USE BIT
#HTI-200H	2" (51MM) H-THREAD MULTI-USE BIT
#HTI-225H	2-1/4" (57MM) H-THREAD MULTI-USE BIT
#HTI-250H	2-1/2" (64MM) H-THREAD MULTI-USE BIT
#HTI-275H	2-3/4" (70MM) H-THREAD MULTI-USE BIT
#HTI-300H	3" (76MM) H-THREAD MULTI-USE BIT

Item No.	Diam/Length	Item No.	Diam/Length	Item No.	Diam/Length
44-01935	5/8"/ 12" UC	44-01940	1"/ 12" UC	44-01945	1-1/4"/ 18" UC
44-01948	5/8"/ 18" UC	44-01941	1"/ 18" UC	44-01954	1-1/4"/ 24" UC
44-01950	5/8"/ 24" UC	44-01942	1"/ 24" UC	44-019541	1-1/4"/ 30" UC
44-01936	3/4"/ 12" UC	44-01921	1"/ 30" UC	44-01955	1-3/8"/ 12" UC
44-01937	3/4"/ 18" UC	44-01943	1-1/8"/ 12" UC	44-01947	1-3/8"/ 18" UC
44-01951	3/4"/ 24" UC	44-01944	1-1/8"/ 18" UC	44-01956	1-3/8"/ 24" UC
44-01961	3/4"/ 30" UC	44-01946	1-1/8"/ 24" UC	44-019561	1-3/8"/ 30" UC
44-01938	7/8"/ 12" UC	44-019461	1-1/8"/ 30" UC	44-01957	1-1/2"/ 12" UC
44-01939	7/8"/ 18" UC	44-01953	1-1/4"/ 12" UC	44-01958	1-1/2"/ 18" UC
44-01952	7/8"/ 24" UC			44-01959	1-1/2"/ 24" UC
44-01949	7/8"/ 30" UC			44-019591	1-1/2"/ 30" UC

Integral Drill

GAS POWERED ROTARY HAMMER DRILL

GAS POWERED ROTARY HAMMER DRILL

DD118N Gas Powered Hammer Drill
2 stroke 22 cc motor • 30:1 mix • 4400 blows per minute • 800 revolutions per minute • maximum drill size 30 mm (1-1/8in) • weighs 12-3/4 lb. • uses SDS-Plus drill bits • high speed impacts allows for rapid drilling progress • gas power and light weight for excellent portability • made in China

Lake Tahoe Basin Trail Crew cuts granite boulder on the Tahoe Rim Trail—2009—LC Kenway

Monhegan Associates Trail Crew—Monhegan Island, Maine

Building Stone Steps at Pebble Beach

November 2015

Photo by LC Kenway

Hand Drilling Rock - by Lester C. Kenway
The art and science of hand drilling stone all but disappeared with the introduction of pneumatic drills during the early part of the Twentieth Century.

Hand drilling tools and technique
1. The hand drilling tool is called a **"*star drill* "** which gets it's name from the cross pattern made by the two intersecting cutting edges of the drill. Each time the drill is struck by a hammer, the cutting edge pulverizes a small amount of stone. A hole is formed as this process is repeated many times.

2. With one person, the process is called single jacking. The hammer weighs 3 or 4 pounds, and has a short (10 inch long) handle. The worker either kneels or sits facing the drill, and rotates it about 1/8 turn after each blow. Starting (or collaring) a hole takes care and skill. Once a hole is started in the rock, the process becomes more routine.

Note: Double jacking, where two people hammer a drill bit held by another, using 6 or 8 pound hammers, was a common practice in earlier times, but requires a greater level of skill and trust, and is generally recommended for more experienced workers.

3. As the hole is drilled, it is necessary to remove the stone dust from the hole. If the dust is allowed to accumulate, it will eventually jam the star drill, and prevent it from being turned. For shallow holes, a squeeze bulb syringe (turkey baster) or a section of 1/4" diameter rubber hose can be used to blow dust out of the hole. In deeper holes, the dust can be spooned out with a steel feather from a wedge set, or a home made slender metal or plastic scoop made for the purpose. As the holes get deeper, water can be added to the hole to allow the dust to stick to the spoons.

4. Holes deeper than 12", are often made with a series of drill steels. star drills are typically available in 12", 18", 24", etc. lengths, and can be used in sequence to drill deeper holes. Since the diameter of the drills is worn down during the drilling process, it is often advisable to either grind the external radius of the longer drill bits smaller than the shorter drills, or use a drill 1/8" smaller for the following bit to avoid the bit becoming jammed in the hole.

5. The process of drilling rock with tempered steel bits involves periodic sharpening of the drills. It is wise to have several star drills on hand so that bits can be sharpened while drilling work continues. Bits can be sharpened with coarse files in the field, or on a bench grinder back at the shop. Repeated sharpenings will remove the outer layer of high temper steel. This will become apparent when the drills begin to loose their edge quickly after being sharpened. A competent blacksmith can re-temper the drills and extend their useful life.

Refer to the USDA Forest Service *Hand Drilling and Breaking Rock for Wilderness Trail Maintenance* by Mrkich and Oltman 1984 for further information.

Hand drilling granite with Tamco Star Drills. Pacific Crest Trail Association Workshop, Truckee CA, 2009 - Photo by LC Kenway

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STONE CUTTING

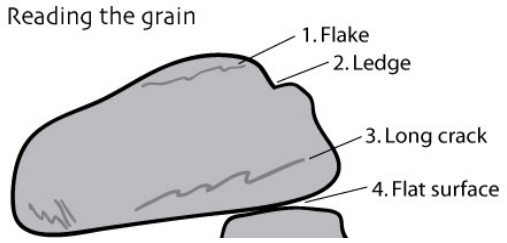
Lessons from Coastal Maine Granite Quarries
by Lester C. Kenway

The Maine coast was home to a flourishing granite industry throughout the 1800's and well into the first half of the 20th century. High quality gray granite, was found in numerous locations along the coast. Stone was shipped to eastern cities, used in the construction of buildings, sidewalks and streets.

The demand for granite products was all but eliminated by the move to reinforced concrete architecture after World War II. Almost all of the Maine quarries are now closed, with a handful of craftsman keeping the knowledge of these techniques alive.

Acadia National Park is engaged in a long term program dedicated to preserving historic stonework throughout its Trail system. This project seeks to duplicate high standard stone trail work completed by stone masons and CCC crews during the early 20th century. A summary of these methods follows:

1.Read the grain. This refers to discovering the 3 primary directions of likely breakage in granite by assessing evidence shown in the shape and surface of the stone. These directions were sometimes referred to as "The Lift" (a plane parallel to the surface of the earth), "The Drift" (a plane

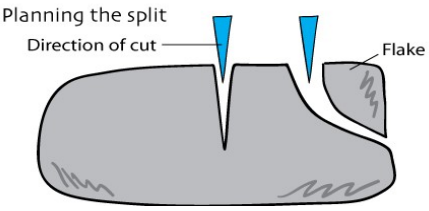


perpendicular to the Lift), and "The Hard Way " (a plane at right angles to both the Lift and the Drift). Finding these directions when stone is in place is quite straightforward. Boulders are more difficult.

Evidence:

- Flakes on the surface of a rock often run parallel a splitting plane.
- Small ledges may indicate one of the planes
- Long cracks may indicate one of the planes
- The largest flat surface on the boulder is likely to be either parallel or perpendicular to one of the planes. If a boulder is very rounded, evidence will be hard to find.

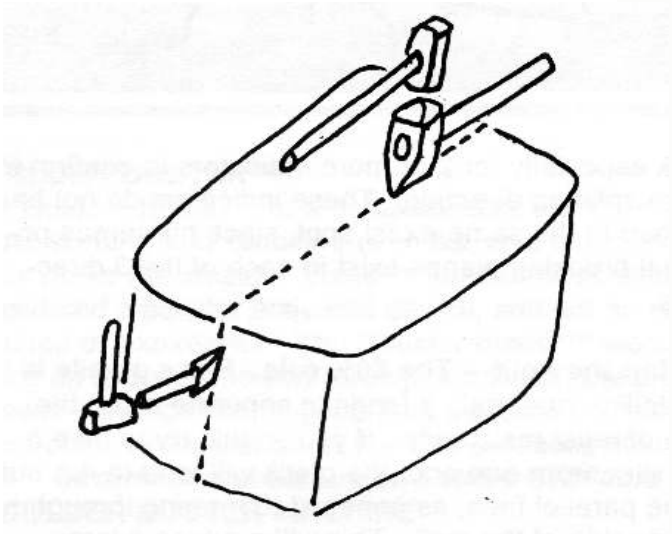
Look especially for 2 or more indicators to confirm the same splitting direction. These indicators do not have to point to the same exact spot, since



numerous potential breaking planes exist in each of the 3 directions.

2.Plan the split - The 50% rule. Since granite is a crystalline material, it tends to separate along the path of least resistance. If you should try to take a thin slice from one end, the crack will tend to run out to the parallel face, as opposed to running through to the far side of the rock. This will produce a large unattractive "spalled" surface on the rock, and a worthless curved flake. The safest strategy is to cut each stone into halves. These halves can then be cut in half again, until stones of usable size are produced.

3. Score the line. Once the direction of split has been chosen, It is marked on the stone with crayon or chalk. Scoring means repeatedly striking along the line with a bevel edge tool to send shocks through the crystalline stone, weakening the stone along the chosen plane. This increases the



likelihood of a successful split, and reduces the amount of force that needs to be applied to part the stone. Small stones can be cut without using

4. Drill holes for wedges These holes can be drilled by hand with star drills (if you work in a wilderness area) or with various gas, electric or air powered drills that are available. The holes need to be spaced evenly along the score line, and drilled in the same plane as has been defined by the scoring. Experience with the size and type of stone will determine optimum spacing for wedges. Typical spacing for smaller sets (3/4" - 1") would be 4" to 6" apart, while spacing for large sets (1-1/4" to 1-3/8") would be 8" to 12" apart. The more sets of wedges used in a split, the more pushing power available to separate the stone.

♦Holes should be drilled as deep as the straight part of the shim or feather. Shallow holes will result in the feathers being bent by the wedge (or plug).

♦If holes are drilled deeper than the shim, the wedge can drive the shims down into the hole and straighten out the top of the shim.

♦Feathers can be used to spoon stone dust out of holes, and to check the depth of the hole. Do not use a wedge to check hole depth, since it will be difficult to get it out of a hole if you drop it in.

5. Place feathers and wedges and split stone

♦All wedge sets are placed in the holes oriented so they all push together in the same plane in order to push the halves of stone apart.

♦Wedges are driven until they are "loaded". This is indicated by each wedge emitting a tone or ringing sound. When all wedges are loaded, the stone is allowed to react to the pressure for 1 to 3 minutes.

♦ Wedges are driven equally, a little bit at a time. The sound of the tone of each wedge, when it is struck, can indicate the relative tightness of each wedge. If the wedges seem to be going hard, more scoring can be done between the wedges.

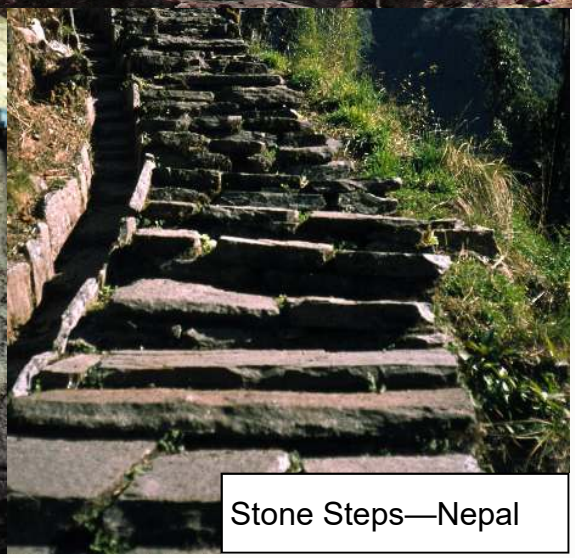
♦Eventually, a crack will show along the scored line.

At this point, drive only one wedge, so other wedges can be retrieved. You can then drive a lone wedge into the crack and retrieve the remaining wedge set. The two halves of stone can

Chimney Pond Trail—Katahdin

Adam Gilbert of Townsend Vermont

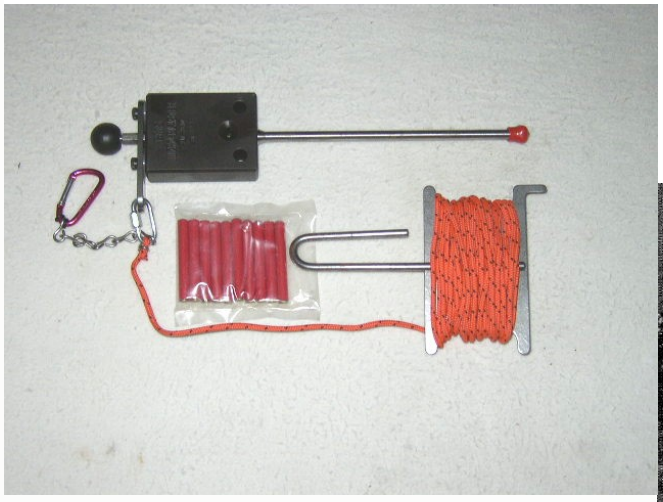
Hunt Trail—Katahdin



Stone Steps—Nepal

ROCK BREAKING

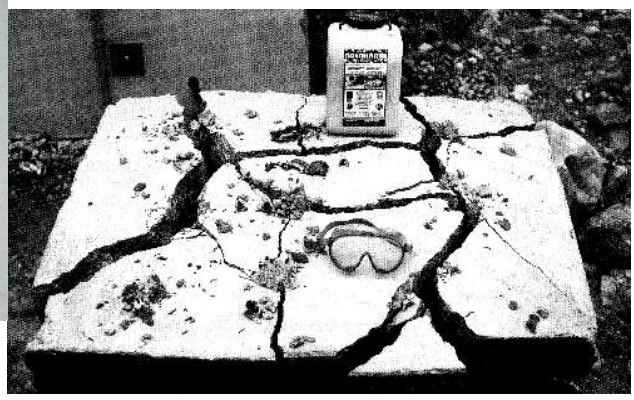
EZEBREAK MICRO BLASTER
Low energy demolition system • utilizes a gas producing cartridge to crack rock and masonry • operated remotely with a 25 foot pull cord • requires a 5/16 inch diameter hole, 9 inches deep • packaged in plastic case (13.5”x10”x3.5”) • Micro-Blaster comes complete with hole blower, bull pins (for wedging apart cracked rock), and release cord • loads shipped separately.



BMS MICRO BLASTER II
New version of Micro Blaster where compressed air (or CO2) and plastic tubing replaces the pull cord.

BMS MICRO BLASTER III - TRIPLE UNIT
New version of Micro Blaster allows multiple charges to be triggered simultaneously with great effect • a tank of compressed air works well at remote sites.

BETONAMIT (beh-tah-na-mite)
A non - explosive cracking agent • non-toxic powder is mixed with water and poured into holes of 1-1/4”, 1-3/8” or 1-1/2” • mix hardens and expands, exerting pressures of 12,000 PSI • reinforced concrete, boulders, and ledge are fractured overnight with no noise, vibration or flyrock • no licenses or permits needed • three year shelf life • one product for all temperatures • putty type for horizontal holes or holes with water seeping in • instruction book
#TYPE R liquid (11 lb. mix)
#TYPE S putty additive (4 oz.)
#THERMOMETER 25 to 125 deg thermometer that will fit down a 1” hole.



Microblaster III demonstration with Carrol Bassett at Dupont State Forest, North Carolina with Professional Trail Builders, 2012, photo by LC Kenway.

STONE TOOLS

Trail crews who work in stone are among the few who still utilize stone cutting tools. While over-reliance on shaping tools can slow down work, there are times when the right tools greatly speed up the process. Pre-scoring stone prior to drilling can greatly reduce the size of the drill holes and wedges that will be needed to cut the stone. Various tools

HAND CHISEL: (carbide tipped) is used to chisel high spots on a stone • trace lines, chip off the edges of drill holes • 3/4" to 1" wide**.**

HAND POINT: (carbide) is used to take off high spots, or to shape a stone • blows are focused to a point • sizes 3/4" to 1"

HAND SET: (carbide) is used to remove material parallel to the edge of a flat stone • flat faced blade is placed on the stone and slightly angled back before striking. Can be used to trim drill holes • The carbide should **never** be used to cut stone • must be placed against relatively smooth stone or the carbide may fracture • carbide edges up to 4" wide • The tool stem (1"

HAND TRACER: (carbide) is used to score a line on a stone • Tracers are similar to hand chisels, except the blades are much wider • The blade is placed in position and struck with a hand hammer • tracing back and forth will cause smaller stones to split along the line • tracers are also used to mark a line that holes will be drilled into • Tracers are helpful for scoring vertical sides of boulders where ***rifting hammers*** are difficult to use • carbide edges up to 4" wide • 1" or 1-1/8"

CUTTER'S HAND HAMMER: Is used to strike hand tools or wedges and shims • Hammers are hardened for longer wear • sizes from 2 lb. to 4 lb.

COMFORT GRIP HAND CHISEL

COMFORT GRIP HAND POINT .

COMFORT GRIP HAND TRACER

Comfort Grip tools serve the same purpose as the standard stone tools. They have a larger diameter stem with a smooth scalloped surface for an easier grip. The stem is a nominal 1-3/8" diameter

STONE BUSTER: Used 3 different ways • strike stone cutting tools with flat face • strike with another hammer to deliver a precise blow to the stone • swing carbide edge to trim or shape stone • vertical or horizontal carbide edge

HAMMER SET: Similar in application to the hand set • tool hand is away from the stiking point • position tool on stone and then strike with hand hammer • vertical or horizontal carbide edge

STONE TOOLS

RIFTERS OR SLAB SPLITTERS: are used to score lines on stone. Tracing back and forth by patient workers will usually cause the stone to split along the scored line. The Rifter is held by its handle by one person while another person strikes its head with a hammer of equal weight. When cutting large stones, pre-scoring greatly reduces the size wedges needed, and increases the chance a of large straight successful split. Tempered steel edge. Tool is **not** designed to be swung like an axe. Available in weights of 6 to 12 lb.

BULL SET: is used to trim stone parallel to the edge of a stone. The tool has a broad flat edge, designed to drive the impact deep into the stone. The Bull set is designed to be held by its handle by one person while its head is struck by another person with a striking hammer of equal weight. Available both in tempered steel or carbide edge in weights of 8 to 12 lb.

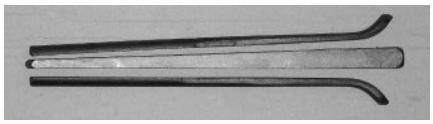
MASON (MASH) HAMMER: Is used to break stone off the edge of a large stone with the flat face. The blade is used to break up stone into smaller pieces by swinging like an axe. Good tool for making crush/fill, and for breaking off rocks protruding from the trail surface. Available in weights of 3 to 16 lb.

CARBIDE HAMMER POINT: For fast and easy roughing out stone. Good for removing high spots. Hammer can be swung or struck with another hammer while keeping your hand away from the action. Fiberglass handle included.

STONE SPLITTING WEDGES AND SHIMS

Available in a variety of sizes. With good stone, careful scoring, and good technique, wedges can split stone as thick as 6 to 10 times their own length.

ITEM NUMBER	HOLE SIZE
1/2 WS SET	1/2 IN X 2-5/8 IN
5/8 WS SET	5/8 IN X 2-3/4 IN
3/4 WS SET	3/4 IN X 4 IN
7/8 WS SET	7/8 IN X 5 IN
1-1.25 WS SET	1 IN X 6 IN
1.25-1.50 WS SET	1-1/4 IN X 8 IN
1.50-1.75 - WS SET	1-3/8 IN X 12 IN



Block of Andesite cut with Rifting Hammer. Pacific Crest Trail Association workshop, Cascade Locks Or. 2009

BULL SET

BULL SET: Is used to trim the side of a stone. The tool has a broad flat edge. Instead of dividing the stone, it shears a layer off the edge. One of it's best uses is to shear off drill holes after the stone has been cut using feathers and wedges. With a few strokes between each drill hole a flat section of stone is broken away, leaving a textured surface. This operation takes only a few minutes. The Bull Set is held by its handle on the stone by one person. The tool is tipped slightly so as to use one edge at a time. A second person swings a striking hammer onto the Bull Set. The striking hammer must of equal or heavier than the Bull Set in order avoid shattering the hammer face. (creating high velocity shrapnel). Available both in steel or carbide edge in weights

RIFTING HAMMER

RIFTERS OR SLAB SPLITTERS: Are used to score lines or to cut thinner stone without drilling. The tool was originally used to cut sections of granite curb stones (about 6" thick to length. Tracing back and forth by patient workers will usually cause the stone to split along the scored line. The Rifter is held by its handle by one person while another person strikes its head with a striking hammer of equal or greater weight. When cutting large stones, pre-scoring greatly reduces the size of wedges needed, and increases the chance a of large straight split. Tempered steel edge. Tool is ***not*** designed to be swung like a wood splitting maul. Available both in carbide or steel edge in weights of

MASON'S AND SPALLING HAMMERS

WARWOOD TOOLS - Wheeling West, Virginia

MASON'S HAMMERS
Beveled striking face on one side • flat face on other side • designed for cutting and shaping stone • pein end intended for making score lines in stone and masonry • not for striking stone tools • specify wood, fiberglass or no handle.
#12810 3 lb Mason Hammer
#12820 4 lb Mason Hammer

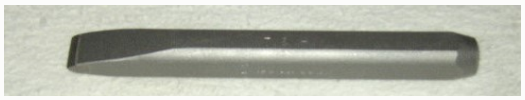
SPALLING HAMMER
Beveled striking face on one side • crowned oval face on other side • pein end intended for making score lines in stone and masonry • specify wood, fiberglass or no handle.
#12010 4 lb Spalling Hammer

STONE TOOLS

TROW & HOLDEN - BARRE, VERMONT
STONE TOOLS
Trow and Holden has been providing stoneworkers and artists with quality tools since 1893.

HAND POINTS, CARBIDE
#CHP34 - 3/4" Hand Point
#CHP78 - 7/8" Hand Point
#CHP1 - 1" Hand Point

HAND CHISELS, CARBIDE
#CHC34 - 3/4" Hand Chisel
#CHC78 - 7/8" Hand Chisel



COMFORT GRIP TOOLS, CARBIDE
#CCG138C - 1-3/8" Hand Chisel
#CCG138 - 1-3/8" Hand Point
#CCHT1182HD - 1-1/8" Hand Tracer

HAND SETS, CARBIDE
#CHS1112 - 1" x 1-1/2" Hand Set
#CHS1182 - 1-1/8" x 2" Hand Set
#CHS118214 - 1-1/8" x 2-1/4" Hand Set
#CHS118212 - 1-1/8" x 2-1/2" Hand Set
#CHS1183 - 1-1/8" x 3"

HAMMER SETS, CARBIDE
#HHS4CT/V - 4 lb.Vertical - Head only
#HHS4CT/H - 4 lb. Horizontal - Head only

HAND TRACERS, CARBIDE
#CHT1112 - 1" x 1-1/2" Hand Tracer
#CHT12 - 1" x 2" Hand Tracer
#CHT1182 - 1-1/8" x 2" Hand Tracer
#CHT118212 - 1-1/8" x 2-1/2" Hand Tracer,
#CHT1183 - 1-1/8" x 3" Hand Tracer
#CHT1184 - 1-1/8" x 4" Hand Tracer

STONE BUSTERS, CARBIDE
#HSB2CT/V - 2 lb. Vertical - Head only
#HSB2CT/H - 2 lb. Horizontal - Head only
#HSB4CT/V - 4 lb. Vertical - Head only
#HSB4CT/H - 4 lb. Horizontal - Head only

STONE TOOLS

CUTTER'S HAND HAMMERS - HEAD ONLY
#HCH2 - 2 lb.
#HCH212 - 2-1/2 lb.
#HCH3 - 3 lb.
#HCH312 - 3-1/2 lb.
#HCH4 - 4 lb.

SLAB SPLITTERS (RIFTING HAMMERS)
#HSS6 - 6 lb. - Head only
#HSS8 - 8 lb. - Head only
#HSS10 - 10 lb. - Head only
#HSS12 - 12 lb. - Head only

BULL SETS, STEEL EDGE - HEAD ONLY
#HBS10 - 10 lb. Bull Set
#HBS12 - 12 lb. Bull Set

BULL SETS, CARBIDE - HEAD ONLY
#HBS10CT - 10 lb. Bull Set
#HBS12 CT- 12 lb. Bull Set

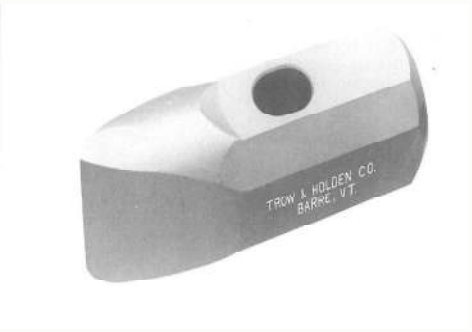
STONE MASON'S(MASH) HAMMER - HEAD ONLY
#HMH3 - 3 lb. Mash Hammer
#HMH3CT - 3 lb. Mash Hammer with carbide tip
#HMH4 - 4 lb. Mash Hammer
#HMH4CT - 4 lb. Mash Hammer with carbide tip
#HMH6 - 6 lb. Mash Hammer
#HMH8 - 8 lb. Mash Hammer
#HMH10 - 10 lb. Mash Hammer
#HMH12 - 12 lb. Mash Hammer
#HMH14 - 14 lb. Mash Hammer
#HMH16 - 16 lb. Mash Hammer

CARBIDE HAMMER POINT
#HHP2CT - 2 lb. Carbide Hammer Point
#HHP4CT - 4 lb. Carbide Hammer Point

QUARRY BUSTER

The Quarry Buster is quite versatile ▪ It can be swung to deliver a powerful splitting blow ▪ the blade can be placed on a stone and struck with another hammer ▪ the quarry buster can be used to strike another hammer or stone.

#HQB10 - 10 lb. Quarry Buster
#HQB12 - 12 lb. Quarry Buster
#HQB14 - 14 lb. Quarry Buster



HAMMER HANDLES - TROW AND HOLDEN
HA-75113SG 13" Cushion Grip Fiberglass Handle

TAMCO
#STM-3400 34" fiberglass handle
#STM-1400 14" fiberglass handle

PEAVEY MANUFACTURING
#R000-036-MH01 36" ash sledge handle
#R000-030-MH00 30" ash sledge handle
#R-000-014-HNDL 14" hammer handle
#R-000-018-SLDG 18" ash hammer handle (3 to 4 lb.)

SNOW AND NEALLEY
#**950-H #951-H** 32" and 36" hickory sledge Handle

SEYMOUR MANUFACTURING
#43204 16" hickory hammer handle for 4 lb. hammers

STONE TOOLS/HAMMERS

COUNCIL TOOLS - Lake Waccamaw, North Carolina.

SLEDGE HAMMERS
#PR40 - 4 lb. sledge with 15” wood handle
#PR40FG - 4 lb. sledge with 15” fiberglass handle
#PR600 - 6 lb sledge with 36” wood handle
#PR800 - 8 lb sledge with 36” wood handle
#PR800FG - 8 lb sledge w/ 36” fiberglass handle
#PR1000 - 10 lb. sledge with 36” wood handle

Stone wall building workshop - Escalante District -Utah - June 2011 - Photo by LC Kenway

DRILLING HAMMERS
New England pattern • heavy, short handled hammers for use with star drills • permit heavy blows with limited swing • **Not for striking stone**
#PR2 2 lb. drilling hammer w/ 10” handle
#PR3 3 lb. drilling hammer w/ 10” handle

Scoring Stone with rifting hammer and sledge. Arizona Trails Association, Prescott AZ, 2009

AMES/JACKSON HAMMERS
Double Faced Sledge Hammers • average quality with handles

#11-963 - 3 lb. sledge with 16” wood handle
#11-968 - 3 lb. sledge with 16” fiberglass handle
#11-969 - 4 lb. sledge with 16” wood handle
#11-970 - 4 lb. sledge with 16” fiberglass handle
#11-978 - 6 lb. sledge with 34” fiberglass handle
#11-988 - 8 lb. sledge with 34” fiberglass handle
#11-993 - 10 lb. sledge with 34” fiberglass handle

STEEL TRIPODS FOR HIGHLINE SYSTEMS

by L. C. Kenway

Many crews have benefited from the use of steel tripods to support cable systems in treeless areas since the early 1990's. This method involves erecting portable tripod towers that substitute for trees found at lower elevations. A wire rope is stretched between two earthbound anchors (usually large boulders) with a Griphoist winch. This arrangement makes it possible to roll loads along the cable with a pulley. Log tripods, lashed with rope, can provide high anchors for systems in

18 ft. tall tripod supports high line.

We developed a way of using simple metal tripods at Baxter State Park. Anyone interested in using this method for moving rock in alpine or otherwise tree-less areas may benefit from the following information:

1. We found 2" x 2" x 1/8" (thickness of wall) steel tubing to be strong enough. We moved rocks weighing over 600 lb. with these tripods.

Black extensions level tower on side slope

2. We were able to to level the tripods on sloping ground by adding adjustable extensions to the base of each leg. These extensions were made of 2-1/2" x 2-1/2" x 3/16" and slid over the tower legs. A 1/2" x 3" bolt was placed in one of several holes drilled in the extension at 6" intervals.

3. We found ropes to be very helpful in slowing the descent of rocks that roll down a sloping cable. At one point we had a runaway rock zip down the cable, knocking down the tower and bending one of the legs. The use of ropes also reduces the amount of foot traffic that would be necessary to move the loads back

Rope belay controls descent of boulder

4. Snatch blocks should be used to suspend the cable from the top of the tripods. Not only does this reduce wear to the cable, but also prevents the towers from being pulled over as the winch pulls in cable.

5. Tripods are capable of making heavy lifts, but will not tolerate sideways forces. If the load is not directly under the cable, **it must be moved under the cable before a lift is attempted.** Attempting to lift items that are not directly under the cable may result in one or both of the towers tilting over. This can happen

Boulder going down the line under belay

6. We found it easiest to set up the system as follows:

- Pick the two anchors, and tension the winch until the cable runs straight between the two end points (in rough terrain, people may have to hold the cable in the air as it is tensioned, so that it does not snag on boulders and other obstacles.)

- Set up the two tripods directly over the cable (two legs aimed at the load, and one toward the anchor).

Note: If the tripods are too close to the anchor, the tripod will be loaded diagonally, and may tip over or fail.

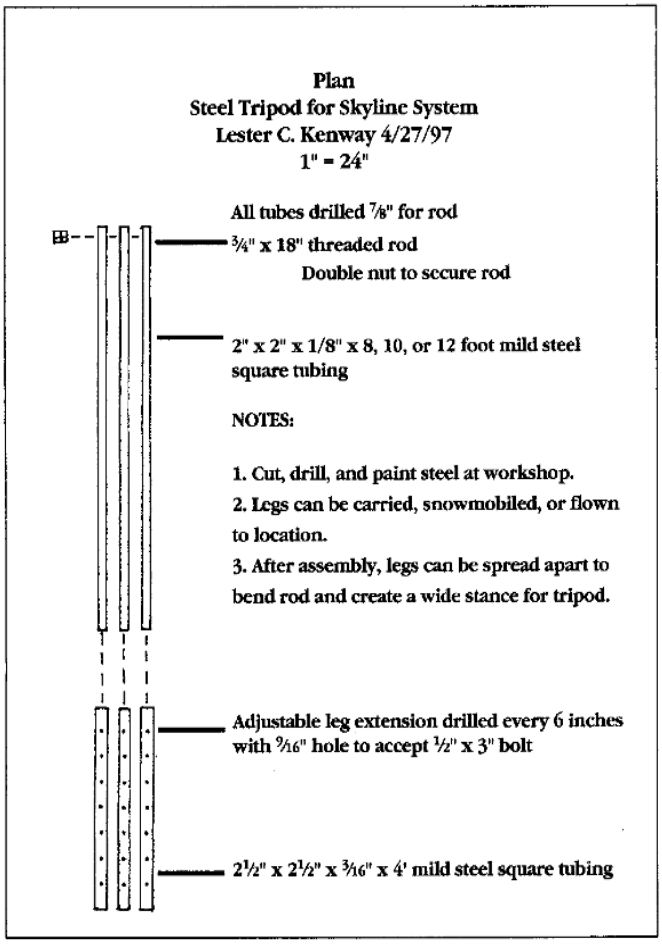
- Slack the cable and hook the snatch block and cable to the top of the towers.

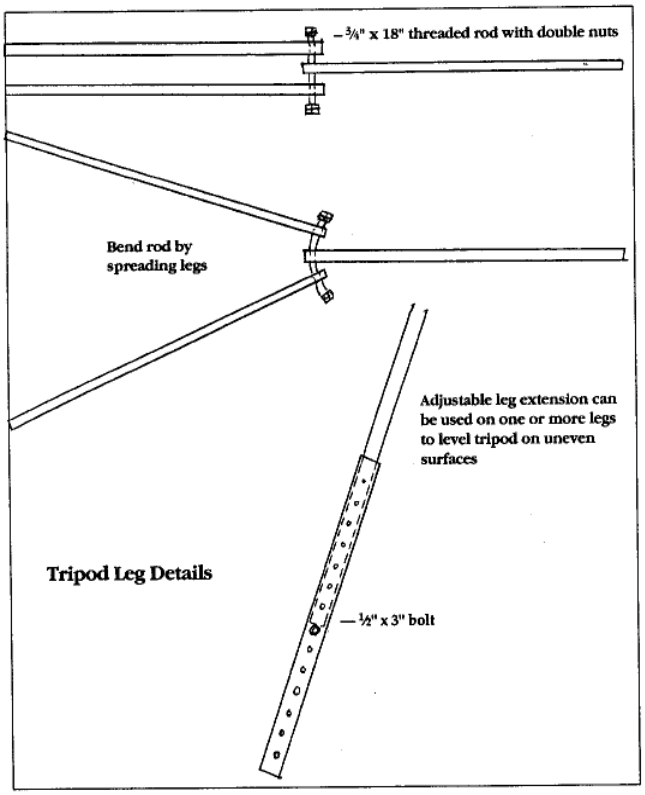
- Test the system before putting a heavy load on it.

7. We were successful in transporting loads of rock over distances as great as 200 feet when the terrain allowed. We learned that we needed to apply up to 2 tons of tension in order to get the sky line sufficiently tight. We accomplished this by using 1 ton winch with a snatch block attached to the end of the sky line with a cable grip. This 2:1 arrangement worked very well.

The initial set-up of one of these systems may require some experimentation, but will probably result in increased productivity and reduced impact to special areas. Perhaps these tips will help crews considering this

Crew loads “rock box” Photo by LC Kenway





Everything you ever wanted to know about Tamco Epoxi

Tamco epoxy is used to mount fiberglass handles into the eyes of steel tools:

Prepare the steel by sanding (strips of sanding belt work well) the inside of the eye to remove paint and to make a rough surface. Paint remover can help too. Prepare the handle by sanding the plastic cover and fiberglass core so the epoxy will bond.

Tamp the handle into the tool head with the handle end flush with the flared top of the tool head. Make sure the handle is square with the head and seal the bottom of the head to the handle with the putty strip (4). You can wrap electrical tape tightly over the putty to improve the seal. Clamp the handle vertical in a vise with the head up.

Prepare the Epoxy:

--Microwave the amber (1) vial for less than one minute in a microwave oven (too hot and you will melt the vial!) to make it warm and fluid.

--Mix (5) the Hardener and the Resin together in a wax paper cup (not plastic) in equal amounts. Mix thoroughly. Add the grey powder (3) for the color and as a filler if needed.

--Pour the epoxy into the eye slowly and along the side of the eye so as not to make air bubbles until the epoxy fills the eye completely.

--Point a 60w desk lamp at the tool's head to keep the epoxy warm so it will harden in 10-12 hours.

1 - Epoxy Resin

2.- Epoxy Hardener

3.- Filler (grey powder)

4.- Putty

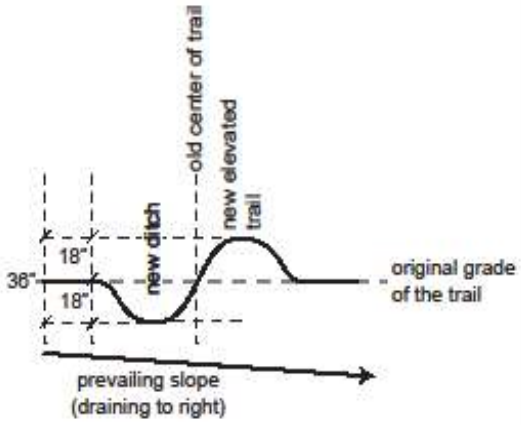
5.- Mixing Spoon

SCA Work Skills—Jefferson National Forest, Virginia

"Ditch and Drain" - is a technique that can be used to rebuild or improve foot trails that cross wet areas or where a trail follows a low and wet old woods road. By building up the lowerside of the old trail with earth excavated from the uphill side of the trail, the trail tread can be elevated above the wet ground. The ditch that follows the edge of the trail drains water down slope which can be diverted with waterbars as terrain allows. This is essentially building a miniature road with drainage ditch. Rock rip-rap can be used to protect the raised trail from scouring and keep the edge of the tread from collapsing into the ditch. You can rip-rap the entire ditch if you can find enough rocks. Good and sustainable trail can be built without importing any material. When "hydric" soils are used, the initial surface may be similar to "pudding" ,but becomes surprisingly firm after the water drains down. Illustrations by Julian Wiggins.

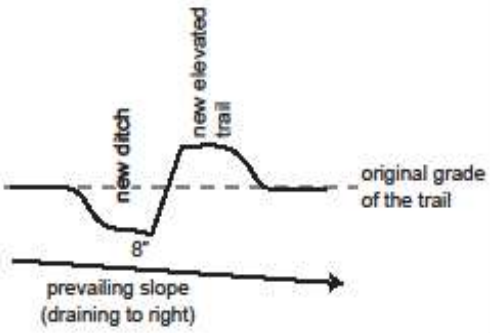
STEP 1: MARK THE CENTER OF THE TRAIL

X-SECTION
STEP 2: EXCAVATE THE UPHILL SIDE OF THE TRAIL



X-SECTION
STEP 3: DIG RIP RAP SHELF

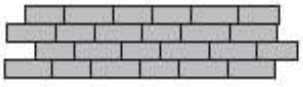
Collect rocks for a rip rap wall. Rocks should be bigger than a brick and up to cinder block size. Dig an insloping shelf 8" wide along the base of the new elevated trail.

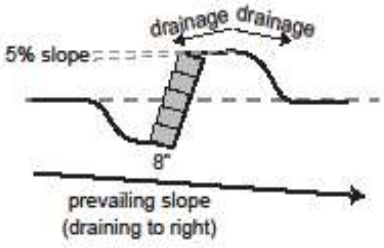


X-SECTION
STEP 4: INSTALL RIP RAP & GRADE TRAIL SURFACE

Build a rip rap wall in the shelf that you have constructed. Start with the biggest rocks at the base and work up to the smaler rocks on top. Once the wall has been completed, grade the surface of the trail so that it drains into the ditch at a 5% slope (~2" in 3'). If building a long section of ditch & drain, be sure to provide cross drainage downslope at least every 300'.

Side view of rip rap wall construction





The Emory Path-Dorr Mt. - Acadia National Park.
Built during the late 1800's Photo by LC Kenway

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