



MOUNTAIN SAFETY RESEARCH

NEWSLETTER



Published by Mountain Safety Research, Inc.
631 South 96th St., Seattle, Wash. 98108 - USA
Larry Penberthy, Editor & Chief Engineer

PURPOSE

Mountain Safety Research, Inc. is a volunteer organization of persons interested in promoting mountaineering safety, as part of their own enjoyment of the sport. By policy, the operation will be without net profit; all available funds will be used for further methods and equipment development and for safety education.

ABOUT MSR

In the spring of 1968, I, your editor, enrolled in the intermediate climbing course of The Mountaineers, Seattle, after having climbed Northwest mountains for 33 years without mishap. The particular stimulus for taking the course was an accident to a 13-year old girl who was a member of a party I was leading. She slid on an icy slope into a deep snow socket, hitting her head on the trees. She was knocked unconscious, head bleeding, and her face went into spasm. Dr. Otto Trott's lecture on head and spinal injuries was fresh in my mind, and I really had a sinking feeling, thinking that her spinal cord had been damaged. We carried out a good rescue, and were fortunate that she had no permanent injury. But I was scared, since I realized that I had made several leadership errors. Hence, I took the course, renewed my First Aid cards, and started thinking how to become a better mountaineer and leader.

Being an engineer and professional inventor, I kept an investigative mind in the course and was soon asked by the chairman to try to learn why several 3/8" Guldline (twisted nylon) ropes had broken a few years earlier in crevasse and snow practice. But when I started testing, the first thing that broke was a carabiner, with a fall of the 200-lb. dummy of only 30 inches. On the next drop of the same distance, the rope broke. Consternation! What goes on here?

From that starting point, the work has continued for one and one-half years now, covering many topics.

Elongation of ropes	Jam nuts	Design of stronger ice axes
Energy absorption of ropes	Rescue pulleys	Ice axe guards
Security of knots	Rock drills and bolts	Body harnesses
New knots	Holding power of pitons	Pack design
New rope techniques	Design of new pitons	Testing of storm shelters
Design of climbing ropes	Ice and snow screws	Igloo tools
Strength of carabiners	Snow flukes and anchor plates	New gloves
Design of carabiners	Energy absorbing devices (Auto-Belay)	Breathing regenerators and masks
Descending rings and slings	Strength of ice axes	Stove fuels
Brake bar design		Belaying techniques
		Belay anchor systems

The results of the text work have been organized into three hours of lecture and demonstration with over 100 slides.

At first the work was organized as a committee of The Mountaineers. But the trustees provided no financial support. After six months, it became apparent that the outlay was more than I could manage alone, and so I formed Mountain Safety Research, Inc. as a vehicle to make and sell safety equipment as a means of supporting the equipment and methods research and the safety education program. Hence, your purchases help keep the work going. After a few mailings, you will be asked to donate \$3 to cover the cost of publishing and mailing for a year. Donations of any size will be welcome, and \$10 or more will bring you the designation of MEMBER, entitling (but not requiring) you to participate in work sessions, contribute technical and safety articles, give the slide lecture and otherwise help in safety education and to have your letters answered fairly promptly.

The editor is unpaid; his labor is donated as a volunteer. Equipment is made by normal factory personnel. (In the business world, the editor is president and chief physicist of Penberthy Electromelt Company, Seattle, and Penelctro Ltd., Leigh-on-Sea, England, melting and process engineers in the glass industry. The editor goes to Europe several times a year, which makes it easy for him to keep in touch with climbing and safety practices there.)

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EDITORIAL POLICY

MSR Newsletter will publish reports on the foregoing list of investigations, and serialize the slide lecture. The Newsletter will also serve as a catalog from which you can order. The story of all items will be given, so that you can understand the rationale of their design. Guest articles on technical and safety subjects will be published, but there will be no stories of climbing the "east buttress". Letters to the editor will be printed as space permits. A few accident reports will be included where such reports might contribute to safety. Advertising will be accepted: institutional without review; specific equipment with test data. Reprinting by other publications with name and address credit will usually be allowed on application.

The writing style will be easy and informal, and the format 8-1/2 x 11 double sheets, printed both sides without binding. Printing is from typing by offset lithography, just like this. The pages are serially numbered and ultimately will be published as a book. Mailing of the new pages will be intermittent, as available time permits.

MSR Newsletter will be translated and published in French, German, Italian, Japanese, and Spanish, with the cooperation of volunteers in those language areas. We already have a mailing list of over 1900.

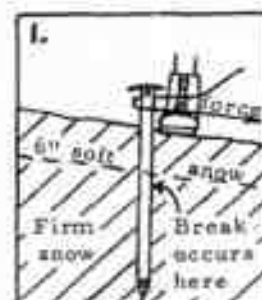
If you have not already done so, send in your name, printed please.

MANUFACTURING POLICY

MSR will do its best to make high-quality equipment, basing its designs on both laboratory and field testing of the forces involved. It is inevitable that improvements will be made in various items from time to time. If there was something wrong with earlier designs, we will recall and replace with corrected equipment. We hope to do our work well enough so that this doesn't happen, but please bring to our attention anything that doesn't work right.

MSR is more interested in the scientific aspects of safety, and is engaging in manufacturing and retailing because there was a tendency in the beginning for manufacturers to ignore our warnings of weakness of certain equipment on the market. However, MSR does not expect to manufacture in large scale, and will be glad to license its designs to other manufacturers who are prepared to hold quality and strength standards.

ICE AXE TEST METHODS



Wooden ice axe shafts break at various places, according to the particular circumstances of loading. The top diagram shows a snow condition typical of a warm day in summer: the underlying snow is firm, and the top 6" of snow is soft. The axe is pointed across the slope, loading the axe in the weaker axis. With a boot axe belay, and the rope several inches below the head, the axe breaks about the middle of the shaft.

We have tested 14 axes in a laboratory fixture simulating this diagram. These included new and used, ash and hickory, plain and laminated. All broke at loads of only 150 to 250 pounds rope force. For comparison, the forces that can be generated in crevasse falls range up to 1000 pounds on icy snow, less on soft snow.



The lower diagram shows the axe being used as an anchor in crevasse rescue. The axe is plunged into the snow all the way, and the snow is fairly hard. The rope is next to the head. In our corresponding laboratory fixture, the only wooden axe we had for test (Grivel laminated) broke off at a load of 500 pounds. For comparison, an MSR axe with aluminum-fiberglass bent at 750 pounds.

In an actual case like drawing 2, in crevasse rescue practice, the head of a new, normal wooden-shafted axe broke off under the weight of a climber while he was waiting to be pulled up!

Why is the test made with the axe in its weaker axis? Because the textbook, Mountaineering--Freedom of The Hills, Pp. 331 and 263, shows it being used that way. (2nd Edition, 1967, published by The Mountaineers, Inc., Seattle, Wash. USA.) Also, P. 81, Blackshaw: Mountaineering, 1968, Kays & Lord, London. Page 261 of Freedom shows the axe with the pick pointed up the slope. The shaft is stronger, but the shaft's holding power in the snow is about a third weaker. Take your choice. A better way to deal with the question is to have a stronger axe shaft, and use it with the wide face resisting the force of pull-out.

To help the investigation, please send a description of the breaking of ice axes you know about. We will publish results when we get enough reports.

We made some tests of actual holding power of axes in snow, but not enough for a comprehensive report. This will be done during the winter and reported in this publication in the spring of 1970.

We have information on about 20 ice axes broken in use. Of these, three were reported in May, 1969. No fatalities, but due only to luck, soft-snow runoff, and a safety belay, respectively. From these reports and our confirming tests, we believe that wooden ice axe shafts are not uniformly strong enough for arresting falls.

ICE AXE SHAFT REINFORCEMENT -- FIBERGLASS

With this fiberglass kit, you can strengthen your present wooden shaft at home. The technique is as simple as painting an axe, and the job can be done in less than an hour. The kit contains resin, activator, fiberglass cloth 8" x 14", plastic gloves, stirring stick, brush, sandpaper, and instructions. The strength of the axe will be raised to about 350-400 pounds, figure 1, and, best of all, will be reliably this strong. The cloth goes around the axe twice. Increases the weight of the axe by 3 oz. Shipping weight 1 lb.

Item 59 \$3.00

The above kit provides clear resin. If color is wanted, order a vial of color: red, yellow, orange, green, blue. You can divide the mixed clear resin and use two colors if you like.

Item 59-C, Specify Color .65

We will apply the fiberglass on your axe if desired. Order Item 59, Item 59-C also if color is wanted. Shipping weight for axes, 2 lbs.

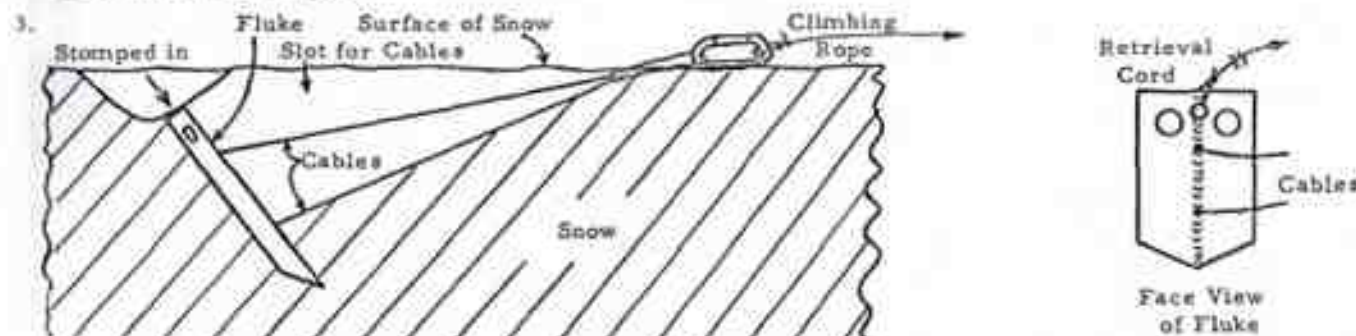
Item 60 Apply fiberglass \$3.50

ICE AXE SHAFT REPLACEMENT

Wooden ice axe shafts do not last forever. Your present steel ice axe head can be fitted with a high-tensile aluminum shaft, same as on the MSR axes. Guaranteed over twice as strong as wooden shafts. Good grip and insulation are provided by a clear layer of fiberglass cloth, applied by us and included in the price. If color is wanted, order Item 59-C, extra cost as above. Normally, you would saw off the present shaft at the bottom end of the tangs and sand only the head. But until April 1970, please send the whole axe so we can test the strength of the tanga-to-wood connection, for the full report later. Also send the glide ring, if 1-5/8" inside diameter or larger. If smaller, order Item 15-4 also. Usually two-week service. Weight 4 oz. more than wood shafts. Specify overall length desired.

- Item 41 \$15.00
- Item 15-4 Glide Ring and Nylon wrist loop 1.95
- Item 15-6 Tubular Plastic Guard Adze and Pick 1.50
- Item 15-7 Tubular Plastic Guard, Adze 1.50
- Item 15-8 Tubular Plastic Guard, Spike .40

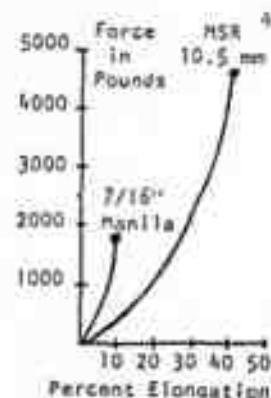
MSR SNOW FLUKE



The MSR Snow Flake is a belaying anchor to be imbedded in snow, and is made from a plate of high-tensile aluminum, bent to a shallow angle for stability and strength. The bent plate has the function of one of the flukes on a ship's anchor, hence the name. Steel cables are attached to stabilize the angle of the fluke to the cable eye at 30°. A slot should be cut with the pick of the ice axe in the snow in the direction of pull to receive the cables. On heavy load, the fluke sails deeper into the snow, and absorbs energy as it goes. In typical, consolidated (but not re-frozen) snow, the 5" x 10" fluke sailed into the snow 20" and along 30", with a restraint of 1600 lbs. This equals the energy of a 200 lb. climber falling 20 ft. The fluke did not come out, and could have absorbed much more energy. Reference: Mountain Magazine (British) January 1969; Summit, March 1969; Clogwyn Climbing Gear, North Wales. Cables test 3500 pounds.

- Item 11 4" x 7" Wt. 7 oz. \$7.50
- Item 12 5" x 10" Wt. 13 oz. 7.95
- Item 13 8" x 12" Wt. 24 oz. 8.50

MSR CLIMBING ROPE



MSR 10.5 mm climbing rope is braided kernmantel (core and sheath) construction. It is made of high tenacity, high softening point (430°F) nylon 707. It has good shock and energy-absorbing properties due to intentional and beneficial 15% shrinkage during manufacture which is available as stretch later without loss of strength during a fall.

The MSR-10.5 rope is a multi-fall rope, providing there is no obvious damage. After loading to 2640 pounds, its length restores in just a few minutes to the original within 5%. The internal strands are not damaged by repeated 2640-lb. loads. Ultimate breaking strength using P-H knots, 4600 pounds.

This rope is smoother than european kernmantel ropes, a feature which is an advantage for lower friction through a series of carabiners, and a disadvantage when using the rope for hauling-up of packs by direct hand grip. A 6-ring prusik instead of a 4-ring prusik is required for more energetic climbers. The rope is also more flexible, having a stiffness factor of 60 as compared with 110 for certain european kernmantel ropes. Most people like this easier handling; some do not. The low-load stretch at 200 pounds is 6.5%, which is

medium for climbing ropes.

The braid is longer, which makes the normal fuzz due to wear more apparent; the strength holds up well, because the fuzz protects the fibers underneath. Please note that life insurance premiums wear out and have to be renewed; the same holds true for ropes.

Weight, 4.5 pounds/100 ft. Color yellow-orange, with red center and ends. 80, 100, 120, 150, 165, and 300 ft. standard lengths. Priced to all at wholesale, 17¢/ft plus \$1 per rope uniform postage Rockies and west, \$1.50 other areas, plus 4.5% tax Washington State only. Item 4-P .17 per ft.

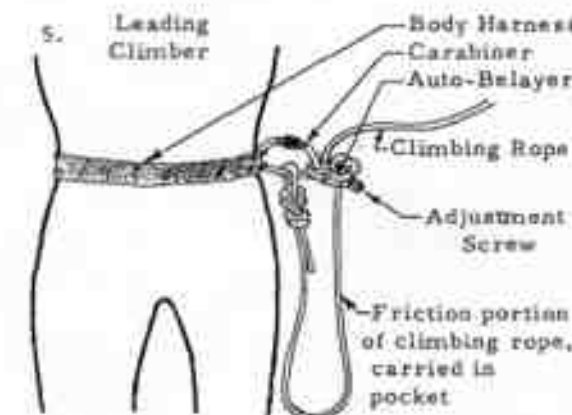
Unprocessed Rope

You can also process your own rope by boiling it for 40 minutes, using Rit dyes in your own color combination. Unprocessed white rope, 11¢/ft, plus postage and tax. Weight 3.9 lbs/100 ft. Allow for 15% shrinkage. Instructions included. The processing is very simple, and is standard practice in the nylon industry. Ref: Handbook of Textile Fibers, Part 2, P. 268 and 294, by Cook (McGraw Publishing Co., England). Item 4-U .11 per ft.

We also sell 10 mm rope, same as 10.5 mm except: strength between P-H knots is 3400 pounds; the fiber is nylon 6 (same as perlon); weight 3.8 pounds per 100 ft. Unprocessed weight is 3.3 lbs/100 ft.

- Item 3-P Processed .14 per ft.
- Item 3-U Unprocessed .09 per ft.

MSR AUTO-BELAYER



At last you can be sure of a dynamic belay by carrying your own automatic belayer. Weight under 4 oz. The A-B is an aluminum plate 2" x 3" with holes, thru which 7 feet of the rope is threaded. A loop is tied in the free end of the rope and is snapped into the body-harness carabiner. The Auto-Belayer is also snapped in, with the 6 feet of rope stuffed into a pocket. If the climber falls, the 6 feet of rope is pulled out of the pocket thru the Auto-Belayer frictionally, thus absorbing the energy of the fall dynamically. The degree of friction restraint is adjustable by the climber, and is usually set for a pull-through force of 800 pounds. That force stops a climber in about one-third the distance he fell. When the peak force is thus limited to 800 pounds, there is much less likelihood that pitons will pull out. Patent applied for-Larry Penberthy.

Item 33 \$7.95

MSR IGLOO TOOL



In stormy, cold weather, an igloo is warmer, quieter, more restful, and more durable than a tent. Expeditions now often carry only one or two tents for emergency, and rely on igloos for general shelter. The MSR igloo tool is a springy aluminum blade with wavy edge and blunt teeth for soft and hard snow. A safer tool than a machete or hacksaw blade. No scabbard needed. 24" total length with lacquered wooden handle. In an emergency, can cut wood. With instructions for igloo building. Weight 7 oz.

Item 34 \$7.00

EDMONT COLD WEATHER GLOVES

Insulated permanently with polyurethane foam, waterproof, reasonably flexible, orange color. Snug fitting knit cuff is silicone-treated by MSR for non-wicking. Slightly rough surface for good gripping qualities. Excellent for igloo building and general snow and cold-weather use. Men's large size only.

BUILDING AN IGLOO Text by Pat Polinsky

Item 52 \$2.95

There are few conditions, if any, in which an igloo cannot be built from snow. Snow conditions may not be perfect, but as a rule of thumb, use that snow which is at the depth where your foot stops sinking. This may require that you discard top layers of snow. Some snow types will require more time and practice for ease of handling the snow. Tramping on the snow to pack it may make the snow useable. Wait a few minutes for the snow to re-freeze before cutting blocks. Sometimes the top layer of snow is not suitable and must be discarded so that the second layer of snow is accessible.

To build a snowhouse requires little equipment. A blade tool, and possibly a string 3 to 6 feet long to draw the diameter of the house, is all that is necessary. A ski, flattened limb of a tree, or even gloved hands can be used to cut blocks in an emergency. Heavy duty, waterproof gloves help to keep the hands warm and dry.

After the house is completed, its soundness is surprising. It is waterproof (water will run down through the snow blocks and will not drip), sound proof (noises from the outside cannot be heard from within), windproof (the air within is still), and it is strong structurally. The insulative properties in extreme cold have been noted by the Arctic explorer, Stefansson. He found the outside temperature in a certain condition to be -50° . Other temperatures around and within the igloo were: -45° at the entrance, -40° at the floor of the entrance, 0° at the door, 20° at the level of the beds, 40° at the shoulder level, and 50° F at the ceiling.

Although temperatures in the Cascades will not be this extreme, you may experience them on an expedition undertaken in future years. The actual temperature may not be extremely low but strong winds quickly lower the surface temperature.

When building the igloo, the maximum practical diameter should be about ten feet. The limiting factor in the diameter is the increase in height and the difficulty due to the larger diameter. With larger diameters construction of a perfect dome shape is demanded for structural stability.

Since the igloo entrance is NEVER sealed or closed (to insure proper ventilation), the top of the entrance should be about 18 inches lower than the bed platform to prevent the warmed air from escaping. When building the igloo, the entrance should be placed so the wind blows past the opening and does not pile snow into it. Strong winds which contain airborne snow and ice particles may cut through at the base of the igloo. Protection is achieved by placing extra blocks of snow at the base on the windward side.

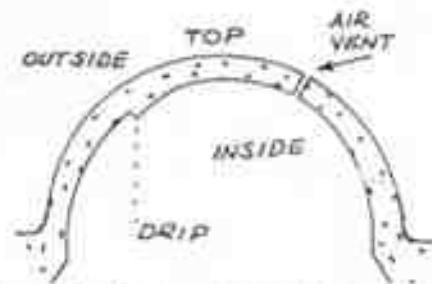
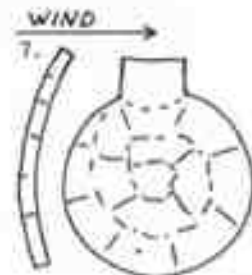
Retention of the insulative properties of an igloo can be disrupted by man-made conditions and by conditions imposed by the weather. When cooking within the igloo, make sure the roof contains a ventilation hole. Drips within the igloo occur where a projection from the surface has been left. To remedy this, pat the surface smooth. With a smooth surface, the water will run down within the snow blocks.

Extreme cold can cause hoarfrost to form on the inside of the igloo when the house is too thin. Loose snow packed on the outside of the igloo will increase the thickness.

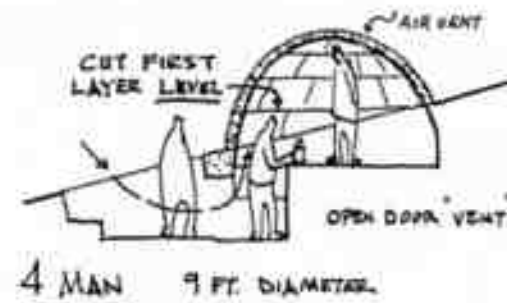
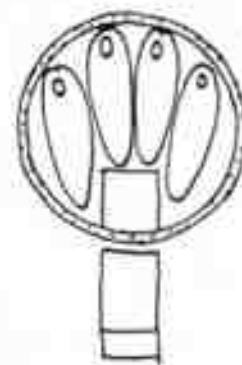
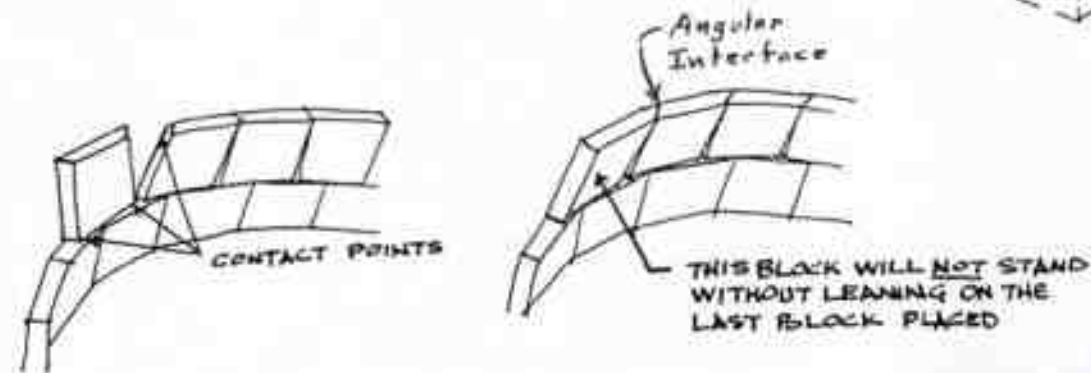
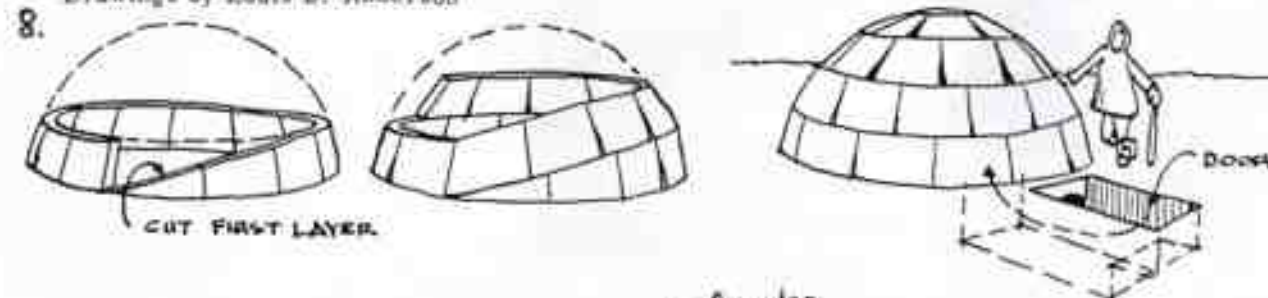
The construction within the igloo is left to the creativity of the builder. Construction of a place to leave the pack, a place to cook and a place to set a candle or flashlight increases the pleasure of staying in the igloo. Windows may be made, if you want to be very fancy, by placing sheets of clear lake ice in your walls.

POINTS TO REMEMBER: Check construction drawings attached.

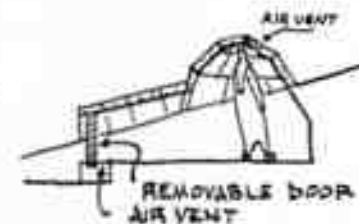
1. Make snow blocks as LARGE as possible (6" thick, 18" high, 30" long).
2. If building on a hillside, cut first layer level as shown in the drawing for the 4-man igloo. Then spiral cut and complete as in a normal house.
3. Tilt each layer in MORE than the layer beneath to form a true dome.
4. Pack the joints gently with handfuls of snow as you go. This helps to keep the blocks from toppling.
5. Build a SMALL igloo (6 feet or less in diameter) the first time. (To increase the space, undercut underneath and beyond the dome.)
6. For safety, always provide adequate ventilation for breathing and cooking.
7. Leave a light on in your igloo when you leave it at night. You may want to find it when you come back.



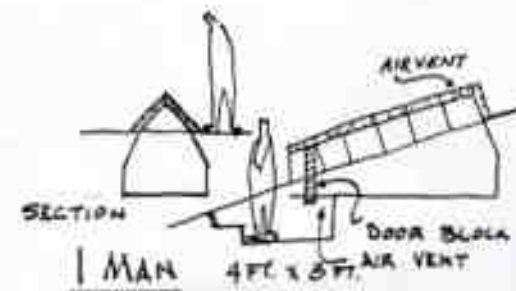
Drawings by Louis B. Anderson



4 MAN 9 FT. DIAMETER

SECTION
2 MAN

4-5 FT. DIAMETER



1 MAN 4 FT x 5 FT

