PICO TECHNICAL NOTE

PICO TN-91-1

MATERIALS AVAILABLE FOR MOUNTAIN GLACIER RESEARCH

- *Bruce Koci*

PICO has a long history of providing drills and related equipment for use in remote areas. A composite hand auger is available with a depth capability of 40 m. Beyond this, electrical systems (mechanical or thermal) are available to drill 300 m using a Kevlar® reinforced electromechanical cable for suspension. All three systems can be transported by small plane, helicopter, pack animal, or manhaul. A description of PICO drilling systems is provided in Proenza *et al.* (1990). Tensile and dome structures can be used for shelter, and several light weight power systems ranging from solar- to engine-driven generators complete the package. In addition, core boxes with a eutectic freezing mixture package are available to ensure the core gets out in frozen condition.

The hand auger is made of glass epoxy composite material normally thought of as water pipe. Extensions used to drive and retrieve the drill are 6 cm diameter CIBA C 150 pipe joined with screw threads. These extensions weigh approximately 1 Kg/m. A lighter version of 4 cm extensions made of graphite spectra epoxy is available at one-third the weight and three times the cost ($365 g/m and $300/m). The largest piece of this drill is 2 m and, unless a motor drive is used, no individual piece weighs more than 3 Kg.

The electrothermal drill is next in simplicity of operation. A resistive element shaped as an annulus is heated to melt through the ice leaving a core of 8 cm diameter. Power requirements can vary from 1,200 watts (minimum suggested for reasonable rate of drilling) to 8,000 watts. However, film boiling occurs about the element at 2,400 watts, limiting drilling efficiency. Power should be supplied at 240 V AC or DC to achieve 2,000 watts at the drill head. Drilling rates are approximately 6 m/hr at that power. A 2-m core barrel and heater weigh 15 Kg, limited to -10°C ice.

The electomechanical systems can be broken into smaller pieces for transport with the heaviest piece being 40 Kg. Packaging is available for animal or man transport and consists of Hardigg® polyethylene boxes or specially designed canvas bags with padding. A drill system used for remote areas has double or triple redundancy since replacement parts are generally unavailable.

Drilling systems are shown in Table 1 with total weight, number of pieces and weight and cube of the largest and heaviest pieces for logistic planning.

Power for drilling can be supplied from a variety of sources including solar-, wind-, or engine-driven generators. While voltage can be varied 240 V AC or DC is preferred. A comparison of solar-, wind-, and engine-driven systems is shown in Table 2.

Technical Notes are occasional reports on new developments and items of interest to the glaciological community. This is a publication of the Polar Ice Coring Office at the University of Alaska Fairbanks operated under contract to the National Science Foundation, Division of Polar Programs. Inquiries should be addressed to Director, PICO, University of Alaska Fairbanks, Fairbanks, Alaska 99775-1710. Phone: (907) 474-5585.

Table 1.

Drill System	Weight Kg	Longest Piece	Heaviest Piece
Hand Auger			
20 m System	20 Kg/1 bag	2 m	4 Kg
50 m System	100 Kg/3 bags	2 m	4 Kg
Electrically Powered Drill System			
200/300 m Winch & Cable	150 Kg	1.2 x .6 x .6 m	150 Kg*
Tower	50 Kg	3 m	10 Kg
Generator	150 Kg	1.2 x .6 x .6 m	150 Kg *
Electromechanical Drill	100 Kg	3 m	100 Kg*
Electrothermal Drill	20 Kg	1, 2, or 3 m	20 Kg
Total with Spares	1000 Kg/22 pcs	3 m	150 Kg*
Without Spares	565 Kg/15 pcs	3 m	150 Kg*

*40 Kg if broken apart

Table 2.

Power 3.5 Kw

System	Cost $1000/Kw	Weight Kg/Kw	Weight (Kg) 200-m Drill
Solar	5	100	–
Wind	2-8	200	–
Engine-Driven Generator	1.5	50	200 Electromechanical 300 Electrothermal

*Solar and wind do not include backup batteries.

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Proenza, L. M., J. J. Kelley, B. Koci, J. Sonderup, M. Wumkes. 1990. Shallow and Deep Ice Coring Devices Developed by the Polar Ice Coring Office. POLARTECH '90 International Conference on Development and Commercial Utilizations of Technologies in Polar Regions, Copenhagen, Denmark. Polar Ice Coring Office, University of Alaska Fairbanks, Fairbanks, Alaska. CP-90-02, pp. 23.