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Support for an Arctic Camp for 10 Persons for 30 Days

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Equipment, tasks, and training necessary for deployment of a camp on sea ice to support 10 persons for 30 days are described. Topics discussed include transportation, shelter, heat, food, fuel, electrical power, communications, packing, handling, personnel training, and basic health considerations.

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FOREWORD

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Support for an Arctic Camp for 10 Persons for 30 Days

J. P. WELSH AND R. E. BURGE

INTRODUCTION

The purpose of this report is to describe in general terms the equipment, tasks, and training necessary for support of a field camp on sea ice in the Arctic. Specific topics to be addressed are transportation (around camp and between shore and camp), shelters, heating, food, fuel, electrical power, communications, special equipment for camp setup/takedown and maintenance, unique applications of skills, training of personnel, survival equipment, basic health considerations, and special packing and handling of equipment.

Many of these topics are discussed in NORDA Report 138 (Welsh et al. 1986).* Lists of equipment described and identification of supplier/sources are provided as Appendix A. Table A1 lists basic equipment, quantity, volume, and weight as shipped or packaged by NORDA to support an ice camp for 10 persons. Appendix B provides the schedule for the Arctic Orientation and Survival Course developed by NORDA's Polar Oceanography Branch Office and a list of the contents of the Polar Oceanography Branch Survival Kit. The three-day Arctic Orientation and Survival Course has been given annually during the last four years to groups of 10 to 30 persons. This hands-on course focuses on equipment and skills specific to survival on sea ice.

BACKGROUND

Establishment of a camp to support 10 persons for 30 days on floating sea ice requires consideration of a number of variables:

1. Purpose and goals of exercise
2. Time of year (season)
3. Geographic location (region)
4. Measurement requirements
5. Levels of arctic experience and training of participants
6. Logistics (transport networks, etc.)
7. Security
8. Atmospheric effects—specific to comunications, travel, sensor/measurement systems
9. Local and regional ice dynamics and weather
10. Funds available
11. Expectations and understanding of the exercise from the sponsor's perspective
12. Sequencing and priority of specific tasks relative to the overall exercise.

The purpose and goals of the exercise and how these are understood by the performer and the sponsor dictate the characteristics of the ice camp. Very complex measurement/observation programs can be conducted by a team of 10 persons living and working at an ice camp over a 30-day period. Each measurement/observation task and the use of necessary instruments must be understood by a minimum of two persons at the camp for each high-priority task and measurement. Each person at the camp must be completely prepared to operate in a survival mode, including a thorough understanding of available firearms, emergency signaling/communications/navigation devices, and basic first aid for cold injuries and all survival equipment available for shelter, heat, food, etc. Each individual must have sufficient survival training specific to living on floating sea ice so that his/her level of competence and confidence is beyond question. These requirements must be compatible with the goals of the exercise as understood by the performer and the sponsor.

The season or time of year may be dictated by

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*Welsh, J.P., R.D. Ketchum, A.W. Lohanick, L.D. Farmer, D.T. Eppler, R.E. Burge and C.J. Radl (1986). A compendium of arctic environmental information. Naval Ocean Research and Development Activity Technical Note 138.

maximum flexibility to attain the goals of the exercise) and will have a significant influence on the choice of an ice floe for the camp. Considerations of the amount of available daylight, and the distribution of seasonal weather and ice dynamics can impact on priority of tasks and sequence of events (Welsh et al. 1986).

The geographic location for the exercise influences many decisions such as communications (electromagnetic interference) and transportation requirements (helicopter, light fixed wing, single or multi-engine, etc.). The quantity and capabilities of materials/equipment to be used on the ice are related, often limited by choice of location. Political boundaries must be considered, particularly if the ice drift might move the ice camp into areas claimed by an unfriendly government (Welsh et al. 1986).

The measurement requirements of the exercise may present some problems because, at the level of detail of a specific measurement, an iterative solution will be necessary and will depend on choices of exercise goals, season and region, logistics, and experience levels of the personnel. An example would be a measurement requiring 24-hr attention of personnel and dependent on consistent RF data transmission throughout the 24-hr period. Some high-latitude locations near the magnetic pole could present a no-go situation. This would require modification of the measurement techniques if the exercise goals are to be accomplished.

The effects of the levels of arctic experience of the individuals at the camp can be significant. Nearly everything requires more time and more diligent effort in an extremely cold climate. Coupled with the effects of the cold on instrumentation and people, this suggests that many accommodations are necessary to achieve the goals of the exercise. Naturally, individuals already having arctic experience will be prepared and more readily make the adjustments and, therefore, be more efficient and effective. Casual observation suggests that approximately three two-week sojourns at a well-run arctic ice camp provide a reasonable level of proficiency. Assignment of tasks for measurement/observation needs to be balanced with camp operation and maintenance to give each person confidence and to develop the skills necessary for survival. This is absolutely necessary with small camps of 10 or fewer persons because of the very real possibility of ice breakup or fire that could destroy all the shelters and force all to go into a survival mode. A larger camp can also break up and have fires; however, with more shelters it is less probable that all shelters will be lost. Although seldom mentioned overtly, considerate treatment of each other in a small camp environment is the key to the success of the exercise. The more experienced the individuals are with living and working in confined (perhaps unpleasant or even dangerous) surroundings, the more prepared they are to be considerate of the welfare of their fellow camp dwellers and thus improve the probability of harmonious progress toward the goals of the exercise.

Logistics touch on and affect nearly everything associated with establishing and maintaining a camp on sea ice. Basic to the logistics are the arrangements for transportation to and from the sea ice of all personnel and equipment required for the camp and the measurement program. Various configurations for the transport are possible, including combinations of platforms. The basic necessary items of shelters, bunks, heaters, messing stove, utensils, etc.), radios, beacons, navigation, generators, fuel, food, and survival equipment for 10 persons on a 30-day stay can add up to approximately 5 or 6 tons and 500 or more cubic feet. For distances of up to 50 miles from the shore base, helicopters can be used to transport equipment as sling loads. During arctic summer deployment, twin-engine helicopters and floats are required for flight over areas of open water. Distances greater than 50 miles require platforms such as Twin Otters either ski- or wheel-equipped depending on season and condition of the ice (availability of suitable runway). Paradrop from C-130 or other large cargo-capable aircraft can be used for delivering fuel, etc., to the campsite and for establishing caches of fuel at positions along the route from shore base to ice camp for helicopter or light fixed-wing aircraft refueling. Capabilities of different aircraft are described in Tables 9.2 and 9.3 of NORDA Report 138. Food for a 30-day camp could be delivered on a routine interval of once a week instead of all at one time. The majority of problems involved in setting up, maintaining and breaking down an ice camp are related to logistics (Welsh et al. 1986).

Two different approaches are considered for provision of food. The preferred approach is to have one professional cook prepare menus, oversee procurement of food and prepare all meals at the ice camp. This approach maximizes available working time of personnel for the main purposes and goals of the exercise. The second approach is to query all camp personnel, develop menus (6000 calories per person per day minimum) and buy the food. Then teams of two should alternate each day to prepare the meals and clean up. Our experience with the latter approach is that it requires a minimum of one man-day of labor per day.

Specialized equipment for food preparation is not required. All kitchen utensils and wares are of the normal everyday variety and can be procured from the GSA stock system or local supermarkets, hardware and department stores, with the exception of the cook stoves. Cook stoves vary from Coleman 2- and 3-burner white-gas-fueled stoves to 4-burner apartment size propane-fueled stoves with ovens. Propane gas bottles in the 20- and 100-lb size have been used. A general selection of knives (butcher, fillet, paring, and table), forks, spoons of various sizes, can openers, spatulas, food turners, and assorted items have been arranged by NORDA in a compartmentalized shipping container along with a supply of melamine plastic cups, bowls, and food trays to form the basic table wares. An assortment of cast aluminum sauce pots in various sizes, light aluminum baking pans, and a stovetop coffee pot complete the NORDA galley equipment. These items are packed in two 30- x 30- x 24-in. containers weighing less than 70 lb each.

A number of stainless steel dish pans (20-qt size) are described in Table Al of Appendix A. These are used to melt the ice for fresh water. Ice is used because it yields more water for a given volume and fits better in the melting pans on the stove.

Because fresh water is usually in short supply, disposable plates, plastic forks, spoons, and knives (for table service) help to conserve water. These disposables are shipped in bulk quantities and are burned with the other refuse at the end of each day.

Atmospheric effects such as radio interference, visibility, etc., can present problems for measurement/observations and travel (local and to and from the shore base). These can be significant, requiring compromises to achieve goals of the exercise.

The local and regional weather and ice dynamics can have a major effect on the success of an ice-camp-based operation. If all goes well the ice will not break under the camp and the wind will not blow away any of the camp shelters, antennas, etc. Rain is seldom welcome at an ice camp because wet personnel at near-freezing air temperatures are very uncomfortable and most of the camp tasks become very unpleasant.

Whiteout conditions are dangerous not only to aircraft but also to personnel who can become disoriented while moving about the ice camp, trip over unseen objects in the snow and become injured. In addition, the drift and fracturing/deformation of the ice can have drastic effects on the camp as well as on any measurement systems installed.

The funding available is a source of potential compromise. The compromises are usually associated with the disproportionate (to temperate zones) costs of logistics. Arctic-compatible measurement systems are usually more expensive than their temperate climate equivalents; thus redundant or backup systems more than double the expense. A rule of thumb for measurement and camp support equipment is that if you must have an item to meet your goals—take two.

Expectations can often be a source of difficult communication and agreement on the goals of the exercise. The fundamental reason for this is the large number of uncontrollable sources of variation that impact the conduct of any exercise in the Arctic. Many measurement or observation goals that are routinely accomplished in temperate zones and even in somewhat stormy open ocean regimes are impossible when tried in the Arctic. It is often hard to achieve a reasonable balance between an obviously reasonable goal and an unreasonable set of environmental constraints.

Determining the sequence and priority of tasks can become a set of very difficult problems. It is common practice to attempt to set a reasonable number of tasks for the best conditions and then set a fallback position to realize success for the highest priority tasks. In the Arctic it is not uncommon to do one's best and still not get results, regardless of how carefully the best and worst case scenarios have been addressed. The priority of the different goals within an exercise must be clear because, more often than not, the means to achieve a goal (especially if a number of groups are competing for necessary assets such as aircraft or instrumentation) will not be sufficient to meet all the requirements.

SCENARIO FOR AN ICE CAMP

The first task after arriving at the shore base and after identifying all your equipment is to select the ice floe on which to establish the camp. The selection of a suitable floe is an art conditioned by good luck. The size, weight, and handling of the measurement equipment often will dictate constraints, such as the requirement for a large fixed-wing aircraft because the equipment cannot be para-dropped. This precludes most summer deployments in the majority of the Arctic because a satisfactory ice runway is rarely available. Arctic winter deployments (excepting nighttime aircraft operation limitations) can usually be conducted because many suitable ice runways can be formed. The usual practice is to conduct a reconnaissance flight to the exercise area and locate a large multi-year ice floe that "looks good." This "looks good" can mean many things. The objective is to find a floe that is thick enough and large enough in area (minimum of a few thousand square yards) to accommodate the exercise measurement program and that will provide uncontaminated salt-free ice for cooking and drinking water, surface access to an aircraft staging area (either a helicopter pad or ice runway, approximately 2000 ft or greater) and some hope that the ice will not break up during the next 30 days in the specific site of the camp. For a 30-day deployment it is prudent to select a floe that has more than one runway possibility and consists of many "rounded" old ice ridges and relatively thick ice, i.e. greater than 3 ft and preferably 6 to 10 ft thick. The best runways are usually on the smoother ice that has formed in the leads adjacent to the selected multi-year ice floe.

After the floe is selected and the spot for the camp is identified, a small party of ice-camp-experienced personnel (2 or 3) should land and walk around the selected campsite area. A number of holes are drilled to obtain direct ice thickness measurements in the camp area and in the proposed runway or landing areas. The campsite, runway(s) and helipad are marked with dye (a 2-gal. bug sprayer works well) and the radio beacon can be set up. After these preparations, the sequencing of transportation of the equipment can begin. The means for transport (i.e. helicopter, fixed wing aircraft, etc.) and the distance from shore base are the major considerations. How items are loaded and in what order are the first decisions. A conservative approach is to transport the two or three most experienced personnel, with the necessary beacon, tent, two-way radio, survival gear, firearms, and provisions for three days, to the ice camp floe. The next priority is to transport a complete shelter (12- x 20-ft) with heater and fuel. The first party unloads these materials at the campsite and begins erecting the first shelter. This shelter will be the mess hall/communications center. Next is the delivery and setup of the primary radio and navigation equipment and antennas. It should be possible (depending on aircraft capability and distance) to have a reasonable core camp set up in one day (12- to 14-hr day). This approach provides safety, communications, navigation, food, and reasonable comfort for the core camp party.

Materials and personnel follow, with the requirement that enough shelter, heat and food are available at the camp to accommodate them. Enough food and fuel for three days is considered prudent as three-day storms are not uncommon. The importance of the right people in the right place at the right time cannot be overemphasized if the camp setup process is to be safe, efficient, and effective. Two people should have responsibility for, and be in charge of, the staging and transport of equipment, etc. One remains at the shore base to direct, load and determine changing priorities because of weight or space constraints. The second person is at the ice camp to make sure that the flow of materials, etc., is (1) in the interest of personnel safety and (2) appropriate for conducting the exercise. This process could continue for 3 to 4 days for a camp that will accommodate 10 persons for 30 days at distances up to 400 miles from the shore base. The camp breakdown usually requires less time because large items, like wooden flooring for the shelters, is destroyed and not returned to the shore base, so that fewer aircraft trips are required.

SHELTERS–TENTS

The ice camp (of the size to support 10 personnel) would consist of five shelters and one or two dome or cabin tents. These numbers may change, depending upon the nature of measurement/observation tasks to be accomplished. A typical approach would be to erect two 12-ft-wide x 20-ft-long Thinsulate (Hansen Weatherport) portable shelters and three 12-ft-wide x 10-ft-long Thinsulate portable shelters. One of the 20-ft-long shelters would be used for a dormitory. Six to ten people can be accommodated in bunk beds in this size of shelter, depending on individual dispositions of personnel.

The first shelter erected (12 x 20 ft) can be joined to a 12- x 10-ft shelter and used for the kitchen, mess hall and day room, and is a reasonable place to locate communications/navigation equipment as someone (e.g. the cook) is usually present to monitor the communications, etc.

The two remaining 12- x 10-ft shelters can be used for electronics and data gathering or hydrohole enclosures and also additional bunk space for personnel. If people seem to cramped in the dormitory shelter, some could use bunks in each of the remaining 12- x 10-ft shelters. No person should bunk in a shelter with a hole through the ice (maintained open) because of the potential problems with wet sleeping bags, etc.

A small dome or cabin tent can be used as the shelter for the toilet. A large dome or cabin tent can be used to house the generator, a snowmobile, and other gas-powered engines when not being utilized. This is a real necessity if the the temperatures are very low, as it can be difficult to start these engines under these conditions without some externally supplied warming. Aladdin-type heaters placed on stable supports inside the tent work very well for this purpose. Fuels are less volatile at low temperature, but liquid fuels must still be stored outside and at a safe distance from shelters. Fire is a potentially life-threatening disaster at a remote ice camp. Propane gas bottles are an exception, they usually must be kept inside the shelter, up off the floor and near the stove so that the propane is warm enough to be used.

The shelters utilized by NORDA are manufactured by Hansen Weatherport Corp (see App. A). They can be procured in many sizes and configurations to suit specific user needs. These shelters are available with a flooring arrangement that also becomes a shipping box for the shelter framing. A somewhat less bulky method is to ship flooring that can be fabricated on site using 2- x 4-in. lumber and plywood. We suggest contacting the company for descriptive packages and current prices.

The dome tent can be obtained in various sizes. We utilize the eight-man size sold by Cabela's of Sidney, Nebraska (see Table A2).

HEATERS

Two types of heaters have been used with success by NORDA's Polar Oceanography Branch: (1) a pot type 50,000-BTU oil burner with a draft control and flue pipe exhaust, and (2) an unvented wick type kerosene heater.

The vented pot oil burner is used in the larger shelters (12 x 20 ft or 12 x 10 ft) where a constant heat source is required, and the wick type is normally used where heat is needed only temporarily (tents). An exception is the full-time use of wick type heaters in the toilet tent because they are small and convenient. Pot type heaters use no. 1 fuel oil and wick heaters use kerosene. However, these fuels are not always available in the Arctic, and a substitute fuel (arctic diesel) must sometimes be used. It burns well in the pot stove and fairly well in the wick heater with minimal tar and wax buildup (that can prevent clean burning).

POWER

A diesel-fueled generator (3 kW or 6 kW) would be more efficient and reliable than a gasoline-powered unit for periods as long as 30 days. However, diesel generators are normally three times heavier and a little larger than gasoline-powered units of the same capacity. The logistics (particularly light aircraft) involved may dictate which system can be utilized. A 3-kW power plant is of a reasonable size for supporting a camp of 10. It can power lighting, small fans for heat circulation, battery charging, and power for communications gear and other electronic instruments. Normally, a smaller gas-driven unit is taken for a backup power supply and can also be used for power needs remote from the camp.

If it is not possible to transport the heavier, more bulky diesel unit, gas-powered units can be used.

The diesel-powered generators used by NORDA are manufactured by Onan Corporation. The gas-powered units are by either Onan or Honda.

POWER CABLES–LIGHTING

All materials when exposed to the low temperature conditions of the Arctic display a new set of physical characteristics. Power cables are no exception. The insulation and covers become very hard and brittle, and when standard cables are unrolled from the normally tight roll used for shipping, they crack and break in many places, leaving the conductors bare and unprotected. To avoid these problems a cable that is made to withstand these conditions should be utilized. Cable type SJEW-A, available from most electronic supply houses, is manufactured to be pliable down to –58°F and has been found to be adequate. At the ice camp, the generator is set up away from the living area shelters to decrease the fire hazard, and a heavy cable, size 12-3, is run from the generator to within the living shelter area. Smaller branch cables, size 14-3, and 16-3, are run to individual shelters.

Lighting for the camp is usually in two forms. Electric lamps, both incandescent and fluorescent, have been used without problems. A drop light (shop lamp) can be obtained from GSA stock and is very useful. The 18- or 24-in. "bright stick" fluorescent lamps can be used as well. As an alternative and backup if power should be lost, the white gas, mantle lantern (Coleman two-mantle or Aladdin) has been used and works very well. The Coleman and Aladdin lanterns also supply heat (for hands, small measurement devices, etc.).

COMMUNICATIONS–BEACONS

Communications are divided into three categories: shore base to ice camp, aircraft to ice camp, and ice camp to field parties.

Either high frequency (HF) single sideband or very high frequency (VHF) FM transceivers are used for the shore to camp communications. If the camp is located near shore, within 10–20 miles, a transceiver with a VHF FM 140- to 155-MHz frequency band and an output power of 125–150 W utilizing a Yagi type antenna will be adequate. Great effort and additional logistics would be required to erect an antenna that would give increased distance and dependability for the VHF FM system.

For distances beyond 20 miles, the HF single sideband 16- to 30-MHz transceiver becomes the primary means of camp-to-shore communications. Even though the range and clarity vary because of ionospheric conditons, a frequency can usually be found at which dependable communications can be established. A unit with an output power of 125–150 W utilizing a long wire or doublet type of antenna has worked well at ranges exceeding 300 miles for NORDA communications.

Aircraft to camp communication is necessary because aircraft are utilized in setting up and servicing most ice camps. Communications are necessary to establish the time of arrival, camp visibility, runway condition, and for emergency. The VHF-AM transceiver (118- to 135-MHz band) is used, often on the unicom frequency of 122.8 MHz. Its normal power output is from 4 to 10 W with the range dependent upon aircraft altitude (line of sight).

Communication from camp to field parties is accomplished using VHF-FM, 140–150 MHz. Small hand-held radios of 4- to 6-W power are commonly carried by one individual in each field party. The FM radio utilized in the first category is the base station for local VHF-FM communications.

A camp operating on drifting sea ice requires a homing or direction-finding beacon so that the support aircraft can find the camp and for search and rescue if required. A nondirectional navigational beacon 200- to 500-kHz frequency band is normally used. A unit with an output power of 50 W utilizing a four-wire radial type antenna has been found to produce the best range. Our experience has shown reliable signal acquisition by aircraft at 5000-ft AGL at a distance of 160 nautical miles. The size and weight may become limiting factors if attempting to utilize a unit of more than 50 W. A direction-finding radio set has been used at ice camps near shore-based public radio transmitters to obtain the position (by resection) of the drifting ice camp. This is a backup for other means of navigation (Loran, Omega, NAVSAT, sextant, etc.).

A very small VHF beacon is available and is very useful in marking tentative camp locations and points of interest; however, many civilian aircraft of the type used to support ice camps do not have the capability to home on them.

BATTERIES

Batteries are often used to provide power for communications and electronic equipment when the noise and mechanical vibrations of a generator prevent its use as the power source. Lead-acid batteries are the most commonly used type. The automative lead-acid battery is the most efficient and least expensive, but there are problems in transporting the sulfuric acid required. The battery that we have relied on the most is of the gel-cell type in which the electrolyte is in the form of a gel. Gel-cell batteries are more expensive and a little less efficient but the safety factor involved is worth the added expense. All batteries are very inefficient at low temperatures. At 68°F a fully charged battery will yield 100% of its current capacity. However, at -4°F it will yield about 65% and at -40°F it will yield 40% of its capacity. So if batteries are to be utilized, this low-temperature effect will have to be considered when estimating current consumption of the equipment or arrangements must be made for keeping the batteries warm. As the temperature affects capacity, it also affects rate of recharging. The charge rate at -4°F is one-sixth that at 68°F.

ICE DRILLS

No arctic ice camp, regardless of size, it seems, can do without an ice drill of some type, whether motorized or hand driven. The most popular type, for drilling holes of 5- to 10-in. diameter, is powered by a small two-cycle 3-hp gasoline, air-cooled engine. Holes may be drilled in ice of thicknesses up to 20 ft with very little effort for the first 8–10 ft and much more effort for the last 10 ft. The drill stem is constructed in spiral flights about 3 ft long, and a new flight is added as the depth of the hole increases. Any hole deeper than 20 ft and larger than 10-in. diameter would require a larger power unit, which would be more difficult to handle by the operating personnel.

TRANSPORTATION

Transportation from the shore base to the ice camp has been discussed. Local around-camp transportation is usually on foot, although snowmobiles and helicopters are often used. Sledges are used for transport of measurement equipment and hotel services equipment. Akios, Nansen and "folding oak" sledges have been used with success. The larger Nansen sledges and Eskimo-style sledges work well with snowmobiles. The Akios and folding sledges work well for short man-haul conditions.

A snowmobile that is powerful enough to be useful will also be large and heavy. This can present a problem in getting it to the ice camp and especially loading it on small aircraft of the type that would normally be used to set up a small camp. This must be considered when planning overall logistics to support the camp. We recommend a snowmobile having a two-cylinder engine with displacement of at least 360 cm^3 and having both forward and reverse drive. A windshield is also advantageous, especially for prevention of frostbite. The major advantage of the snowmobile is in hauling equipment, such as from the runway to the campsite, when setting up the camp and for camp takedown.

FUELS

Usually four fuels are associated with an ice camp: arctic diesel, regular gasoline (sometimes called mo-gas), white gas, and propane.

Arctic diesel occupies the largest volume in the fuel cache. It is normally contained in 55-gal. barrels (drums). An ice camp consisting of five Hansen Weatherports (Thinsulate shelters) and a large tent would require six oil stoves. In determining the amount of fuel required for a 30-day mission, allow for one 55-gal drum per week per stove. Even though the shelters being heated are of different sizes, their fuel consumption will average out to one drum per week. If a diesel generator is used, fuel consumption will depend upon size and power demand. For a 3-kW diesel, one can figure a 55-gal. drum per week for full-time operation. In the Arctic, jet fuel (JP4 or JP5) and arctic diesel are often thought to be similar and, therefore, can be substituted one for the other. However, it is not safe to burn the jet fuel in the stoves or heaters as it has some light hydrocarbons and also additives that can cause minor explosions.

Regular gasoline is used to operate the ice drill power units, snowmobiles, and gas-driven generators if they are used. Again, volume needed depends upon expected use of the equipment. Five gallons per day would be a good figure to use for planning purposes.

White gas, Blazo, and Coleman fuel are used in the mantle lanterns, backup cookstove and emergency supply for the survival equipment. The lanterns will consume the greatest amount, as one or two of these may be used in each shelter. This is only if the AC generator cannot be operated. One-half gallon per day per unit would be a reasonble figure for planning.

Propane is normally required for a compact (apartment size) cooking stove. The smaller 20-lb capacity bottle is best to use because of ease of handling. In most cases it has to be placed inside the heated shelter and above floor level to vaporize sufficiently for operation of the stove. Two 20-lb cylinders per week should be sufficient for a 10-person camp. Be very careful of fuel sources maintained inside shelters—the fire hazard is real and potentially disastrous.

TOOLS

A good general-purpose tool assortment should be assembled for support of the camp. It should contain both mechanical and woodworking tools. Normally a person who has been involved in preparing all items that will be used in the camp and its setup will have a good feel for the tools necessary to support it. Some specialty items that have been found to come in handy are battery-powered drills, electric hand saws, and sabre saws with multi-purpose blades. Some necessary larger tools would be snow shovels, square point shovels, digging picks (to mine ice for water), and ice chisels. A small hand-driven ice drill, 4- to 6-in. blade, is also recommended. A general supply of hardware is necessary: nails, wood, metal and machine screws and nuts. Electrical tape, duct tape, and various sizes of cord and rope will find use during camp operation. Sixty-penny spikes are often used for tent stakes.

APPENDIX A. DESCRIPTION OF EQUIPMENT

Table A1. List of the basic supplies for a camp of 10 persons. The shipping weights and sizes are not representative of the individual items but include the item and shipping container either commercially procured or fabricated by NORDA.

Item	Qty	Shipping size & weight	General description
Shelter	3	72 x 40 x 13 in., 300 lb ea.	10 ft L x 12 ft W Thinsulate shelter
Flooring	3 sets (5 pcs/set)	6 x 2 ft x 8 in., 40 lb ea. pc	Shipping box floor units, 10-ft shelter
Shelter	2	72 x 42 x 15 in., 450 lb ea.	20 ft L x 12 ft W Thinsulate shelter
Flooring	2 sets (10 pcs/set)	72 x 2 ft x 8 in., 40 lb ea. pc.	Shipping box floor units, 20-ft shelter
Tent	2	10 1/2 D x 20 in. L, 22 lb ea.	8-man geodesic tent with fly
Heater	5	42 x 26 x 19 in., 80 lb ea.	Preway oil stove with flue fittings
Heater	2	33 x 19 x 16 in., 40 lb ea.	Alladin wick heater with/spares
Generator	1	36 x 36 x 24 in., 350 lb	3-kW Onan diesel generator
Power Head, Ice Drill	2	45 x 14 1/2 x 14 1/2 in., 80 lb	3-HP, 2-cycle gasoline engine
Ice Drills Drills	3	45 x 14 1/2 x 14 1/2 in., 50 lb	Ice auger, blade section, 7 or 9 in. D.
Extension, Ice Drill	3 bxs. three per box	45 x 14 1/2 x 14 1/2 in., 40 lb/bx.	Extension flights for ice auger
Comm. & Nav. Package	2	40 x 24 x 29 in., 250 lb ea.	Package includes *

* Radio-VHF-FM, 110 W, DC powered, range up to 75 miles dependent on antenna type and height.
Radio-VHF-AM, 10 W, DC powered, range dependent on aircraft altitude.
Radio-HF-SSB, 125 W, DC powered, range up to 300 miles and greater, dependent on atmospheric conditions.
Receiver-satellite navigation, latitude-longitude positioning accuracy: 0.05 mile.
Receiver-direction finding beacon, 150-400 kHz, standard broadcast 535-1605 kHz
Power Supply-AC to DC, 12 V, 30 A

Item	Qty	Shipping size & weight	General description
Antenna	5	10 x 10 x 72 in.	Antennas to support Comms. package
Transceiver	4	32 x 14 x 23 in., 50 lb	VHF-FM hand held
Beacon Transmitter	1	33 x 39 x 16 in., 150 lb	48 VDC, 50-W omni-directional beacon 200-500 kHz
Bedding, Bunks	5 sets	5 x 30 x 72 in., 35 lb/Set 3-in. foam pads	Wood construction made by branch
Sleeping Bags	10	33 x 39 x 16 in., 75 lb, 2 box ea.	Large heavy-duty down filled bag, -30°C with wool liner
Snowmobile	1	120 x 38 x 40 in., 500 lb	Twin cylinder forward-reverse, 360-CC single track machine
Sled	1	144 x 24 x 10 in., 120 lb	Nansen type with rigid A-frame tow bar
Sled	2	84 x 20 x 6 in., 20 lb ea. 48 x 20 x 6 in., 15 lb ea.	Fiberglass Aukiaut (Akio) type w/rope pulls
Stove	1	21 x 30 x 42 in., 140 lb	Four-burner apt. size with oven, LPG
Stove	1	28 x 12 x 5 in., 20 lb	Three-burner white gas type
Lantern	8-10	32 x 14 x 13 in., 60 lb	Two-mantle white gas type
Batteries	12-16	32 x 14 x 13 in., 150 lb Two containers of above size & wt.	Gel-lead acid type 28 amp/hour-for comms. and beacon equipment
Fuel	30 drums (55 gal.)	24 D x 40 in. H, 425 lb ea.	Arctic diesel supply for 30 days.
Fuel	2-3 drums (55 gal.)	24 D x 40 in. H, 425 lb ea.	Mo-gas (regular gasoline) for snow-mobile ice drills, generators
Fuel	10 btls @ 20 lb ea.	12 D x 18 in. H, 200 lb	Liquid propane for cook stove

Item	Qty	Shipping size & weight	General description
Fuel	6 drums (55 gal.)	24 D x 40 in. H, 425 lb ea.	Jet fuel diesel generator (3 kW) is used
Fuel	20 ea (1 gal.)	4 x 6 x 10 in., 200 lb	White gas for lanterns and stove if needed.
Survival Pack	5 ea.	45 x 14 x 14 in., 120 lb ea.	Contents are listed on p. 55 of NR 138
Table	4	34 x 16 x 3 1/2 in., 32 lb ea	Compact folding table with seats
Table	4	6 D x 32 in. L, 11 lb ea.	Roll-up camping table
Chair	8-10	30 x 16 x 3 in., 8 lb ea.	Light-weight folding chair
Toilet Seat	1	15 x 15 x 6 in., 20 lb	Shop-made folding enclosure with commercial foam toilet seat attached
Dish Pan	6-8	20 D x 6 in. H, 5 lb ea.	Standard stainless steel dishpan with loop handles.

Table A2. List of items discussed and their source as available from our records.

<u>Shelters - Thinsulate Portable Shelter</u>

10 ft long x 12 ft wide (12 x 10)

Wt. 300 lb   Vol 20 ft^3 Excludes floor panels

Floor unit - Shipping Box

Wt. 200 lb.   Vol 40 ft^3 ft.

Est. cost of Shelter & Floor - $3000.00

Source: Hansen Weatherport, Gunnison, CO (303) 641-0480

<u>Shelters - Thinsulate Portable Shelter</u>

20 ft long x 10 ft wide (12 x 20)

Wt. 450 lb   Vol. 25 ft^3 Excludes floor panels

Floor unit - Shipping box

Wt. 400 lb   Vol. 80 ft^3

Est. cost of shelter & floor - $5000.00

Source: Hansen Weatherport, Gunnison, CO (303) 641-0480

<u>Tent - Geodesic Dome</u>

8-man capacity

80-in. high - 120-ft^3

Wt. 22 lb   Vol. 1.5 ft^3

Est. cost $260.00

Source: Cabela's, Sidney, Nebraska (308) 254-5505

Heater - Preway Oil Stove

Mod. SVM60D - BTU 50,000

Wt. 50 lb   Vol. 7 ft^3,

excludes flue pipe & draft control

Est. cost $200.00

Source: Preway, Inc., Wisconsin Rapids, Wisconsin (715) 423-1100

Heater - Aladdin Wick Type

Mod. Supra 400-S431 - BTU 21,500

Wt. 25 lb   Vol. 5 ft^3

Est. cost $300.00

Source: Aladdin Ind., Inc., Nashville, TN, (615) 748-3425

Generator - Diesel-Onan

Mod. DJA-3C   3 kW

Wt. 350 lb   Vol. 18 ft^3

Est. cost $3000.00 GSA Contract Item

Source: Onan Corp., Minneapolis, MN (612) 574-5822

Generator - Gasoline - Honda

Mod. EM2200   2 kW

Wt. 100 lb   Vol. 3 ft^3

Est. cost $700.00

Source: American Honda Mo

Ice Drill - Gasoline

Mod. 30, 7- or 10-in. Auger suggested

Wt. 3 lb with 35-in. Auger Vol 4.0 ft^3

Est. cost $200.00

Source: Feldman Eng. & Manuf. Co., Inc., Sheboygan Falls, Wis. (414) 467-6167

Radio Transceiver - HF Single Sideband

Mod. TI-3000 - 125 W

Wt. 27 lb Vol. 2.5 ft^3

Est. cost - $5,000.00

Source: Texas Instruments, Inc., Louisville, TX (214) 462-5220

Radio Transceiver - VHF FM

Mod. Mobile Master II with C-800 Control - 110 W

Wt. 30 lb Vol. 1.5 ft^3

Est. cost - $2,000.00

Source: General Electric Co., Mobile Comms. Div., Local Representative

Radio Transceiver - VHF FM

Mod. MPX Personal Handheld - 5 W
Wt. 1 3/4 lb 8 H x 2.7 W x 1.5 in. D

Est. cost $1300.00

Source: See previous item

Radio Transceiver - VHF AM

Mod. Alpha *720 Mobile with 10-W power option*

Wt. 4 lb 2.5 H x 6.5 W x 10 in. D

Est. cost $1,000.00

Source: General Aviation Electronics, Inc., Indianapolis, IN

(317) 546-111

Radio Transmitter - Beacon Nondirectional

Mod. ND200S with NX200TUB 50 W

Wt. Transmitter - 60 lb Vol. 4.7 ft^3

Wt. Tuner - 40 lb Vol. 6 ft^3

Est. cost - $11,000.00 with antenna

Source: Nautel Maine, Inc., Bangor, Maine (207) 947-8200

Transmitter - Beacon VHF

Mod. RF-700B

Wt. 2 lb 24 L x 2 in. Diam.

Est. cost NA

Source: Nova Tech Designs, Ltd., Victoria, B.C., Canada

Transportation - Snowmobile

Mod. Skandic 377R

Wt. 428 lb 114 L x 38 W x 42.5 in. H

Est. cost: $3,000.00

Source: Bombadier, Inc., Duluth, MN (312) 298-9540

Transportation - Sleds

Mod. Akio Fiberglass, Two sizes

Wt. 4 ft - 15 lb Est. cost $200.00

Wt. 7 1/2 ft - 25 lb Est. cost $300.00

Source: Vaughan Wilson, Seattle, WA

Transportation - Sleds

Mod. Nansen Type

Wt. Approx. 120 lb Dimensions approx. 144 L x 24 W x 10 in. H

Est. cost: $1500.00

Source: For info. contact, Polar Science Center, University of Wash.,

(Mr. Andrew Heiberg), (206) 543-6613

APPENDIX B: DESCRIPTION OF NORDA ARCTIC ORIENTATION AND SURVIVAL COURSE

The major portion of printed material provided with this course is taken from NORDA Report 138 (Welsh et al. 1986).

The primary objective of the course is to provide "hands on experience" with some of the more important equipment used to establish and operate from camps on floating sea ice.

Our goal is to provide all participants with confidence so that they can be contributors to an experiment working from a camp on sea ice.

The hostility of the environment requires attention to details and each individual will be better able to contribute if he/she shares a familiarity with all the equipment necessary for survival. This is especially true for small, remote camps where each person might have to be able to operate all the equipment because of some temporary incapacity of some or all of the other personnel.

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TABLE B1. POLAR OCEANOGRAPHY BRANCH SURVIVAL KIT FOR TWO PEOPLE.

ITEM	QUANTITY	PURPOSE
CONTAINER (ATA 176) (33" X 19" X 16") (5.8 CUBIC FT, 65-LB)	1	HOLD ALL KIT ITEMS
ARCTIC PARKA	1	REPLACE
EXPEDITION PANTS L	1	REPLACE
MUKLUKS SIZE M (WITH INSOLES & FELT LINERS)	1 + 1	REPLACE
MUKLUKS SIZE L (WITH INSOLES & FELT LINERS)	1 + 1	REPLACE
LEATHER GLOVE SHELLS SIZE 5	2	REPLACE
WOOL LINER GLOVES SIZE 5	2	
GORE-TEX LINERS SIZE 10	1	
ICE AXE	2	MULTI
EMERGENCY SLEEPING BAG (3/4 OZ EA) (94" X 35")	2	CONSERVE BODY HEAT
EMERGENCY SPACE BLANKET (56" X 84")	2	TARGET, WARMTH, SIGNAL, WIND PROTECTION
THERMAREST PAD (77" X 25")	2	INSULATION FROM ICE
BLACK PLASTIC SHEET (20' X 20')	1	TARGET, MAKE WATER, WIND, SHELTER,
STROBE LIGHT	1	RAFT, SIGNAL
WHISTLE, MATCHES, SM COMPASS	1	SIGNAL, LIGHT STOVE, LANTERN, DEAD RECKONING
SIGNAL KIT (1 SIGNAL MIRROR, FIRE STARTER, 2 FLARES & RED SMOKE	1	SIGNALING
TEKNA MICRO LITH (FLASHLIGHT)	2	SIGNAL & LIGHT
SURVIVAL CARDS & GROUND TO AIR SIGNAL INFO	1	INFORMATION
COMPASS	1	TRAVEL, DEAD RECKONING, RESECTION FROM LANDMARKS FOR POSITION
FIRST AID KIT (PAK-AID)	2	FIRST AID
MSR GK STOVE WITH SPARE PARTS	1	HEAT, MAKE WATER, COOKING
FUEL BOTTLES	2	FUEL
SIGG TOURISTER KIT	1	COOKING, MELTING ICE, SNOW STERILIZE
SIERRA CUP	2	DRINKING, EATING
PEAK 1 LANTERN WITH CASE & SPARE MANTLE	1	HEAT, LIGHT
LOCATER/TRANSMITTER (121.5, 243.0 & 282 VOICE WITH BATTERIES	1	COMMUNICATION
FOOD (3 DAYS-2/DAY)	6	EATING
SNOW KNIFE	1	SHELTER, WIND BREAKER
POLYPROP OR NYLON LINE 50'-100' 1/8"	1	TIE DOWN, ETC
GEODESIC (2-MAN) TENT	1	SHELTER
TOILET PAPER (IN ZIP LOCK BAG)	1 ROLL	MULTI
GI CAN OPENER	1	OPENING C&K RATIONS
SIGNAL SURVIVAL SMOKE ORANGE 1.5 OZ	1	SIGNAL
POCKET SURVIVAL TOOL	1	MULTIUSE, REPAIR
THERMOMETER	1	TEMP, WIND CHILL
EMERGENCY SPACE BLANKET (SPORT BLANKET)	1	WARMTH, WIND GROUND COVER, SIGNAL, TARGET
PLASTIC TUBE SURVIVAL PACK	1	PERSONAL CARRY
ZIP LOCK PLASTIC BAGS	1 DOZEN	DRY, STORE, MAKE WATER
HARD CANDY	1 LB	
ACE BANDAGE	1	
LIP BALM	1	
SUN SCREEN	1	
GLACIER GLASSES	1	

TABLE B2. NORDA POLAR OCEANOGRAPHY BRANCH OFFICE
ARCTIC ORIENTATION AND SURVIVAL COURSE
SAMPLE SCHEDULE

	Day 1	**Wednesday**
0900	INTRODUCTION - SLIDES/ORIENTATION/HANDOUTS OPEN DISCUSSION	
1100	LUNCH	
1200	DISCUSSION & EXAMINATION OF NORDA SURVIVAL BOX EQUIPMENT, COMMUNICATIONS & NAVIGATION EQUIPMENT	
1530	----	
	Day 2	**Thursday**
0900	ERECT SHELTERS (Wear Old Clothes)	
1100	LUNCH	
1200	COMPLETE SHELTER SET-UP AND SLEEP OVERNIGHT (CONDITIONS PERMITTING)	
1530	----	
	Day 3	**Friday**
0900	FIREARMS QUALIFICATION/FIRING RANGE	
1000	SHELTER TAKE DOWN AND PACKING	
1100	LUNCH	
1200	MEDICAL LECTURE - VIDEO	
1330	DISCUSSION	
1530	COURSE COMPLETE	

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