UNITED STATES ANTARCTIC PROGRAM

Field Manual

Continental Version 2018-2020

This Manual was prepared for the National Science Foundation's Office of Polar Programs (NSF/OPP) by Antarctic Support Contract (ASC) field support personnel and grantees. It brings together decades of first-hand field experience in Antarctica with the United States Antarctic Program (USAP).

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Cover: Field camp in Wright Valley, McMurdo Dry Valleys. Photo by Melissa Li.

Table of Contents

Program Information

Communications

Field Gear

Weather Observations and Ice Assessment

Aircraft Operations

Reference Information

Program Information

National Science Foundation Introduction

The purpose of the United States Antarctic Program (USAP) Field Manual is to provide an overview of USAP field logistics, operations, and safety. It contains information relevant to field deployments and living and working in an Antarctic field camp and is intended to enhance your success in the field. It is your responsibility to be familiar with the skills and techniques covered in this manual.

This is intended to be a reference manual and it should be taken into the field with you. Valuable knowledge is provided. Safety, environmental stewardship, and your health are of paramount importance. Continued vigilance and action in these areas are essential to maintain a safe and productive environment for work in Antarctica.

The harsh conditions encountered in the field setting, coupled with relatively short deployments and important scientific objectives, require effective leadership and constant risk management from all team members. Reducing the risk of injury and illness depends on a combination of systematic risk assessment, hazard elimination or control, appropriate use of personal protective equipment, and safe work practices.

This manual is designed to be used in conjunction with the USAP Field Practices Manual located on www.usap.gov. The Field Practices Manual provides pre-deployment, planning information that is useful during the Support Information Packet (SIP) process. Use of these manuals and adherence to the guidelines set forth will enhance both your safety and productivity while working in Antarctica.

We wish you a very safe and productive field season.

Kelly Falkner	*Director, Office of Polar Programs*
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Emergency Management

The Emergency Operations Center (EOC) is on call 24/7. The staff will collect the caller's name, phone number, and location; classify the situation (e.g., injury or illness, spill, aircraft mishap, vehicle accident, loss of shelter); and gather the information necessary to assess needs and risks and determine appropriate actions. If a search-and-rescue (SAR) is launched, it may involve the USAP SAR team and/or the Joint SAR Team (JSART), which is composed of both USAP and Antarctica New Zealand (ANZ) personnel.

First Aid Emergency Response Checklist

- **Survey the scene.**
  Is it safe? What happened? How many are injured? Who can help?
- **Do a primary assessment of the victim.**
  Do an ABC check: Airway, Breathing, Circulation
- **Radio or call for help, if needed.**
  Alert other field team members or people in the vicinity.
- **Do a secondary assessment of the victim.**
  Interview the victim, check vitals, conduct head-to-toe exam.
- **Call MacOps.**
  Inform MacOps of the incident and victim's condition, the condition of other camp members, and any plan. Request assistance or evacuation if needed. Request transfer to medical personnel, if necessary.
- **Stabilize the patient until help arrives.**
  Keep patient warm and dry, move to shelter if possible, be reassuring, and provide food and warm liquids if appropriate. Improvise toilet equipment, if necessary.
- **Follow up.**
  Notify appropriate manager and other involved parties about the incident. Complete and submit the required incident report as soon as possible.

Emergency Numbers for MacOps

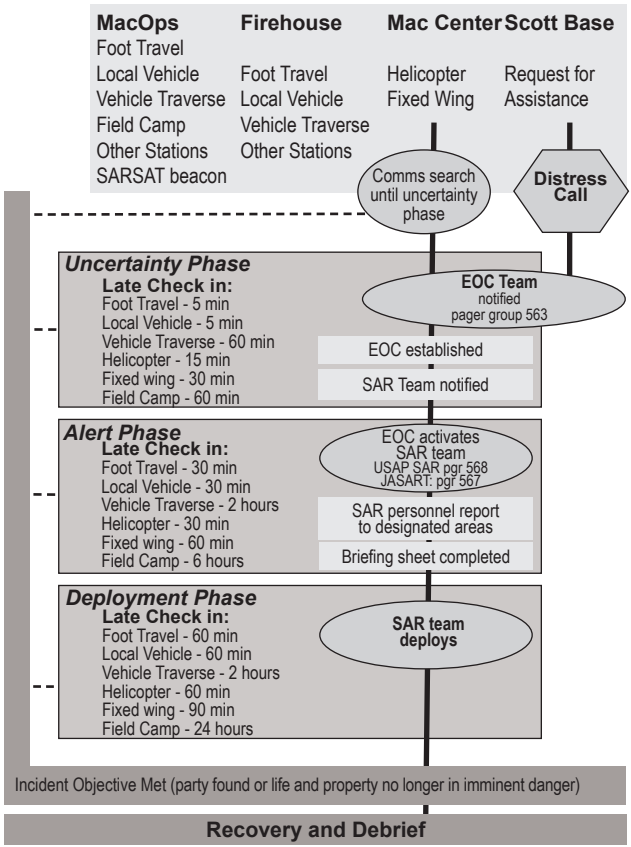
Phone 2586
VHF Channel 3

HF	7.995 MHz	11.553 MHz

Iridium 00-8816-763-12464

Emergency Response Flow Chart

In response to a distress call or a failure to check in from foot travel, local vehicle, vehicle traverse, helicopter, fixed wing aircraft, or field camp.



USAP Operational Risk Management

Probability	Consequences				
	none (0)	Trivial (1)	Minor (2)	Major (4)	Death (8)
Certain (16)	0	16	32	64	128
Probable (8)	0	8	16	32	64
Even Chance (4)	0	4	8	16	32
Possible (2)	0	2	4	8	16
Unlikely (1)	0	1	2	4	8
No Chance 0%	0	0	0	0	0

None	No degree of possible harm
Trivial	Incident may take place but injury or illness is not likely or it will be extremely minor
Minor	Mild cuts and scrapes, mild contusion, minor burns, minor sprain/strain, etc.
Major	Amputation, shock, broken bones, torn ligaments/tendons, severe burns, head trauma, etc.
Death	Injuries result in death or could result in death if not treated in a reasonable time.

USAP 6-Step Risk Assessment

USAP 6-Step Risk Assessment	
1) Goals	Define work activities and outcomes.
2) Hazards	Identify subjective and objective hazards.
3) Safety Measures	Mitigate risk exposure. Can the probability and consequences be decreased enough to proceed?
4) Plan	Develop a plan, establish roles, and use clear communication; be prepared with a backup plan.
5) Execute	Reassess throughout activity.
6) Debrief	What could be improved for the next time?

Field Camp Put-In Procedures

Upon arrival at the camp site, while aircraft is still on the ground

- Assist the flight crew with unloading the aircraft, as directed.
- If staying overnight, establish communication with MacOps using a satellite phone or radio; verify the camp name, the name of the camp leader, and the number of people in the camp. Confirm the time of daily check-in.
- For fixed-wing supported camps:
  - Establish a shelter; set up a tent away from the landing area.
  - Establish a flame; light a camp stove.
  - Inform the pilot when these tasks are complete.
  - Obtain the following information from the pilot:
    - An altimeter reading for the site (to program the Kestrel®).
    - The direction of Grid North (to establish directional flags for weather observations).
  - Keep clear of the aircraft and any prop wash as it departs.
  - Test the VHF air-to-ground radio (if you have one) with the pilot once the aircraft has become airborne.

Immediately after the aircraft has departed

- Identify the best location for the camp; look for a spot that offers easy access to research sites, avoids hazards, and provides protected areas for shelters. Consider storm wind direction (study the topography for clues) and helo pad and/or skiway location to create optimal camp orientation.
- For helo-supported camps, it is recommended to keep camp elements a minimum of 25 meters away from the primary flight path. Be aware of rotor wash and keep a secure landing zone at all times in case of unexpected or last-minute helo landings.
- Set up all tents with equal and appropriate spacing, taking whiteout scenarios and drifting into consideration.
- Set up the HF radio, solar panel, and antenna. Test the radio by contacting MacOps.
- Set up a camp toilet area. This may be a tent with a human waste container or a hole in the snow (in areas where accumulation is permitted).

As soon as practical

- Place all fuel containers and equipment (e.g., generators) in containment.

- Establish a site for trash. Be sure all trash is correctly packaged and labeled for return to McMurdo Station.
- Erect flag lines between tents and/or cargo lines in case of whiteout.
- Set-up a camp survival cache with spare fuel, food, and a personal locating beacon. The toilet tent is often a good candidate if it's a Scott Tent.
- Establish GPS coordinates for cargo lines, tents, and the survival cache. Store this GPS in an easily accessible location for a whiteout situation.

Field Camp Daily Tasking Checklist

Communications

- Complete daily check-in call before the appointed time. Inform MacOps of the number of people at the camp and whether or not all is well.
- Helo-supported camps:
  - Monitor Channel 7 at all times and especially if a helo is in the area, in case the pilot is trying to reach you.
  - If expecting a flight that day, call Helo Ops between 0700 and 0730 with a weather update.
- Fixed-wing supported camps: Make weather observations and call them into MacWeather at the pre-arranged times.
- Call MacOps after 1900 for the next day's flight schedule, or call the fixed-wing or helicopter supervisor to confirm any upcoming flights.
- Call work centers, as necessary, to request or confirm material for any impending resupply.
- Inform Fixed-Wing Ops or Helo Ops of the amount and nature of items expected and the expected delivery date.
  - Fixed-wing supported camps: Follow the communications plan established with the Fixed-Wing Office to arrange resupply.
  - Helo-supported camps: Call Helo Ops three business days in advance of a requested flight with all flight details (e.g., passengers, cargo, mission).

Record Keeping

- Record any pollutant spills using the "Field Spill Reporting Sheet."
- Record any information each day that will be required in the camp report. For helo-supported groups, this includes all locations where team members were dropped off and picked up while in the field.

Housekeeping, Health and Safety

- Sort waste and recyclables and keep them in proper containers.
- Check for and clean up any pollutant spills.
- Check and tighten all guy lines and anchor points.
- Keep landing areas clear of debris.
- For helo-supported groups, keep a secure camp at all times, with all items tied down, in case a helo needs to land unexpectedly.
- Monitor surroundings and weather patterns for indications of coming storms.

Resupply

- Check levels of commonly used items, such as propane, food, paper towels, toilet paper, and hand sanitizer. Make a list and call the BFC for resupply once a week, remembering that many items have a long lead time.

Field Camp Pull-Out Procedures

In the days leading up to pull-out:

- Package equipment and cargo not being used. Record the weight, cube, and type of retrograde cargo for each box. For flight planning, this information must be passed to the Fixed-Wing or Helo Ops supervisor three days in advance of pull-out.
- Package hazardous cargo in its original packaging and label it. Locate original hazardous cargo documentation, as the pilot may request it.
- For helo-supported groups, have a passenger manifest available (passenger names and flight weights), as the pilot may request it.
- Identify a staging area a convenient but safe distance from the helo pad or landing strip and stage cargo there when it is packaged and ready to go.
- Communicate with the Fixed-Wing or Helo Ops supervisor to confirm pull-out flights and relay cargo details. For helo-supported groups, call the helo hangar at least three business days in advance to request the pull-out flight. Provide helo staff with all known flight details at that time. Call immediately if any details change over the next two days.
- Notify MacOps of planned pull-out date.
- Plan the take-out in stages. Cargo and passengers slated for the last flight should include essential gear, survival food for one week, and someone to provide weather observations, in case the takeout needs to be aborted for any reason.

- Communicate with Lodging personnel at least two days before arriving in McMurdo to arrange or confirm room assignments.
- Take GPS coordinates of all release sites for the end-of-season environmental report.

Day of pull-out:

- In fixed-wing supported camps, begin hourly weather observations six hours before an LC-130 aircraft leaves McMurdo and three hours before a KBA aircraft (Twin Otter or Basler) leaves McMurdo.
- If there are no known issues and your aircraft is on track to pick you up, take down tent(s).
- Place all remaining camp items in the staging area and conduct a visual sweep of the camp site ensure all items have been removed.
- Disassemble the radio(s) and antenna(s).
- Before takeoff, take one last look to make sure everything and everyone is on the plane!

After return to McMurdo Station:

- For helo-supported groups, work with the helitechs to ensure all items have been picked up from the cargo line.
- Take the time necessary to clean and return all equipment to its proper storage area or department. See the “Camp Gear Return Procedure” for details.

Field Camp Hut Etiquette

Please complete the following before leaving the hut:

Trash

- Sort and pack all trash and recycled materials and take them back to McMurdo Station for proper disposal.
- No trash or recyclable items should be left in hut containers.

Floors, surfaces, and furniture

- Sweep the floor.
- Wipe all tabletops and chairs clean.
- Arrange chairs and tables neatly.

Personal items

- Conduct a thorough sweep of the hut in order to locate and remove all personal and project-specific items.

Food and dishes

- Wash and put away any dishes, utensils, and cookware.
- Non-perishable food should be neatly packaged, labeled, and stored in its proper area.
- Take perishable food back to McMurdo Station.

Thank you for leaving the hut in a clean and tidy condition for the next field team.

Camp Gear Return Procedures

Allow sufficient time *for returning equipment to the BFC. Field teams are responsible for cleaning the gear, sorting it, and ensuring it is checked in by BFC personnel. Gear return can take from an hour to two days, depending on the type of gear and its condition.*

- Call the BFC in advance (x2348) to make an appointment for gear return.
- At the appointed time, bring all camp gear to the BFC and make piles of like items (e.g., sleeping bags, Thermarests®) on the floor downstairs.
- Remove all flight tags, cargo stickers, and duct tape from the gear.
- Report any damage to a BFC staff member, or tag it as such.
- A BFC staff person will inspect the gear, inventory it, check it in, and print out an "Outstanding Returns" sheet for any missing items. Locate and return these missing items or make a note on the sheet explaining what happened to them.

BFC items needing extra attention:

- Tents – All communal cook tents must be set up, swept out, and scrubbed. Make an appointment with the BFC personnel so they can assign a location and provide the proper cleaning tools.
- Dishes, thermoses, food coolers, stoves, water coolers, and five-gallon buckets – Wash and dry these items, using the sinks at the BFC. Please repack the kitchen box and inform a BFC staff member of any missing content.
- Climbing ropes and equipment – Inform BFC staff of any issues with the equipment or any falls on the rope. Also, please check ropes before returning them. BFC staff will check all equipment during the winter, but field-team knowledge and assistance is valued and appreciated.
- Pee bottles and toilet seats – Clean and bleach these items. A system with directions is in place downstairs at the sink next to the washing machine. Please do not leave them for other people to clean.

- Trash – Separate, clean, and dispose of all trash in the bins outside the BFC. Each category needs to be bagged. Extra bags are in the BFC bay.
- Human waste – Please take it to the Waste Barn and place in the appropriate container.
- Cage – Please clean out the cage completely! Throw out garbage, sweep floors, and wipe off shelves. DO NOT LEAVE ANYTHING IN THE CAGE! It will be inspected by a BFC staff member when this task is completed.
- Jerry cans – Consolidate like fuel and empty all unknown or unmarked jerry cans in the waste barrel near the flammables van. Please tag and label any full or partially full cans with the contents. Place them under the appropriate sign outside the flammables van.
- Food – Dry food that is in good condition and unopened can be returned to the BFC. Frozen food cannot be returned, as it may have thawed during transport.

Survival Bags Explained

Local Survival Bags - Red

Needed - When traveling off established roadways outside of McMurdo town limits (Examples: Cape Evans, Cape Royds, Windless Bight).

Not Needed - Within town limits or on established roadways, such as Phoenix Road or Williams Field Road.

from the BFC

Helo Survival Bags - Orange

Needed - When passengers disembark a helicopter at locations other than an established camp.

Not Needed - If passengers disembark at an established camp, at a location with a survival cache, or at a tent camp with all components of a survival bag.

from Helo Ops

Red and orange bags contain everything – including fuel. Bags should be opened only in an emergency.

Deep Field Survival Bags - Blue

Needed - When traveling away from any camp in the deep field.

Not Needed - If traveling via LC130, Twin Otter, or Basler to an established camp. The aircraft carries survival bags for all passengers.

Deep-field survival bags have no fuel! Fuel bottles must be obtained from a BFC staff member and then hazardous-certified separately by Science Cargo.

from the BFC

The fuel should be kept near or in the survival bag so the kit remains complete.

Local-Field Survival Bag Contents

Red, shiny, dry bags - Supports 2 people for 3 days

- o 2 ea sleeping bags
- o 2 ea bivy bag
- o 2 ea ensolite™ pad, 24"x48"
- o 1 ea mtn tent w/instructions & repair kit
- o 1 ea collapsible snow shovel
- o 1 ea snow saw
- o 1 ea first aid kit
- o 2 bt white gas, 22 or 33 oz bt in ziplock™ bag and PVC

Tent stake bag:

- o 10 ea assorted stakes
- o 2 ea ice screws
- o 1 ea snow flukes (ok if missing)
- o 1 ea hammer

Cook & Stove Set Bag:

- o 1 set cookset, 1-2 pots w/lid
- o 1 ea signal mirror
- o 1 ea MSF Whisperlite™ Stove w/ instructions, repair kit, & 4 bx. matches (35/bx) wrapped in foil

Toilet Paper:

- o 1 roll toilet paper

Food Bag:

- o 6 ea dehy meals
- o 3 ea large chocolate bars or 6 ea small
- o 12 ea tea bags, assorted
- o 12 ea hot chocolate
- o 2 pk Mainstay™ food bars, 9 bars/pk (2 per person per day) or 10 Bumper™ Bars

Utensil set contains:

- o 1 ea pot handle
- o 2 ea mug, hard plastic
- o 2 ea spoon
- o 1 tube or bottle burning paste wrapped in foil
- o 1 ea pocket knife

Clothing Bag:

- o 1 bag misc. clothing (hat, mittens, gaiter, etc.)

Ziplock™ Bag:

- o may contain a book or game, not essential
- o survival manual
- o 50 ft parachute cord
- o 1 ea contents list

Deep-Field Survival Bag Contents

Blue, shiny,dry bags - Supports 2 people for 3 days

Note: Full fuel bottles cannot be flown on LC-130 aircraft. They must be hazardous certified separately. This survival bag is intended for people traversing away from a fixed camp on a daily basis. Fuel should be added to this bag from camp stock.

- o 2 ea sleeping bags
- o 2 ea bivy bag
- o 2 ea ensolite™ pad, 24"x48"
- o 1 ea mtn tent w/instructions & repair kit
- o 1 ea collapsible snow shovel
- o 1 ea snow saw
- o 1 ea first aid kit

Tent stake bag:

- o 10 ea assorted stakes
- o 2 ea ice screws
- o 1 ea snow flukes (ok if missing)
- o 1 ea hammer

Cook & Stove Set Bag:

- o 1 set cookset, 1-2 pots w/lid
- o 1 ea signal mirror
- o 1 ea MSF Whisperlite™ Stove w/ instructions, repair kit, & 4 bx. matches (35/bx) wrapped in foil

Toilet Paper:

- o 1 roll toilet paper

Food Bag:

- o 6 ea dehy meals
- o 3 ea large chocolate bars or 6 ea small
- o 12 ea tea bags, assorted
- o 12 ea hot chocolate
- o 2 pk Mainstay™ food bars, 9 bars/pk (2 per person per day) or 10 Bumper™ Bars

Utensil set contains:

- o 1 ea pot handle
- o 2 ea mug, hard plastic
- o 2 ea spoon
- o 1 tube or bottle burning paste wrapped in foil
- o 1 ea pocket knife

Clothing Bag:

- o 1 bag misc. clothing (hat, mittens, gaiter, etc.)

Ziplock™ Bag:

- o survival manual
- o 50 ft parachute cord
- o 1 ea contents list

Survival Cache Contents

Staged at fixed camps

Exact quantities and supplies may vary, depending on average population and specific camp criteria.

Supplies:

- o sleeping bags
- o ensolite™ pads, 24"x48"
- o collapsible snow shovel
- o snow saw, ice ax, sledge hammer
- o assorted tent stakes
- o ice screws
- o snow flukes
- o mountain tents (large camps do not have tents since there are several Jamesways or Rac-tents.)
- o parachute cord (100 ft)
- o signal mirror
- o pocket knife
- o pee bottles
- o human waste buckets
- o toilet paper rolls
- o sledge hammer

First Aid:

- o first aid kit, group
- o books - *Medicine for Mountaineering, Cold Injuries*

Cooking:

- o Coleman fuel
- o Coleman two burner stove
- o MSR Whisperlite™ stove
- o pot, 10 qt
- o pot, 5 qt
- o pot, 3 qt
- o plates
- o utensils (fork, knife, steak knife, spoon)
- o mug, hard plastic
- o pot grips
- o fry pan
- o matches
- o cleaning pads, scrubbies

Food:

- o dehydrated meals
- o oatmeal
- o meals-ready-to-eat (MREs)
- o hot chocolate
- o bars (granola, chocolate)

Environmental Guidelines

Environmental stewardship and protection in the Antarctic is essential. The United States is a signatory to the Antarctic Treaty (1959) and the Protocol on Environmental Protection to the Antarctic Treaty (Protocol, 1991). These agreements are implemented in the U.S. under the Antarctic Conservation Act of 1978, Public Law 95541, as amended by the Antarctic Science, Tourism, and Conservation Act of 1996, Public Law 104-227.

The Antarctic Treaty sets Antarctica aside for peaceful purposes, primarily scientific research, cooperation, and the exchange of information. The Protocol commits to comprehensive protection of the Antarctic environment, including a ban on commercial mineral exploration, and through its six Annexes requires environmental impact assessment of all proposed actions and conservation of native fauna and flora (including management activities to limit introduction of non-native species). The Protocol also establishes protocols for waste disposal and waste management, prevents marine pollution, and establishes a process for area protection and management. Adherence to Protocol obligations by USAP participants relies on education programs for each of these areas.

United States Federal regulations implementing the ACA can be found in the Code of Federal Regulations (CFR) Title 45, sections 640, 641, and 670 through 674. For questions or to obtain additional information regarding the information presented below, contact ASC Environmental (Environmental@usap.gov).

Antarctic Specially Managed Areas (ASMAs)

ASMAs are areas in which careful planning and coordination are required to avoid activity conflicts, improve coordination among field parties, and reduce the risk of cumulative environmental impacts. The two ASMAs covered by this manual are the McMurdo Dry Valleys (ASMA 2) and Amundsen-Scott South Pole Station (ASMA 5).

Please note: Personnel intending to enter the McMurdo Dry Valley ASMA are required to attend specific Dry Valley ASMA training beforehand. The management plans for each ASMA contain information regarding Restricted Areas and/or Managed Areas with which the entrant should be familiar.

Antarctic Specially Protected Areas (ASPAs)

ASPAs are areas designated to protect outstanding environmental, scientific, historic, aesthetic, or wilderness values. This includes

protecting ongoing scientific research from inadvertent disruption or contamination. ASPAs require an ACA permit to enter. ASPAs located directly within the McMurdo Station area include Arrival Heights, ASPA 122, and Discovery Hut at Hut Point, ASPA 158.

There are several ASPAs located within the McMurdo Dry Valleys, ASMA 2. These include: Lower Taylor Glacier and Blood Falls, ASPA 172; Canada Glacier, Lake Fryxell, Taylor Valley, ASPA 131; Barwick and Balham Valleys, ASPA 123; Linnaeus Terrace, ASPA 138; and Botany Bay, Cape Geology, ASPA 154. Additional ASPA sites located on, or in the vicinity of, Ross Island include: Cape Royds, ASPA 121; Backdoor Bay, Cape Royds, ASPA 157; Cape Evans, ASPA 155; New College Valley, ASPA 116; High Altitude Geothermal Sites of the Ross Sea Region, ASPA 175; Cape Crozier, ASPA 124; Beaufort Island, ASPA 105; Lewis Bay, ASPA 156; and Northwest White Island, ASPA 137.

Additionally, there are 26 Historic Sites and Monuments (HSM) in the Ross Sea Region. Some HSMs are incorporated within ASPAs, such as the historic huts from early Antarctic Expeditions (e.g. HSM 15, Shackleton's Nimrod Hut in ASPA 157; HSM16, Scott's Terra Nova Hut in ASPA 155; HSM 18, Scott's Discovery Hut in ASPA 158;), and some are individual HSMs.

USAP participants who find something of historical significance (pre-1958) are asked to note the location, describe the artifact, and notify ASC Environmental or NSF Environmental of its presence.

For additional information regarding ASMAs, ASPAs, or HSMs, refer to http://www.ats.aq or query ASC Environmental via email at environmental@usap.gov.

ACA Permits

An ACA permit is required to: 1) enter and work in an ASPA; 2) take native mammals or birds, or remove or damage such quantities of native terrestrial or freshwater plants that their local distribution or abundance would be significantly affected; 3) engage in harmful interference of native mammals, birds, non-marine invertebrates and non-marine plants; 4) introduce non-native species into Antarctica; or 5) export native mammals or birds or parts thereof. The term "take" also applies to dead mammals or birds, bird eggs, mummified seal teeth, feathers, etc. Research with marine invertebrates, plants, and fish do not require an ACA permit.

An ACA permit is not needed for entry into an ASMA; however, personnel entering or working in an ASMA are required to know and

follow the code of conduct specified in the applicable ASMA Management Plan. For any questions regarding ACA permits contact the NSF ACA permit officer at acapermits@nsf.gov.

Spill Prevention, Clean-up, and Reporting

- All spills of designated pollutants (e.g., fuel, glycol, transmission fluid) need to be reported immediately upon their discovery, regardless of spilled volume.
- To reduce the occurrence of spills, appropriate secondary containment and spill kits must be available for any fueling operation.
- For camps with a camp manager, spills should be reported directly to the camp manager.
- For McMurdo-based camps without a camp manager, spills should be reported to the Firehouse (via MacOps).
- For Peninsula-based field camps without a camp manager, spills of any designated pollutants should be reported to the location of the daily check-in.
- All spilled, designated pollutants need to be cleaned up to the greatest extent practicable and disposed of through the hazardous waste system.

Waste Management

- Releases of human waste or gray water are only permitted in accumulation zones, i.e., areas where snow and ice are thickening relative to the surrounding area. Releases onto blue ice, into crevasses, or on ice-free land are not permitted. No releases to the environment are permitted in the McMurdo Dry Valley ASMA or within ASPAs.
- All hazardous waste (e.g., fuel-contaminated material, lab waste, chemical containers, aerosols, radioactive material) requires special handling and labeling. Questions regarding hazardous waste management should be directed to the Waste Department at each station or to the marine lab technician on the vessels.
- The ACA has strict guidelines on managing hazardous waste. Be sure to remove all hazardous waste from the field at the end of each field season.

Human Waste

- Human waste must not be discharged onto ice-free land, sea ice, or in blue-ice areas. Discharge can only occur in snow accumulation areas and only with permission to do so.

- Surface discharge of urine is not allowed anywhere on the continent. If urine discharge is specifically approved, it may only be discharged to the subsurface (into a pit or hole).
- Personnel must carry a pee-bottle when bathrooms or outhouses are not available. Used pee-bottles must be cleaned and emptied by personnel before they leave the station (McMurdo has dedicated pee-bottle cleaning stations at the Science Support Center (SSC) and the BFC).
- Human waste and gray water should be planned for retrograde to McMurdo Station. For planning purposes, the table below provides estimates of volumes generated.

Usage Rates for Buckets and Containers

Human Waste Type	Container Type	Persons/Days
Human Solid Waste	5-gallon bucket (1)	5 people for 5 days (minimum)
Urine	5-gallon bucket (1)	1 person for 5 days
Gray Water	5-gallon bucket (1)	1 person for 5 days

Interactions with Animals

- Personnel should not interfere with wildlife unless they have an ACA permit and are specifically trained for the activity being conducted.
- Maintaining a distance of 15 to 20 feet from animals is generally sufficient, but if an animal's behavior is altered or disturbed, individuals should increase that distance.

Non-Native Species

- No non-native species of animal or plant may be introduced onto land, ice shelves, or into water in the Antarctic Treaty area, except in accordance with an ACA permit.
- To avoid introducing non-native species into Antarctica, personnel must clean all science gear and personal equipment before arriving on the continent.
- To avoid cross contamination, personnel must also clean gear and personal equipment before transiting between Antarctic field sites.
- If a suspected non-native species is observed in Antarctica, it should be reported immediately to the environmental representative.

End-of-Season Report

- At the conclusion of field activities, all Peninsula-based and McMurdo-based science groups must submit an Environmen-

tal End of Season Report (EOS) to Environmental@usap.gov. The forms are available on the station intranet, or science personnel can request one from the above email address.

- To make the process simpler and more accurate, the Environmental EOS should be populated with information throughout the season. Do not try to remember everything at the end.
- The next section provides a general summary of the information required when filling out the Environmental EOS.

Environmental End-of-Season (EOS) Report: General Information Required

The following information must be tracked and quantified in the EOS (as a Microsoft Excel spreadsheet). Please refer directly to the EOS report form for specifics.

Section A – Field Camp Summary

Part 1: Camp or site information

Part 2: Fuel use

Part 3: Hazardous materials use (non-fuel)

Part 4: Waste disposition

4a: Containerized waste

4b: Discharged sanitary waste

Part 5: Items remaining at camp closeout (fuel, hazardous materials, waste)

Part 6: Fuel, waste handling, spill prevention and response suggestions

Section B – Summary of Field Activities

Part 1: Equipment deployed

Part 2: Materials released

Part 3: Environmental disturbances in the Dry Valleys

Part 4: Spills

EOS Report Form Instructions

- Please complete the EOS form thoroughly and send it electronically as a Microsoft Excel file to the Environmental Department. (Environmental@usap.gov).
- Completion of the form is a requirement for each science group and ASC work center. All end-of-season reports are submitted

to the NSF, and data in the reports are compiled in the USAP Master Permit.

- All principal investigators (PIs) or their designated environmental POC must complete the form. Field camp managers must complete a form separately.
- Please use the drop-down menus in the Microsoft Excel spreadsheet form for consistent reporting.
- For all field parties, please submit GPS coordinates of any science equipment installations, sampling or coring locations, temporary camps, releases (planned and unplanned), equipment left in the field over the winter, and/or disturbances of any kind (past or present). GPS data should be reported in decimal degrees to five decimal places.
- Specific to field parties operating in an ASMA or ASPA, please submit GPS coordinates for each of the following environmental disturbances (refer to the ASMA or ASPA management plan http://www.ats.aq/documents/ATCM38/WW/atcm38_ww005_e.pdf for additional details):
  - Sample sites
  - Soil pits
  - Non-established helicopter landing sites
  - Tent sites outside facility zones (remote camps) – please GPS the perimeter of the camp location
  - Fuel storage locations outside facility zones
  - Waste handling and storage location outside facility zones
  - Any releases of fuel (intentional or unintentional) or equipment
- Contact ASC Environmental (at the above email address) with any questions or comments you may have regarding the EOS form or any other environmental issue.
- Please save and send the form with the file name: Group number_PI_YearEOS.xls (e.g., B-001_Smith_2017_EOS.xls)

Communications

Regional Travel Communication Requirements

Travel off established roadways is tracked by MacOps.

Established roadways include ice road to Ice Runway, snow roads to the Long Duration Balloon (LDB) site and Phoenix Runway, and dirt roads between McMurdo, Scott Base, T-Site, and Arrival Heights.

Requirements:

- Check-out by radio (to ensure it's working)
- Check-in before estimated time of return (ETR) (failure to do so initiates emergency response)

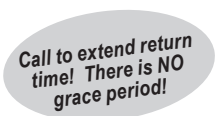
Solo Travel: Requires NSF authorization and additional requirements. Defined as: a) single person traveling alone or b) any number of people traveling on a single snowmobile.

Weather: Condition 3 - Standard travel procedures in place
Condition 2 - No snowmobile travel / no solo travel
Condition 1 - No travel of any kind allowed

Check-out Procedure: Use VHF radio. "MacOps, MacOps, this is (vehicle number or call-sign) calling on (channel name)"

Provide the following when prompted:

- Vehicle number(s)
- Event number (or department)
- Destination
- Number of people on board
- Driver name (one name per group)
- Point of contact (in McMurdo) and phone/pager number
- ETR to McMurdo or estimated time of arrival (ETA) at destination



Overnight Stays

- Before departing McMurdo, provide the names of all members
- Provide one-way check-out to site, morning check-in at site, and one-way checkout for return.

If you are late

After five minutes the Emergency Operations Center (EOC) is activated. This includes the NSF station manager, ASC station manager, emergency communications manager, field science manager, information technology manager, and the fire chief.

Field Camp Communication Requirements

Before Departing McMurdo:

- o Comms equipment pickup: contact communications coordinator at Bldg 159, ext 2378
- o Test the gear - call MacOps for comms check

Arrival at Field Site: Put-in call required *before* aircraft departs camp:

- o Location name
- o Camp leader name
- o Number of people (by event number)
- o Confirm daily check-in time

Daily Check-In Call: Check-in *before* your scheduled time:

- o Location name
- o Number of people (by event number)
- o "All is well"

Return from the Field (Pull-Out):

- o Notify MacOps when leaving camp vacant

Aircraft Daytrips:

- o No communications with MacOps required - the flight is tracked by MacCenter and Aviation Ops
- o Establish communications with helicopter pilot on VHF Channel 7 before the helo departs
- o MacOps is available for comms checks, message relays, or to record a location

EMERGENCIES

- o Notify MacOps directly
- o Medical - call MacOps transfer line and indicate if URGENT or not

If you are late

After one hour the Emergency Operations Center (EOC) is activated. This includes the NSF station manager, ASC station manager, emergency communications manager, field science manager, information technology manager, and the fire chief.

Communication Systems

The USAP uses four systems for field party communications, depending on field party location: telephone, VHF radio, HF radio, and Iridium satellite phone.

Telephone

Field camps in the McMurdo vicinity that are equipped with telephone service can contact MacOps directly by dialing **2586**. That number rolls over to four available lines, so callers are always able to get through.

VHF Radio

VHF radio is the primary form of wireless communication in and around McMurdo Station. This is a shared resource monitored by multiple users. Proper radio etiquette should be maintained when transmitting on this or any radio network. Always refer to the frequencies by the channel name and not the channel number. Radio communications should be brief and on-topic. This is especially true when using the VHF field-party repeaters, which operate on renewable energy sources and can become disabled in periods of poor weather and heavy communications traffic.

McMurdo deploys three different VHF systems:

1) **Simplex.** In this system, each unit communicates directly with other units. All units use the same frequency to transmit and receive, so communications are one-way and one-at-a-time.

   These functional areas use a simplex system: Science, Tower/Airfield, Utilities, Aerospace Ground Equipment/Air National Guard (AGE/ANG), Marine 16, and all air band channels.

2) **Simplex with Base Station.** Where buildings and hills block radio signals, a base station is used. An antenna is placed at the highest point, such as a hill, a tall building, or a radio tower. The radio at the tower, called a "base station," is connected to a remote dispatcher's console. All units, including the base station, transmit and receive on the same frequency. If two units can't communicate directly, the dispatcher relays messages.

   These functional areas use the McMurdo base station: I-Net, Fire, Fuels, and Helo Ops.

3) **Semi-Duplex.** For areas farther from McMurdo, such as camps in the Dry Valleys, semi-duplex repeaters are used. A repeater is a radio receiver/transmitter combination. The repeater is installed on a hill, a tall building, or a radio tower, and it auto-

VHF Channel Use			
Simplex (Line of sight)	**Name**	**General Use**	
	I-Net	Shuttle operations; antenna at T-site (not monitored by MacOps)	
	Science Net	Comms between field parties (not monitored by MacOps)	
	Helo Ops	Comms between helo hangar, helicopters, helo field parties (not monitored by MacOps)	
Semi-Duplex (Repeaters increase range)	**Name**	**Repeater Location**	**Areas of Coverage**
	MacOps	Crater Hill (above McM)	McMurdo area, sea ice areas south of Erebus tongue
	Mount Aurora	Black Island	McMurdo area, sea ice area south of Erebus tongue, ice shelf
	Wright Valley	Mount Newall	Wright Valley, New Harbor, sea ice areas
	Taylor Valley	Mount Coates	Taylor Valley (Lake Hoare, Lake Fryxell, Lake Bonney, F6)
	Mount Terror	Mount Terror	Cape Crozier, Windless Bight, areas south of Ross Isand
	Mount Brooke	Varies	Repeater location and use varies each season
	Mount Erebus	Mount Erebus	Line of sight to west side of Mount Erebus

VHF Radio Operations
Listen before transmitting (to ensure channel is not in use).
Hail MacOps and wait for reply before giving checkout information.
Key-pause-talk to ensure entire transmission gets through.
Keep batteries warm (and always carry a spare).
Do not over-use repeaters (power conservation).

matically retransmits the signal it receives on one frequency (F1) on another frequency (F2). The control point at the dispatcher's desk transmits and receives just like a mobile radio.

These functional areas use the McMurdo semi-duplex system: MacOps, all field party repeaters, all flight-following repeaters, and the Movement Control Center (MCC).

VHF Frequency Assignments at McMurdo Station	
Frequency (MHz)	**Name/Description**
118.2	APPR (Approach) – Air Traffic Control - frequency for controlled airfields.
118.5	HELOFF (Helicopter Flight Following) – Air Traffic Control - used to coordinate helicopter movements.
121.5	GUARD/VHF (Guard) – aircraft emergency and distress.
123.45	ANG (Air National Guard) – common air-to-air frequency.
126.2	TOWER (Military Common – Air Traffic Control) - frequency for controlled airfields.
129.7	TIBA (Traffic Information Broadcast by Aircraft) – primary Antarctic operational frequency.
134.1	GRND (Ground – Air Traffic Control) - frequency for controlled airfields.

Field Party Plan

1 I-Net
2 Fire
3 MacOps (rpt)
4 Science
5 MCC/Fleet Ops (rpt)
6 Helo FF (no rpt)
7 Helo Ops
8 Taylor Valley (rpt)
9 Mount Brooke (rpt)
10 Mount Terror (rpt)
11 Mount Aurora (rpt
12 Wright Valley (rpt)

*Channels monitored by MacOps are in **BOLD**.*
Channels 13-16 not available on all radios.

McMurdo Plan

1 I-Net
2 Fire
3 MacOps (rpt)
4 Science
5 MCC/Fleet Ops (rpt)
6 Airfield Tower
7 Helo Ops
8 Utilities
9 Fuels
10 Mount Terror
11 Mount Aurora (rpt)
12 Wright Valley (rpt)
13 Taylor Valley (rpt)
14 Mount Brooke (rpt)
15 **Mount Erebus (rpt)**
16 Marine 16

South Pole Station uses the same authorized VHF frequencies as McMurdo, but the channels are not permanently assigned to specific work centers or functions, as they are at McMurdo. Instead, VHF assignments for channels 1 thorugh 7 are determined seasonally or on demand. 129.7 MHz is reserved for monitoring aircraft, same as McMurdo Station.

HF Radio

If field parties are issued an HF radio, team members should follow the setup instructions to verify that radio settings are correct. (**Note:** Point the antenna toward Black Island for comms check with MacOps **before** departing McMurdo.)

The antenna should be elevated at least four feet off the ground. Ensure all shorting bars are connected, except for the desired frequency. MacOps continuously monitors the following two frequencies:

7.995 MHz	11.553 MHz

At South Pole, the US-17 circuit is used for passing information between outlying stations and McMurdo, as well as for daily camp check-ins. The following three frequencies are monitored continuously and used in the listed order of priority:

Primary	Secondary	Tertiary
7.995 MHz	4.770 MHz	11.553 MHz

Note: The loss of saved frequency programming in the nine available channels of the radio indicates an internal battery failure and does not render the unit inoperable. Manually tune the radio to the desired frequency and operate normally. Always speak clearly, loudly, and slowly into the microphone.

Phonetic Alphabet

Whenever letters or groups of letters have to be pronounced separately, e.g. to identify unusual words, call-signs, or in conditions of difficult communication, the phonetic alphabet should be used:

A	Alpha	H	Hotel	O	Oscar	V	Victor
B	Bravo	I	India	P	Papa	W	Whiskey
C	Charlie	J	Juliet	Q	Quebec	X	X-Ray
D	Delta	K	Kilo	R	Romeo	Y	Yankee
E	Echo	L	Lima	S	Sierra	Z	Zulu
F	Foxtrot	M	Mike	T	Tango		
G	Golf	N	November	U	Uniform		

Iridium Phone

Deep-field camps are also issued Iridium (satellite) phones. Iridium satellite coverage is not guaranteed in and around McMurdo Sound, and users should keep this in mind when attempting to access the satellite phone network. When possible, move to an area free from obstructions to obtain the best reception possible.

Note: The Iridium phones issued by the USAP are administered by the Department of Defense. Dialing sequences to and from other commercial Iridium phones may vary.

Note: If your field party has multiple units, the Iridium with the lowest phone number is designated as the Alpha line. The next ones are Bravo, Charlie, Delta, and so on.

The following numbers are pre-programmed into the Iridium phones. Additional numbers and dialing sequences are available from MacOps.

Pre-Programmed Iridium Numbers		
MR1	MacOps 00-8816-763-12464	Calls cannot be transferred
MR2	MacOps Transfer 00-697-720-568-1042	Calls can be transferred to Mc-Murdo business lines
MR3	MacWeather 00-8816-763-20030	McMurdo weather department
MR4	Helo Ops 00-8816-763-29073	Helo hangar
MR5	Medical 00-8816-763-15142	**Do not use unless directed** Call MacOps for emergencies
MR6	Search & Rescue 00-8816-763-15141	**Do not use unless directed** Call MacOps for emergencies

Iridium Dialing Instructions

From Iridium to Iridium: Dial 00-8816-763-XXXXX

1. Power up the Iridium phone.
2. Wait for the telephone to register with the network and show a signal level in display.
3. Dial 00 to access the satellite network.
4. Dial 8, the country code for Iridium phones.
5. Dial the area code and eight-digit Iridium number.

Example: 00 8 (816) 763-12464 for MacOps

To a commercial (non-USAP) Iridium phone: Dial 00 698 (8816 or 8817) XXX-XXXXX.

From Iridium to a regular phone:
(whether in U.S. or McMurdo via Denver)

1. Power up the Iridium phone.
2. Wait for the telephone to register and display a signal level.
3. Dial 00 for an international call.
4. Dial 697 to connect to FTS (Federal Telephone System).
5. Dial area code (DO NOT dial "1" before dialing the area code).
6. Dial seven-digit telephone number.
   Example: 00 697 (720) 568-1042 for the MacOps transfer line

From Iridium to any McMurdo or Scott Base extension:
(via NZ Telecom)

1. Power up the Iridium phone.
2. Wait for telephone to register and display a signal level.
3. Dial 00.
4. Dial 698 (this code also works for all international calls).
5. Dial NZ country code 64.
6. Dial 2409.
7. Dial McMurdo four-digit phone extension.
   Example: 00 698 64 2409 2586 for MacOps

From Iridium to a U.S. Toll Free number:
Dial 00 699 1 (800/888/877) XXX-XXXX.

From Iridium to an international number:
Dial 00 698 + country code + city code + local number.

To a USAP Iridium from any phone:

Any USAP Iridium phone may be dialed via a U.S. domestic phone by using a Hawaii area code. Replace the Xs below with the last four digits of the Iridium number.

If SIM card's last five digits start with a 1: Dial 808-659-XXXX

If SIM card's last five digits start with a 2: Dial 808-434-XXXX

If SIM card's last five digits start with a 3: Dial 808-684-XXXX

If SIM card's last five digits start with a 4: Dial 808-851-XXXX

If SIM card's last five digits start with a 5: Dial 808-852-XXXX

For example, if the Iridium number is 8816 763 2XXXX, dial 808-434-XXXX.

Iridium Text Messages

Iridium phones cannot send outgoing text messages. However, short text messages can be sent from a computer to an Iridium phone. There are two ways to do this:

Option 1: Send the message via the commercial website https://messaging.iridium.com/

Follow these directions:

- In the cell labeled "Handset or Pager Number" enter the phone number (8816763XXXXX) of the target phone.
- In the cell labeled "Message Text" type the message. Use standard characters only. There is a 160 character limit.
- In the cell labeled "Reply Email" the sender's address can be entered to let the recipient know who the message is from. This cell is optional.
- In the cell labeled "Prove you are not a robot" enter the code presented immediately above. If only a small black and white box is visible, try a different browser. Some versions of Internet Explorer are not compatible with this function.
- When ready to send, click the "I am not a robot" button and the message will be sent. "Your message has been successfully submitted" will display, but this does not confirm delivery, nor does it confirm that the message has been read.

Option 2: Send the message via email. Use the following address, with the target phone's number in place of the x's:
8816763xxxxx@inah.pac.disa.mil

- The message must be in PLAIN text. In the outgoing message in Outlook, go to "Format Text" and select "Plain Text."
- Leave the subject line blank.
- Type in the body of the email. There is a 120-character limit.
- The message should start with camp recipient's initials, so camp personnel know to whom to pass the message.
- The sender's initials should come at the end of the message body.
- Do not include a signature line or any other extras.

No automated "read confirmation" is sent to the message originator. If the originator requests or requires confirmation that the message was read, the recipient should call the originator.

Note: Generally, friends and family should only be provided the secondary Iridium number (Bravo Phone), keeping the primary Iridium (Alpha Phone) for business purposes, and they should be informed that the Iridium phones are a shared resource.

Receiving Messages

To check for Iridium text messages in the field, power up the Iridium and place a call. This places the Iridium phone in the satellite constellation and begins the download of queued messages. The Alpha line may be used.

If there is no need to talk to anyone in particular, call this number: 00-697-720-568-2211. Once the device attempts to connect, you can end the call. At this point, the satellites should forward any queued messages.

Iridium Troubleshooting

Disconnect and reconnect all accessories (battery, antenna, adapters, etc.) to ensure there are solid contacts. If possible, move to an area clear of obstructions.

Frequently Used Iridium Numbers

DEPARTMENT	ROUTING	NUMBER
MacOps	Iridium	00 8816 763 12464
MacOps Transfer	via Denver	00 697 720 568 1042
MacWeather	Iridium	00 8816 763 20030
AVIATION		
Aviation Operations supervisor	via Denver NZ Telecom	**00 697 720 568 1043** 00 698 64 24 09 2529
Fixed-Wing Operations supervisor	NZ Telecom	00 698 64 24 09 2697
Helo Hangar office	Iridium via Denver NZ Telecom	**00 8816 763 29073** 00 697 720 568 1002 00 698 64 24 09 2277
SCIENCE SUPPORT		
Berg Field Center (BFC)	via Denver NZ Telecom	**00 697 720 568 1021** 00 698 64 24 09 2348
BFC food room	NZ Telecom	00 698 64 24 09 2461
Crary Lab supervisor	via Denver NZ Telecom	**00 697 720 568 1045** 00 698 64 24 09 4169
Field Safety Training	NZ Telecom	00 698 64 24 09 2345
Field Support supervisor	NZ Telecom	00 698 64 24 09 2067
Field Support manager	via Denver NZ Telecom	**00 697 720 568 1003** 00 698 64 24 09 2545
Science & Tech Projects manager	NZ Telecom	00 698 64 24 09 3189
Mechanical Equipment Center (MEC)	NZ Telecom	00 698 64 24 09 2352
Science Construction	via Denver NZ Telecom	**00 697 720 568 1016** 00 698 64 24 09 2221
INFORMATION TECHNOLOGY & COMMUNICATIONS		
Comms Techs	via Denver NZ Telecom	**00 697 720 568 1061** 00 698 64 24 09 2796
Crary IT Support	NZ Telecom	00 698 64 24 09 4242
CHALET		
Chalet Administrator – Grantee Travel	NZ Telecom	00 698 64 24 09 2734
MEDICAL		
Clinic front desk	via Denver NZ Telecom Iridium	**00 697 720 568 1048** 00 698 64 24 09 2551 00 8816 763 15142
Bold indicates a preferred number.		

Field Gear

Shelters

Before field teams deploy to the field, they should become experienced in erecting the tents they are issued. The tents should be set up in McMurdo and their condition double-checked.

Tents should have a solid anchor for every guy line, and these should be checked daily to ensure they are tensioned. Loose guy lines make the tent more prone to wind damage, and they make catastrophic failures in a storm more likely. Hard knots should be avoided. Instead, use taut-line hitches or trucker's hitches for guy lines, as they are easy to undo. Field team members should practice and become familiar with these knots before deploying.

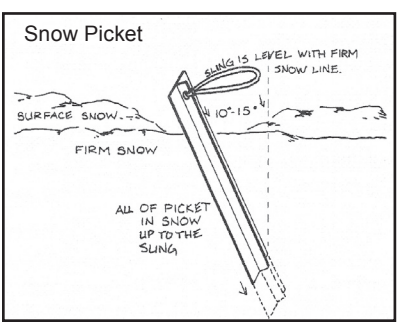
Anchoring Tents at Deep-Field Snow Camps

Establishing Wind Direction

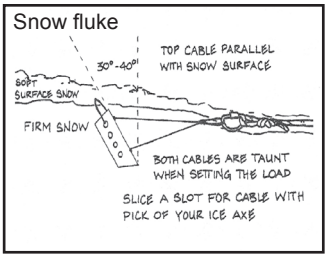
The most important factor in the set-up process is securely anchoring the tent so it can withstand high winds. Field teams should first determine the prevailing wind direction by observing patterns in the snow. Long rows of drifts (sastrugi) in, for example, a north-south orientation will indicate that the prevailing wind is either from the north or south. Look for etching at the ends. If the prevailing wind is from the south, the snow at the southern end of the sastrugi will be etched. Orient the tent with the main door opening downwind but at a 45-degree angle to the prevailing wind. This will help prevent drifting that blocks the door.

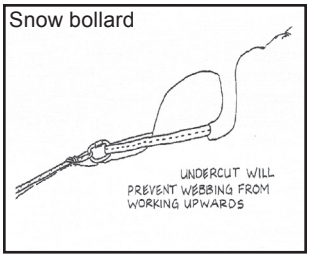
Anchoring in Hard Substrate

The best method for anchoring a tent is determined by the substrate. If the snow or ground is hard-packed, hammer long stakes or sections of bamboo ("pickets") at a 15-degree angle away from the tent, and attach guy lines to these.



Snow flukes and snow bollards represent additional ways to anchor tents, camp items, or other objects in hard snow areas (see illustrations on following page).

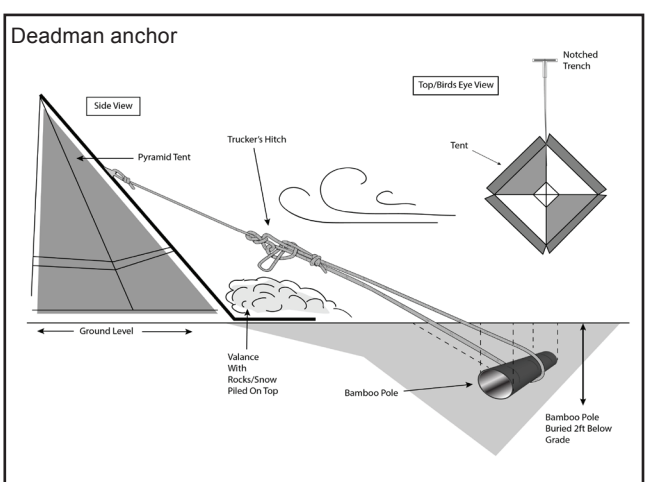




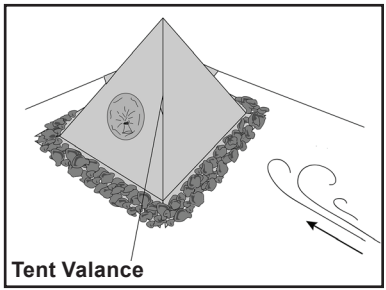
Anchoring in Soft Substrate

If the snow, sand, or soil are soft, bury a long stake or piece of bamboo ("deadman") in a slot perpendicular to the angle of pull, with a guy line attached at the mid-point. The guy line runs in a straight line from the deadman to the tent, via a slot notched in the ground or snow. The deadman should not be buried too close to the tent or it will be pulled upward when the line is tensioned. In very soft snow, the deadman anchor should be buried two feet deep or more.

Note: If anchoring on rocky land, especially in a volcanic area with sharp rocks, be aware that the guy line exiting the ground from the deadman could abrade in windy conditions. Monitor it frequently



and replace it if necessary. Alternatively, fabricate a make-shift sheath around the line from rock sample bags or whatever else may be on hand. Placing a length of bamboo between the guy line and ground may also help keep the line off sharp rocks.

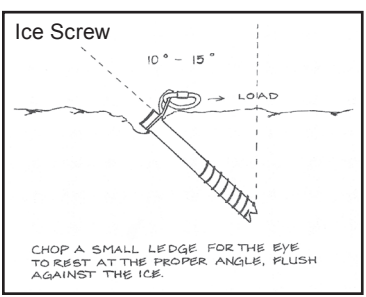


Tent Valance

All issued tents have a valance or "skirt" on either the tent fly or body. These should be fanned out flat and weighted down with snow or rocks to help keep the tent anchored in windy conditions. This also prevents wind from going underneath the valance and lifting up and damaging the tent. It also helps keep the tent warmer. Be careful not to pile rocks onto the wall of the tent, as this could abrade and tear the fabric in high winds.

Snow Walls

Snow walls, which are constructed with blocks cut from the snow, shelter tents from wind. If it is a windy day or if the camp is at a windy location, field teams may need to construct walls before attempting to set up a tent. Ideally, blocks are cut with a saw in hard-packed snow, but a shovel or ice ax may work. Since snow conditions can change over a small area, probe the snow to see if there is an area harder than others. If only soft snow conditions exist, the snow can be packed down with boots to see if it hardens (sinters) after an hour or more.

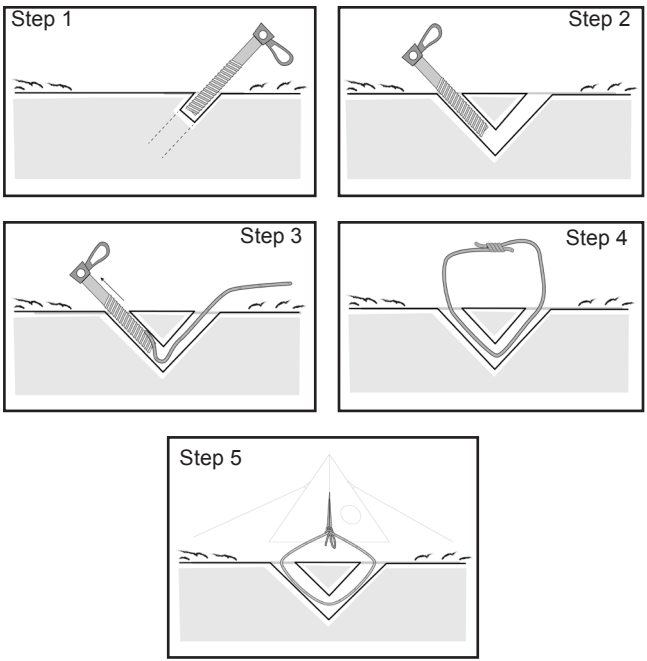


Anchoring Tents on Sea Ice and Blue-Ice Glaciers

If the snow on the ice is deep enough, anchor the tent as described above. Otherwise, clear off any snow and anchor the tent to the ice with ice screws. Team members may also drill V-threads (two holes

that intersect to form a V-shaped channel), use an ice screw or ice drill to feed a guy line through the channel, and attach the line to the tent.

V-Thread Anchor



Anchoring Tents in the McMurdo Dry Valleys

It is important that field teams adhere to environmental regulations and consider helicopter restrictions for site selection and camp set-up in the Dry Valleys. Team members should consult with the environmental department before departing for the field. Most commonly visited Dry Valley areas have pre-determined camping locations.

Large boulders can provide a wind break, and large rocks or stacks of rocks can be tied off as anchors. If the field team is using metal stakes for anchors, it may take several minutes to sledge

hammer each one into the frozen soil. If the team intends to move camp, members should take extra anchors, as it may be difficult to remove some from the frozen soil.

Emergency Shelters

If a tent is lost, the first and most important order of business is to arrange for protection from the wind, as this will increase the odds of survival.

The quickest emergency shelter to construct in snow is a trench. Dig a three-foot-deep, shoulder-width trench in the snow, making it long enough for a person to lie down, with extra room for gear. Cover the trench with a tarp, and anchor the tarp with snow blocks, bamboo stakes, shovels, sleds, or other equipment. Snow blocks or slabs may also be used to cover the trench opening. A trench can accommodate two people if the bottom is excavated to form a bell shape. However, the surface opening should remain shoulder wide.

Other emergency snow shelters are snow mounds (Quinzhee huts), snow caves, and igloos. Keep in mind that ventilation is critical if a stove is to be operated in any snow shelter.

On sea ice or on a blue-ice glacier, a wind break can be created by re-positioning snowmobiles and sleds.

Stoves and Heaters

The Berg Field Center (BFC) issues propane and white-gas cooking stoves to field parties. The Facilities department maintains the heaters in semi-permanent field camps and sea-ice huts. This guide provides information on stove and heater safety, basic operation, and troubleshooting. Contact Facilities or BFC personnel for assistance or further guidance.

Stove Safety

Liquid-fuel stoves are potentially hazardous due to the flammability of the fuels and the toxicity of the carbon monoxide they produce. Therefore, it is important for field personnel using a stove to follow these safety measures:

- Test all stoves before field deployment.
- Do not use stoves without adequate ventilation.
- Do not release fuel-tank pressure near an open flame.
- Use extreme caution when refueling. Skin contact with supercooled fuel can cause instant frostbite.

- Check for leaks before every use.
- Release pressure in the fuel tank before packing and storing.
- Pack stoves and fuel away from food.
- Do not cook in mountain tents, except in emergencies.
- Preheat the stove outside the tent.
- Insulate base of stove so it won't melt through tent floor.

Residues of evaporated gasoline are combustible. Designate a pair of gloves for fueling operations and don't use them near stoves. Should a person's clothing become ignited, stop, drop, and roll to extinguish flames.

Carbon Monoxide Risks

Carbon monoxide (CO) is a colorless, odorless, tasteless, and toxic gas produced by the incomplete combustion of carbon compounds, including the fossil fuels used in heaters and stoves. Dangerous amounts of CO can accumulate when fuel does not burn properly and/or when an area is poorly ventilated. Both of these situations can occur when someone is cooking in or heating a tent.

CO displaces oxygen in the bloodstream, starving the heart, brain, and other vital organs. People are even more susceptible to CO poisoning at altitude.

Carbon Monoxide is Dangerous

There have been several cases of CO poisoning in Antarctic field camps from improper stove use. This is completely avoidable. The best way to prevent CO poisoning is to ensure that any structure in which cooking is taking place is well ventilated. Because CO has no color, taste, or smell, it is better to be safe than sorry. In short:

- ALWAYS ventilate the tent.
- NEVER cook in or heat a tent without leaving a door or window cracked.
- Be especially vigilant if sleeping in a heated structure.
- VENTILATE, VENTILATE, VENTILATE!

Also, field teams must use a CO detector (issued from the BFC) when cooking, but the detector should not be attached directly to the stove. The detectors are not fool-proof, so all team members should remain vigilant of CO risks and symptoms. For information on the signs, symptoms, and treatment of CO poisoning, consult the First Aid section of this manual or contact the medical department.

MSR® WhisperLite™ Stove

Assembling the Stove

1. Fill the MSR® fuel bottle to within two inches of cap.
2. Screw the pump snugly into the fuel bottle.
3. Pump the plunger 15 to 20 times for a full bottle. Additional strokes will be necessary if the bottle is not full.
4. Insert the fuel line through the hole in the heat reflector.
5. Rotate the stove legs into the slots in the flame reflector.
6. Insert the end of the fuel line into the fuel-tube bushing on the pump. Lubricate the end of the fuel line with lip balm, and be extremely gentle when inserting.
7. Snap the catch arm securely into the slot on the pump body.

Operating the Stove

Priming:

1. To preheat the stove, the priming flame must contact the generator tube.
2. Open the control valve until fuel flows through the jet and fills the priming cup ½ full.
3. Close the control valve.
4. Light the priming cup or wick.
5. Place a windscreen around the stove.

Lighting:

1. As the priming flame diminishes, slowly open the control valve.
2. If the stove goes out, wait for the stove to cool and re-prime it.
3. If the stove burns with a yellow, erratic flame but the priming cup is still burning, turn the control valve off and prime longer.

Cooking:

- The stove should burn with a steady blue flame.
- To simmer, operate the stove with low pressure in the fuel bottle.
- Note that there is a delay between control valve turns and changes in flame intensity.

Shutting Off the Stove:

1. Turn the control valve off.
2. Wait for the stove to cool before disassembling.
3. To depressurize the fuel bottle, move away from heat,

sparks, or flame. Turn the stove assembly upside down and open the control valve. Pressure will be eliminated through the jet.

Safety Tips

- Do not use these stoves in mountain tents.
- Ensure the stove assembly has no fuel leaks.
- Securely lock the catch and ensure the stove is properly assembled.
- Clear the area of flammables and spilled fuel.
- Do not open the control valve more than three full turns.

MSR® WhisperLite™ Stove Troubleshooting

Problem	Possible Cause	Remedy
Fuel leaks at control valve	Control valve O-ring torn or damaged	Replace O-ring*.
	Control valve threads are damaged or stripped from over-tightening	Replace with new pump.
Fuel leaks at pump/fuel bottle connection	Incorrect fuel bottle in use	Use only MSR® fuel bottle.
	Bottle threads are damaged or bottle is dented	Replace bottle.
	Fuel bottle O-ring is torn or damaged	Replace O-ring*.
Fuel leaks at fuel line/pump connection	Fuel tube O-ring is torn or damaged	Replace O-ring*.
	Fuel tube bushing is damaged or missing	Replace bushing*.
Fuel leaks at fuel line	Fuel line is damaged	Replace fuel line or entire stove.
Fuel leaks at shaker jet	Shaker jet is loose	Tighten with jet and cable tool*.
	Shaker jet is damaged	Replace shaker jet*.
Fuel leaks through the shaker jet when control valve is off	The pump is damaged from over tightening the control valve	Replace pump.
Burner cap turns bright red and a dull roar is audible	The flame is burning under the burner cap instead of through the flame rings	Clean the jet, ensure the correct jet is installed, and ensure flame rings are clean and installed correctly.
Pump not pressurizing	Dry leather pump cup	Lubricate or replace pump cup.
	Dirt in check-valve assembly	Clean check-valve assembly.

Erratic yellow flame	Insufficient priming	Shut off the stove, let it cool down, and re-prime it.
	Fuel bottle is over-pressurized	Reduce bottle pressure.
	Improper fuel used	Replace fuel.
	Old or poor quality fuel	Replace fuel.
	Improper jet installed	Replace jet.
	Incorrect flame ring installation under burner cap	Re-install flame rings. Correct order is wavy, flat, wavy, flat, wavy, flat, wavy.
	Weather conditions are cooling the generator tube	Use windscreen and heat reflector.
	Lack of oxygen at high altitudes	Reduce fuel bottle pressure and open windscreen.
Reduced performance; diminishing flame, slow boil	Insufficient pressure in fuel bottle	Pump plunger as required to increase pressure.
	Obstructions in jet and/or fuel line	Remove obstructions.
	Incorrect jet installed for fuel type	Install correct jet.
* Stove and pump replacement parts available in the repair kit.		

Coleman® Gas Stove

Operating the Stove

Filling the Tank:

1. Close the valve and unscrew the tank cap. Do this carefully if the tank has pressure inside.
2. Use a fuel funnel (with filter) to fill the tank. Use white gas only.
3. Wipe off any spilled fuel and replace the cap.

Caution: Never open the tank around an open flame! Never remove the cap while the stove is running!

Pressurizing the Tank:

1. Close the cap and ensure the generator valve is closed.
2. Turn the pump plunger handle to the left to open.
3. Place a thumb over the small hole in the handle and pump 35 to 50 times.
4. Turn the plunger handle to the right to tighten.
5. Put the stove handle into the opening on the side, insert the generator into the mixing chamber, and place the tank in hanger brackets.

Lighting the Stove:

1. Close the auxiliary burner valve.
2. Turn the fuel-valve lever to the “up” position.
3. Hold a match above the main burner and open the fuel-flow valve wide.
4. Let the stove burn for one minute with fuel-valve lever up.
5. When the flame is blue, turn the valve lever down.

Note: Add more pressure if needed, but hold the tank firmly. If the flame does not burn fully, open and close the valve to clean the tip. After the main burner is lit, the auxiliary burner can be lit by opening the valve on the left side of the stove. If there are problems, refer to the “Troubleshooting Guide” included with the stove.

Shutting Off the Stove:

1. Put the fuel-valve lever in the “up” position and let the stove burn for one minute to reduce carbon deposits.
2. Turn off the valve. The flame will burn for a few minutes until the gas in the generator is gone. When the flame is out, let the stove cool before packing it away.

Coleman® Gas Stove Tips

Most problems associated with Coleman® stoves occur in extremely cold temperatures. This stove was not designed for use in sub-zero temperatures, and measures must be taken to enhance its performance:

- Use white gas only. Always use clean, filtered gas.
- Do not overfill the tank, as this impedes performance.
- The pump mechanism becomes impaired as temperatures drop. Keep the pump plunger oiled. Also, the rubber or leather pump cup sometimes dries out. It is essential to keep it oiled and pliable.
- In temperatures below -6°C, the stove generator must be preheated to ensure the fuel vaporizes. Apply priming paste along the generator and above the burner. Light it with a match. Allow at least three minutes of burning to ensure the stove is sufficiently preheated. When the flame burns down, make sure the lever is up and open the valve. The burner should light from the paste.
- Keep the stove and tank clean. Grease deposits can flame up. Line the inside of the stove with foil for easy cleaning.

Note: Place the stove where it can be thrown out of the tent in an emergency. Keep a small fire extinguisher nearby.

Coleman® Gas Stove Troubleshooting

If the fuel does not vaporize, liquid gas collects in the manifold assembly and a strong, blue flame cannot be achieved. The stove will sputter and spark, and the flame will be orange and sooty. If this occurs, shut the stove down and allow it to cool completely. Remove the tank assembly and clean fuel from the manifold and burners with absorbent pads provided in the spill kit (the small, black nylon bag). Replace the tank assembly and repeat the lighting process.

To access the control valve assembly (behind the knobs and under the burners) for troubleshooting:

1. Unscrew the burners
2. Turn the stove over and unscrew the nuts on the bottom. It should be possible to push the burner assembly up and release the retaining ring that holds the burner to the metal tray. Alternatively, spread the retaining rings to release the burner assembly.
3. Remove the metal tray for access to the burner and control valve assemblies.

Coleman® Gas Stove Troubleshooting		
Problem	**Possible Cause**	**Remedy**
No pressure	Cracks, dryness, creases, or tears in pump	Remove and inspect pump; replace if necessary and oil.
	Leaking tank lid gasket	Check gasket; replace if necessary.
	A flooded pump cylinder indicates a faulty pump valve	Replace pump valve.
	Broken seal at valve assembly and tank junction	Tighten by one rotation, if possible; replace seal if necessary.
	Loose generator	Tighten.
Loses pressure too fast	The tank will lose pressure the longer it sits without periodic pumping	If pressure is lost soon after pumping, check all joints and gaskets.
	Leaky cap and gasket	Replace if necessary.
Yellow flame	Bad or dirty generator	Clean or replace.
	Manifold assembly is flooded	Turn stove off, cool, remove tank assembly, and wipe out excess fuel.
	Bad fuel	Drain and replace with new fuel.

Orange flame (on older stove with flame rings)	Corrosion on flame rings	Remove flame rings as on a white gas stove. Lightly use steel wool or a nylon brush to remove corrosion from each ring and improve flame quality.
Flame at generator/manifold assembly	Tip of generator is loose	Tighten.
Weak flame	Generator too cold	Preheat generator.
	Bad or dirty generator	Clean or replace generator.
	Pressure too low	Increase pressure.
	Manifold assembly is flooded	Turn stove off, cool, remove tank assembly, and wipe out excess fuel.
	Contaminated fuel	Replace fuel.
	Control valve nut too loose	Remove the metal tray (see above). There is a small nut where the copper tube meets the control valve assembly. Try tightening (or first loosening then re-tightening) this nut. This often works on new stoves that burn poorly.
Flaring	Loose gas tip	Tighten gas tip (at end of generator).
	Flooded burner	Shut down stove and dry it out
	Excessive pressure in tank	Reduce pressure.
	Insufficient priming	Shut down stove and re-prime.
	Premature switch to “on” position of fuel flow switch	Refrain from opening fuel flow switch too early.
	Contaminated fuel	Replace fuel.
	Grease in stove	Clean grease out of stove. Line the bottom of the stove with foil and change when dirty.
Poor gas flow to burner	Clogged generator	Clean or replace generator.
	Cleaning needle is non-functional or bent	Check the needle and replace if necessary.

Coleman® Propane Stove

Note: Propane cylinders should only be stored outside of a tent. Use a long propane hose though an opening in the tent door or window to connect the cylinder to the stove.

Setting up the Stove

1. Press on latch to open the lid.
2. Position the wind baffles.
3. Insert wire clips into slots.
4. Close both burner valves firmly.
5. Remove the regulator from storage under the grate.
6. Attach the regulator, hand tight, to hose or propane bottle.
7. Inspect the gasket on the stove connection before attaching the regulator.
8. Screw the regulator hand-tight onto the stove.

Operating the Stove

Lighting Electronic Ignition Stoves

1. Open the burner valve and rotate the igniter knob several times until the burner lights.
2. Use a match to light the burner if the igniter fails.

Lighting Standard Ignition Stoves

1. Hold a lighted match near the burner and open the valve.
2. Adjust the flame with burner valves.

Shutting the Stove Off

1. Close the burner valves firmly.

Storing the Stove

1. Remove the propane cylinder or hose.
2. Unscrew the regulator from the stove and store it under the cooking grate.

Preway® Diesel (AN-8) Heater

These heaters are installed in huts in the McMurdo Dry Valleys.

Lighting the Heater

1. Make sure the Preway® is level. This is very important! If it is not level, it will not burn correctly.
2. Make sure the outside fuel valve at the tank is open and the breather tube is open to prevent “air lock.” If there is no breather tube, loosen the upper bung cap.
3. Open the valve behind the Preway®.
4. Take a small piece of toilet paper, wrap it around the end of a wire, and place a small amount of burn paste on it.
5. Push the safety lever down on the carburetor.

6. Open the valve knob on the carburetor to “3” (the halfway position).
7. Allow a small amount of fuel (about two tablespoons) to puddle in the bottom of the burn chamber.
8. Shut off the valve knob on the carburetor.
9. Light the fuel in the burn chamber with the tissue on a wire, removing it once the fuel is lit.
10. Allow the fuel to burn until the flame is nearly out. This preheats the chamber.
11. Open the valve knob on the carburetor to “3” again and push down the safety lever.
12. Adjust heat as desired. Typically these heaters burn poorly and will soot excessively on either “1” (too low) or “6” (too high), reducing performance and requiring frequent cleaning. Stick with settings “2” through “5.” For reference, a properly burning heater doesn’t require cleaning more than once every couple of months.

Shutting Off the Heater

Close all valves and lift the safety lever on the carburetor.

Things Not To Do with a Preway®:

- Do not leave burned tissue in the chamber, and do not throw any other combustibles in the burn chamber. Yes, they will burn (partially), but the heater will soon stop working and be full of partially burnt ashes. The Preway® is not an incinerator.
- At start-up, do not turn the stove up to a high number immediately. Let the heater warm up first on “3” or it will make frightening “woofing” sounds.
- Don’t leave the burn chamber door open longer than necessary when the heater is burning. It interferes with proper drafting by letting too much air in.
- NEVER wire down the safety lever on the carburetor. If it needs to be “held down” for operation, there is an internal problem that needs to be addressed. Wiring down the lever poses two risks: 1) flooding the heater with too much fuel (creating a mess), or 2) flooding the structure with the full contents of the fuel barrel (even bigger mess).

Kuma® Stoves, ARCTIC Heater

Kuma Stoves will replace the old Preway heaters and are installed in sea-ice huts, some Dry Valleys huts, and at deep-field fixed camps.

Caution: The handles on the side of the heater are surprisingly hot.

Do not touch or hang towels or clothing over the handles.

Please read instructions completely before lighting the stove.

Starting the Heater

1. Be sure that the burn chamber is clean before lighting.
2. Open stove door and remove stainless steel mesh cylinder and burn ring from the burn pot.
3. Turn on all supply valves (tank and in-line valves).
4. If there are any leaks in the system, turn off all valves immediately.
5. Turn control knob on carburetor to setting 1.
6. Move ON/OFF lever on carburetor to the correct position to start the flow of fuel oil into the burn pot. Depending on what model of carburetor is on your particular stove, it may need to be pressed down for ON, or be pulled up for ON. The correct orientation will be indicated on each carburetor near the ON/OFF lever.
7. When enough fuel has entered the burn pot to fill the center groove (~ 4 tablespoons), turn the control knob AND the carburetor lever OFF.
8. Replace burn ring into the burn pot so the cupped part of the ring is face-up (as if it would hold water). The stove will not burn properly if the ring is face down.
9. Squeeze a small amount of burn paste (about the size of a marble) onto the end of the metal wire, light the paste, and place the fireball into the puddle of oil in the burn pot. Using the wire, spread the fireball around the fuel puddle.
10. Replace the stainless mesh cylinder and close the door tightly (turn door handle until it is snug). Do not overtighten!
11. Wait for the fuel in the burn pot to catch fire. After the flame begins to die down (it could take several minutes), turn the carburetor ON again (ON/OFF lever) and turn the control knob to setting 1.
12. The flame should gradually get larger and within a few minutes the stove should begin burning a blue flame.
13. Run the stove for at least 15 minutes on low (setting 1) to allow chimney and stove to heat up before adjusting the temperature. Failure to allow proper heating time will cause the system to soot up.
14. After fifteen minutes, turn control knob (1 to 6) to achieve desired heat level. Repeat: Make sure the flue and stove are warmed up before making any carburetor adjustments.

Adjustments should be of no more than one-quarter turn, and each should be allowed to stabilize for five minutes before making any further adjustments.

Warning: Do not light a flooded or hot stove!

Warning: Do not throw foreign objects in burn chamber! No paper, wrappers, matches, or used tissues!

Note: Tissue paper can be used to light fuel if you run out of burn paste, but do not leave burned tissue paper in burn pot.

Shutting Off the Kuma Heater

1. Trip the float switch on the carburetor and turn the dial on the carburetor to 0 or "off" (clockwise).
2. The ball valve near the fuel filter can also be turned off to stop the flow of fuel to the heater. Do not adjust the "firematic" valve that is between the fuel filter and the stove (the only round handle on the fuel line that resembles a spigot).

Empire® Vented Propane Heater

These heaters are installed in sea-ice huts.

Starting the Heater

1. Turn on propane at the tank by turning the knob all the way to the left.
2. Open the combustion air vents on the wall.
3. Open the valve behind the stove (the handle in line with the tube to the stove).
4. Set the heat dial (numbered 1-7) to "1."
5. Remove the front panel of the stove by lifting the bottom out and then up.
6. Remove the pilot-light sight glass.
7. Push and hold down the control knob; turn from "off" past "ign" to "pilot."
8. Light the pilot with a match; don't bother with the piezo igniter.
9. Hold the control knob down in "pilot" position for one minute after lighting.
10. Let the control knob pop up and move it to the "on" position.
11. Replace the sight glass and front panel of stove.
12. Adjust heat dial as desired.

Shutting Off the Heater

1. Set heat dial to “1” and control knob to “pilot.”
2. Close combustion air vents.

Note: The pilot light should be left on at all times unless the tank is being changed or the hut is being moved. Be sure and turn off the propane at the tank if moving the hut.

Sleds

The Berg Field Center (BFC) issues several types of sleds that can be towed behind a snowmobile or pulled with a rope by someone skiing or walking. Each field team should consult with BFC staff to determine which sled type matches the team’s requirements.

Loading and Securing Cargo

Following are illustrations showing how to distribute the cargo load on a Nansen sled. The same principles apply to the other sleds.

Load the heaviest items on the bottom. Place small items in sled bags. The survival bag should be placed at the top of the load, along with anything the team members might need during the day. Rock boxes (18” L x 12” H x 12” D wooden boxes) make convenient containers for fieldwork and can be loaded with both samples and gear. Rock-box platforms are available if the team anticipates hauling a large number of boxes.

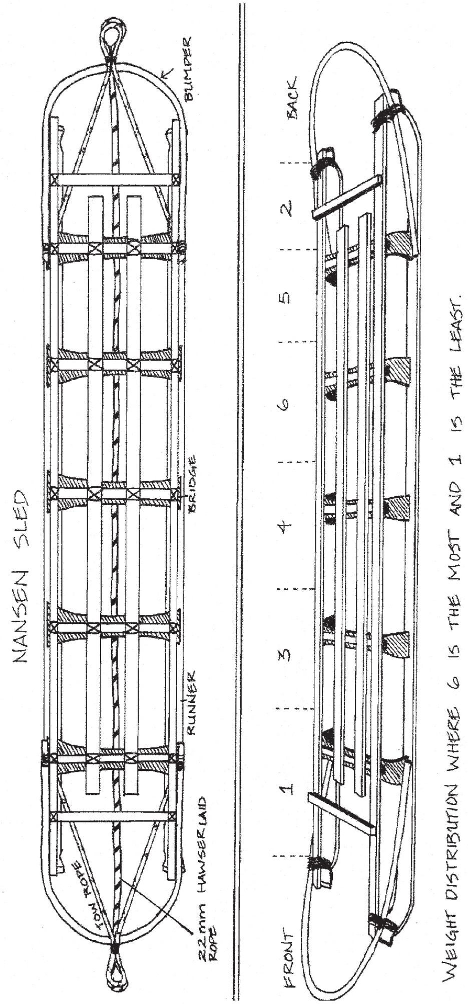
It is best to transport fuel drums on drum cradles for stability.

- Nansen sleds can haul two drums side to side.
- Siglin® ultra high molecular weight (UHMW) sleds can also accommodate two drums side to side.
- Komatik sleds can carry up to five drums side by side.

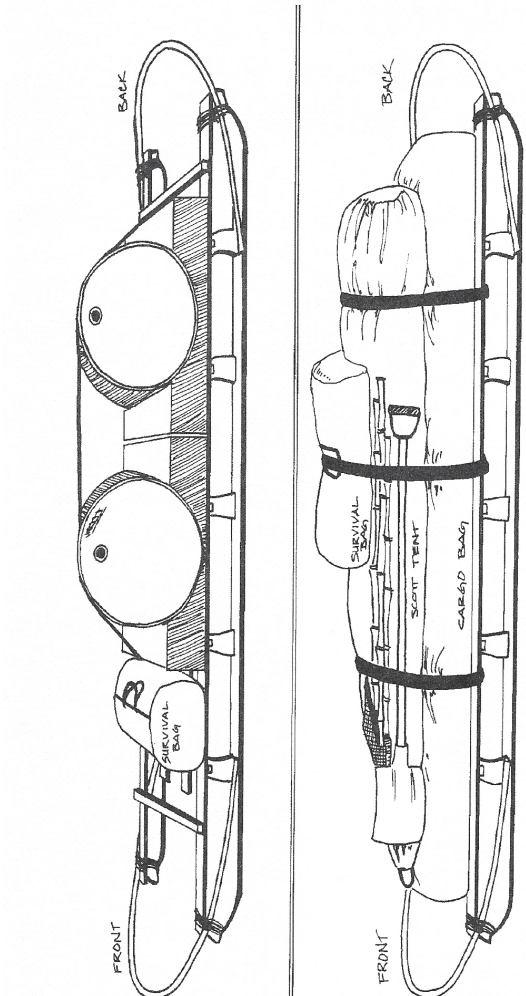
Secure the finished load tightly with cord, cargo straps, or bungee cords. Banana sleds have fabric cargo covers attached along the sides. The fabric folds over the cargo and is tied down. Siglin UHMW sleds have side ropes for lashing down gear.

Avoid using hard knots when rigging loads for travel. Use taut-line hitches or trucker’s hitches instead, as they are easy to undo if it becomes necessary to re-tension a cord. Be sure to check all lashings periodically and every time the team stops for any reason. Also inspect the snowmobile, tow plate, ropes, and sled at the same time for any developing structural issues. Re-tighten the lashings if they have become loose. It is prudent to bring extra lashing supplies into the field.

Nansen sled weight distribution example



Nansen sled load example



Pulling Sleds with a Snowmobile

With ideal surface conditions, a tail wind, and light loads, a snowmobile may achieve seven miles per gallon (mpg). Soft snow conditions, heavy loads, and strong head winds significantly reduce fuel efficiency. Mileage can drop to as low as two to three mpg. In good conditions, a snowmobile may be able to pull up to 2,000 pounds. Soft snow and a head wind will reduce that substantially. It is important for field teams to keep these things in mind when planning loads and fuel consumption.

Snowmobile operators pulling a sled should adhere to the following rules:

- Attach sleds equipped with rigid tongues directly to snowmobiles. Other sleds attach with a tow rope.
- Before driving, rock sleds back and forth to break the runners and bottom free of the ice.
- Drive slowly. Driving fast over uneven terrain may cause a sled to tip over, which can damage not only the sled and cargo, but the snowmobile as well.
- Drive even more slowly if pulling passengers.
- Maintain situational awareness and regularly look back to ensure everything is riding securely, especially passengers.
- Stop gradually so the sled doesn't run into the back of the snowmobile.

Snowmobiles

The Mechanical Equipment Center (MEC) provides training in the operation and maintenance of snowmobiles, generators, and other equipment to science team members before they deploy to the field. General operation and troubleshooting guidance is provided here as a reference. Contact the MEC for assistance or further guidance, if required.

Operational Guidelines

- All riders and passengers must wear a helmet! This includes people pulled on a sled behind a snowmobile.
- Each operator is responsible for checking the machine before each use.
- Ensure the correct fuel is used. Snowmobiles have two-stroke engines that require gasoline (mogas) pre-mixed with lubricating oil. The mixture ratio is 50:1 (12 ounces of oil per five gallons of mogas).

- To avoid over-working the electric starter, the pull starter should be used when the engine is cold.
- A snowmobile's center of gravity is just in front and toward the bottom of the fuel tank. Operators must shift body weight for turning and as needed for the load, the terrain, and the snow and ice conditions.
- Be mindful of track tension. In general, if the track is slapping against the frame tunnel while the snowmobile is in motion, it is too loose. Adjustments to both tension and alignment are made via long bolts at the end of the suspension.
- Watch for loose trailing straps and ropes, as these can get tangled in the tracks and around axles.
- Never shift the transmission unless the snowmobile is stopped. Shift gently. If gears will not engage, turn off the engine, shift gears, and restart. Abusive shifting can cause drive-train problems that are not repairable in the field.
- Park snowmobiles so they face into the prevailing wind, and always cover them. This reduces the likelihood of snow fouling the points and accumulating under the cowling.

Preventative Maintenance

Daily

- Check operation of the snowmobile.
- Check the suspension, particularly when operating on ice. Look for broken suspension components.

Weekly

- Check for loose mounting bolts on bogie wheels, skis (particularly the two bolts through the springs), rear suspension, and steering. A small suspension problem can rapidly become serious (e.g., slashed tracks, broken bogie mounts).

Loading, Towing, and Driving

Loading

- Maintain a low center of gravity.
- Place survival packs on the front to help maintain ski contact on hills.
- Keep straps tied down; ensure there are no loose ends.
- Place frequently used items where they are easy to access.

Towing a Sled

- Sleds may be towed with rigid tongues or ropes, depending on the circumstances. Rigid tongues are preferable.

- Check the hitch mechanisms on both snowmobile and sled for proper operation.
- Cover the load to protect it from track spray, if necessary.
- Check load tie-downs for tightness and security shortly into each trip.
- Check both the sled and the load frequently.

Driving

- Whenever possible, drive on a proven trail or a hard surface.
- If driving in powdery snow and the snowmobile begins to bog down, head in the straightest line possible for firmer or packed snow; sharp turns will compound the problem. Maintain the throttle.
- If the machine slows and reaching firmer snow appears impossible: STOP! DO NOT CONTINUE SPINNING THE TRACK!
  – Tip the snowmobile on its side (in both directions, if necessary), clear snow from the track, and pack the snow under the track.
  – Dig a ramp out of the hole and attempt to ease the machine out of the hole, with other people pushing. Or use a tow rope and have another snowmobile pull the stuck one out.

  Caution: If a stuck machine does not come out quickly when towing it, stop towing and dig more. Continual towing wears drive belts prematurely and can cause them to break. It can also damage engine parts.

Troubleshooting

Fuel Flow Problems

Symptoms: The engine cranks but it won't run; no fuel is present in the line from the pump to the carburetor; the engine may run briefly after priming.

Diagnosis and Cure:

1. Check the fuel level in the tank.
2. Pry the fuel line off the carburetor, pressurize the fuel tank (i.e., seal and blow into the vent line) to see if fuel flows out the end of fuel line. Crank the engine to see if fuel pulses out the end of fuel line.
3. If fuel flows adequately and pumps adequately, the problem may have been small ice crystals in the fuel pump valves. Pressurizing the tank dislodged them, solving the problem. Replace the line and continue operation.

4. If fuel flows when the tank is pressurized but does not pump, the problem is in the fuel pump. First, disconnect the vacuum pulsation line from the center of the fuel pump to the engine crankcase. Blow through the line. If it is blocked, clean ice out of the line with wire. Check the nipples on the pump and crankcase for obstructions. If the vacuum line is operational but fuel still does not pump, replace the pump or remove it and thaw it.
5. If fuel will neither flow nor pump, then either the line or the fuel filter is clogged. Clean the line or replace the filter.
6. If the tank is under vacuum pressure when the cap is open, check the vent line for obstructions or pinches. Occasionally the vent hose will rub on the exhaust and melt. Make sure the tank is venting properly.
7. If all of the above is tried and still no fuel flows, check the line for cracks or holes. Look for any obvious fuel deposits (i.e., discolored snow) in the engine compartment. Repair or replace the line.

Starter/Cranking Problems

Symptoms: Engine cranks slowly or not at all when key is turned.

Diagnosis and Cure:

1. Usually this problem indicates a dead battery. If that is the case, the engine must be pull-started. Once the engine is running, the battery should begin to recharge, unless it is shorted or the rectifier is faulty. The battery can also be charged with an AC charger, if one is available.
2. If the battery is fine, check the in-line fuse (30 amp) in the red wire near the starter or see if the red-green wire has slipped off the terminal on the starter solenoid. Finally, the starter itself may be faulty.

Spark Problems

Symptoms: The engine cranks but it won't start. Fuel is present in the line between the fuel tank and carburetor.

Diagnosis and Cure:

1. Remove both spark plugs. Push the spare plugs into the wire caps, ground the metal plug bodies to the metal engine housing, and crank the engine. If a spark can be seen at the electrodes of the spare plugs, the problem may be that the installed plugs were fouled with excessive fuel, ice, or a piece of carbon. Install the new plugs or clean and reinstall the old ones. Note: When the engine is cold, it may be hard to see the spark in direct sunlight.

2. If a spark is not present, the problem is in the electrical system. First, check the kill switches and all electrical connectors. If they are in the correct position and operational, the solution to the problem depends on the engine type.
    a. 503/550: These models have an electronic ignition, so the problem is probably the igniter box. Replace the igniter box.
    b. Other engines: The problem may be a bad coil or a shorted wire.

Power Problems

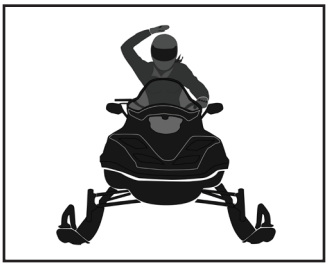
Symptoms: The snowmobile runs but it lacks power.

Diagnosis and Cure:

- If engine seems to be running fine, but the snowmobile has trouble with uphill starts, the problem may be with the clutch-driven pulley. Remove the cowling and see where the belt is riding on the pulley. It should be along the outer edge of the driven pulley when the snowmobile is at rest. If the belt is instead slotted down between the driven-pulley halves, check for ice in the drive and driven pulley. Shift the transmission into neutral and rev the engine slowly until the belt works its way to the outer edge.
- If the engine has very low power or dies when revved, remove the carburetor and check for ice. If ice is present, thaw out the carburetor and reinstall it. If the engine is weak and runs rough, but the carburetor is ice free, the problem may be a bad spark in one cylinder. Follow the procedures outlined in Spark Problems.
- The problem may be altitude. If hill-climbing performance is weak and the problem isn't the belt or an iced-up carburetor, check the spark plug color. Chocolate brown is correct; gray or white too lean; and black signifies a mixture that is too rich. For altitudes up to 4,000 feet, decrease jet size by one increment from the standard setting (i.e., 290 to 280). From 4,000 feet to 8,000 feet, decrease it by two increments. From 8,000 feet to 11,000 feet, decrease it by four. Remember to enrich the mix when returning to lower altitudes.

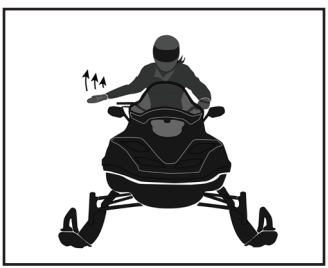
Driver Communication

Hand signs for group travel on snowmobiles

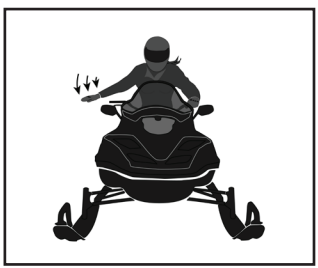


Hand on head: “OK, ready to depart.”

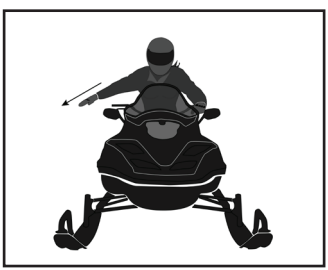
Fist in air, elbow at right angle: “Stop” or “Stopping.”



Arm outstretched, palm up, pushing up: “Speed up” or “Speeding up.”



Arm outstretched, palm down, patting down: “Slow down” or “Slowing down”



Arm outstretched, pointing: “Watch out for crevasses and other hazards.”

Honda Generator

Generator Safety

- Place the generator on a firm, level surface. If the generator is tilted or turned over, fuel may spill or the generator may become contaminated with soil or water.
- To prevent a fire hazard and provide adequate ventilation, keep the generator at least three feet away from tents or other equipment during operation. Do not place flammable objects close to the generator.
- Know how to stop the generator quickly. Know how to operate all the controls.
- Do not let the generator get wet, and do not operate it with wet hands. The generator is a potential source of electrical shock if misused.
- Gasoline is extremely flammable and is explosive under certain conditions. Do not smoke or allow flames or sparks where gasoline is stored or where the generator is refueled. Refuel it in a well-ventilated area, with the engine stopped.
- The engine muffler becomes hot during operation and remains hot for a while after stopping the engine. Do not touch the muffler or engine until the generator has cooled down. Let the engine cool before storing the generator indoors.

Pre-Operation Check

1. Check and add fuel (mogas), if necessary.
2. Check and add engine oil (0W30), if necessary. Check the oil level every time fuel is added.
3. Check the air cleaner element to ensure it is clean and free of ice and snow. It should feel oily.

Starting the Engine

1. Make sure the AC circuit breaker is in the “off” position. It may be hard to start the generator if a load is connected.
2. Turn the fuel valve to the “on” position.
3. Pull the choke rod or lever to the closed position. **Note:** Do not use the choke if the engine is warm.
4. If the generator is so equipped, make sure the auto-throttle switch is off.
5. Move the engine switch to the “on” position.
6. Pull the starter grip slowly until resistance is felt, then pull briskly. **Note:** Do not allow the starter grip to snap back. Return it slowly by hand.

7. Once the generator has started, push the choke rod or twist the choke lever to the open position as the engine warms up.
8. Allow the engine to warm up for three to five minutes; do not apply a load during this time.
9. Once the generator is warm, turn on a breaker or plug in a load.

Stopping the Engine

1. Turn off the breaker or unplug the load.
2. Allow the generator to run unloaded for two minutes to cool down.
3. Turn off the engine switch.
4. Turn off the fuel supply.

Troubleshooting

Symptom: The engine will not start.

Diagnosis and Cure:

1. Check that the engine switch is on.
2. Check to see if the oil-alert lamp flashes when the starter is pulled. If it does, add oil.
3. Ensure all loads are disconnected from the AC receptacles.
4. Check to see if there is a spark at the spark plug. Ground the side of the electrode to the engine and pull the recoil starter to see if a spark jumps the gap. If there is no spark, replace the spark plug.
5. Check to see if gasoline is reaching the carburetor. Place a suitable container under the carburetor and loosen the drain screw. Fuel should flow freely. If it does not, check the fuel valve on the tank.

Symptom: The engine starts but stops immediately.

Diagnosis and Cure:

1. Check the oil level. If it is low, fill the oil reservoir to the top of the dipstick.
2. Restart the engine.

Symptom: There is no electricity at the receptacles.

Diagnosis and Cure:

1. Check to see if the AC circuit breaker is on.
2. Check the appliance or equipment plugged into the generator for defects.

SunBox Power Systems

The SunBox Power System is a portable, self-contained solar power supply that can be disconnected and disassembled quickly for transportation. The unit is composed of three components: a weatherproof box, a solar panel stand, and an output cable. The input and output cables connect to the battery box via sturdy, screw-on, weatherproof connectors. The system is fully grounded, and all wiring and electrical components are rated to -40° C. Maximum output is 300 watts AC or 80 watts DC.

Directions:

1. Open the box and inspect the unit for damage or loose wires. Correct as necessary.
2. Decide on the configuration of the solar panels. They can be mounted on top of the box with four 1/4 X 20 bolts, they can stand independently and be tied down, or they can be spread out to face the sun for maximum input. However they are configured, ensure the panels are secure in case of wind gusts.
3. Connect the three-pin solar plug to the three-pin receptacle.
4. Connect the five-pin extension cord to the five-pin receptacle.
5. Turn the 40-amp breaker to “on” and turn the switch on the far side of the inverter to “on.” AC power will now be available.

When battery power is low, the AC and DC outputs will disconnect. The power will not return until battery voltage reaches 12.2 volts DC. Disconnect loads and let the system recharge. Recharge time from 80% discharge is approximately three days in the sun. Keep in mind there is rarely full sun in Antarctica for three days in a row.

Weather Observations and Ice Assessment

Antarctic Weather

Weather in Antarctica is characterized by extremes: extreme temperatures, extreme winds, and extremely variable local conditions. All of this makes Antarctica a challenging place to work and live. The temperatures can vary from below -40°F (-40°C) to above freezing during the course of an austral summer. Moderate to strong winds are common. It's an unusual day when there is not at least a breeze blowing. The wind takes its toll on people, making camp chores, such as setting up tents, difficult. More importantly, wind chill increases the risk of hypothermia and frostbite. The wind chill chart in the reference section shows the effect of wind on perceived termperature.

McMurdo Area Weather

Storms arrive quickly and are sometimes fierce enough to halt all outside activity. Storms can also be very localized. Weather at McMurdo Station can produce near-zero visibility with blowing snow (halting flight operations), while the McMurdo Dry Valleys, which are 50 miles away from McMurdo, might be calm and sunny. Approaching storms are usually preceded by high, thin bands of cirrus clouds (mare's tails), followed by thicker layers of cirrus, which may cause a halo-like effect around the sun. The clouds grow progressively thicker and lower over the next six to 12 hours until the arrival of low cumulus clouds and the main front. Blizzards can happen any time of year and may last from several hours to several days.

Storms usually approach McMurdo Station from the south, through the gap between Black Island and White Island. They eventually obscure Minna Bluff with blowing snow or low clouds, at which point there is usually less than an hour before bad weather hits. Travel is difficult and dangerous during storms and should be avoided. Blowing snow can hide crevasses or sea-ice cracks. Even moderate winds can produce a layer of dense, blowing snow that may be as thin as a few feet or as thick as 1,000 feet. Whiteouts are equally dangerous phenomena. In a whiteout, thick, low clouds reduce surface definition, and the horizon is obscured. It's difficult or impossible to know if one is on a flat or sloping surface. It is also difficult to judge distances or the size of objects. Travel should only be attempted during a whiteout if there is an emergency. People caught unexpectedly in a whiteout should stop and wait for visibility to improve enough to reveal a recognizable landmark.

Antarctic Weather in Remote Locations

Weather conditions vary widely throughout the Antarctic continent, depending on a location's elevation, topography, and relative distance from the ocean. The polar plateau is very cold because of its higher altitudes and greater distance from the moderating effect of the sea. Areas near the coast can be subject to wet, heavy precipitation and warm days with intense sunlight. Winds at remote Antarctic sites range from calm and light to sustained hurricane force. Past reports and weather data can help parties plan for weather conditions at a given site. Still, it is best to expect the unexpected when it comes to weather.

Antarctic Weather Forecasting

Weather forecasting for U.S. Antarctic stations is done under the auspices of the National Science Foundation and is coordinated through the SPAWAR (Space and Naval Warfare) Systems Center in Charleston, South Carolina. SPAWAR also has a presence at McMurdo Station. Compared to most places in the world, Antarctic weather forecasters have fewer data collection sites upon which to base their forecasting models. Forecasters rely heavily on weather observations called in from remote field sites. They also use satellite imagery, data from automated weather stations, and a weather modeling system, the Antarctic Mesoscale Prediction System (AMPS), which produces twice daily forecasts for the Antarctic continent.

Terminal Aerodrome Forecasts (TAFs)

Weather forecasts for remote sites are called Terminal Aerodrome Forecasts (TAFs), and they are generated each day for sites scheduled to receive aircraft. A TAF is automatically generated for a given site based on the aircraft schedule; field personnel do not need to request one in advance. TAFs are usually issued every eight hours for a 24-hour period and are effective for 24 hours from the time they are issued.

Occasionally, an amended or corrected TAF will be issued between the standard issue times. Amended TAFs are issued when the current TAF no longer adequately describes the ongoing weather or the forecaster feels the TAF is not representative of the current or expected weather. Corrected TAFs are issued when there is misinformation on the original TAF.

USAP Field Party Weather Observing

Field parties must identify the person or persons responsible for making weather observations each day and reporting these observations to the McMurdo Weather Center (MacWeather). Weather observations made at remote field locations facilitate safe and timely aircraft operations to those locations. The data also support the continent-wide weather forecasting system.

When to Make Observations:

1. If no aircraft activity is planned:
   a. Make three daily weather observations and report them to MacWeather at 1800 Zulu (Z), 0000Z, and 0600Z.
   b. On holidays, only two observations need to be reported: morning (1800Z) and evening (0600Z).
   c. All observations should be recorded and called in to MacWeather within 15 minutes of the scheduled time.
   d. Begin the observation about 15 minutes before the top of the hour. (Weather observations should take 10 to 15 minutes to complete.)
   e. Call in the observation within five minutes of the hour.
2. If a fixed-wing aircraft is scheduled to arrive:
   a. Hourly observations begin six hours before an LC-130 and three hours before a Basler or Twin Otter aircraft is scheduled to depart from its original location en route to a remote camp.
   b. Hourly observations continue while the aircraft is on the ground at camp.
   c. If there is a change in the weather before an hour has passed since the last observation, a special observation is reported.
   d. Observations return to the normal daily schedule when the aircraft departs.
3. If a helicopter is scheduled to arrive, camp personnel should call the hangar Iridium with a weather update between 0715 and 0730 or between 0745 and 0800.

Setting Up a Weather Observation Site

Altitude and Grid North

Key information for setting up a weather observation station is available from the pilot of the aircraft. Upon arrival, the designated

weather observer should ask the pilot for an exact altitude reading. This number is required to take accurate pressure readings with the handheld weather meter (Kestrel®). Also, the pilot should be able to identify grid north. This will assist in setting up the flagged weather-observation site.

Grid North Versus True North

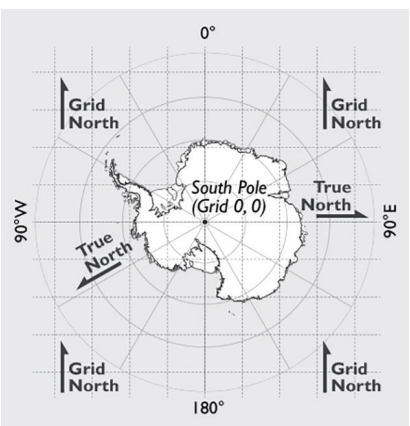
In order to avoid confusion, especially when traveling where lines of longitude converge near the South Pole, fixed-wing aircraft pilots navigate using directions based on an artificial grid pattern overlaying the continent, rather than on true compass directions. The designated weather observer in a fixed-wing supported camp should use these grid directions and not true or magnetic direction readings when observing and reporting the weather.

Helicopter pilots use true compass direction to navigate, and helicopter-supported groups should use that for reporting weather.

North has been conventionalized in two ways:

True North is defined as the direction of a line of longitude that ends at the North Pole.

Grid North is defined on the Antarctic Polar Stereographic Grid, with 0 degrees longitude acting as the reference (central) meridian and the South Pole as the origin (0, 0).



Determining Grid Directions

To determine grid north, face true north and treat your meridian as the prime meridian (0^0 or 360^0). For east longitude camps, grid north will be true north (360) minus the longitude of the camp.

For west longitude camps, grid north will be true north (0) plus the longitude of the camp. Once grid north has been identified, grid south, east, and west can be determined easily.

Examples: For a camp located at 167^0 E, subtract 167^0 from 360^0. Place the flag for grid north at 193^0 true (i.e. "true" to your subjective orientation, where 167^0 E is treated as 0^0).

For a camp located at 60^0 W, add 60^0 to 0^0 (true north). Place the flag representing grid north at 60^0 true.

Note: The declination between magnetic north and true north varies widely throughout the continent. Observers using a magnetic compass to determine direction must be sure to use an accurate declination for their location.

Grid Direction Flags

Upon arriving at a camp, team members should create a weather-observing site. Use four flags placed a few meters apart at the points representing grid north, grid south, grid east, and grid west. Label each flag with its grid direction. The observer should stand in the middle of this flag configuration when making weather observations. This will help determine the direction of the wind and provide a consistent point from which to observe sky and ground conditions.

Visibility Markers

To help determine visibility levels, team members should place a second layer of flags spaced 400 meters (1/4 mile) away, in line with each directional flag. If possible, additional flags should be placed at major intervals, such as 800 meters (1/2 mile), 1,600 meters (one mile), and/or 3,200 meters (two miles). The team members should measure and record distances to landmarks that can be seen from camp for additional help in determining visibility.

Setting Up the Handheld Weather Meter (Kestrel®)

Weather observers in remote locations often use a handheld weather meter to measure wind speed, temperature, dew point, and pressure. The handheld weather meter discussed in this manual is the Kestrel® 4000. Observers using a different meter should refer to the user instructions for that meter.

The Kestrel® 4000 is available through the Berg Field Center (BFC). The field team member picking it up should ensure the Kestrel® is set to measure temperature in Celsius, wind speed in knots, and altitude in feet. Extra batteries should also be procured at that time, in case the batteries in the Kestrel® lose power in the field. The Kestrel® must be returned to the BFC promptly at the end of the season.

The Kestrel® should be stored in an inside coat pocket or a warm area when not in use. The liquid crystal screen will function only at temperatures above -10°C (-14°F). At colder temperatures, the screen will be sluggish and eventually fade, although the device will still record data. The Kestrel® should be returned to a warm, inside coat pocket as soon as possible after use.

Setting a Reference Altitude and Barometric Pressure on the Kestrel®

Obtain the remote site's altitude in feet from the aircraft pilot. (Be sure to notify the pilot in advance so he or she knows to provide this information before departing.)

Navigate to the barometric pressure (BARO) screen and press the center COMMAND button to enter. On the screen, go to the reference altitude (Ref Alt) line. Use the left and right buttons to increase or decrease its value to equal the altitude (in feet) provided by the pilot. Be sure the Kestrel® is set with feet as its default altitude measurement. Notice that the barometric pressure reading changes in response to changes in the altitude number. Press the COMMAND button to save and exit the adjustment mode.

Next, go to the altitude screen and navigate to the reference pressure line. Enter the barometric pressure number now shown in the BARO screen. Since the Kestrel® is used to monitor barometric pressure for weather reporting, it should be kept in the same location (i.e., at the same altitude), because the pressure will change with changes in altitude. Read the pressure from the BARO screen.

Weather Reporting Sheet

Record weather observations on the Surface Weather Observations form (METAR/SPECI). MacWeather provides this form, which is too detailed to print here. Review how to fill it out at your weather briefing with MacWeather personnel before deploying to the field. Guidance is also provided in the following sections. **Note:** It is not necessary to maintain a written record of each observation. MacWeather will record and track the observations called in.

Camp Name/Location

List the latitude and longitude of the camp. If the camp has a name, provide that too. Example: Whillans Ice Plain Camp - Latitude: 83.65 S, Longitude: 167.4 W

Time in Zulu (GMT)

Weather observations should be reported using Zulu (GMT) Time. For example, if a weather observation is called in at 0700 New Zealand Daylight Time, it should be referred to as the "Eighteen Z Observation" since 0700 NZ time is 1800 Zulu (GMT).

Direction of Winds

The observer should stand in the middle of the flagged weather-observing site and use the feel of wind on the face and/or any visual cues, such as blowing flags and blowing snow, to determine the grid direction of the wind. Wind direction readings should be taken for at least two minutes. The average direction over that time should be reported. Wind direction is identified according to the following:

calm	no direction, report "winds calm"
northeast	023 to 067 degrees
east	068 to 112 degrees
southeast	113 to 157 degrees
south	158 to 202 degrees
southwest	203 to 247 degrees
west	248 to 292 degrees
northwest	293 to 337 degrees
north	338 to 022 degrees
variable	wind must be 6 knots or less

Speed of Winds

Confirm the Kestrel® is set to record wind in knots. Power it up and navigate to the wind speed screen. Expose the impeller (the small, revolving wheel at the top of the Kestrel®) by rotating open the plastic cover. While viewing the Min/Max/Avg screen, hold the unit into the wind (the screen facing the observer). When the screen displays "--average" press the button to begin collecting data. Press it again when the screen displays "--stop" to stop collecting data and hold the values on the display. Press the button when the screen displays "--clear" to clear the data. Collect enough data to calculate a two-minute average for all measurements.

Visibility at Surface

Visibility is the measure of how far an observer is able to see objects like flags or rock outcrops that are not obscured by weather, as viewed from ground level. Visibility should be recorded in meters and as an average of all quadrants.

Visibility distances are broken down to "Reportable Visibility Values." Miles and feet are included in the Reportable Visibility Value chart for reference, but observers should call in observations using meters. For example, visibility estimated at 700 meters must be reported as either 600 or 800 meters since 700 is not a Reportable Value. The term "Unrestricted Visibility" refers to visibility that is 9,999 meters or greater. All visible distances 9,999 meters or greater are reported as "Unrestricted."

Present Weather

This entry is a description of the weather effects that may or may not be restricting visibility, as seen at ground level. Examples include precipitation, such as snowfall or fog, and obstructions to visibility from blowing or drifting snow. It is possible to have two or three present-weather effects and obstructions to visibility in a given entry. For example: snow and drifting snow; or snow showers, fog and blowing snow.

Weather categories (with visibility obstruction):

No Weather	Visibility not obstructed by any weather condition
Snow	Visibility less than 9000m and precipitation steady
Snow Grains	Visibility is less than 9000m; steady precipitation of small, round, flat snow pieces
Ice Crystals	Can occur at any visibility, including unrestricted visibility
Fog	Only reported when visibility is less than 1200m
Mist	Looks like fog; reported when visibility is between 1200 and 9000m
Snow Showers	Visibility less than 9000m; precipitation intermittent
Ice Pellets	Visibility less than 9000m in steady precipitation of tiny hailstones <5mm (rare event)
Blowing Snow	Visibility less than 9000m
Drifting Snow	Visibility greater than 9000m

Reportable Visibility Values		
Meters	**Statue Miles**	**Feet**
0	0	0
100	1/16	328
200	1/8	656
300	3/16	984
400	1/4	1312
500	5/16	1640
600	3/8	1969
800	1/2	2625
1000	5/8	3281
1200	3/4	3937
1400	7/8	4593
1600	1	5249
1800	1 1/8	5906
2000	1 1/4	6562
2200	1 3/8	7218
2400	1 1/2	7874
2600	1 5/8	8530
2800	1 3/4	8858
3000	1 7/8	9843
3200	2	10500
3600	2 1/4	11810
4000	2 1/2	13120
4400	2 3/4	14440
4800	3	15750
6000	4	19690
8000	5	26250
9000	6	29530
Unrestriced 9999 or more	7 or more	

Amplification of Weather

This is a more detailed description of weather severity, such as “Light,” “Heavy,” or “Moderate.” Examples (including accompanying obstructions to visibility):

None	
Light Ice Pellets	Visibility not restricted
Moderate Ice Pellets	Visibility reduced to between 3 and 7 miles (4800 to 9000m)
Heavy Ice Pellets	Visibility reduced by ice pellets to less than 3 miles (4800 m)
Light Snow	Visibility greater than ½ mile (800m)
Moderate Snow	Visibility between ¼ and ½ mile (400-800m)
Heavy Snow	Visibility less than ¼ mile (400m)

Cloud Layers

Each cloud layer is usually reported using two entries: the first represents the amount of sky covered by a layer and the second represents the cloud layer height. At least one layer is reported (even if it's "sky clear"), and often two or three cloud layers are reported. The heights of cloud layers are reported in feet (not meters). If there is more than one layer, begin with the lowest layer. Examples:

Entry #6 – Cloud Layer 1, Few at 1,000
Entry #6a – Cloud Layer 2 (if needed), Scattered at 5,000
Entry #6b – Cloud Layer 3 (if needed), Broken at 10,000

To report cloud layers, always round to the nearest 100 feet for layers that are 5,000 feet or less. For layers between 5,000 feet and 10,000 feet, round to the nearest 500 feet. For layers 10,000 feet and above, round to the nearest 1,000 feet. Example: A cloud layer at 1,150 feet is rounded to 1,100. A cloud layer at 5,300 feet is rounded to 5,500 feet.

Summation Principle

A higher cloud layer cannot be reported as having less total area coverage than the area below it. The higher layer is considered to include the amount of sky coverage from all of the clouds below it. For example, if the lowest cloud layer is reported as "broken," the next higher layer must be reported as either "broken" or "overcast," even if there are only a few clouds in the higher layer.

Using Cloud Types to Estimate Layer Heights

A cloud's appearance or type will give clues as to how high it is. Following are some typical Antarctic cloud heights:

Cloud Type	Description	Typical Height
Stratus	Low, grey, shapeless sheet stretching wide	1,500 feet or less
Stratocumulus	Low, lumpy, rounded, with some blue sky visible	1,000 - 5,000 feet
Cumulus	Low, puffy, popcorn-like, vertical development	1,000 - 5,000 feet
Altostratus	Mid-level, uniform sheet of grey cloud	4,000 - 9,000 feet
Altocumulus*	Mid-level puffy clouds, sometimes in patterns. One part of the cloud is usually darker, "castles"	4,000 - 9,000 feet
Cirrus	High, whispy, feathery, see-through clouds	10,000 - up to 19,000 feet
Cirrostratus	A high, very thin sheet of see-through clouds	10,000 - up to 19,000 feet
Cirrocumulus	High, thin, wavy or rippled clouds in part of the sky	10,000 - up to 19,000 feet
** Altocumulus includes lenticular clouds. These are dangerous for air operations and must be reported in the Remarks section.*		

Additional Ways to Determine Cloud Layer Height

Ceiling Balloons Also called "weather balloons," ceiling balloons are helium-filled balloons released from ground level. Their ascent is timed and the balloons observed until clouds hide them from view. Cloud height is then determined based on a chart that shows how fast a given balloon will rise. Not all remote camps will have ceiling balloons, as they require the transport of compressed gas. Additional training is required for those using ceiling balloons to determine cloud height.

Pilot Report Observers may confirm the heights of cloud layers with pilots who fly into camp. The aircraft's instrumentation allows pilots to determine exact heights of cloud layers as they fly through them. A pilot report is called "PIREP" (pronounced "pie rep") and should be used only periodically, not for every single flight.

Total Sky Cover

This includes all of the layers of clouds taken as a whole. Sky cover is measured in "oktas" or eighths. If half of the sky is cloudy, that is described as 4/8 or four oktas. The oktas are grouped into the following categories:

Value	Amount of sky covered by cloud
Sky Clear	0/8 coverage Sky must be totally clear; do not encode a layer height.
Few	1/8 - 2/8 coverage Anything from one tiny cloud up to 25% of the sky covered.
Scattered	3/8 - 4/8 coverage
Broken	5/8 -7/8 coverage
Overcast	8/8 coverage If the cloud is "see-through," it is still considered overcast.
Vertical Visibility	Sky view is obscured. Sky is entirely covered by fog and/or blowing snow; cloud layers cannot be discerned.

Temperature and Dew Point

Both of these readings should be recorded directly from the Kestrel®. Navigate to the correct screen by using the up and down arrows. Navigate to lines within a screen using the side to side arrows.

These data are reported in the nearest whole degree Celsius.

Negative temperatures and dew points are recorded with an "M" before the number (example: M06).

The dew point will never be higher than the temperature.

Sometimes the dew point will not register on the Kestrel® in extreme cold conditions. If this occurs, omit the dew point report from the weather observation.

Barometric Pressure

For this item, report the station pressure and not the altimeter. Station pressure is the atmospheric pressure at the station elevation. It should be read directly from the Kestrel® and reported in inches of mercury to the nearest five-thousandth of an inch.

Always round down. For example, 29.249 inches would be reported as 29.245 inches.

Surface/Horizon Data

These descriptions help pilots anticipate visual conditions for landing. The surface definition is relayed first, horizon definition second.

Surface Definition This entry describes how the contours of the ground and/or snow surface appear. Surface definition is judged by the relative distinctness of features like sastrugi or vehicle tracks in snow. Observers should notice how surfaces appear in good weather to use as comparison in changing weather.

This is a critical planning detail for helicopter pilots, as they are not allowed to fly over poor surface definition. Helicopter-supported groups on the ice shelf or sea ice must convey this information to the helo coordinator or helo supervisor if they are expecting a flight.

Surface Definition Levels

Good	Snow surface features such as sastrugi, drifts, and tracks are easily identified by a shadow. The sun is usually not obscured.
Fair	Snow surface features can be identified by contrast. No definite shadows exist. The sun is usually only dimly visible.
Poor	Snow surface features cannot be readily identified except from close up. The sun is usually totally obscured.
Nil	Snow surface features cannot be identified. No shadows or contrast exist. Dark objects appear to float in the air. The sun is totally obscured. The overcast may have considerable glare, which appears to be equally bright from surface reflection and from all directions.

Horizon Definition This is an observer's judgment as to the ease with which the sky can be distinguished from the land or snow surface.

Horizon Definition Levels

Good	The horizon is sharply defined by shadow or contrast. There is an obvious difference between land and sky (i.e., white surface and blue sky) and the horizon is distinct.
Fair	The horizon may be identified, though the contrast between sky and snow surface is not sharply defined. The sky distinguishable from land, and the horizon is visible. "Fair" horizon conditions are often observed when clouds are approaching or during light precipitation.
Poor	The horizon is barely discernible. Though it is difficult to distinguish the sky from the snow surface, there still seems to be a (hard to see) separation between the two. "Poor" is observed in conditions similar to those that cause "nil," only less severe.

Nil Total loss of horizon. The snow surface merges with the whiteness of the sky. No horizon is visible, which is common when there is a low stratus layer and blowing snow.

Examples:

Snow surface and horizon are both easily seen
= good and good

Surface contrast is seen in dim sun and the horizon is hard to discern
= fair and poor

Surface has no shadows or features and the horizon is not discernable
= nil and nil

If a poor or nil horizon is visible in one grid direction only and the rest of the horizon is more easily seen, report this condition in the remarks as, for example, "poor horizon grid south through west" or "nil horizon grid east."

Remarks

The remarks section should also be used to describe any significant weather-related phenomena that are not reflected elsewhere in the report. This could include weather seen in the distance, weather in a small quadrant (such as different surface or horizon definitions), or weather seen in the vicinity (such as fog, mist, or lenticular clouds at 2,000 feet grid northwest). Use plain language for remarks; no code is needed.

Calling in a Weather Observation

By Iridium (satellite) phone – dial MacWeather at 8816-763-20030.

By HF Radio – use the frequency that works best to contact MacOps. Provide MacOps with the observation and request it be passed to MacWeather.

Example weather observation call:

"Hello, this is Chris from Whillans Ice Plain Camp with the Six Z Observation." [Wait for affirmation between relaying bits of information.] "We are at 83.65 south latitude and 167.4 west longitude. Winds: Grid Northwest at 12 knots. Visibility: 1,600m. Present weather: snow and mist. Amplification of weather: light snow. Clouds: Broken at 1,000, Overcast at 5,000. Total sky cover: eight oktas. Temperature: negative ten. Dew point: negative fifteen. Barometric pressure: 28.245. Surface Definition poor, Horizon Definition poor. Remarks: all winds grid, mist in the vicinity at grid north. Thanks. Goodbye."

Calling for a TAF

To receive a TAF for a specific site, call MacWeather at 8816-763-20030. This call may be placed at any time on a day that an aircraft is scheduled for the site. Only the most recently generated TAF will be provided, regardless of the time of the call.

TAFs are relayed in an abbreviated format. The caller should have a pencil and paper ready at the start of each call. Below is an example of a typical TAF, followed by an explanation of how to interpret each section.

Example #1:

SDM TAF 0915/1015 (1004/1104NZDT) VRB04KT 1600 BR FEW010 BKN030 OVC050 QNH2855INS

BECMG 0917/0919 (1006/10008) VRB06KT 0400 SN FG OVC007 QNH2850INS

Translation:

The forecast (TAF) for Siple Dome (SDM) is in effect from 0400 NZ time on the 10th of the month to 0400 on the 11th of the month (0915/1015 (1004/1104NZDT)).

Winds will be Variable at 4 knots (VRB04KT).

Visibility will be 1,600 meters. (1600).

Mist will be present (BR).

The first layer of clouds will be Few at 1,000 feet (FEW010).

The second layer of clouds will be Broken at 3,000 feet (BKN030).

The third layer of clouds will be Overcast at 5,000 feet (OVO050).

Barometric pressure will be 28.55 inches (QNH2855INS).

Then, beginning at 0600 on the 10th day of the month NZ time (1006/10008), the weather will begin to transition from the previous forecast to a different one. By 0800 on the 10th day, the new forecast conditions should be in effect. (BECMG 0917/0919).

Winds will increase to Variable at 6 knots (VRB06KT).

Visibility will drop to 400 meters (0400).

There will be moderate snow and fog. (SN FG).

Skies will be Overcast at 700 feet (OVO007).

Barometric pressure will be 28.50 inches (QNH2850INS).

Example #2:

NBY TAF 0915/1015 (1004/1104NZDT) GRID08010KT 8000 -SN BR BKN010 OVC020 QNH2837INS

TEMPO 0920/0924 (1009/1013) 2400 -SN BR OVC010

BECMG 0923/1001 (1012/1014) VRB06KT 9999 NSW SCT010 BKN030 QNH2834INS AMD 1900

The following table explains how to interpret each section.

Terminal Aerodrome Forecast (TAF) Table

Abbreviation	Meaning	Translation for TAF Example #2	Notes/Examples
NBY	Station Identifier	Byrd Surface Camp (NBY is the abbreviation for the airstrip at Byrd Camp)	WSD – WAIS Divide NZSP – South Pole AGO3 – AGO Site # 3
TAF	Report Type	Terminal Aerodrome Forecast	
0915/1015	Forecast date and time	09 (9th day of the current month) 15 (1500, the time of issue in GMT/Z) 1015 (the forecast goes through the 10th day of the month at 1500 GMT/Z)	
(1004/1104NZDT)	Conversion to New Zealand time		Sometimes the New Zealand time will be included in parenthesis following Zulu time.
GRID08010KT	Wind Direction and Speed	GRID080 – Winds are forecast to come from Grid 80 degrees (grid east). 10KT – Wind speed forecast at 10 knots	Wind direction is always noted in three digits. 005 = 5 degrees. 040 = 40 degrees. Wind speed is always noted in two digits. 08 = 8 knots. 35 = 35 knots.
8000	Visibility in Meters	Visibility on the ground is 8000 meters (5 miles)	9999 represents unrestricted visibility. This is used for any visibility of 7 miles or greater.
-SN BR	Forecast Weather	-SN – light snow BR - mist *(a handy way to remember that BR equals mist is to think "Baby Rain")*	SN - moderate snow -SN - light snow +SN - heavy snow FG - fog IC - ice crystals BLSN – blowing snow DRSN – drifting snow NSW -no significant weather

Terminal Aerodrome Forecast (TAF) Table (continued)

BKN010	Cloud Layer 1 height in feet	The lowest cloud layer is a broken layer (covers 5/8-7/8 of the sky) at a height of 1,000 feet.	Cloud heights are given as three digits and omit the last two zeros of the number. 005 = 500 feet. 010 =1,000 feet. 100 = 10,000 feet (just add two zeros to get the height number).
OVC020	Cloud Layer 2 height in feet	The next higher of clouds is an overcast layer (clouds cover the entire 8/8 of sky) at a height of 2,000 feet	
QNH2837INS	Barometric Pressure	Station pressure is forecast to be 28.37 inches.	
TEMPO 0920/0924 (1009/1013) 2400 -SN BR OVC010 Change to one hour long	Temporary Condition	A temporary condition (for no more than 30 minutes) will occur between the exact times of 2000 Zulu and 2400 Zulu on the 9th day of the month. Visibility will drop to 2400 meters and the cloud layer will become a single overcast layer at 1,000 feet.	Since wind direction, wind speed and pressure are not included in the TEMPO, it is assumed that they stay the same as in the original forecast.
BECMG 0923/1001 (1012/1014) VRB06KT 9999 NSW SCT010 BKN030 QNH2834INS	Becoming: The forecast conditions will change to a new one during the stated times. The new forecast will be in effect by the end of the BECMG period.	From 2300 on the 9th day of the month (Zulu) to 0100 on the 10th day of the month (Zulu) conditions will begin switching from the original forecast to a new one. By 0100 winds will be Variable at 6 knots. Visibility will be unrestricted. There will be No Significant Weather. Clouds will be Scattered at 1,000 feet and Broken at 3,000 feet. Pressure will be 28.34 inches.	New Zealand time is 12-13 hours ahead of Zulu time (depending on Daylight Savings Time). Therefore, the Zulu time forecast often appears to be for an earlier date. Be sure to check the Z versus the NZDT times.
AMD 1900	Time of amended forecast	This TAF is an amended forecast issued at 1900.	

Sea Ice Assessment

A McMurdo Sound Sea Ice Report is available bi-weekly while the sea ice is open for travel. The report consists of a satellite image with sea-ice routes overlaid and current conditions noted. Personnel should review the report before traveling on the sea ice and contact Field Safety and Training personnel with questions, if any.

Safe travel on the sea ice requires paying attention to weather conditions, ice thickness, ice color, ice temperature, and cracks.

Weather

Poor weather conditions will obscure surface definition, making it difficult or impossible to detect cracks. Use extra caution if surface definition or visibility is poor. Strong winds can be particularly dangerous, especially at the ice edge, where large chunks of the sea ice can break off and blow north with little warning.

Ice Thickness

Strong currents can erode the ice from below. This is hazardous because there may be no obvious indication of thinning from the surface. The currents typically occur later in the season and usually over underwater shoals. Land formations that indicate a potential shoal are long, low-angle ridges or peninsulas that descend into the sea. However, shoals can also occur offshore of steep slopes, such as the north side of Little Razorback Island. At McMurdo Station, the areas adjacent to Cape Armitage (at the base of Observation Hill), Hut Point, and Knob Point/Cinder Cones historically experience strong currents and thinning ice later in the season. In addition, as the air and sea temperature rise, the sea ice becomes progressively weaker and thinner everywhere.

Ice Color

The color of the sea ice is a good indication of its thickness and safety. In general, white or milky blue ice is the safest. In McMurdo Sound, these colors indicate solid ice 24 or more inches thick. Ice that is sky blue and has a slick, scalloped surface is multi-year ice that is several feet thick.

Ice of different ages and thickness will be marked by a thin line on the surface and, usually, slight differences in elevation. If the color of the ice changes abruptly, travelers should stop immediately and investigate. Darker ice indicates a hazard. Ice that is young or has thinned to six inches or less will appear grayish, even beneath a

thin crust of snow. This ice may support an adult on skis but should never be traversed in a vehicle. Gray ice can also form as a result of surface flooding and subsequent freezing of the surface water, which often occurs at tidal cracks. It is always important to investigate areas of gray ice. Sea ice that appears black is very thin and should be avoided at all times.

When traveling off established routes, field team members should drill the sea ice every 100 meters if the ice surface is consistent, and much more frequently if there are variations in color or texture.

Ice Temperature

Colder ice is stronger. The colder the ambient air temperature, the more the ice grows. And the colder the sea ice, the stronger the overall structure. Just looking at the surface will not disclose the true strength of the ice. Sea ice strength is measured according to four temperature periods:

Period 1	Period 2	Period 3	Period 4
<14° F	14°- 23° F	23°- 27° F	27°- 28.5° F

Sea Ice Cracks

Cracks are fissures or fractures in the sea ice that form in response to environmental, geographical, and mechanical pressures, such as wind, waves, tidal action, and the pressure of ice shelves and glaciers pushing against the sea ice. Tidal cracks form along coastlines and around islands, grounded icebergs, and glacier tongues. Other cracks radiate out from the land, especially from headlands and glacier tongues, like the spokes of a wheel.

Cracks should be avoided whenever possible. If crossing one is unavoidable, cross it in a line perpendicular to the crack. Never cross a system of multiple, closely set cracks in a manner that places a vehicle on more than one crack at a time. Avoid sets of cracks that form triangular wedges. These could break off and turn over under the weight of a vehicle.

Snow cover on the sea ice can hide cracks. When traveling off established routes, look for continuous linear features and sagging areas of snow, sometimes of different color tones. Watch for areas where snow has drifted differently, especially if the drifted area is in a long, straight line. Good visibility and lighting are essential to seeing these features. Also, pay attention to seals or signs of seals, such as feces, urine, seal shadows, and breathing holes. Their presence anywhere on the sea ice indicates the presence of a crack.

Crack Types

There are four general types of sea-ice crack:

- Tidal
- Straight edge
- Working (active)
- Pressure ridge

Each is described and discussed during sea-ice training. Field party members working on the sea ice should learn to identify and evaluate each type.

Safe Ice Thickness Standards for Cracks

Effective crack width is the distance over which the sea ice in a crack is less than the minimum required for a vehicle, based on ice period. The effective width cannot exceed 1/3 of a vehicle track length or area of a tire in contact with the ice. Use the following Light Vehicle Sea Ice Guidelines to determine required ice thickness and effective width for the vehicle in use.

Light Vehicle Sea Ice Guidelines

Vehicle	Maximum Effective Crack Width (in)	Minimum Ice Thickness (inches)			
		Period 1	Period 2	Period 3	Period 4
Pisten Bully	36	12	12	17	17
Hägglunds	27	15	16	21	22
Snowmobile	20	5	5	6	7
Mattracks	15	12	13	17	18
** If towing a sled or trailer, different ice thickness requirements may apply. Please contact FS&T at X2345 for more information.*					

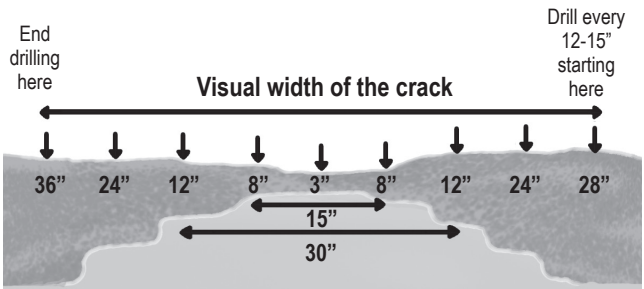
How to Profile a Sea-Ice Crack

Stop the vehicle before reaching a crack and check for other cracks nearby.

1. Determine the nearest edge of the crack by removing snow down to bare ice.
2. Using an ice ax, probe for open water or weak spots to determine if it is safe to cross by foot.
3. If it is safe, shovel the snow out of the crack from edge to edge, clearing at least one shovel blade width.

4. Drill holes every 12 inches in a straight line, beginning outside one crack edge and ending outside the other, making certain to drill healed shelves and any visible fractures.
5. Drill each hole either to water level or to a full Kovaks drill flight length (>30 inches).
6. Measure the ice thickness in each hole.
7. Pay attention to the characteristics of the ice shavings (dry, moist, or slushy).

Sea Ice Crack Profile Example



Effective width of the crack

In this example, for a Pisten Bully in period 1 or 2, the effective width is 30". For a snowmobile, it is 15".

Rule 1: Ice thickness must be ≥ the Sea Ice Guidelines for specific temperature periods.

Rule 2: Effective width of the crack must be ≤ 1/3 of the vehicle track length.

Aircraft Operations

Camp Put-In, Fixed-Wing

Communication and Shelter

Before the put-in aircraft departs, the field team must make radio contact with MacOps. The team must also erect a tent for shelter. The most efficient way to do this is to split the team into two groups. One sets up a tent and lights a stove (well away from the aircraft and turning area), while the other sets up the radio and antenna (also well away from the aircraft) and establishes communication.

Altitude and Grid North

Also, before the plane departs, one member of the field party must obtain the altitude of the camp site and the location of Grid North from the aircraft navigator or pilot. Grid North should be marked immediately with two flagged bamboo poles. The altitude is used to set the altimeter in the meteorological kit. Both parameters are necessary for weather observations and reporting.

Camp Communications, Fixed-Wing

Daily Check-in

At a pre-arranged time every day, field parties must engage in radio communication with McMurdo via MacOps. Radio communication between some areas of Antarctica and McMurdo is poor. Sometimes it is necessary for field parties to relay their daily check-in through South Pole Station, a major field camp, or another remote field party. If a field party fails to make the daily check-in, the Emergency Operations Center (EOC) is activated and the emergency response chain is started, activating the SAR team.

In addition to the daily check-in, field teams may speak with the fixed-wing office any time between 0730 and 1900 daily in order to pass along information or request resupplies, schedule changes, or camp pull-out times.

Weather Observations

Field teams may be required to provide weather observations during daily communications and should be prepared with the information in the correct order. Field teams may also be asked to relay weather information for another field party.

When an aircraft mission to the camp is planned, field team personnel are required to report weather observations hourly, beginning

six hours before the scheduled launch of an LC-130 and three hours before a Kenn Borek aircraft. These observations continue until the aircraft lands. Refer to the Weather section for more information.

Camp Pull-Out, Fixed-Wing

The camp pull-out schedule must be coordinated with Fixed-Wing personnel, who will need detailed information regarding the weight, cube, and type of returning ("retrograde") cargo; the estimated weights and dimensions of any cargo pallets; and the specifics of any scientific samples (e.g., Keep Frozen, Do Not Freeze).

Waste Removal

Remote, deep-field groups must return all waste to McMurdo. This may or may not include human waste. See the Environmental section for more detail.

Equipment Staging

The field camp must be entirely broken down. All gear must be staged and ready for quick loading when the aircraft arrives. For LC-130 flights, all gear must be palletized.

Retrograde Hazardous Cargo

When field parties return hazardous cargo to McMurdo, it must be properly packaged and labeled, in a manner similar to how it was originally shipped (e.g., matches in foil, 12-volt batteries in wooden boxes). Each item must have its own separate and complete hazardous declaration (haz dec) to give to the flight crew. Preserving the packaging, labels, and paperwork generated for the cargo's field deployment flight makes it easier to prepare the cargo for its return flight to McMurdo.

Partially full fuel drums should be tightly capped and tipped on their side to confirm a good seal. **Caution:** When tipping the drums, nsure that spill containment is in place to catch any leakage. Containment must also be used if the drums are shipped on their side. Snowmobiles must have between ¼- and ½-tank of fuel. No more and no less.

Ski-Way Preparation

The ski-way should be prepared well in advance of the aircraft's arrival, per the requirements provided by Fixed-Wing Office staff before the field team deployed.

Communication with Incoming Aircraft

The field team member assigned to the radio is responsible for communicating all requested information to the incoming aircraft. This person should know the condition of the ski-way, the current wind conditions, and the altimeter setting. While on final approach, the aircraft commander will not want to respond to radio transmissions, but he or she will appreciate short statements regarding changes in weather, particularly wind direction.

Note: Do not interfere with the aircraft during final approach unless there is an emergency.

Returning to McMurdo Station

Return all field equipment to the appropriate work center. Package and mark cargo that will be shipped to the U.S. Specific instructions for this process are in "Instructions for Packaging and Shipping," a document sent to all researchers before they deploy to Antarctica.

Camp Put-In, Helicopter

After passengers disembark the helicopter, the pilot will listen on Channel 7 and will not depart until a field tream member establishes radio contact and calls out the helicopter's tail number. If communication cannot be established because of radio malfunction, the field party will be flown back to McMurdo. **Note:** Field parties should test radio equipment before deploying to the field.

Helicopter Safety

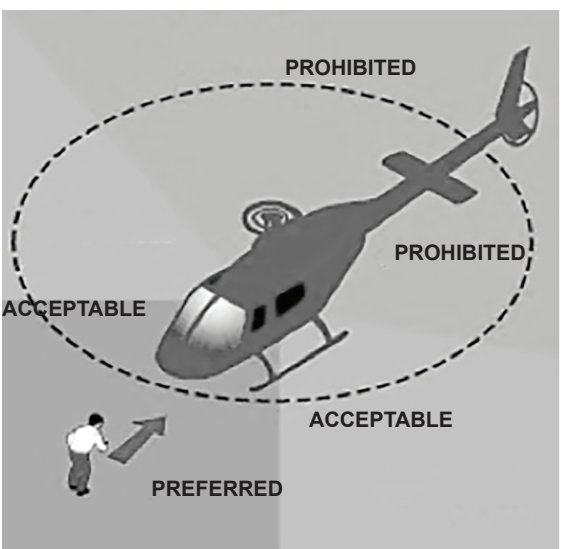
When exiting or approaching the helicopter, remain in the pilot's view. Proceed in a crouch. Do not approach the helicopter without the pilot's visual acknowldegment. Never, ever reach up or chase after a hat or other article that has blown away.

- Any movement on the helicopter pad must be authorized by the heli-pad staff, either on the pad or in the hangar.
- ALWAYS obey the pilot's orders.
- NEVER approach a helicopter until the pilot gives a thumbs-up signal.
- NEVER walk near the tail rotor; always approach from the front of the helicopter.
- Carry long loads, such as bamboo poles, Scott tents, or survey rods, low and level to the ground.
- Do not smoke in or near the helicopter.
- Remain seated with seat belts fastened at all times.

- Wear a helmet.
- Assume the crash position if so warned by the pilot.
- In the event of an emergency, remain in the aircraft until all motion has stopped.
- Know the location and operation of emergency exits.
- Know the location of first-aid kits.
- Know the location of aircraft survival equipment.

Loading the Aircraft

In McMurdo, the heli-pad staff will load and unload the helicopter. In the field, field team members must perform this function. On most 212-supported missions, a heli-tech will be on board to assist with loading and unloading, but helitechs do not fly on A-Stars, so all field team members are responsible for knowing how to perform this function. The pilot is ultimately responsible for passenger safety and will determine if the helicopter can be loaded or unloaded with the rotors turning. However, all passengers have the right to request that the rotors be shut down if there is any safety concern.



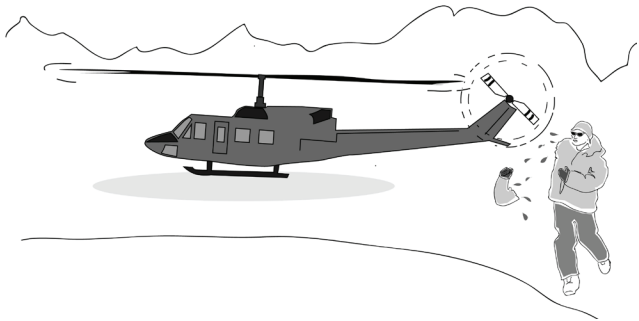
Carry supplies and tools horizontally and below waist level.

Always approach or exit on the downslope for more clearance.

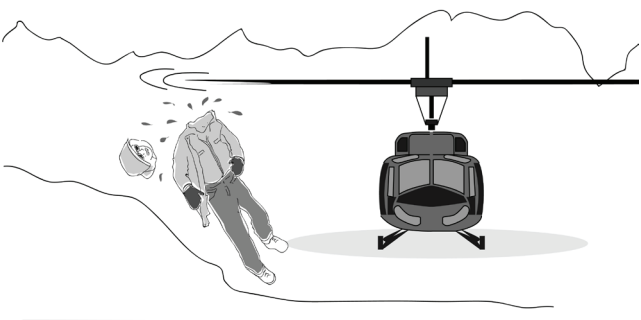
If blinded by snow or grit, stop, crouch lower, or sit down and wait for help.

If disembarking while the helicopter is at a hover, get out and off in a smooth unhurried manner.

Never approach or leave when the engine and rotors are running down or starting up.



NEVER approach a helicopter from the rear.



NEVER move upslope near a helicopter when the rotors are in motion.

Boarding

On 212-supported missions, a heli-tech will lead field team members to the helicopter when the pilot is ready for boarding. On A-Star flights, the pilot will indicate when passengers should board. Once seated, passengers must strap themselves in and connect to the helicopter intercom system. They must not talk to the pilot during takeoff or landing.

Survival Equipment

For all flights, helicopter pad staff will ensure sufficient survival bags are on board to accommodate all passengers.

Camp Communications, Helicopter

Radio Equipment

For a camp put-in, field teams must have the following equipment:

- VHF handsets with the field party frequency plan
- HF radio(s)
- Antennas
- Batteries and recharging capabilities for the duration of the field stay
- A complete back-up radio

Use VHF Channel 7 for direct communications with helicopter pilots, and know the tail number of your support helicopter. **Note:** Channel 7 is line-of-sight only, so arrange for other channels if you anticipate needing a longer range. Call directly back to Helo Ops in McMurdo for more complex communications.

Daily Communications

Overnight field groups must make daily radio contact with MacOps. Established field camps with phones can simply call in. The required daily check-in is extremely important, and a SAR response will be initiated if a field party fails to make its daily check-in.

If a flight is scheduled for a field camp, the field party will be asked to provide a local weather observation between 0715 and 0730 or between 0745 and 0800. Also, if the field party needs to make changes or if there is any other information to convey regarding support for that day, they must contact the helicopter office before 0730, which is when helicopter operations personnel begin developing the operational plan for that day.

Before returning from the field, all field parties need to contact the Lodging department in McMurdo to arrange accommodation.

Field Resupply

In camps with phone access to McMurdo, field parties can call individual departments for resupply items. These departments will notify Helo Ops of the resupply, but in order to ensure timely arrival, field parties should notify Helo Ops as well. Resupply requests can also be communicated via radio to the BFC, or after hours with MacOps. Both will relay the information to Helo Ops.

Schedule Changes

New flight requests and changes to flight schedules must be submitted three business days in advance. Requests may be communicated over the radio or telephone, but if good communications are not available the requests may be written and passed to a pilot for delivery to Helo Ops staff.

Camp Pull-Out, Helicopter

Field teams that return unneeded material and equipment to McMurdo throughout the season will find their camp pull-out relatively easy. To ensure that all camp items are picked up and nothing blows away, two team members should remain in the field to accompany the last flight.

Returning Material from the Field

The most efficient way to return material from the field – and reduce pull-out flights – is to use resupply flights, camp moves, and day-use helicopter flights. During the daily communication with Helo Ops staff, field groups can pass information concerning retrograde material so it can be incorporated into the schedule on flights of opportunity. Remember: helicopters can sling loads back to McMurdo or to Marble Point for staging, so don't let boxes and barrels pile up at camp. Retrograde it early! Label waste properly, per instructions from the environmental and waste management departments.

Scientific Sample Shipment to McMurdo

Introduction

Scientific samples represent the end product of years of planning, months of work, and extensive funding by the NSF. They are irreplaceable. Therefore, all personnel involved with handling or transporting samples must follow an established procedure to ensure the preservation of scientific data.

This procedure addresses the unaccompanied transport of scientific samples from the field to McMurdo Station via helicopters or fixed-wing aircraft. It is designed to minimize the potential for loss or damage of these samples during transport, receipt, and storage. However, it is not meant to reduce flexibility. For example, if a field team member wishes to load samples on a helicopter but does not have the proper form, the samples will still be accepted, and all personnel will do their best to ensure they are properly handled.

Procedure

If a field team intends to send unaccompanied samples from the field to McMurdo Station, team members should discuss the process with the Crary Laboratory staff before deploying to the field. Crary staff will provide the team with either "Sensitive Sample" Chain of Custody (COC) forms and green DayGlo labels or "Non-Sensitive Sample" COC forms and pink DayGlo labels, depending on sample requirements.

In general, grantees package the samples, notify either the Crary Laboratory point of contact (ext. 4188, pager 855, or at mcm-Lab-Samples@usap.gov) or the Science Cargo supervisor, schedule pickup with aviation operations, and make necessary entries on the appropriate COC form.

It is the grantee's responsibility to package samples in a manner that adequately protects them against temperature variations and vibration during transport. Packaging should be sufficient to cover extended periods due to weather or other delays. Appropriately colored DayGlo notices should be attached to sample boxes for ease of identification and tracking. These brightly colored labels draw attention to the boxes and reduce the likelihood that they will be misplaced or overlooked.

It is also important to enter on the COC form the aircraft tail number and the time samples were placed on the aircraft. The pilots, loadmasters, helicopter technicians, ground crew, Crary personnel, USAP cargo personnel, and others involved in the cargo process will fill out their portions of the COC and deliver the samples to the appropriate location.

The following information should be provided in any correspondence or radio communication regarding the samples:

- Number of containers
- Storage requirements
- Time of pickup
- ETA in McMurdo

Reference

Knots

Knots are essential for camping and life in the field. This section contains illustrations showing how to tie thirteen useful knots. Below are descriptions of these knots, as well as suggestions regarding when each one might be most useful.

Knot terminology:

Knot – ties a rope to itself.

Hitch – ties a rope to another object, such as a post, stake, or eye-ring grommet.

Bend – Ties two different pieces of rope together.

Bight – A curved or slack section of rope between two ends.

Useful Knots

Figure 8 on a Bight – Forms a secure, non-slip loop at the end of the rope. Use the tail end to make a stopper knot. Difficult to untie after a heavy load.

Examples of when to use in the field:

- Climbing and mountaineering
- Creating a loop for a carabiner to attach sleds to snowmobiles

Bowline – A loop knot that creates a closed, fixed circle at the end of a line. This is a secure knot that doesn't slip when loaded and is easy to untie. (Learn to tie it with one hand for fun or rescue situations). Make a small loop, then the rabbit comes out of the hole, around the tree, and back down the hole. Use a stopper knot.

Examples of when to use in the field:

- Tying around a tent loop to use as a guyline
- Tying down cargo

Clove Hitch (Double Hitch) – Great all-purpose hitch to secure a rope when pulled from a post in two directions. It consists of two half hitches around an object then passes under itself, making it a good binding knot. It's easy to untie, but needs tension or it will come undone. It can be tied from the middle of the rope.

Examples of when to use in the field:

- Starting or ending lashing
- Attaching a rope to a carabiner, eye ring grommet, stake, or post

Round Turn and Two Half Hitches – A hitch ties a rope to an object, such as a post or ring. This is a great all-purpose hitch to

secure a rope when pulled from a post in one direction. It is strong, doesn't slip, and is easy to untie.

Examples of when to use in the field:

- Lowering survival bags from deck of ship to small boat below
- Securing survival bags to a bamboo or metal stake so they don't blow away

Sheepshank Knot – A shank knot is used to shorten a rope or take up slack. It requires tension.

Example of when to use in the field:

- When you need a short length of rope, but don't want to cut the line

Sheet Bend – A bend knot that joins together two ropes of different sizes or thicknesses. Use the thicker or more slippery rope as the bight, with the thinner rope going around it.

Examples of when to use in the field:

- Lengthening a guy line
- Fixing a boot lace with p-cord or string
- Using scraps of line to make one of useful length

Taut Line Hitch – An adjustable loop knot that can slide back and forth along a line. The loop easily adjusts under tension, but remains secure once the knot is pulled tight. It is secure, as long as there is tension. (Note: The taut line hitch is a combination of the clove hitch and the round turn hitch.)

Examples of when to use in the field:

- Replacing a tent guy line
- Adjusting the tension on a guy line to achieve optional line tension

Square Knot/Reef Knot – A binding knot used to tie two ends of a single rope together: right over left, left over right.

Examples of when to use in the field:

- Lengthening a rope by tying two lines together
- Tying up a bundle of bamboo poles
- Tying bandages

Prussik – Friction hitch used to attach a loop of 5mm cord around a rope.

Examples of when to use in the field:

- Climbing and mountaineering
- Tying items to a guy line so they don't blow away

Trucker's Hitch – Stretches a rope between two anchor points. It's essentially a block and tackle knot that uses mechanical advantage and friction. Form the loop with the slack part of the line so it does not tension on itself and can quickly be undone and re-tensioned. This knot can be tightened with more force than the Taut Line.

Examples of when to use in the field:

- Tensioning guy lines between deadmen and the tent
- Tying and secure sled loads

Water Knot – Joins two lengths of webbing or straps.

Examples of when to use in the field:

- Lengthening two pieces of webbing
- Joining two cargo or cam straps together

Double Fisherman's Stopper Knot – Joins two lengths of rope and is very easy to tie. (It is two overhand knots.)

Examples of when to use in the field:

- Making slings in climbing
- Making adjustable necklaces and bracelets
- Camping crafts on bad weather days

Alpine Butterfly – Forms a fixed loop in the middle of a rope without needing access to either end. Shortens a long climbing rope, or creates a bight in the middle of a rope.

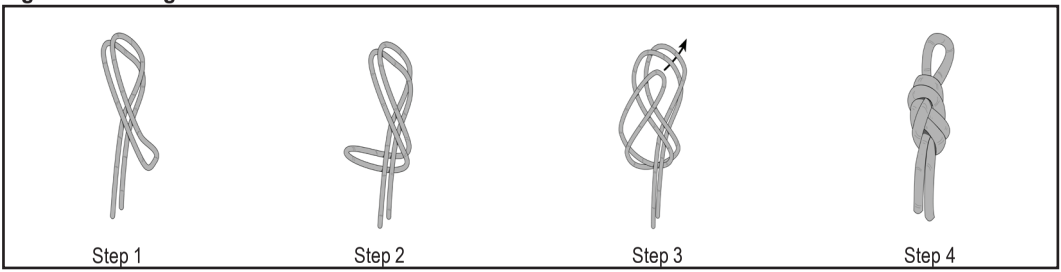
Example of when to use in the field:

- Connecting members of a roped-up mountaineering team

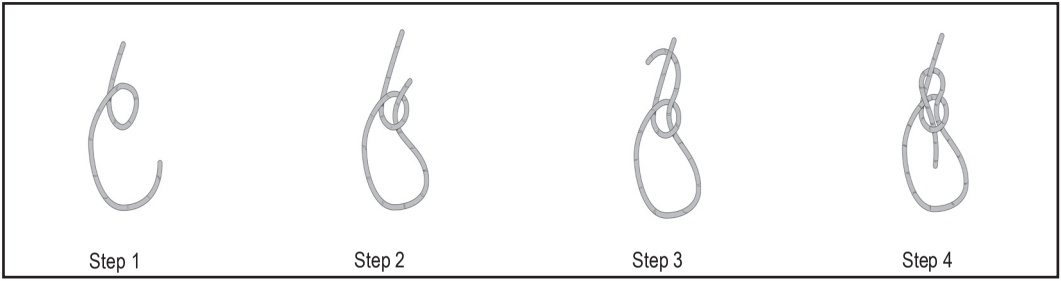
See the folowing pages for descriptive illustrations.

Knot Illustrations

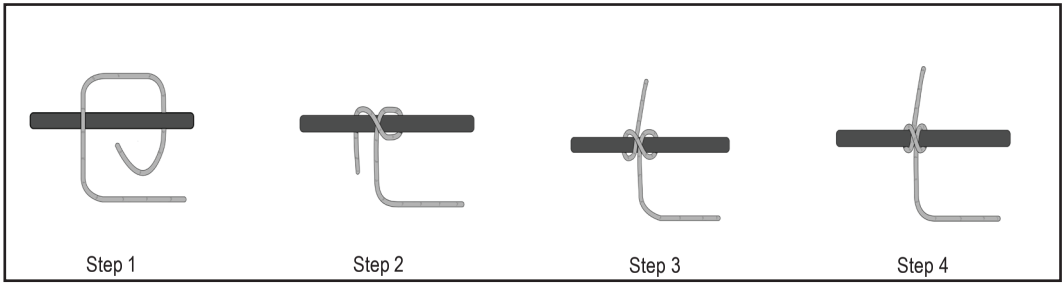
Figure 8 on a Bight



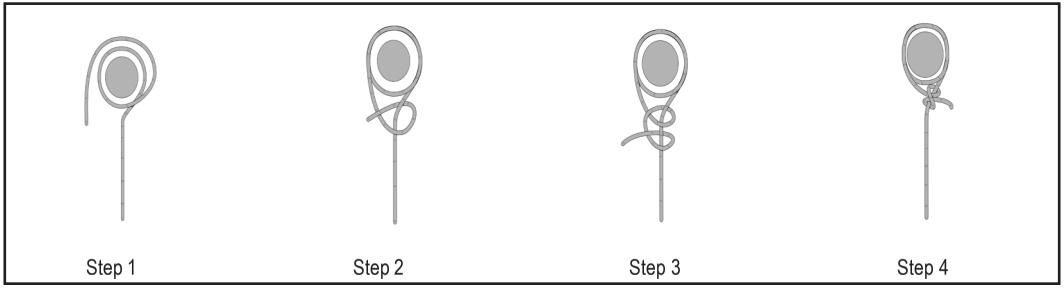
Bowline



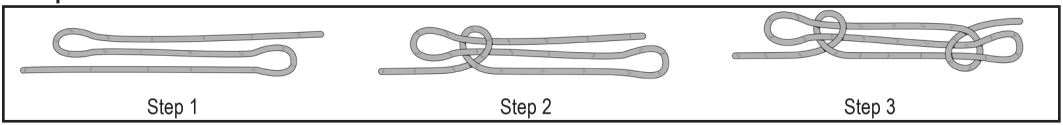
Clove Hitch (Double Hitch)



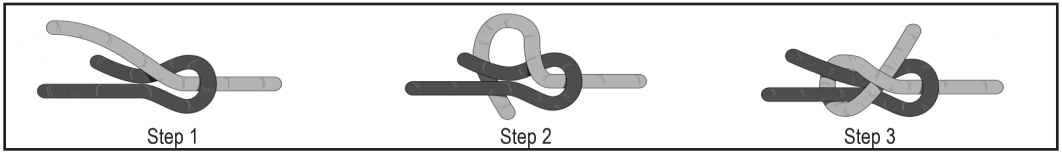
Round Turn and Two Half Hitches



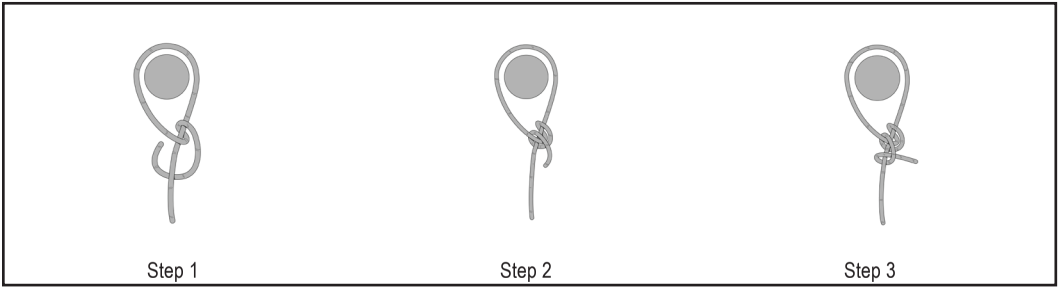
Sheepshank Knot



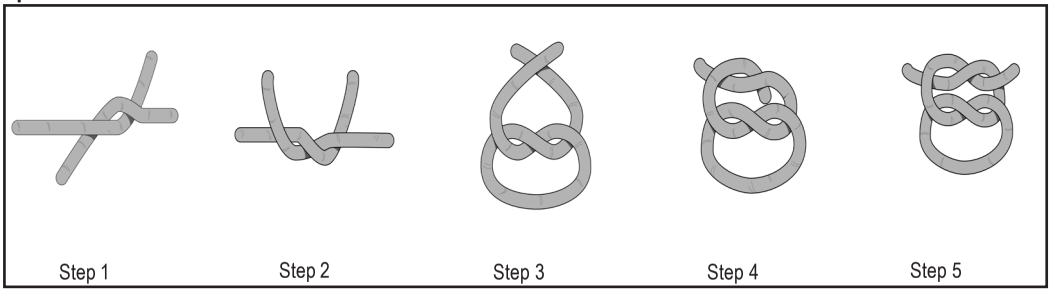
Sheetbend



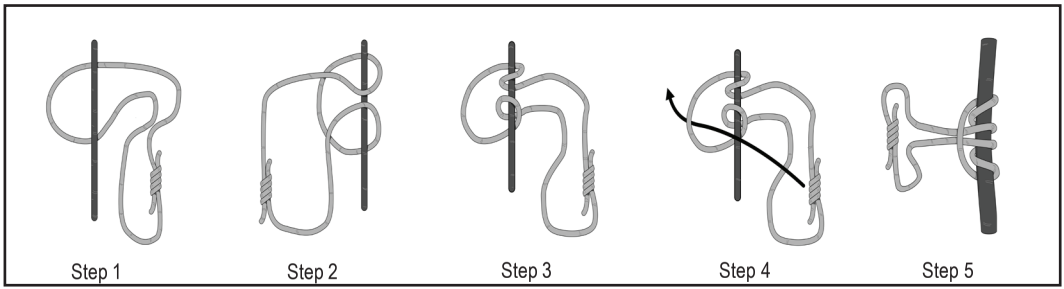
Taut Line Hitch



Square Knot or Reef Knot



Prussik



Trucker's Hitch

Step 1

Step 2

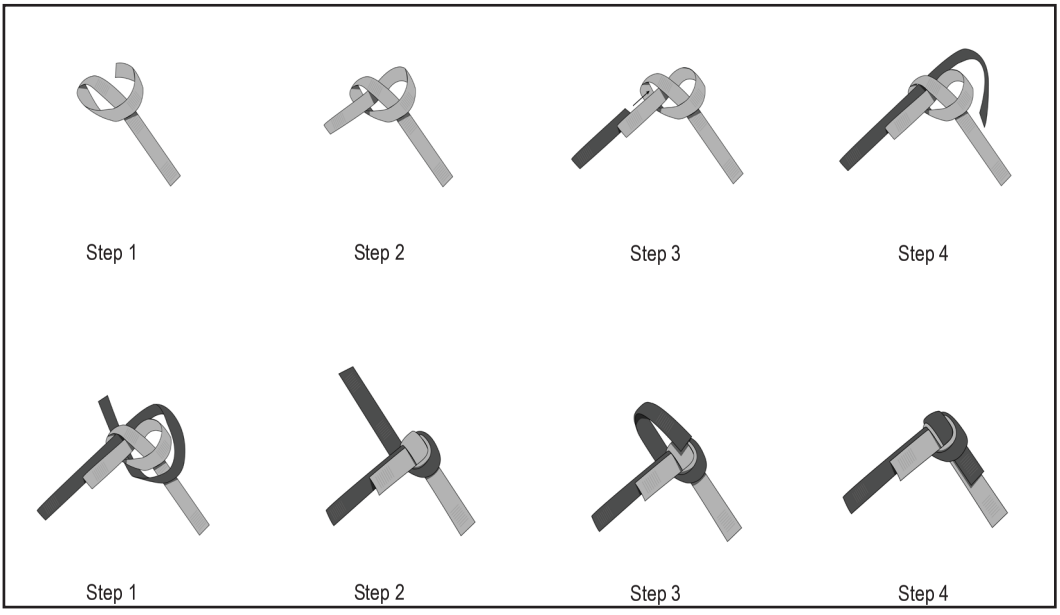
Step 3

Step 4

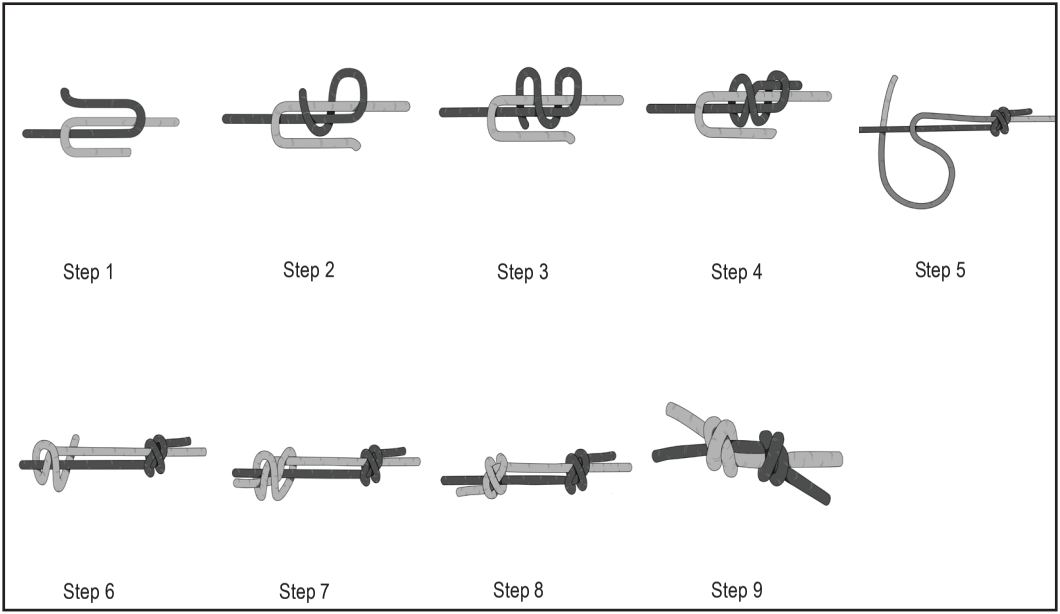
Step 5

Step 6

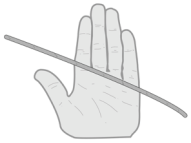
Water Knot



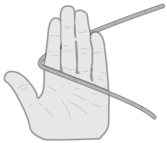
Double Fisherman's Stopper



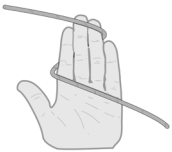
Alpine Butterfly Loop



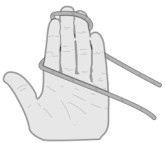
Step 1



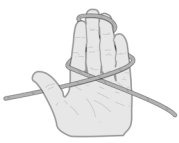
Step 2



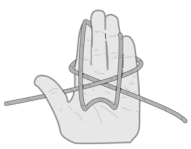
Step 3



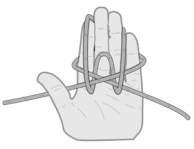
Step 4



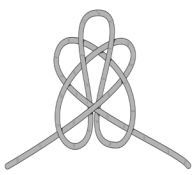
Step 5



Step 6



Step 7



Step 8

Step 9

Wind Chill Chart

Wind Chill Chart

NOAA — National Weather Service

Wind (mph)	Temperature (°F)																	
Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes · 10 minutes · 5 minutes

$$\text{Wind Chill (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T = Air Temperature (°F) V = Wind Speed (mph)

REFERENCE

Fuel	Tank Size		Gross Weight	Tare Weight	Cube
	55-Gallon		400lbs	50 lbs	16
	5-Gallon		45 lbs	10 lbs	2
Propane	**Tank Size**	**Net Quantity**	**Gross Weight**	**Tare Weight**	**Cube**
***Supply fills propane tanks to approximately 75% of capacity*	100-pound	45kg	155 lbs	55 lbs	16
	40-pound	18kg	69 lbs	29 lbs	4
	20-pound	9kg	37 lbs	17 lbs	3
	10-pound	5kg	23 lbs	13 lbs	2
Mechanical Equipment Center	**WEIGHT (lbs)**	**CUBE (ft^3)**	**Dimensions (LxWxH in.)**	**Fuel**	**Tank Size**
SNOW MOBILES					
Tundra snowmobile	400	123	115x37x50	Mogas/Oil	6.9 gallons
Skandic WT (1995, 96, 99)	575	136	119x41x48	Mogas/Oil	11 gallons
Skandic SWT 503 snowmobile	625	165	119x42x56	Mogas/Oil	11 gallons
Skandic SWT 550 snowmobile	675	160	124x43x52	Mogas/Oil	11 gallons
2009/11 Skandic WT 550 snowmobile	600	165		Mogas/Oil	12 gallon
Alpine I	685	118	114x35x51	Mogas/Oil	6.0 gallons
GENERATORS, BOXES					
1.0 Kw Honda generator	30	1.5	17x9x15	Mogas	0.61 gallons
1.8 Kw Honda generator	110	3.5	20x17x17	Mogas	2.9 gallons
Field Box; 1.8 Kw gen	65	9	27x22.5x24.5	n/a	No tank

GENERATORS, BOXES (continued)					
2.0 Kw Honda generator	50	2	18x18x10	Mogas	.96 gallons
2.5 Kw Honda generator	110	3	20x16x16	Mogas	2.9 gallons
3 Kw honda generator	68	3	17.3x15.7x18.9	Mogas	2.7 gallons
3.5 Kw Honda generator	145	5	24x20x19	Mogas	4.5 gallons
Field Box; 3.5/5.0 Kw gen	85	12	30x25x27.5	n/a	No tank
5.0 Kw Honda generator	180	6	26x20x20	Mogas	4.5 gallons
HEATERS					
Herman Nelson BT400-10 w/ cover	320	14	56x20x22	Mogas	16 gallons
Herman Nelson BT400-45 OCH w/ cover	350	34	54x23x48	Mogas	16 gallons
Herman Nelson BT400-45 OCH w/ cover and trailer	526	120	81x44x58	Mogas	16 gallons
Hermie Prime Mover, Honda GX 160, goes with -45	44	3.5	19x15x19	Mogas	No tank
Hermie Prime Mover, AU7-B-344, with -10	60	2.5	16x16 diam.	Mogas	No tank
Hermie Prime Mover AU7-B-344, with -10 w/ box	100	5	20x20x20	Mogas	No tank
Arcotherm (Field unit with skiis)	395	115		JP8	
TRIWALL					
Triwall	20	3.5	20X20X16		
Triwall	35	31	41X36		
Triwall, large (44 cube)	42	44		None	No tank
Triwall, small (18 cube)	26	18		None	No tank

Conversion Table

	To Convert	To	Multiply By
Weight	Pounds	Kilograms	0.4536
	Kilograms	Pounds	2.2046
Distance	Inches	Millimeters	25.4
	Millimeters	Inches	0.0394
	Inches	Centimeters	2.54
	Centimeters	Inches	0.3937
	Meters	Feet	3.2808
	Feet	Meters	0.3048
	Meters	Yards	1.0936
	Yards	Meters	0.9144
	Kilometers	Miles	0.6214
	Miles	Kilometers	1.609
	Kilometers	Nautical Miles	0.5396
	Nautical Miles	Kilometers	1.853
	Statute Miles	Kilometers	1.6093
	Kilometers	Statute Miles	0.6213
Density	Cubic Feet	Cubic Meters	0.0283
	Cubic Meters	Cubic Feet	35.3145
	Cubic Yards	Cubic Meters	0.7646
	Cubic Meters	Cubic Yard	1.3079
Volume	Liters	Gallons	0.2642
	Gallons	Liters	3.7854
	Liters	Pint (liquid)	2.1134
	Pint (liquid)	Liters	0.4732

NZDT - Zulu Time Conversion

NZDT	Zulu	NZDT	Zulu
0:00	11:00	13:00	0:00
0:30	11:30	13:30	0:30
1:00	12:00	14:00	1:00
1:30	12:30	14:30	1:30
2:00	13:00	15:00	2:00
2:30	13:30	15:30	2:30
3:00	14:00	16:00	3:00
3:30	14:30	16:30	3:30
4:00	15:00	17:00	4:00
4:30	15:30	17:30	4:30
5:00	16:00	18:00	5:00
5:30	16:30	18:30	5:30
6:00	17:00	19:00	6:00
6:30	17:30	19:30	6:30
7:00	18:00	20:00	7:00
7:30	18:30	20:30	7:30
8:00	19:00	21:00	8:00
8:30	19:30	21:30	8:30
9:00	20:00	22:00	9:00
9:30	20:30	22:30	9:30
10:00	21:00	23:00	10:00
10:30	21:30	23:30	10:30
11:00	22:00	11:30	22:30
12:00	23:00		
12:30	23:30		

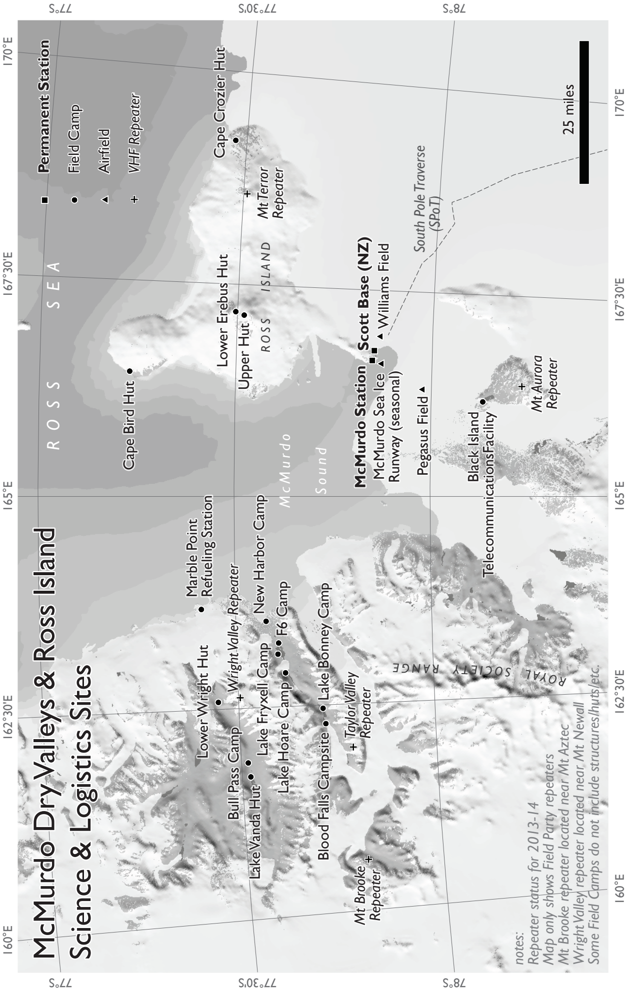
Weather observations are reported in Zulu Time. For example, the 8:00 am weather observation from a McMurdo-based field camp operating on New Zealand time would call in the 1900 Zulu observation.

New Zealand Daylight Savings (NZDT) time is generally September to April. NZDT to Zulu is GMT+13 hours.

Temperature Conversions

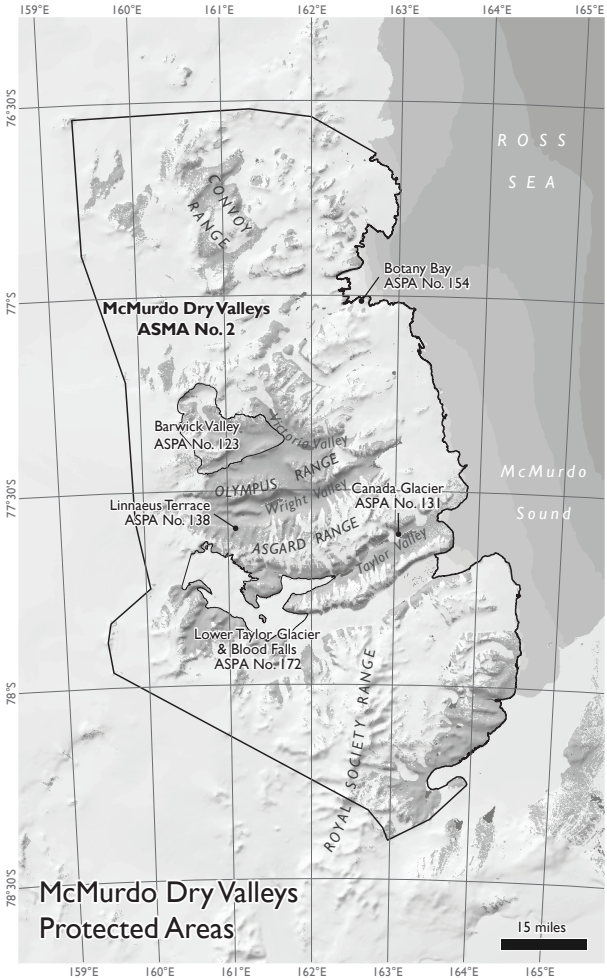
Fahrenheit	Celsius
40	4.44
35	1.67
32	0
30	-1.11
25	-3.88
20	-6.66
15	-9.44
10	-12.22
5	-15
0	-17.77
-5	-20.55
-10	-23.33
-15	-26.11
-20	-28.88
-25	-31.66
-30	-34.44
-35	-37.22
-40	-40.00
Fahrenheit to Celsius: (F degree-32) x (5/9)	
Celsius to Fahrenheit: (1.8 X C degree)+32	

Dry Valley and Ross Island Science Logistics



Taylor Valley camps

Dry Valley ASMA

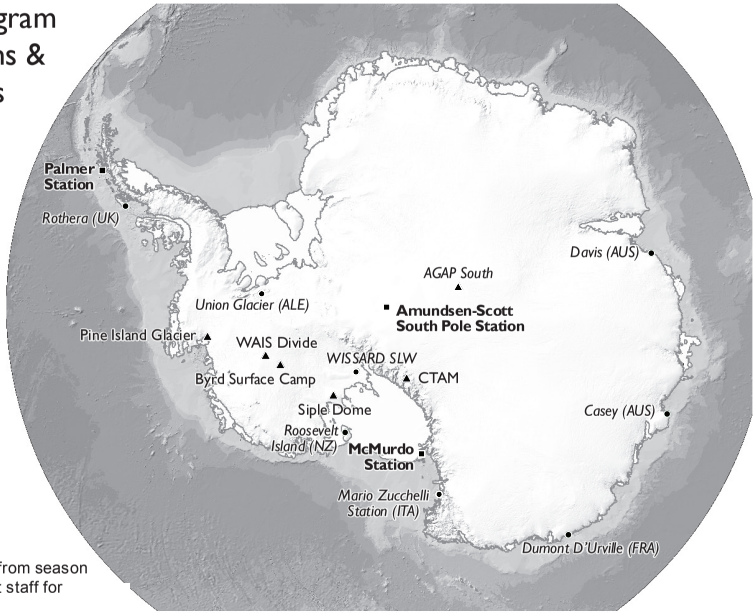


Ross Island ASMAs

REFERENCE

U.S. Antarctic Program Permanent Stations & Deep Field Camps

- ■ **Permanent U.S. Station**
- ▲ Deep Field Camp
- • *Other USAP or International Site*



Note: Deep-field camps change from season to season. Contact Field Support staff for current locations.

REFERENCE